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Authors:	CLAs:	Robert Stavins, Zou Ji
	LAs:	Thomas Brewer, Mariana Conte Grand, Michel den Elzen, Michael Finus, Joyeeta Gupta, Niklas Höhne, Myung-Kyoon Lee, Axel Michaelowa, Matthew Paterson, Kilaparti Ramakrishna, Gang Wen, Jonathan Wiener, Harald Winkler
	CAs:	Daniel Bodansky, Anita Engels, Adam Jaffe, Jorge Leiva, Richard Newell, Sheila Olmstead, William Pizer, Robert Stowe, Marlene Vinluan
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Chapter 13: International Cooperation: Agreements & Instruments

Contents

Executive Summary

This chapter surveys and synthesizes the scholarly literature on international policies, institutions, and agreements pertaining to climate change. The chapter's scope includes climate policy principles and architectures; lessons from existing climate and non-climate international agreements; linkages between such agreements and regional and national policies; interactions between climate change policy and other policies; and the performance of climate policies and institutions.

Climate Policy Principles and Architectures [13.2, 13.3, 13.4]

Climate change is a global commons problem, because greenhouse gas (GHG) emissions from any source mix uniformly in the atmosphere and have global impacts. For this reason, international cooperation is necessary for mitigating climate change. If one country or sub-national entity were to reduce emissions, in the absence of cooperation, the benefits of those reductions would also be distributed across the globe—in the form of reduced concentration of greenhouse gases everywhere, relative to what would have been the case without the abatement in question. No one could be excluded from those benefits, despite their not having shared in the costs of mitigation. On the other hand, the benefits accruing to the firm or individual that reduced emissions would be insignificant relative to the mitigation costs incurred. As a result, there is very little incentive for firms and individuals (and countries) to reduce emissions in the absence of international cooperation *(High Agreement, Robust Evidence; Very High Confidence)*.

A key challenge is to design international policies or agreements that attract sufficient participation. Conceivable agreements and instruments intended to solve the collective action problem of climate protection can be evaluated along a number of dimensions, including four assessment criteria: environmental effectiveness, aggregate economic performance, distributional impacts, and institutional feasibility. [13.2]

While substantial attention in international policymaking has been on the United Nations Framework Convention on Climate Change (UNFCCC) processes, a notable change since the Fourth Assessment Report (AR4) is that the landscape of international cooperation on climate has become significantly more complex. Climate change is addressed by an increasingly broad range of policies and institutions, which span all scales of governance *(High Agreement, Robust Evidence; Very High Confidence)*. [13.3]

The scholarly literature considers numerous potential models of international cooperation that could facilitate progress on climate change mitigation and adaptation. These approaches vary in the degree to which they are centrally organized and managed. At one end of the spectrum is strong multilateralism, whereby countries and regions agree to a high degree of mutual coordination of their actions: for example, fixed targets and timetables for emission reductions. The Kyoto Protocol is an example of such an approach. A less-centralized approach would structure international cooperation around harmonized national policies, where national or regional policies are made compatible through, for example, harmonized carbon taxes, cap and trade schemes, or standards. Finally, at the other end of the spectrum, decentralized architectures may arise out of heterogeneous regional, national, and sub-national policies, which may vary in the extent to which they are internationally linked. [13.4]

Existing International Agreements [13.5, 13.12, 13.13]

The UNFCCC is currently the only international climate policy institution with virtually universal membership and with the authority to serve as a venue in which governments can negotiate agreements to address climate change. International cooperation has brought about political agreement on limiting global temperature increase to no more than 2°C above pre-industrial levels, although the overall level of mitigation produced to date by such cooperation appears inadequate for this purpose *(High Agreement, Medium Evidence; High Confidence)*. Other consequences of international cooperation have included agreeing to reduction targets for 2012 and 2020 and actions for 2020. [13.13]

As noted, climate change is also addressed in other fora. A prominent development since AR4 is the emergence of a large number of international agreements not centred on sovereign states – transnational climate governance initiatives. These include: public-private partnerships, private sector governance initiatives, NGO transnational initiatives, and sub-national transnational initiatives. [13.12]

The literature considers the potential advantages of this new regime complex: greater flexibility and efficiency in the negotiation process in smaller fora, and the ability for agreement to emerge from smaller groups and then expand. But the literature also reflects possible key disadvantages: lower legitimacy due to a lack of universal membership, and lower environmental effectiveness due to insufficient participation and resulting high levels of emissions leakage to countries outside the agreement *(Medium Agreement, Medium Evidence; Medium Confidence)*. [13.5]

Linkages between Climate Policies [13.6, 13.7]

In the absence of, or as a complement to, a binding international agreement on climate change, linkages among existing and nascent regional, national, and sub-national programs are a potentially important form of international cooperation and can function as a de facto international policy. Due to the scale effects that occur when carbon markets are enlarged, they have been the primary means of regional policy linkage. A number of carbon markets have accepted emissions credits from the project-based Kyoto Mechanisms, CDM and JI, and effectively led to a deeper international market. This has generated substantial demand for such credits, of which nearly 1 billion have been issued by May 2012. On the national level, two examples exist– the EU Emissions Trading System (EU ETS), which since 2005 brings together 27 European Union member states and also includes Norway, Liechtenstein, and Iceland; and the U.S. state of California, which is set to link with one or more Canadian provinces after California's cap-and-trade system begins operating in January 2013. Another recent development has been experimentation in policy linkages at the sub-national level. (See Chapter 15.)

The benefits of policy linkage may include lower mitigation costs, increased credibility of market signals, and increased liquidity due to expanded market size. Linking national policies with international policies may also provide flexibility by allowing a group of parties to meet emissions reduction obligations in the aggregate. However, policy linkage also raises the concern that the linked policies will be diluted (as linked systems are only as stringent as the weakest among them), and that countries may be unwilling to accept an increase in mitigation costs that could result from linking with a more ambitious system *(Medium Agreement, Medium Evidence; Medium Confidence)*.

Interactions Between Climate Change and Other Policies [13.8, 13.9, 13.10, 13.11]

Many interactions exist between climate change and other issues, such as sustainable development, poverty alleviation, public health, international trade, technology transfer, capacity building, and investment and finance.

First, interactions between climate change policy and trade are marked by a diversity of synergies and conflicts. Trade and climate interact at many levels including: World Trade Organization-related issues; regional and bilateral trade agreements; and international agreements governing maritime transportation and aviation. [13.8]

Second, international technology-oriented agreements may also play an important role in the climate regime, particularly where they have the potential to lower mitigation costs. Such agreements could include activities for knowledge sharing, joint collaboration and funding of research and development, technology transfer, and technology deployment. [13.9]

Third, climate change policies can be complemented by capacity building in developing countries to promote effective implementation by creating an enabling environment for mitigation, adaptation, monitoring and evaluation activities. Central to many capacity building activities are institutional development and systemic observation. [13.10]

Fourth, governance of investment and finance for climate change mitigation are increasingly important foci of international climate negotiations. [13.11]

13.1 Introduction

Due to uniform mixing of greenhouse gases (GHGs) in the atmosphere, induced climate change is a global commons problem. For this reason, international cooperation is necessary for mitigating climate change. This chapter critically examines the ways in which agreements and instruments for international cooperation have been and can be organized and implemented, drawing upon evidence and insights found in the scholarly literature.

The topical scope of the chapter is defined by the range of feasible – indeed conceivable – international agreements and other policy instruments for cooperation regarding climate-change mitigation and adaptation, as well as related environmental and economic issues. The disciplinary scope spans the social sciences of economics, political science, international relations, law, public policy, and sociology; relevant humanities, including history and philosophy; and – where relevant to the discussion–the natural sciences.

After the introduction, the chapter continues in section 13.2 with a consideration of useful framing concepts and principles, including the "tragedy of the global commons," and an assessment of conflicts and complementarities among these principles. Next, potential criteria for assessing means of international cooperation are introduced, including aggregate economic performance, distributional and social impacts, and institutional feasibility.

Section 13.3 turns to lessons for climate policy from previous international agreements, including implications for participation and for compliance. Agreements assessed include not only previous international climate regimes, but also other international environmental agreements, as well as international agreements on other issues.

Section 13.4 examines alternative climate policy architectures, starting with an examination of the key generic elements of international cooperation: the legal character of an agreement; country participation and burden-sharing methods; and flexibility mechanisms. Then, we examine in general terms and with specific examples three categories of approaches to international climate policy cooperation: strong multilateralism; harmonized national policies; and decentralized architectures and coordinated national policies.

Section 13.5 examines existing multilateral and bilateral agreements and institutions across various scales, starting with international schemes: climate agreements under the United Nations; other climate-focused forums; and international coalitions. Transnational agreements and institutions are also considered, as are relationships with other potentially relevant institutions.

Section 13.6 assesses linkages between international and regional cooperation, with some focus on the interaction of regional and international carbon markets, as well as interactions with other regional policies. Section 13.7 provides an analogous investigation of the linkages between international and national policies. It also examines collaboration among other international arrangements and various national and sub-national institutions.

Section 13.8 considers the relationship of climate change policy with international trade policy, focusing on: World Trade Organization (WTO)-related issues; regional and bilateral trade agreements; other international venues; public goods, club goods, and trade; and implications for alternative policy options.

Section 13.9 turns to mechanisms for technology development, transfer, and diffusion, starting with the rationale for such mechanisms, followed by an examination of alternative modes of international incentive schemes to encourage investment flows. Also considered are the relationship between intellectual property rights and technology development and transfer, and modes of international collaboration intended to encourage knowledge development and sharing.

Section 13.10 focuses on capacity building in five areas: mitigation and adaptation; monitoring and information sharing; institutional development; mechanisms for technical assistance; and an assessment of the current status of assistance for capacity building. Section 13.11 covers the topic of investment and finance, beginning with modes of governance for public and private financial flows, and then turning to the implications for international cooperation. The respective roles in international cooperation of the public and private sectors and of public-private partnerships are the subject of Section 13.12.

Finally, section 13.13 provides a performance assessment of policies and institutions for international cooperation on climate change, beginning with a performance assessment of existing forms of cooperation: the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol, as well as agreements outside of the UNFCCC. Then, the performance of proposed modes of international cooperation is considered according to criteria developed in section 13.2.

13.2 Framing concepts for an assessment of means for international cooperation

This section introduces the key concepts and criteria for analysing international cooperation on climate change. It builds on earlier IPCC reports. In the Third Assessment Report, Toth et al. (2001, p. 607) list three features of climate change that could well be addressed through international collaboration: the public-good nature of climate protection, the multiplicity of decision makers involved, and the heterogeneity of emission levels and climate change impacts around the world.

13.2.1 Framing concepts and principles

13.2.1.1 The tragedy of the global commons and the need for international cooperation

Global climate change is a global commons problem because GHG emissions from any source mix uniformly in the atmosphere and have global impacts. Therefore, in the absence of collective action to limit emissions, overuse of the atmosphere as a depository of GHGs is likely. Given that GHGs mix globally, mitigation of climate change through emissions reduction, enhancement of sinks, and climate engineering yields benefits from which no individual or institution (e.g., government) on Earth can be excluded. (I.e., these benefits are global public goods.) The partial exception to this is solar radiation management, which could create excludable benefits for some actors. These characteristics create incentives for actors to “free ride” on other actors’ investments in climate protection by not participating sufficiently in mitigation efforts.

Overuse of open-access resources and the obstacles to cooperative protection in the presence of incentives to free ride have been analysed extensively and are well-understood (Gordon, 1954; Hardin, 1968; Stavins, 2011). The literature suggests that effective common property management of open-access resources is needed to limit overuse of the resource by individual participants (Ostrom, 2001; Wiener, 2009). The global nature of climate change makes its management particularly challenging (WCED, 1987; Kaul et al., 1999, 2003; Byrne and Glover, 2002; Barrett, 2003; R Stewart and Wiener, 2003; Sandler, 2004).

Public goods problems may be addressed through policies that incorporate “external” costs and benefits into prices, providing incentives for private actors to more optimally reduce external costs and increase external benefits (Baumol and Oates, 1988). Public goods problems may also be addressed through legal remedies, such as compensatory payments and injunctive relief (J Gupta, 2007b; Faure and Peeters, 2011; Haritz, 2011). In the absence of government action, individual actors who bear the costs and benefits of public goods problems may self-organize schemes to supply public goods, particularly if the groups are small, know each other well, expect repeated interactions, can exclude non-members, and can monitor and sanction over-consumption (Ostrom, 1990, 2010a; b, 2011). However, in the case of climate change, uncoordinated action may be less effective than coordinated action, for several reasons: actors are multiple and diverse in their perceptions of the costs and benefits of collective action; emissions sources are geographically widespread; mitigation costs vary (are non-homogeneous); and the impacts of climate change are uncertain and distant in space and time (Toth et al., 2001, pp. 607–608). Hence, cooperative action by various governance institutions and other actors are at the heart of global climate protection provision.

The difficulty in internalizing external costs occurs both at the national and international level. At the national level, incentives to adopt and implement policies that seek to provide climate protection are weak due to free riding and powerful interest groups preventing collective action (Olson, 1971; Victor, 2011). These incentives could be strengthened by the creation of coalitions of constituencies (Wiener and Richman, 2010) or the activities of policy entrepreneurs (Rabe, 2007a; Schreurs and Tiberghien, 2007; Kern and Bulkeley, 2009). In that respect, see Chapter 15. At the international level, collective action may be even more difficult to incentivize than at the national level, not only because of the larger scale, dispersion, and heterogeneity of actors, but also because there is no world government, and each country must consent to a treaty to be bound, therefore requiring policies to attract participation in international regimes (Barrett, 2003, 2007; R Stewart and Wiener, 2003; Schmalensee, 2010; Brousseau et al., 2012). Taking the climate benefits alone, there is very little incentive for firms, individuals, or countries to reduce emissions in the absence of international cooperation. However, some reduction of greenhouse gas emissions can occur without cooperation as the positive externality of otherwise self-beneficial actions, such as actions to reduce energy expenditure, enhance the security of energy supply, and reduce local air pollution.

FAQ 13.1. Given that GHG emissions abatement must ultimately be carried out by individuals and firms within countries, whom governments have jurisdiction over, why is international cooperation necessary?

International cooperation is necessary for a number of reasons. First, climate change is a global commons problem due to the fact that greenhouse gases uniformly mix in the atmosphere. In the absence of collective action, overuse of the atmosphere as a depository for greenhouse gas emissions is therefore likely. Climate protection is a global public good and no individuals, firms, or nations can be excluded from the benefits of climate policy actions. These characteristics create incentives for actors to “free ride” on others’ investments in climate protection. Section 13.2 of this report goes into more detail. Second, international cooperation helps to level the playing field and ascertain how responsibilities are to be divided among countries given principles adopted in international agreements (see 13.3). Third, international cooperation allows for linkages between national and regional policies, which may reduce mitigation costs, increase credibility of price signals, and expand market size and liquidity. Fourth, international cooperation may help to bring international science and knowledge together to craft policy instruments that are most likely to be effective. Finally international cooperation allows parties to take advantage of existing international agreements and coalitions in related areas such as forests, renewable energy, trade, investment, technology transfer and intellectual property rights to enhance effectiveness.

Though firms and individuals are indeed the actors that ultimately must reduce their emissions, they do not generally have the authority to make commitments to international agreements that form the basis of international cooperation. Thus, negotiations intended to address climate change are among national governments, though business firms and groups representing civil society provide significant input to these processes. Section 13.2 and 13.3 go into more detail.

13.2.1.2 Principles

Several principles have been advanced to shape international climate change policies. In the IPCC’s Third Assessment Report, Banuri et al. (2001) discuss general principles, whereas in the Fourth

Assessment Report, Gupta et al. (2007) list four criteria for evaluation of policy instruments, some of which overlap with the principles discussed below. Several principles are enumerated and explained in the literature, including the Framework Convention on Climate Change (UNFCCC, 1992) and the Rio Declaration on Environment and Development (Rio, 1992): "equity," "common but differentiated responsibilities and respective capabilities" (Article 3(1)), relative needs, vulnerability, burdens in countries of differing wealth (Article 3(2)), "precaution" and "cost-effectiveness so as to ensure global benefits at the lowest possible cost" (Article 3(3)), and "sustainable development" (Article 3(4)). For a detailed discussion on equity and sustainable development see Chapter 4.

These principles can be grouped into six broad categories: The principle of maximising global net benefits makes the trade-off between aggregate compliance costs and aggregate performance benefits explicit and also incorporates the notion of seeking efficiency by maximising the difference between aggregate benefits and costs (N Stern, 2007; Nordhaus, 2008; Bosetti et al., 2010). A related principle is cost-effectiveness, which allows for policies with the same level of performance to be compared on the dimension of aggregate cost (Toth et al., 2001; S Gupta et al., 2007).

Second, the precautionary principle emphasizes anticipation and prevention of future risks (Bodansky, 2004; Wiener, 2007; Urueña, 2008). Some see precaution as a strategy for effective action across diverse uncertain scenarios (Barrieu and Sinclair-Desgagné, 2006; World Bank, 2010, pp. 54–55), although the application of precaution varies across risks and countries (Hammit, 2010).

Third, sustainable development is a principle that, broadly defined, emphasizes the need to consider the resource needs of future generations in making decisions about current resource use (IPCC, 2007, chap. 12; World Bank, 2010, pp. 39–48).

Fourth, the principle of "common but differentiated responsibilities (CBDR) and respective capabilities" refers to the varied historic responsibility—and current capability and capacity, of countries with regard to climate change (Jacoby et al., 2010). It also recognizes actors' diverse needs and capabilities (Jonas, 1984; Dellink et al., 2009).

Fifth, fairness is a principle that emphasizes distributive justice across and within countries, especially to improve the well-being of the least-well-off (Vanderheiden, 2008; Baer et al., 2009; Okereke, 2010; Posner and Sunstein, 2010; Posner and Weisbach, 2010; Somanathan, 2010; Cao, 2010b). This principle may also apply in a broader assessment of well-being (Sen, 2009; Cao, 2010a).

13.2.1.3 Conflicts and complementarities

These principles may be mutually reinforcing (Cao, 2010a; b), but there may also be conflicts or tradeoffs among them. For example, high cost-effectiveness may have negative impacts on sustainable development if cost effectiveness is calculated on a short time horizon (van Asselt and J Gupta, 2009). Or, maximizing global net benefits may lead to actions that decrease distributive fairness, although Posner & Weisbach (2010) and Baer (2009) argue that the two principles can be reconciled by either normatively adjusting the net benefit calculus to account for changes in relative utility, or by adopting redistributive policy in addition to climate policy. Different approaches to fairness may also conflict with each other when operationalized (Fischer and R Morgenstern, 2010) or lead to different results (Dellink et al., 2009). While the principles themselves may remain the same, policies that apply these principles will change as economies evolve over time (R Stewart and Wiener, 2003; Barrett, 2010; RO Keohane and Victor, 2011) and as their interpretation changes.

13.2.1.4 Principles and goals

Most agreements that advance international cooperation to address climate change incorporate goals, which flow in large part from principles. "Goals" are "long-term and systemic" (as contrasted with absolute emissions-reduction "targets," which may flow logically from the goals but which are "near-term and specific") (S Gupta et al., 2007, pp. 769, 777). The goals of an international agreement might include, for example, stabilization levels (or a reduction in a previously-agreed stabilization level) of atmospheric concentrations of GHGs—or reductions in impacts of climate change.

13.2.2 Potential criteria for assessing means of international cooperation

The principles elaborated above may inform the identification of criteria for choosing among agreements and instruments that are intended to solve the collective action problem of climate protection. (Criteria may be traded off against each other (Barrett and Stavins, 2003); on the variety of possible instruments, to be discussed later in this chapter, see: (Aldy and Stavins, 2007, 2010a; Barrett, 2007; S Gupta et al., 2007)). Gupta et al. (2007, p. 751) have put forth one set of such criteria: environmental effectiveness, cost-effectiveness, distributional considerations, and institutional feasibility. **Table 13.1** shows the relationship of these criteria to the principles elaborated above.

Table 13.1: Principles and criteria

Criteria (13.2.2)	Principles it draws on (13.2.1.2)
Environmental effectiveness	Sustainable development Precaution
Aggregate economic performance	Maximising global net benefits (economic efficiency) Cost-effectiveness
Distributional impacts	Sustainable development Common but differentiated responsibilities and respective capabilities Fairness
Institutional feasibility	Fairness

The selection of metrics of success influences both ex-ante assessments of alternative policies, and ex-post evaluations of actual performance (Hammitt, 1999; Fischer and R Morgenstern, 2010). In addition to the selection of evaluation criteria, policy evaluation can be considered in the context of three caveats: First, in practice, an ex-ante evaluation of a policy may overestimate the costs (and the benefits) of the policy, often by overestimating the extent of implementation (Harrington et al., 2000; Harrington, 2006). Or ex-ante evaluation may be biased in favour of the policy because interactions between proposed policies and other existing policies may be difficult to predict, and these interactions are typically costly (Levinson, 2012).

Second, while evaluation of proposed policies can be informed by lessons learned from regime complexes in other contexts (see section 13.5), such lessons come with extrapolation bias, since the generalizability of findings in other contexts applied to the climate context is unknown. Finally, in comparing existing policies using these criteria, it can be helpful to keep in mind that as institutions evolve, the performance of particular policies developed by them may also change, limiting the ability to evaluate the policy ex-ante. These caveats hold in Section 13.13 where assessment criteria are applied to evaluate instruments and policy measures.

13.2.2.1 Environmental effectiveness

A primary environmental objective of international cooperation in this area has been to stabilise GHG concentrations at levels sufficient to "prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" (UNFCCC, 1992, sec. Article 2; JB Smith et al., 2009). Other international climate-focused policymaking forums do not aim to address this objective holistically, but rather focus on specific sectors, technologies, rules, or systems (Moncel et al., 2011).

There are three distinct categories of mitigation actions, around each of which metrics to measure environmental effectiveness can be developed. First, GHG emissions from anthropogenic sources can be reduced, for example by switching from high-emission methods of power generation to low-emitting methods, such as renewable power generation or power generation from fossil fuels coupled with carbon capture and geologic storage.

Second, atmospheric GHG concentrations can be reduced by methods of sequestration that remove these gases from the atmosphere by enhancing sinks (biological sequestration, e.g. in forests), or capturing gases directly from the atmosphere and storing emissions underground (air capture with geological sequestration).

Third, global temperatures can be directly reduced through solar radiation management (SRM) projects that change the earth's surface albedo or reflect solar radiation through (for example by injecting sulfate aerosols into the upper atmosphere or by placing mirrors in space). SRM does not address GHG concentrations, and becomes ineffective once discontinued (IPCC, 2011b; Bodansky, 2011). Neither does it address ocean acidification triggered by increasing concentrations of CO2.

Assessment of environmental effectiveness of the three mitigation options requires taking into account ancillary risks of unintended side-effects of mitigation policies (S Gupta et al., 2007; Revesz and Livermore, 2008). Such risks might include unintended changes in emissions of other GHGs, emissions in other countries, or emissions of other air pollutants—and might include unintended loss of biodiversity. For example, corn-based biofuels may reduce CO2 emissions from automobiles (compared to petroleum fuels), but may also spur conversion of forests to agriculture (reducing CO2 sinks), increasing food prices, and affecting other air pollutant emissions (Clapp, 2009; Ewing and Msangi, 2009; World Bank, 2010, pp. 45–47).

The impacts of climate change can also be reduced through increasing resilience and adaptability in the face of damages from gradual change and the more remote risks of extreme catastrophic impacts (Weitzman, 2009). (See also the report of Working Group 2, particularly chapters 14-17).

13.2.2.2 Aggregate economic performance

Efficiency refers to the maximization of net benefits, that is, the difference between social benefits and social costs (N Stern, 2007; Nordhaus, 2008; Bosetti et al., 2010). Calculation of a policy's net benefits involves the summation of monetized environmental performance and the full measure of social cost. Cost effectiveness refers to the ability of a policy to attain a given level of environmental performance at least cost, taking into account impacts on dynamic efficiency, notably technological innovation (A Jaffe and Stavins, 1995). Unlike net benefit assessment, cost effectiveness analysis takes the environmental performance of a policy as given and seeks the least-cost strategy to attain it (Hammitt, 1999). Further, while analysis of a policy in terms of its cost effectiveness still requires environmental performance of the policy to be quantified, it does not require environmental performance to be monetized.

13.2.2.3 Distributional and social impacts

As noted above, distributional equity and fairness may be considered important attributes of climate policy – for their own sake, for their impact on measures of well-being (Posner and Weisbach, 2010), and for their impact on political feasibility (Jacoby et al., 2010). Different policies may have different impacts on distributional equity (Fischer and R Morgenstern, 2010), assessed along several dimensions: intra-generational equity (which includes geographic, income or wealth, and demographic equity), and inter-generational equity.

These criteria relate to options in international agreements for burden sharing across countries (including through differentiated targets, allowance allocations, or prices), and for the timing of emissions reductions (including through targets and emissions budgets over time). Although, in theory, all social impacts can be assessed as part of aggregate net benefits, some social impacts may require special attention, such as international or national security, energy security, food security, and water security.

13.2.2.4 Institutional feasibility

The institutional feasibility of international climate policy may depend upon agreement among national governments and by governments and intergovernmental bodies (Wiener, 2009; Schmalensee, 2010). Four sub-criteria of institutional feasibility need to be assessed: participation, compliance, legitimacy, and flexibility.

The literature has examined a broad array of incentives to promote breadth of participation in international agreements (Barrett, 2003; Barrett and Stavins, 2003; R Stewart and Wiener, 2003; Hall et al., 2010; Victor, 2010; World Bank, 2010, pp. 55–58; Olmstead and Stavins, 2012). Others have suggested that participation limited to countries with the highest emissions better enhances institutional feasibility (Leal-Arcas, 2011). In either case, sovereign states are not bound by an international treaty or other arrangement unless they consent to participate.

Compliance can challenge institutional feasibility because participation is only meaningful if countries adhere to an agreement's provisions. Mechanisms to ensure compliance are important both for long-term performance and for incentives to participate ex ante (Barrett, 2003). Incentives for encouraging compliance can be built into policies, such as tradable permit systems (Wiener, 2009; RO Keohane and Raustiala, 2010). However, compliance is fundamentally problematic in international agreements, as there is no authority that can reliably impose sanctions upon national governments.

Legitimacy is a challenge for institutional feasibility because to attract participation and compliance, cooperative regimes depend on shared understanding both that the substantive rules (outputs) and decision-making procedures (inputs) are legitimate (Scharpf, 1999), and thus that other regime members will continue to cooperate (Ostrom, 1990, 2011). In practice, the legitimacy of substantive rules is typically based on ideas about distributive fairness (see above), while procedural legitimacy is typically based on participative and deliberative arrangements (on the latter, see (Stevenson and Dryzek, 2012)).

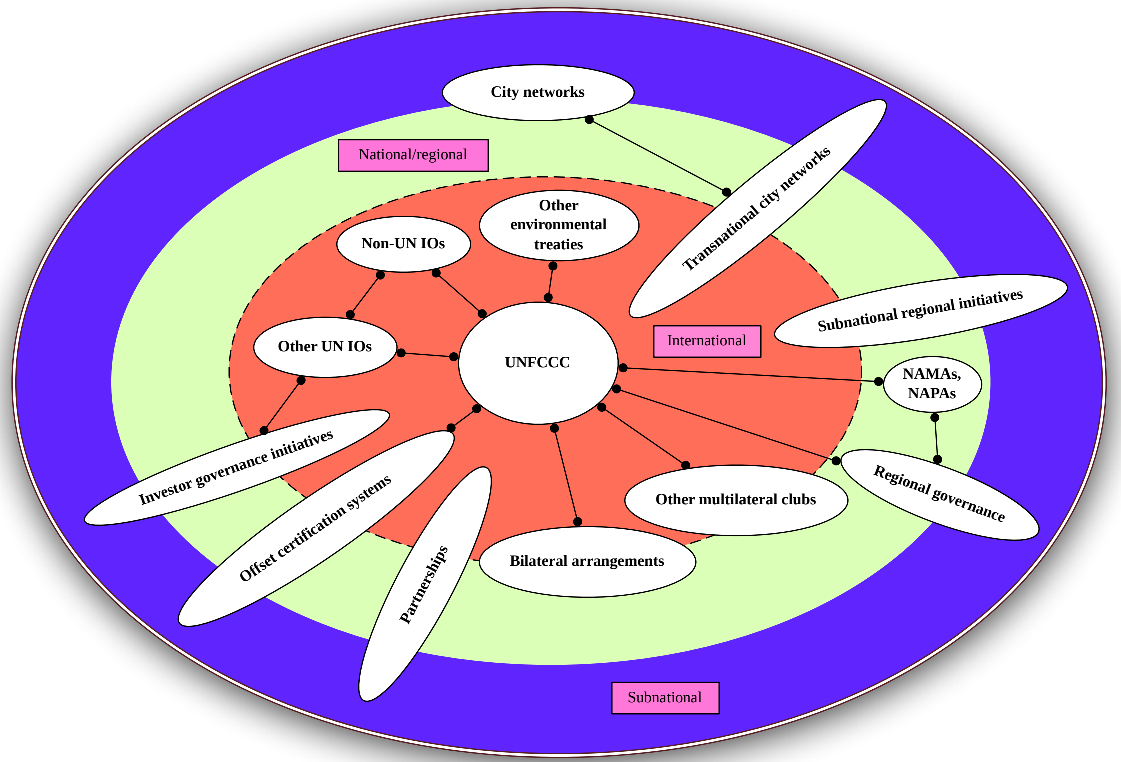
Institutional feasibility to develop policies that are flexible or adjustable may be important to adapt to new information or to adapt to changes to initial economic and political circumstances. The institutionalization of learning among actors is thus an important aspect of success, to enable them to adapt to changing circumstances. While institutional arrangements to craft policies that incorporate a purposive process of experimentation, evaluation, learning, and revision may be costly, policies that do *not* incorporate these steps may be overly rigid in the face of change and potentially even more costly (Greenstone, 2009; Libecap, 2011). Simultaneously, excessive flexibility may undermine incentives to invest in long-term solutions.

13.3 International agreements: lessons for climate policy

Lessons can be drawn from the increased attention to climate change in a range of existing international agreements and from formal models of possible agreements.

First, while most attention to date has been on the UNFCCC processes, a notable change since the publication of AR4 is that the landscape of international agreements on climate has become significantly more complex. Climate change is increasingly addressed in a range of other fora and institutions (see notably (RO Keohane and Victor, 2011; Bulkeley et al., 2012)). As illustrated in

Figure 13.1, this includes a variety of transnational, non-state, as well as regional and sub-national agreements and other forms of cooperation which have emerged—many since the mid-2000s, and many which have previously focused on issues other than climate change, e.g. trade (see section 13.8) and energy (Chapter 7). The literature suggests that climate change is being addressed across a wider range of institutions and scales than previously.



The landscape of agreements on climate change

Legend: (Note: these are not necessarily exhaustive lists of the examples, but either a representative set of examples or the principal ones)

UNFCCC	Kyoto Protocol, Clean Development Mechanism, International Emissions Trading
Other UN Intergovernmental organizations	Intergovernmental Panel on Climate Change, UN Development Programme, UN Environment Programme, UN Global Compact, International Civil Aviation Organization, International Marine Organization, UN Fund for International Partnerships
Non-UN IOs	World Bank, World Trade Organization
Other environmental treaties	Montreal Protocol, UN Conference on the Law of the Sea, Environmental Modification Treaty, Convention on Biological Diversity
Other multilateral "clubs"	Major Economies Forum on Energy and Climate, G20, Asia Pacific Partnerships on Climate and Energy, REDD+ Partnerships
Bilateral arrangements	e.g. US-India, Norway-Indonesia
Partnerships	Methane to Markets, Renewable Energy and Energy Efficiency Partnership, Climate Group
Offset certification systems	e.g. Gold Standard, Voluntary Carbon Standard, Climate Change and Biodiversity Alliance standard
Investor governance initiatives	Carbon Disclosure Project, Investor Network on Climate Risk
Subnational regional initiatives	Regional Greenhouse Gas Initiative, Western Climate Initiative, Midwestern Greenhouse Gas Reduction Accord
City networks	US Mayors' Agreement, Transition Towns
Transnational city networks	C40, Cities for Climate Protection, Climate Alliance, Asian Cities Climate Change Resilience Network

Figure 13.1. The landscape of agreements on climate change

Figure 13.1 shows the landscape of international cooperation, with some linkages to national and sub-national scales (addressed in Chapters 14 and 15 of this report; for a more detailed discussion of these initiatives, see section 13.5).

As a consequence of this change, design of future agreements (for climate agreements and those across other issues) needs to take account of the actual and potential linkages between institutions across different scales and issue focus. It is no longer simply a question of choices between different types of single agreements, but how to manage the interaction between various sorts of agreement. Careful design of cooperative arrangements will be needed to prevent mutually competing agreements and to maximise potential institutional synergies.

Lessons may also be learned from the game-theoretic approach in environmental economics (Finus, 2001, 2003; UJ Wagner, 2001; Barrett, 2003) and the rationalist school in political science (Downs et al., 1996; Underdal, 1998), which analyse the incentives and motivations of actors to form and comply with international environmental agreements (IEAs) and multilateral environmental agreements (MEAs). Such literature has grown substantially in the last two decades (Tangen and Hasselknippe, 2005; Chambers, 2008; Muñoz et al., 2009).

While assumptions or models are easily identified, they have also been criticized for their simplicity and sometimes high specificity. Therefore it is important that any general conclusions be drawn only with caution. In this section, we refrain from listing assumptions in detail, (but see, e.g., (Finus, 2001, 2003)) and restrict attention to the most general and policy-relevant conclusions. Some issues covered by Toth et al. (2001) and Gupta et al. (2007) are reiterated if they appear particularly important or if new evidence has emerged.

The game-theoretical literature assumes that there is currently no supranational institution that can impose an IEA on governments and subsequently enforce it. Thus, IEAs are self-enforcing. However, international institutions can help to negotiate and administer an IEA. They can do so in their roles as coordinator and moderator, i.e. via reductions in transaction costs of cooperation and the generation of trust (R Keohane, 1989; Finus and Rundshagen, 2006), or via changing the interests of actors by providing new information or building capacity (PM Haas et al., 1993).

A cost-effective allocation of environmental targets might fulfil one of the key criteria for the evaluation of an IEA. However, if the allocation leads to an asymmetric distribution of the net gains from cooperation without compensatory measures, such an agreement may lead to low participation and a poor compliance record, or alternatively simply a "lowest-common denominator" agreement (Ward et al., 2001). In addition, if states seek to maximise domestic political gains and competitive advantage over other countries rather than absolute gains in environmental outcomes for all, as some suggest is the case for climate policy, then such asymmetric outcomes can make cooperation even more difficult (Ward, 1993; Grundig, 2006). Other literature has considered the potential of and barriers to agreeing to a reciprocity-based climate regime (Saran, 2010).

13.3.1 Participation

The procedures of accession to international treaties are typically specified in membership rules, which can be open or exclusive. A major finding in the theoretical literature is that even in the context of a public good such as climate protection, exclusive membership helps to stabilize IEAs and hence leads to improved performance (Carraro and Marchiori, 2003; Eyckmans and Finus, 2006; Finus, 2008; Finus and Rundshagen, 2009). However, there is little empirical evidence that this is true in practice, primarily because there are no exclusive institutions with authority to host climate negotiations.

Multiple agreements may be an interim solution, in the absence of a comprehensive legally binding treaty on climate change. In Toth et al. (2001), the issue of single versus multiple agreements was covered. Since that time, the landscape of climate agreements, as shown in Figure 13.1, has evolved considerably. In the light of the practical difficulties encountered in negotiating a comprehensive legally-binding agreement in the short term, multiple agreements may be a pragmatic interim solution. For instance, in the context of international trade policy, after slow progress within the WTO after the Doha round, bilateral and multilateral agreements among a small group of countries have emerged. Whether these will evolve into an effective global agreement—or perhaps render such evolution less likely—cannot yet be assessed. Some argue that multilateral institutions and transnational organisations have developed global administrative law, which may inform and influence governance across multilateral agreements, networks of agreements, transnational executive accords and, and implementation in executive and judicial systems (Kingsbury et al., 2005). In the climate regime, such law is developed through recommendations by the subsidiary bodies to the Conference of the Parties to the UNFCCC (Churchill and Ulfstein, 2000; Hey, 2001; Brunnée, 2002; J Gupta, 2011).

An international regime might achieve depth (ambition of emissions reduction) and breadth (meaning breadth of participation) in different sequence. Schmalensee (1998) argues for breadth first, in large part to give time to develop "…institutions to ensure broad international participation in emissions abatement, which is essential to any serious effort." (See also Schelling (1992).) Other scholars suggest that because of the urgency of the climate-change problem, equity concerns arising from historical emissions, or both, that depth come before breadth. The trade-off between the level of abatement by a sub-set of actors and participation in an IEA has been described as a comparison between an "ambitious versus a modest treaty" (Finus and Maus, 2008; Courtois and Haeringer, 2011) or between an incomplete (deep and narrow) versus a consensus (broad but shallow) treaty (Barrett, 2002).

In the presence of transfers (either directly through monetary or in-kind transfers or indirectly through the initial allocation of emission permits), it has been shown that participation may depend on the type of burden-sharing scheme (Weikard et al., 2006; Eyckmans and Finus, 2006; den Elzen et al., 2007; Höhne et al., 2007; Nagashima et al., 2009; Bossetti et al., 2009). Recent research on optimal transfer schemes (Carraro et al., 2006; McGinty, 2007, 2011; Eyckmans and Finus, 2009; Weikard, 2009; Fuentes-Albero and Rubio, 2010) stresses that it is not sufficient to consider only plausible and widely accepted equity criteria for the redistribution of the gains from cooperation, e.g.: (Ringius et al., 2002) if they violate the fundamental interests of some parties. The literature suggests that issues of equitable burden sharing and transfer need to be addressed at the same time.

Linking agreements may help, but transaction costs reduce the benefits, and so linkages should be carefully chosen and designed. Many linkages exist between climate change and other issues, such as sustainable development, poverty alleviation, public health, international trade, and foreign direct investment. These and other linkages create opportunities, potential co-benefits, or harms that have not yet been thoroughly examined. Linking climate agreements with agreements that cover different policy issues (see Toth et al. (2001), and the literature cited there) has been proposed as an alternative measure to transfers that can support participation. Apart from balancing asymmetric net benefits from cooperation, like transfers, issue-linkage may change the incentives for participation (Finus, 2003; Carraro and Marchiori, 2004). Either the issue with which climate change is linked provides an exclusive advantage to members, or it imposes a negative externality on outsiders, or both. This can pull outsiders into the joint agreement.

Linking with regard to research and development (R&D) may produce benefits for participants in the collaborative effort. Linking can only work, however, if the benefits of joint R&D efforts do not spread to non-members, if non-members become sufficiently disadvantaged through lack of competitive technology, or both. The design of the linkage between an IEA and a trade agreement should also take into account these fundamental forces (Lessmann et al., 2009).

However, the advantage of issue linkage diminishes if transaction costs of negotiations are accounted for. With increasing numbers of negotiating parties and numbers of linked issues, diseconomies of scale may arise. This may be one of the reasons that some scholars, (e.g., (Barrett, 2010; Barrett and Toman, 2010; Falkner et al., 2010; RO Keohane and Victor, 2011)) have recently proposed to negotiate issues like mitigation, financing adaptation and mitigation in developing countries, and technological transfers separately instead of in one climate agreement (and maybe among a smaller group of key countries) in order to overcome the current stalemate in multilateral climate negotiations.

For the landscape of climate agreements to have an adequate aggregate effect, linkages between multiple elements (see Figure 13.1) have to be better articulated. Linkages across the landscape of agreements on climate change might take the form of mandating action by subsidiary bodies and reports-back, agreed links between institutions (e.g. memoranda of understanding), loose coordination, and delegation. The links represented in Figure 13.1 includes each of the four types, or show no connection. The literature on transnational governance acknowledges a gap in that "interactions are understudied in all areas of transnational governance" (Abbott, 2011). Related literatures suggest that important characteristics may be reciprocity (Saran, 2010), competition between private governance regimes (Helfer and Austin, 2011), relationships of conflict or interpretation (ILC, 2006), collaboration (Young, 2011), the catalytic role of the UNFCCC (UNFCCC, 2007a), NGOs as norm entrepreneurs (Finnemore and Sikkink, 1998), accountability (Bäckstrand, 2008; Ballesteros et al., 2010), learning (Kolstad and Ulph, 2008), as well as hierarchy (higher bodies mandating lower levels) and redundancy (safeguards against inaction at lower levels). Delegation, for example under CDM to various subsidiary bodies, is said to increase efficiency by utilising best-equipped agents to address problems, by reducing transaction costs of policy-making, and by enhancing credibility through enforcement (JF Green, 2008). Relationships between international agreements and instruments are unclear, often contested and will need careful and considered definition.

Some recent studies (Barrett, 2006; de Coninck et al., 2008; Hoel and de Zeeuw, 2010) consider the opportunities of pure R&D cooperation to develop environmental "breakthrough technologies" to produce low- or even zero-carbon energy. Barrett (2009) suggests that inducing technological change may create greater momentum for participation in a climate agreement than market-based instruments alone.

Whether adding adaptation to mitigation measures in the policy portfolio will encourage or discourage participation remains an open issue (Barrett, 2008). Adaptation is an issue crucial for highly vulnerable countries and these are more likely to support agreements that address adaptation and its funding (Huq et al., 2004; Mace, 2005; Ayers and Huq, 2009; Denton, 2010; JB Smith et al., 2011). A theoretical analysis will require empirical evidence whether and which adaptation and mitigation measures are substitutes or complements. Several studies indicate that adaptation reduces the marginal benefits from mitigation measures and vice versa (Ingham et al., 2005; Buob and G Stephan, 2011; Ebert and Welsch, 2011). However, the benefits of important types of adaptation are local and private, and thus it is more difficult to forge reciprocal agreement, than across mitigation and finance, where mutually beneficial deals can be more readily struck.

Earlier experimental research suggested that reducing uncertainty about the benefits and costs of mitigation can render IEAs less effective, showing that as parties learn of the actual costs of mitigation, so their incentive to participate may shrink (Kolstad, 2005, 2007; Kolstad and Ulph, 2008). However, more recent work (Dellink and Finus, 2009; Finus and Pintassilgo, 2011) has qualified this conclusion by showing that transfers increase incentives to participate, and that removing uncertainty can have a significant positive impact on participation. Asymmetry may increase participation (Finus and Pintassilgo, 2011), but recent experimental evidence suggests that uncertainty about the tipping point of disastrous climate change impacts reduces the success of cooperation (Dannenberg et al., 2011).

13.3.2 Compliance

A prerequisite for successful compliance strategies is an independent and high-quality regime of measurement, reporting and verification (MRV) with a high frequency of reporting (Toth et al., 2001). Provisions for greater transparency in MRV are being developed (Winkler, 2008; Breidenich and Bodansky, 2009; Ellis and Moarif, 2009). Lessons on MRV from other multilateral regimes include attention to accuracy, evolution over time, combining self-reporting with third-party verification, including independent technical assessment as well as some form of political or peer review, and public domain outputs (Pew Center, 2010).

Some research suggests that the Kyoto Protocol is unusual among MEAs in having established an "elaborate and multifaceted" compliance system (Oberthür and Lefeber, 2010; Doelle et al., 2012) other MEAs rely on self-reporting of domestic actions. The design of sanction mechanisms currently in place under the Kyoto Protocol, however, has also been criticized for not being fully credible (Halvorssen and Hovi, 2006; Barrett, 2009; Vezirgiannidou, 2009).

Due to the difficulty of designing credible sanctions, few alternatives to the Kyoto structure have been put forward, although the regime is continuously being modified. Monetary penalties as part of the European monetary institutions have proven largely ineffective, as no second-order punishment is available if penalties are not paid.

Trade sanctions, such as those institutionalized under the Montreal Protocol, are put forward as one principal alternative compliance mechanism. Barrett (2009) and Victor (2010) argue that they are not a feasible option for enforcing a climate treaty, as most trade sanctions would not be compatible with WTO rules. Others argue that WTO-compatible design is feasible in the case of border adjustments with obligations to buy allowances (Ismer and Neuhoff, 2007; Monjon and Quirion, 2011). In any case, trade sanctions pose significant risk of reducing cooperation. The number of goods affected by the sanctions could be large, potentially fuelling a trade war that may negatively affect even those countries that intend to be the punishers.

Enforcing compliance can be enhanced by deterrence mechanisms that use credible threats of punishment to incentivize honest reporting. As long as the discounted net benefits from cooperation are larger than the discounted payoff from free-riding and subsequent punishment, compliance can be enforced.

Finally, there is a considerable literature on the potential use of legal remedies to address climate damages. (Penalver, 1998; DA Grossman, 2003; M Allen, 2003; Gillespie, 2004; Hancock, 2004; Burns, 2004; Doelle, 2004; Verheyen, 2005; Jacobs, 2005; J Smith and Shearman, 2006). There has been little suggestion that such remedies be formally incorporated into climate agreements, and there would be significant obstacles to doing so, but this is nonetheless a potential avenue for encouraging compliance, perhaps indirectly. Gupta et al. (2007) reported on the evidence from various legal actions and potential actions that have been considered in the theoretical literature. Haritz (2011) has argued, based on an analysis of the literature and court cases, that it is theoretically possible to link the IPCC scale of likelihood with a scale based on legal standards of proof required for various kinds of legal action. Liability for climate change damage at supranational level (de Larragán, 2011; Gouritin, 2011; Peeters, 2011), and at national level in the United Kingdom (Kaminskaite-Slaters, 2011), the United States (Kosolapova, 2011), Netherlands (van Dijk, 2011) has been explored. Climate litigation and legal liability may put additional pressure on corporations and governments to be more accountable (J Smith and Shearman, 2006; Faure and Peeters, 2011). However, there are key analytical hurdles to establishing important legal facts, such as causation and who is to be held liable.

13.4 Climate policy architectures

"Policy architecture" for global climate change refers to "the basic nature and structure of an international agreement or other multilateral (or bilateral) climate regime." (Aldy and Stavins, 2010a, pp. 1–2) The term includes the sense of durability, with regard to both policy structure and the institutions to implement and support that structure (Schmalensee, 1998, 2010), which is appropriate to the long-term nature of the climate-change problem.

13.4.1 Elements of international cooperation

Policy architecture for climate change, given the global-commons nature of climate change, maps to a significant degree to the structure of international cooperation. Therefore, it is useful to first explore the basic elements of international cooperation for climate change: legal bindingness; country participation and burden-sharing methods; and flexibility mechanisms.

13.4.1.1 Legal bindingness

International agreements among national governments, including especially the commitments that these agreements include, may be legally binding or non-legally binding upon the parties. Legal bindingness involves four related dimensions: (1) legal form (e.g., treaty, protocol to a treaty, decision of the UNFCCC Conference of the Parties, political agreement), which reflects whether the instrument is governed by international law; (2) whether a provision is "expressed in obligatory language" (Werksman, 2010) ("shall" vs. "should" or "aim") (3); "…whether [commitments] are expressed in sufficient detail to accurately assess compliance"; and (4) the institutions, procedures, and mechanisms designed to implement an agreement by monitoring, reviewing, and encouraging compliance with commitments (Werksman, 2010).

Table 13.2 provides a taxonomy of options with regard to the nature of the commitments in international agreements (Bodansky, 2003, 2009).

Table 13.2: Typology of commitment in international agreements for climate change

Type of Commitment	Description	Example
Mandatory provision in a legally-binding agreement with enforcement mechanisms	A legally-binding commitment can be subject to a mandatory compliance system, with authority to respond to violations. Enforcement can also come in the form of reciprocity for non-compliant actions.	The targets and timetables in the Kyoto Protocol and the Marrakech Accords, which set forth detailed rules to operationalize Kyoto and established a compliance procedure, including consequences for non-compliance. (World Trade Organization is the strongest example of this type, though not in the climate realm).
Mandatory provision in a legally-binding agreement	"Legally binding," but subject only to self-enforcement.	Article 4.1 of the UNFCCC, mandating, *inter alia*, national emissions inventories.
Mandatory provision in a non-legally-binding ("political") agreement	Such a provision binds the party, though in principle less so than if the agreement were legally-binding.	The targets and actions submitted by UNFCCC parties in response to the Copenhagen Accord.
Non-mandatory provision in a legally-binding agreement	Such a provision still does not bind the parties, but carries somewhat more weight, given the nature of the document in which it is embedded.	The UNFCCC target for developed countries to return their emissions to 1990 levels by the year 2000 was stated as an "aim" rather than a legal requirement (UNFCCC, 1992, sec. Article 4.2).
One-way ("no-lose") commitments	A commitment can be designed with legal consequences that bestow benefits to parties exceeding a baseline level of compliance. Since such a commitment has no legal	No-lose targets under some sectoral crediting mechanisms are "one-way commitments," since a country (or sector association) faces no penalty if its emissions exceed a baseline,

	consequences for falling short of the baseline, it is non-binding.	but receives emission reduction credits if the emissions are reduced below the baseline.
Non-mandatory provision in a non-legally-binding ("political") agreement	An aim or aspiration, expressed in hortatory, non-binding language. This type of provision typically includes one or more statements of principles or norms.	Targets set in the 1989 Noordwijk Declaration, at a ministerial conference on climate change held prior to the 1992 Rio summit.

There are various perspectives within the scholarly literature regarding whether a (binding) treaty is necessary to stimulate greater national and local action, or not. Absent an international authority that can impose obligations on states—that is, in an "anarchic" international states system (Waltz, 1979; A Thompson, 2006)—execution of legally-binding international agreements depends on states' consent to limit their future freedom of action. In general, accepting a commitment in binding form signals a high level of seriousness by states, increases the costs of violation (either through an explicit enforcement mechanism, the lost benefits associated with compliance, or loss of reputation and credibility in future negotiations), and sets in motion domestic legal-implementation mechanisms, including ratification in those states that require it (Bodansky, 2003). Nevertheless, domestic law may be enforced more effectively than international law.

However, the distinctions between binding agreements (e.g., treaties), and political agreements that lack a formal legal foundation, often referred to as "soft-law" (e.g., codes of conduct, declarations, guidelines, action plans, recommendations) are blurred (Bodansky, 2010). In particular, states may treat norms that lack a legal foundation as binding and enact domestic legislation required for implementation and enforcement; conversely, binding international legal commitments may lack binding domestic enforcement mechanisms (Boyle, 1999). An example of the first is the UN General Assembly's (UNGA's) resolution establishing a moratorium on high seas driftnet fishing, which many states treat as binding even though UNGA resolutions have the status only of recommendations (Bodansky, 2010).

Regardless of the degree of "bindingness," an international cooperative agreement can be legitimated (i.e., justified or perceived to be justified) by the sources of an agreement's authority. In an "anarchic" international system of states, legitimacy almost always flows from the consent of parties and typically relies on the perceived fairness of procedures leading to the agreement (e.g., democratic voting rules: (Albin, 2001; Grasso and Sacchi, 2011)) and the desirability of the outcomes of the agreement (Bodansky, 1999; Bernstein, 2005). At the same time, since international law is shifting in the direction of administrative law, the issue of state consent is becoming less and less important. (See section 13.3.1 above).

13.4.1.2 Participation and burden-sharing methods

Participation rules in an international climate agreement might reference the number of parties, geographical coverage, or the share of global GHG emissions covered. Parties might vary with regard to the nature (e.g., actions versus quantitative emissions-reduction targets) and specificity of their commitments. These might evolve over time, either as prescribed by the agreement ex-ante, or as a party's circumstances change, allowing for more or less stringent obligations.

International agreements might specify norms of fairness, or burden-sharing rules that partly determine how parties are differentially obligated. For example the Rio Declaration included the principle of "common but differentiated responsibility" (Principle 7, incorporated into the UNFCCC), and the UNFCCC established the objective of "dangerous anthropogenic interference with the climate" (Article 2). International agreements might then operationalize these norms in quantitative burden-sharing formulas or metrics. Burden-sharing methods are implicitly reviewed in AR4, in the context of a detailed comparison of "recent proposals for international climate agreements" (S

Gupta et al., 2007, pp. 770–773), grouped by national emission targets and emission trading, sectoral approaches, policies and measures, technology-development-oriented actions, adaptation, financing and proposals focusing on negotiation process and treaty structure (Table 13.2). Chapter 4.3 of the Fifth IPCC Assessment Report analyses in depth: challenges to agreement on the distribution of effort; equity rules already present in climate negotiations (in particular, under the auspices of the UNFCCC); and principles that might guide burden-sharing more generally (e.g., the right to sustainable development). There is considerable discussion of burden-sharing in the scholarly literature (Bohringer and Heinz Welsch, 2006; Höhne et al., 2006; F Wagner and Sathaye, 2006; den Elzen et al., 2007; den Elzen and Höhne, 2008, 2010; Winkler et al., 2009; Chakravarty et al., 2009; Baer et al., 2009; Mearns and Norton, 2010; Cao, 2010a; Frankel, 2010; Ekholm et al., 2010).

13.4.1.3 Flexibility mechanisms

Flexibility mechanisms utilize markets and lower the cost of reducing emissions, relative to traditional regulatory regimes, as they direct investments in emissions reductions toward lower-cost opportunities available in various jurisdictions. They can involve trading emissions allowances, in practice to date under cap-and-trade programs, generating project-based offsets credits, or combinations of the two. Generally, credits from non-capped sources can be generated through project-based mechanisms or crediting of policies and sectoral actions. The former have been developed since the mid-1990s. The latter are still being discussed with regards to post-2012 climate policies in the context of policies in developing countries (Nationally Appropriate Mitigation Actions, or NAMAs). Additionally, inter-temporal flexibility may be added to an allowance-trading regime through banking and borrowing of allowances, by which regulated entities may transfer current obligations to the future or vice versa.

The Kyoto Protocol provides three flexibility mechanisms (Articles 6, 12 and 17): Joint Implementation (JI),the Clean Development Mechanism (CDM), and international emissions trading (IET). JI and CDM both generate offset credits from projects that reduce GHG emissions, and IET allows for government-to-government trading of Kyoto emissions allowances. The credits from JI and CDM may be used by Annex B countries to meet their emissions-reduction obligations. In practice, the key driver of investment in CDM projects has been the European Union Emission Trading Scheme (EU ETS), which takes advantage of Article 4 of the Kyoto Protocol, which allows parties to meet their Kyoto commitments jointly. The EU ETS—by far the world's largest market-based GHG-compliance regime—allows regulated entities (companies or plants) to use CDM and JI credits to meet a portion of their ETS obligations.

Project-based crediting requires the definition of a baseline from which emission reductions are calculated. The counterfactual character of the baseline continues to trigger controversies. Vöhringer, Kuosmanen, and Dellink (2006) argue that emission leakage due to market price effects is unavoidable, while Kallbekken, Flottorp, and Rive (2007) stress that regardless of the baseline used, the CDM will reduce carbon leakage. Schneider (2011) shows that for projects reducing the potent greenhouse gas HFC-23, the baseline methodology actually provided incentives to increase emissions. However, Kollmuss, Lee, and Lazarus (2010) see the possibility to prevent baseline gaming by a clear regulatory framework. CDM regulators have rejected a significant share of baseline methodology proposals (A Michaelowa et al., 2009; Millard-Ball and Ortolano, 2010).

Baseline setting is closely linked to the question of whether a project is "additional," i.e., whether the project is motivated primarily by anticipated revenue from credit sales, rather than being attractive for investors in the absence of this revenue. As a reaction to criticism in the media, by NGOs, and by scholars regarding alleged lack of additionality in the CDM, additionality tests have become increasingly elaborate (A Michaelowa et al., 2009). For the CDM, baselines, additionality, and emissions-reductions are subject to third-party audit. However, due to inadequate quality of audits, regulators have been forced to introduce multi-layered procedures that led to high transaction costs. Flues, Michaelowa, and Michaelowa (2010) show econometrically that regulatory decisions about project registration and baseline methodology approval have been influenced by political economy considerations. There is ongoing debate in the literature about the efficacy of CDM governance (JF Green, 2008; Lund, 2010; A Michaelowa, 2011; Böhm and Dhabi, 2011; P Newell, 2012, p. 136).

Under the CDM, it was generally thought that companies from industrialized countries would invest in mitigation projects in developing countries and receive the resulting credits. Instead, companies in developing countries are approached by CDM consultants who identify potential projects. The companies then finance these CDM projects out of their own resources and eventually sell the credits as a new export product, with the CDM consultant receiving a share (A Michaelowa, 2007). The fear, even if unfounded, of losing this export revenue, as well as of having used up low-cost emission reduction options, may be a deterrent against taking up national emissions commitments (Castro, 2012). Therefore, it has been proposed to discount CDM credits in order to provide an incentive for taking up stricter national targets (L Schneider, 2009).

Scholars and UNFCCC negotiators have given considerable attention to proposed approaches to offset emissions in separate jurisdictions—or to reduce emissions domestically—through consideration of an economic sector or policy domain—rather than a project—as the “unit of regulation.” A sectoral or policy approach has the virtue of greater flexibility than a project-based approach, in that variations in performance can be averaged over a much wider set of emitters. However, a central government must be involved in passing through revenues from credit sales, and it must have the administrative capacity to do so. Another clear challenge is that sectoral and policy approaches rely on setting baselines, against which performance is measured. Setting baselines (e.g., “business as usual”) may present challenges even greater than those by which additionality is determined in project-based approaches (Okubo et al., 2011). (See (Sawa, 2010) for more on advantages and disadvantages of sectoral approaches).

13.4.2 Cooperation in solar radiation management (SRM)

As discussed in section 13.2.2.1, international climate policy can be designed to adapt to climate change and/or to achieve goals and targets to attenuate climatic variation by reducing emissions from sources, and removing and sequestering greenhouse gases from the atmosphere (by enhancing sinks). Alternatively, climate policy can be designed to undertake carbon dioxide removal (CDR) or solar radiation management (SRM), (both of which are also discussed in Chapter 5, Section 5.8).

CDR is the use of techniques to extract GHGs directly from the atmosphere and store them in variously-proposed sinks. Solar radiation management (SRM) covers multiple techniques to shield the Earth from incoming energy from the Sun, thereby preventing excessive warming of the Earth. Examples of SRM include adding reflective sulphur particles to the upper atmosphere, increasing clouds with reflective properties, or placing mirrors in space. The literature examines the potential effectiveness, side effects, lifetime of effects, reversibility and failure risks CDR and SRM. Some SRM techniques, in particular, could have significant adverse side effects, especially if they were deployed hastily in a rush to prevent a climate crisis (Royal Society, 2009; Vaughan and Lenton, 2011).

SRM options may be inexpensive enough for small states and even non-state actors, such as wealthy individuals, to undertake (Barrett, 2008a; Victor, 2008; Bodansky, 2011), though CDR and other SRM approaches might need to be implemented by numerous countries in order to be effective (Humphreys, 2011). Smaller-scale actors may perceive advantages to be first-movers with SRM, in order to ensure both global climate protection and a favourable distribution of regional impacts from their selected SRM projects (Ricke et al., 2010). Hardly any cooperation might be needed for SRM’s development and deployment—indeed, there might be a race to launch a preferred SRM project—if it turns out that its risk-adjusted benefits out-weigh the possibility of severe collateral damages—and its costs are indeed as low as suggested by much of the literature.

Thus, SRM poses the converse of the collective action and governance challenges arising from emissions-reduction efforts (Victor, 2008; Victor et al., 2009; Virgoe, 2009; House of Commons Science and Technology Committee, 2010; Millard-Ball, 2011; Bodansky, 2011). The main issue for international cooperation could be to develop institutions and norms to address potential negative consequences in other social or environmental fields. Thus, some analysts have recommended that international governance be organized for SRM research and testing, to develop institutions to decide when to deploy them, how to maintain their capability, or to monitor and evaluate this research and its use (Victor et al., 2009; Blackstock and Long, 2010).

13.4.3 Approaches to international cooperation

Approaches to international cooperation vary in the degree to which they are centrally organized and managed. On one end of the spectrum of possible approaches, countries and regions agree to a high degree of mutual coordination of their actions, with, for example, fixed targets and a common set of rules for elements, such as emissions trading. On the other end of the spectrum, national policies are established that may or may not be linked with one another.

13.4.3.1 Strong multilateralism

A strong multilateralism approach to international cooperation establishes goals, targets, or both that are generally binding, for participating countries, for a set of future years. The Kyoto Protocol and the EU Emissions Trading System (EU ETS) have adopted targets and timetables (the Kyoto Protocol for participating Annex I countries and the EU ETS for participating EU nations), one realisation of strong multilateralism (Bodansky, 2007). Other centralized approaches to international cooperation could expand on targets-and-timetables by also specifying the mechanism for implementation of the goals and/or targets of the agreement; such an approach could establish, for example, a global cap-and-trade system or global emission tax.

In the literature, targets-and-timetables has been coupled with normative notions of fairness and/or prospective conditions for political acceptance to establish quantitative targets and timetables for all countries and all years in a potential international agreement (Agarwala, 2010; Frankel, 2010; Cao, 2010b; Bosetti and Frankel, 2011).

The so-called “pledge and review” scheme, exemplified to a certain degree by the Copenhagen Accord and the Cancún Agreements, is an architecture in which a participating nation or region registers to abide by its stated domestic commitments. Because the "pledge and review" system requires cooperation to come to an agreement, it could be considered an example of strong multilateralism, although its voluntary nature may also render it an example of coordinated national policies (section 13.4.3.3)

13.4.3.2 Harmonized national policies

A less-centralized approach would be to structure international cooperation around harmonized national policies. In this class of approaches, national policies are made similar or even equivalent to one another in some key dimension, such as through an equivalent national carbon tax (RN Cooper, 2010), similar cap and trade schemes, or implementation of similar technology or performance standards.

13.4.3.3 Decentralized architectures and coordinated national policies

Finally, even more decentralized architectures may arise out of different regional, national, and sub-national policies, and subsequently vary in the extent to which they are linked internationally. One form of decentralized architecture is directly- or indirectly-linked regional, national, or sub-national tradable permit systems (J Jaffe et al., 2009). In such a system, smaller-scale tradable permit systems can be linked directly (e.g. through mutual recognition of the permits from other systems) or indirectly (e.g. through mutual recognition of an emission-reduction credit system such as the CDM). In practice, this is already emerging. However, the question of linking such systems is not as simple as might be thought, principally because of varying: emissions reductions requirements; proportions of target emissions that may be covered by offset credits; use of ceiling or floor prices; and accounting units (J Jaffe et al., 2009; Bernstein et al., 2010).

Similarly, heterogeneous regional, national, or sub-national policies could be linked either directly or indirectly (e.g., cap and trade linked with a tax) (Metcalf and Weisbach, 2012). Linkage of heterogeneous policies can occur through trade mechanisms (e.g., import allowance requirements or border adjustments) or via access to a common emission reduction credit system (e.g., CDM, as with indirectly linked tradable permit systems).

FAQ 13.2. What options are available to make progress on international cooperation on climate change mitigation?

The literature suggests that there are trade-offs between inclusive approaches to negotiation and agreement (i.e., approaches with broad participation, as in the UNFCCC) and exclusive approaches (i.e., limiting participation according to chosen criteria—for example, including only the twenty largest emitters). Due to its universal membership, the UNFCCC has a high degree of legitimacy in forging international climate policy among many parties around the world. However, a number of other multilateral forums have emerged as potentially valuable in advancing the international process. While at present no institution other than the UNFCCC has been given authority by national governments to host negotiations on climate change, some of these smaller groups can advance the process through informal consultations, technical analysis and information sharing, and implementation of UNFCCC decisions or guidance (e.g., with regard to climate finance). Examples include the Major Economies Forum on Energy and Climate (MEF), the Group of Twenty (G-20) and Group of Eight (G-8) Finance Ministers, and the city-level C-40 Climate Leadership Group. Section 13.5 goes into more detail.

In terms of how these organizations could foster international cooperation, there are a number of potential policy architectures. "Policy architecture" for global climate change refers to "the basic nature and structure of an international agreement or other multilateral (or bilateral) climate regime." There is a wide range of potential policy architectures for global climate change, some of which may have the potential to be scientifically sound, economically sensible, and politically pragmatic—characteristics that might render the architecture more likely to be accepted by governments and more environmentally effective. Architectures may be categorized into three groups: strong multilateralism; harmonized national policies; and decentralized architectures. An example of strong multilateralism is a targets-and-timetables approach, which sets aggregate quantitative emissions-reduction targets over a fixed period of time and allocates responsibility for this reduction among countries, based on principles jointly accepted. The UNFCCC's Kyoto Protocol is an example of an operative strong multilateral approach. The second approach is to harmonize national policies. An example in principle (though not put into practice) might be harmonizing domestic carbon taxes. An example of the third approach of decentralized architectures and coordinated national policies might be linkage among domestic cap-and-trade systems, driven not through a multilateral agreement but largely by bilateral arrangements. The literature suggests that each of the various proposed policy architectures (and categories of architectures) for global climate change has advantages and disadvantages with regard to mitigating climate change. Section 13.4 goes into more detail.

13.5 Multilateral and bilateral agreements and institutions across different scales

13.5.1 International

13.5.1.1 Climate agreements under the United Nations

Due to its universal membership, the UNFCCC has a high degree of legitimacy among many parties around the world. Steps taken under the Convention and its Kyoto Protocol have led to more extensive action than under any other climate agreement. However, it has also been argued in the literature that the multilateral process, as currently structured, does not adequately address the climate problem (den Elzen, Hof, Mendoza Beltran, et al., 2011).

The Kyoto Protocol's key achievements may be the stimulation of a set of national policies, including the world's largest carbon market in the 27 member states of the European Union (that is, the European Union Emissions Trading System or EU-ETS, see Chapter 14), the increasing number of emissions trading schemes in other countries and regions, and the mobilization of thousands of offset projects in developing countries through the CDM (A Michaelowa and Buen, 2012). As of 31 May 2012, 8,584 CDM projects are in the "pipeline"—at one relatively advanced stage of development or another. Of these, 1,580 are "registered" (accepted by the CDM Executive Board as a CDM project activity) and have issued CERs; 2,590 have been registered, but have not yet issued CERS; and 4,414 have been "validated" (i.e., have successfully undergone a process of review by several bodies), but have not yet been registered. CDM projects had generated approximately 943 million CERs through May 2012, and projections in original project documents suggest that the total issued could be well over 2 billion CERs by the end of 2012 (UNFCCC, 2012a; UNEP Risoe Centre, 2012). The Kyoto Protocol process has also led to the creation of international initiatives such as the Adaptation Fund, discussed below in this section. Emission limits under the Kyoto Protocol remain relatively modest compared with levels consistent with the lower stabilisation levels assessed by Metz et al. (IPCC, 2007).

For the first time, developing countries proposed relative emission reductions (expressed as reductions in emissions intensity, deviation below business-as-usual, or other metrics) under the Copenhagen Accord and the Cancún Agreements, and agreed to measures for monitoring, verification and reporting (MRV) of emissions. Overall, the Copenhagen and Cancún commitments and pledged actions are nonetheless likely to remain inadequate to keep temperature increases below 2°C (den Elzen, Hof, Mendoza Beltran, et al., 2011; B Hare et al., 2012; Höhne et al., 2012).

Negotiations for a second commitment period of the Kyoto Protocol were launched in Montréal in 2005, and discussion on a second track of long-term cooperative action under the Convention turned into negotiations under the Bali Action Plan (UNFCCC, 2007b). The Durban conference of the Parties in 2011 agreed on the principles of the second Kyoto commitment period, albeit with a number of key industrialized countries including Canada, Japan and Russia stating that they would not participate. An extensive literature examined what options could be pursued "post-2012", after the end of the first commitment period under the Kyoto Protocol. The literature now contains several surveys of diverse proposals (see summary of pre-2007 literature in (S Gupta et al., 2007; Höhne et al., 2008; Aldy and Stavins, 2010a; Moncel et al., 2011).

The literature following the Copenhagen, Cancún and Durban UN climate conferences reflects differing interpretations of recent negotiations (Dubash, 2009; Rajamani, 2010; Werksman and Herbertson, 2010; Müller, 2010). Copenhagen was assessed as a failure by those who expected a new climate treaty, while others saw the political agreement reached among a small group of world leaders as a major step forward (Ladislaw, 2010). Others noted more specific effects, such as the change in the organization of carbon markets (Bernstein et al., 2010). Some observers credit Cancún with saving the multilateral process (Grubb, 2011), but it remains unclear whether this heralds an incremental approach opposed to multilateralism (Khor, 2010), or is a step towards a later legal agreement (Bodansky and Diringer, 2010).

In Cancún, parties to the UNFCCC reached a political agreement to quantify the UNFCCC's climate stabilization objective in terms of a limit to temperature increases of 2°C above pre-industrial levels, with the expressed possibility of strengthening it further to 1.5°C (UNFCCC, 2010). The literature has assessed the probabilities of emissions pathways staying below 2°C (WBGU, 2009; Victor, 2009; Rogelj et al., 2009; den Elzen and Höhne, 2010; den Elzen, Hof, and Roelfsema, 2011; Höhne et al., 2012), with the general finding that current pledges are inadequate for that purpose.

Durban in 2011 also produced the Durban Platform for Enhanced Action, in which the delegates agreed to reach an agreement by 2015 on a "protocol, legal instrument or agreed outcome with legal force" that will bring all countries under the same legal regime by 2020. This approach is "applicable to all Parties."

The principle of common but differentiated responsibilities and respective capabilities in climate change mitigation has been central in international climate negotiations (Rajamani, 2006, 2011). The literature reveals competing views regarding the meaning of this principle and the obligations it may entail, including its legal status and operational significance (Höhne et al., 2006; Halvorssen, 2007; Winkler et al., 2009; O'Brien, 2009; Winkler, 2010; Hertel, 2011).

The UN has brought about the creation of a number of new institutions. Under the Kyoto Protocol, an Adaptation Fund was set up to provide direct access to financing for developing countries, financed through a 2% levy on CDM transactions and governed by a majority of developing countries (Liverman and Billett, 2010; Horstmann, 2011; Ratajczak-Juszko, 2012). Ayers and Huq (2009) maintain that its governance structure avoids many of the issues of ownership and accountability faced by other funds. Harmeling and Kaloga (2011) examine the influence of competing interests on funding decisions by the Adaptation Fund Board. Under the Adaptation Fund, Multilateral Implementing Entities (MIEs) have had the most success in securing funding, followed by National Implementing Entities (NIEs), but none by Regional Implementing Entities (RIEs). This has led to calls for transparency in project assessment (Harmeling and Kaloga, 2011). Grasso and Sacchi (2011) discuss issues of justice in Adaptation Fund financing decisions to date. Further research into the distribution of adaptation finance across countries, sectors and communities is required to assess the equity and efficiency of such funding (Persson, 2011).

The literature on climate finance has shaped innovations in a range of financial instruments and a new Green Climate Fund under the Convention (Ballesteros et al., 2010; UNFCCC, 2010, 2011a; Nakhooda, 2010; AGF, 2010; Pew Center, 2010; Haites, 2011; A Michaelowa, 2012a). Funds have proliferated but rarely have been financed (A Michaelowa, 2012a). The Adaptation Fund and its Board (noted above) have been established under the Kyoto/Copenhagen/Cancún process, to coordinate previously fragmented aspects of adaptation policy, as has a new Technology Committee, with modalities and linkages to other institutions (UNFCCC, 2011b). Analysts note that the financial means of the institutions falls far behind the expected means (Harmeling et al., 2011) and stress the importance of promoting synergies with development (Liu, 2011).

13.5.1.2 Other climate-related forums

Beyond the UNFCCC, climate change is addressed in other forums for international cooperation. Gupta et al. (2007) assessed several partnerships focused on particular themes, technologies, or regions. Some of these partnerships have defined themselves as contributions to the UNFCCC rather than as alternatives. For example, in addition to the inclusion of measures for Reducing Emissions from Deforestation and Degradation (REDD) in the UNFCCC/Copenhagen/Cancún process, the REDD+ partnership has "resulted in an Agreement on Financing and Quick-Start Measures to Protect Rainforests" in a non-binding agreement among more than 50 countries and pledges of more than $4 billion (Bodansky and Diringer, 2010). Michaelowa (2012a) and Stewart, Kingsbury and Rudyk

(2009) describe multiple avenues for climate change financing to assist transitions to low-carbon technologies. UN agencies beyond the UNFCCC have increasingly addressed various dimensions of climate change, including human development (UNDP, 2007; UNDESA, 2009), the emissions gap (Höhne et al., 2012) and finance (AGF, 2010).

New initiatives on international cooperation for adaptation and its funding have been created, such as the World Bank's Pilot Program on Climate Resilience, and the European Commission-established Global Climate Change Alliance (GCCA), which pledges regional and country-specific finance. Bilateral institutions such as the French (AFD) and German (KFW) Development Banks and the Japan International Cooperation Agency (JICA) direct international flows of finance to developing countries (Atteridge et al., 2009; JB Smith et al., 2011).

Fragmentation in the various objectives, conditions and eligibility requirements of the different funds present developing countries with challenges in identifying and applying for appropriate funding (Czarnecki and Guilanpour, 2009). The UNDP Millennium Development Goal Achievement Fund had, as of November 2010, received all of the US$90 million pledged to adaptation funding (JB Smith et al., 2011). The literature examines the relationship between adaptation and development finance, including concerns about measuring conventional official development assistance (ODA) and how much adaptation funding is "new and additional" (Stadelmann et al., 2010; JB Smith et al., 2011). A number of developing countries have established national funding entities to coordinate domestic and international funding for adaptation with development funding (JB Smith et al., 2011).

The Major Economies Forum on Energy and Climate (MEF), which has a particular focus on policy for developing and deploying clean energy technologies, had its origins in a process initiated in 2007 by the George W. Bush administration in the United States as the "Major Economies Meetings". The Obama administration subsequently continued the process under its new name. Its members -- Australia, Brazil, Canada, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, the Republic of Korea, Mexico, Russia, South Africa, the United Kingdom, and the United States – together account for about 80% of global emissions (WRI, 2012). Its meetings are intended to advance discussion of international climate change agreements (MEF, 2009). However, the MEF is not recognized by its own participants as a forum for negotiating binding agreements – it is explicitly a venue for discussion, and outputs are a Chairs' summary rather than formally agreed text (Leal-Arcas, 2011). The existence of the MEF may be evidence of an overall increase in the fragmentation of global environmental governance (Biermann and Pattberg, 2008; Biermann, 2010).

In addition to the MEF, the International Renewable Energy Agency (IRENA) was established in 2009 to advance the development and transfer of renewable energy technologies, with a focus on financing renewable energy (Florini, 2011). By November 2010, IRENA's membership included 148 states plus the European Union (EU) (Etcheverry, 2011).

The Group of Twenty (G-20) Finance Ministers from industrialized and developing economies may have a basis to address climate finance, building on its core mission, which is to discuss economic and finance policy. The make-up of the G-20 is similar to that of the MEF, with the addition of Argentina, Saudi Arabia, and Turkey. Houser (2010) finds that the G-20 might help to accelerate the deployment of clean energy technology, help vulnerable countries adapt to climate change impacts, and help phase out fossil-fuel subsidies. At its meeting in Pittsburgh in 2009 (G-20, 2009), the G20 gave considerable attention to climate change policy issues, in particular the related issue of reducing fossil-fuel subsidies—though in subsequent meetings it has given much less attention to climate and energy. Likewise, since 2005, the G8 heads of state and government have held a series of meetings relating to climate change culminating in the G8 leaders agreeing on 2°C as a goal for the limit to temperature increases (G8, 2009). Van de Graf and Westphal (2011) explore both opportunities for and constraints on the G20 and G8 with regard to climate—the constraints including "internal divisions, a lack of legitimacy, the absence of several key players, and the lack of mechanisms for successful implementation of collective action."

In 2010, Bolivia convened a World People's Conference on Climate Change and the Rights of Mother Earth in Cochabamba, culminating in a People's Agreement (WPCCC and RME, 2010). Analysis emphasises the participation of social movements (LA Sandberg and T Sandberg, 2010), arguing for "radical climate justice" (Roberts, 2011) and an approach to law that seeks to establish "rights of nature"(Cullinan, 2002; Aguirre and ES Cooper, 2010).

The regime of SRM and CDR related fora has also begun to take shape and is similarly comprised of many institutions. Under the London Convention and Protocol, the International Maritime Organization (IMO) held that, given the uncertainty surrounding negative impacts, ocean fertilisation other than 'legitimate scientific research' should not be permitted (Reynolds, 2011). Other existing multilateral treaties and agreements that may relate to geo-engineering include the 1977 UN Convention on the Prohibition of Military or any Other Hostile Use of Environmental Modification Techniques (the ENMOD Convention), though it restricts only "hostile" actions; the 1992 Convention on Biological Diversity (CBD), which adopted a statement at its COP 10 in October 2010 calling for a moratorium on geo-engineering (Tollefson, 2010); the UNFCCC provision requiring assessment of the adverse impacts of climate mitigation measures (Article 4(1)(f)); the convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention, 1991) (UNECE, 1991); the Antarctic Treaty System (1959) (US Department of State, 2002); and finally, on-going developments in human rights law and in environmental law (Reynolds, 2011; UNEP, 2012). Further, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967) (United Nations, 2002) may apply to the use of sun-deflecting mirrors in space. See also, Section 13.4.2 above on geoengineering and its governance.

Some authors conclude that attempts to develop a comprehensive, integrated climate regime have failed, due to resistance to costly policies in both developed and developing countries (Michonski and Levi, 2010; RO Keohane and Victor, 2011), or alternatively because of the nature of the problem with its complexity and fundamental need for costly collective action (Hoffmann, 2011). Other analyses emphasise the legitimacy of the UN, particularly citing its universal membership (W Hare et al., 2010; Winkler and Beaumont, 2010; Müller, 2010; La Viña, 2010), noting that fragmentation of the climate regime could create opportunities for forum shopping, a loss of transparency, and reduced ambition (Biermann et al., 2009; W Hare et al., 2010; Biermann, 2010). Other studies have examined the evolution of multilateralism (Bodansky and Diringer, 2010) and possible transitional arrangements from fragmentation to a comprehensive agreement (Winkler and Vorster, 2007), or alternatively how to manage fragmentation so that it may become synergistic rather than prone to conflict (Biermann et al., 2009; Oberthür, 2009). In a fragmented world, linking multiple agreements into a coherent whole is a major challenge.

The literature has considered the advantages and disadvantages of negotiating climate policy across multiple forums and institutions. Some suggest that such "regime complexes" may emerge from smaller "clubs" and then expand (RO Keohane and Victor, 2011; Victor, 2011). Regimes need (external) incentives for participation and (internal) incentives for compliance (Aldy and Stavins, 2010b). A key advantage of smaller forums or "clubs" may be greater efficiency in the negotiation process, as emphasised in the general political science literature on negotiations (e.g.: (Oye, 1985)), but the literature also reflects key disadvantages, including that such clubs lack universality and hence legitimacy (Moncel et al., 2011), and that the environmental effectiveness of clubs may be undercut by leakage of emissions sources to other countries outside the club (Babiker, 2005). Flexibility is another advantage cited, although the approach is not necessarily superior (RO Keohane and Victor, 2011) and has to date not brought about high levels of participation and action. While the smaller number of countries represented in the MEF might make it a more effective negotiation forum than the more inclusive UNFCCC (if in fact the MEF were given authority to host negotiations by its members), some are concerned about a small set of large countries reaching decisions that affect a much larger set; and some may not be comfortable with a process chaired by a single nation

(Stavins, 2010). Smaller clubs must address conflicts where the climate change regime intersects with other major policy regimes (Michonski and Levi, 2010).

13.5.1.3 Relationships with other potentially relevant institutions

Acting on climate change requires functions other than negotiation and high-level governance, including analytical support to international mitigation and adaptation efforts, as well as implementation. Different institutions may be suited to various functions (Michonski and Levi, 2010). Because creating a new organization requires significant start-up costs and the marginal effort of creating legitimacy for climate agreements in existing knowledge-based organizations may be low (Depledge, 2006; Oberthür, 2006), using existing institutions to facilitate climate agreements may be more cost-effective than creating new institutions.

One potentially relevant existing institution is the International Energy Agency (IEA), which was originally established as a consortium of oil-importing countries, as a response to actions by OPEC (Scott, 1994; Goldthau and Witte, 2011). Another potentially relevant institution is the Organisation for Economic Co-operation and Development (OECD). While, the IEA has limited itself to industrialized oil-importing countries, the OECD has granted membership to a few developing countries. The IEA and OECD are increasingly mandated by their members to provide analytical support. The IEA may be well-placed to reduce uncertainty about countries' performance by collecting, analysing, and comparing energy and emissions data. Likewise, the OECD has a unit for economic analysis of climate policy and impacts, and could play a role in building knowledge (OECD, 2009).

International agreements on a related but distinct issue, depletion of the stratospheric ozone layer, have also contributed to reductions in greenhouse gas emissions. These agreements include the Montreal Protocol on Substances that Deplete the Stratospheric Ozone Layer (1987) and its successor agreements. Through the phase-out of substances that are both ozone depleters and GHGs, and other substances that are substitutes for ozone depleters and are GHGs, the Montreal Protocol and its successors have contributed significant reduction in GHG emissions. Recent literature suggests that some ozone-depleting substances and their substitutes that are also GHGs have been dealt with effectively under the Montreal Protocol (Velders et al., 2007, 2009). Parties have proposed amendments to the Montreal Protocol in order to accelerate the phase out of substitutes of ozone depleting substances that are also strong greenhouse gases (Mauritius & Micronesia, 2009).

The UN Convention on Law of the Sea contains important provisions on environmental protection (Redgwell, 2006), and may have increased significance with regards to the governance of marine-based carbon sequestration or geo-engineering options (Virgoe, 2009).

13.5.1.4 International coalitions

New coalitions have arisen among countries across the international climate negotiations. These coalitions are groups of countries presenting coordinated positions in the international treaty negotiations (e.g. the UNFCCC, Kyoto, Copenhagen, Cancún, and Durban) – as contrasted to subgroups or "clubs" of countries seeking to regulate GHG emissions in their region of the world (discussed above).

Such international coalitions in the climate negotiations include the Alliance of Small Island States (AOSIS) which has played a significant role since the early 1990s; various groupings of industrialized countries at different times, including the Umbrella Group, also known as JUSCANZ (Japan, the USA, Canada, Australia and New Zealand); the Environmental Integrity Group, which was the first coalition of industrialized and developing countries, the Cartagena Group, formed at the Copenhagen COP in 2009 (including more than 30 industrialized and developing countries); and the BASIC countries (Brazil, South Africa, India and China), whose emergence in Copenhagen is seen by some as a counterweight to the United States and the European Union (Olsson et al., 2010; Rong, 2010;

Nhamo, 2010). The Coalition of Rainforest Nations played a major role in getting REDD+ included in the international negotiations process in the years after Kyoto. Other active coalitions addressing other issues as well as climate include the Comision Centroamericana de Ambiente y Desarollo (CCAD), and the Bolivarian Alliance for the Americas (ALBA).

In February 2012, a group of seven partners (Bangladesh, Canada, Ghana, Mexico, Sweden, and the United States, together with the UN Environment Programme) launched a new "Climate and Clean Air Coalition" to reduce levels of black carbon, methane and HFCs; on 24 April 2012, UNEP announced the addition of six additional partners to this coalition (Colombia, Japan, Nigeria, Norway and the European Commission, along with the World Bank).

13.5.2 Transnational

A prominent development since AR4 is the emergence of a large number of international agreements not centred on sovereign states (see (den Elzen, Hof, Mendoza Beltran, et al., 2011; B Hare et al., 2012; Höhne et al., 2012). These are most commonly referred to as transnational climate governance initiatives (Biermann and Pattberg, 2008; Pattberg and Stripple, 2008; Andonova et al., 2009; Bulkeley et al., 2012). In the most comprehensive survey, Bulkeley et al. (2012) document 60 of these initiatives, which can be grouped into four principal types: public-private partnerships, private sector governance initiatives, NGO transnational initiatives, and sub-national transnational initiatives. The first two (dealing directly or indirectly with private sector initiatives) will be dealt with in section 13.12; the other two (related to government or community initiatives) here.

NGO transnational initiatives attempt to influence the activities of global corporations directly through transnational partnerships, some of which involve collaboration with the private sector. They have set up certification schemes for carbon offset credits, such as the Gold Standard – which is limited to renewable energy and demand-side energy efficiency projects - or the Community Carbon and Biodiversity Association standard, with its aim to increase the quality of forestry credits (Bayon et al., 2007; Bumpus and Liverman, 2008). Certified offset credits have commanded a price premium above other ("standard") credits (Sterk and Wittneben, 2006; Ellis et al., 2007; Nussbaumer, 2009; P Newell and Paterson, 2010). These certification schemes have been used for the Voluntary Carbon Market as well as for the CDM (see 13.12).

City-level governments have collaborated, notably through the C40 Climate Leadership Group and ICLEI's Cities for Climate Protection program (Kern and Bulkeley, 2009; Román, 2010; Bulkeley et al., 2012). These engage city governments in both collaboration and competition to develop low-carbon development strategies. Larger sub-national units have developed transnational collaborative schemes. Most notable are the North American sub-federal cap and trade schemes being developed, notably the U.S. state of California's, to be implemented in early 2013 (Rabe, 2007b; Selin and VanDeveer, 2009; Bernstein et al., 2010) (See 13.6.1.2).

13.6 Linkages between international and regional cooperation

A number of countries are involved in regional (i.e. multi-country) policy collaboration, whose experiences feed back into the development of the international policy regime. Generally, regional collaboration has been triggered by the setup of an international regime (Wettestad, 2009) and can be seen as part of multi-level governance (J Gupta, 2007b).

13.6.1 Interaction of regional and international carbon markets

Due to the scale effects that occur when carbon markets are enlarged, carbon markets have been the primary means of regional policy integration. The most significant regional carbon market, by a wide margin, is the EU Emissions Trading System (EU ETS), which since 2005 brings together 27 European Union member states and is linked with the Norwegian system. A sub-national system, the Western Climate Initiative (WCI), was considered in the United States, but California is the only state that remains active. California's cap-and-trade system may be linked with two or more Canadian provinces after it begins operation in January 2013.

13.6.1.1 European Union Emission Trading Scheme (EU ETS)

The EU ETS is the key means for Europe to achieve its Kyoto commitments, although the system is fundamentally independent of the UNFCCC and the Kyoto Protocol. Experiences with the UK emission trading scheme starting in 2002 and the Danish emission trading scheme of 2003 had shown that lack of liquidity was a major challenge to the functioning of these markets (S Smith and Swierzbinski, 2007). The wave of accessions to the European Union from Eastern Europe in 2004 allowed the inclusion of the ETS in the accession negotiation packages. The EU ETS thus covers three very diverse sets of countries: Western/Northern/Southern Europe, generally seen as constrained by the Kyoto emission targets; Eastern Europe, with a surplus of Kyoto units (Assigned Amount Units); and Cyprus and Malta, without emission targets under the Kyoto Protocol.

The states of the European Economic Area (EEA) (i.e. the EU member states plus Norway, Iceland and Liechtenstein) have been linked to the EU ETS through incorporation of the EU ETS Directive into the EEA agreement in 2007 from the start of the second trading period (Tuerk et al., 2009). Norway had previously had its own system, which suffered from low liquidity.

Interaction of the EU ETS with international carbon markets works through the project-based Kyoto Mechanisms. Import of units through international emissions trading is not allowed, but companies covered by the EU ETS can import CDM and JI credits. A relatively liberal import regime for the pilot phase was laid down in a "Linking Directive" approved in 2004 (Flåm, 2009). Only forestry credits were banned.

For the ETS second or Kyoto phase, 2008-2012, countries proposed import thresholds; several proposals were adjusted downwards by the Commission. In the absence of an international agreement, imports were limited to credits from CDM projects registered before 2013. New (2013 inception or later) CDM projects can only export into the European Union if located in least developed countries (Skjærseth, 2010; Skjærseth and Wettestad, 2010). In its third phase (2013-2020), the ETS aims to achieve reductions of 1.74% per year to reach a level of 1720 Mt CO2 by 2020 (Clò, 2010).

Literature on the political underpinnings of the ETS suggest that centralised structures, promoted by the European Commission and Parliament, will lead to higher environmental ambition than decentralised approaches (Skjærseth and Wettestad, 2008). In a post-2012 regime, the European Union could potentially link the EU ETS to other schemes; legislation for the period until 2020 allows negotiation of such bilateral treaties. Cross-boundary transfers of EU allowances are mirrored by transfers of Kyoto units. For this purpose, an international transaction log has been created.

13.6.1.2 Western Climate Initiative (California)

The Western Climate Initiative (WCI) was triggered by the passage of a strong greenhouse gas mitigation bill in California – the Global Warming Solutions Act of 2006 (Assembly Bill 32). The WCI was originally envisaged to include seven western U.S. states and four Canadian provinces, enter into force in 2012, and feature linkage among a set of state and provincial cap-and-trade systems, with an overall aim of reducing GHG emissions by the member states/provinces to 15 percent below 2005 levels by 2020 (Rabe, 2007b; Selin and VanDeveer, 2009; Bernstein et al., 2010). However, the launch of the WCI system has been delayed to 2013, and – more importantly -- is now likely to include only California and Québec, with the possible addition of Ontario, British Columbia, and Manitoba.

California's rules are still being developed, but appear likely to allow some fraction of emission reductions to be covered by offsets from outside of the state (Mehling and Haites, 2009; Benson, 2010), which is essential for linkage to occur. Legal scholars (M Barnett, 2010) have assessed whether the WCI infringes legal prerogatives of the federal governments of the United States and Canada, respectively, and found it to be legally valid.

13.6.2 Other regional policies

The Asia-Pacific Partnership for Clean Development and Climate, which was time-limited and has now concluded, involved about 50% of the world population, GHG emissions, and world economic output. It included countries that had not ratified the Kyoto Protocol, was very soft in the hard/soft legal continuum, but may have had a modest impact on governance (Karlsson-Vinkhuyzen and van Asselt, 2009; McGee and Taplin, 2009) and encouraged voluntary action (Heggelund and Buan, 2009).

Besides being covered by international organizations, such as the International Council of Local Environmental Initiatives, voluntary mitigation action of cities is taking a regional character (Kern and Bulkeley, 2009). In Europe, the Climate Alliance has close to 1400 member cities from a number of countries. The Climate Alliance has supported rainforest conservation projects in the Amazonian region.

Increasingly, market-transformation initiatives for energy efficiency improvement are undertaken on a regional level. Examples are the Motor Challenge, which includes 30 European countries which share the aim of improving industrial motors (Bertoldi and Elle, 2010), the U.S. and Canada Consortium for Energy Efficiency, which brings together utilities and municipalities (IEA, 2010) coordinated standard-setting in joint committees in Australia and New Zealand (Cogan, 2003).

13.7 Linkages between international and national policies

13.7.1 Overview

As the landscape of multilateral and other international agreements on climate has become more complex, the links between international and national levels have become more varied. Interactions between agreements that vary across issues, scale, scope, and participation are characterized by a diversity of potential synergies and conflicts. The landscape of climate agreements has been illustrated in Figure 13.1, and earlier sections have noted different analyses of fragmentation and the need for overall coherence.

International policy may trigger more ambitious national policies. Treaties provide greater certainty that others will also act, thus addressing key concerns that countries will free ride. Some literature suggests that national and sub-national settings may provide useful laboratories to test policy instruments before implementation at the international level, in a setting where actions may be less risky and/or more politically feasible (A Michaelowa et al., 2005; Moncel et al., 2011; Zelli, 2011).

International climate policy can shape domestic climate discourse, but may not inspire proactive action (Tompkins and Amundsen, 2008). Conversely, the implementation of international policy is affected by national political structure which can be decentralized, centralized, or consensus-based, e.g. decentralization in Italy (Massetti et al., 2007), France (Mathy, 2007) or Canada (Harrison, 2008), centralization in China (Teng and Gu, 2007) or the UK (Barry and Paterson, 2004; Compston and Bailey, 2008) and the consensus culture in the Netherlands (J Gupta et al., 2007).

Earlier sections have pointed to various considerations that are important (13.3) in linking national and international climate agreements (13.4), in the context of fragmentation (13.5). Some literature suggests various kinds of linkages can assist with “interplay management” to enhance environmental outcomes (Eckersley, 2008; Oberthür, 2009; Biermann, 2010). A typology of such linkages might distinguish, in descending order of strength or hierarchy, among overarching institutional frameworks (in which the higher institution may mandate others to undertake certain tasks); agreements between independent institutions or agreements; and unilateral management by individual institutions.

Where national policymaking lags, policy experimentation has occasionally taken place at the sub-national level (Rabe, 2007b), most notably in California (see section 13.5 above). Another important example is New South Wales (Australia), which operated an emissions trading system from 2003, though this system was terminated and folded into Australia's new carbon-tax scheme in July 2012.

Finally, linking national policies with international policies may provide flexibility by allowing a group of parties to meet obligations in the aggregate. The Kyoto Protocol (Article 4) provides for such inter-regional flexibility, and the European Union has taken advantage of the Protocol's provision through its internal burden-sharing decision, through which the Kyoto commitment of an 8% emissions reduction is redistributed among EU-15 member states in a way that the commitments of these states range from -28% (Luxembourg) to +27% (Portugal) (A Michaelowa and Betz, 2001; Hunter et al., 2011).

13.7.2 Linkages between the Kyoto instruments and national policies

Making use of the Kyoto instruments (e.g. CDM and JI) is driven by national mitigation policies to achieve industrialized countries' emissions commitments. While governments of some industrialized countries buy emissions credits directly, others introduce instruments with emissions commitments for private companies, like the EU Emissions Trading System (EU ETS). These companies can then use emissions credits generated under the Kyoto Protocol to satisfy part of their commitments (A Michaelowa and Buen, 2012).

All industrialized countries limit imports of credits generated by the Kyoto mechanisms for various reasons. One reason is to keep the carbon price high to induce technological innovation. Another is to avoid diminishing environmental effectiveness by allowing required emissions-reduction to occur in other jurisdictions or because of concerns about the quality of credits ("additionality"). For example, the European Union has prohibited the import of Assigned Amount Units into the EU-ETS in order to prevent the use of surplus units from countries in transition, colloquially called "hot air" (A Michaelowa and Buen, 2012) . In 2011, credits from certain CDM project types were banned for use in the EU-ETS from 2013 onwards due to possible emissions leakage (L Schneider, 2011). The geographical distribution of CDM projects across developing countries has been uneven, with 80% of CDM projects in Asia and less than 3% in sub-Saharan Africa (Bibby, 2012) The low levels of participation by least developed countries (Silayan, 2005; De Lopez et al., 2009) may indicate the need for institutional and procedural reform of the CDM (De Lopez et al., 2009) and more development-oriented approaches to mitigation (Miller, 2008).

The Kyoto mechanisms also interact with the national policies of countries in which projects are implemented. The CDM Executive Board allows developing countries to adopt mitigation policies without penalty through the argument that the ensuing projects are then not additional (A Michaelowa, 2010) as well as avoiding perverse incentives not to adopt mitigation policies (Winkler, 2004). Instead, countries may subsidize renewable energy while generating CDM credits. There are indications that the availability of CDM credits has accelerated the introduction of feed-in tariffs in China (Schroeder, 2009). Freeing emission units for sale under international emissions trading requires national mitigation policies, unless there is a surplus of units in a business-as-usual situation as in countries in transition (Böhringer et al., 2007).

Investment law, defined through over 3,000 multilateral and bilateral investment treaties, and private international law apply to the CDM and emissions trading contracts. Proposed standardised contracts link the CDM to investment law by covering the choice of language and the process and forum for dispute resolution, and could expose contractors to the costs associated with international arbitration (J Gupta, 2008; Klijn et al., 2009).

Linkage of national policies with the Kyoto mechanisms can be direct or indirect. In the former case, the same units are valid throughout the linked systems. Indirect linkage is achieved through acceptance of a third unit in a certified emission reduction credit system by several systems. Figure 13.2 shows trading schemes and linkages.

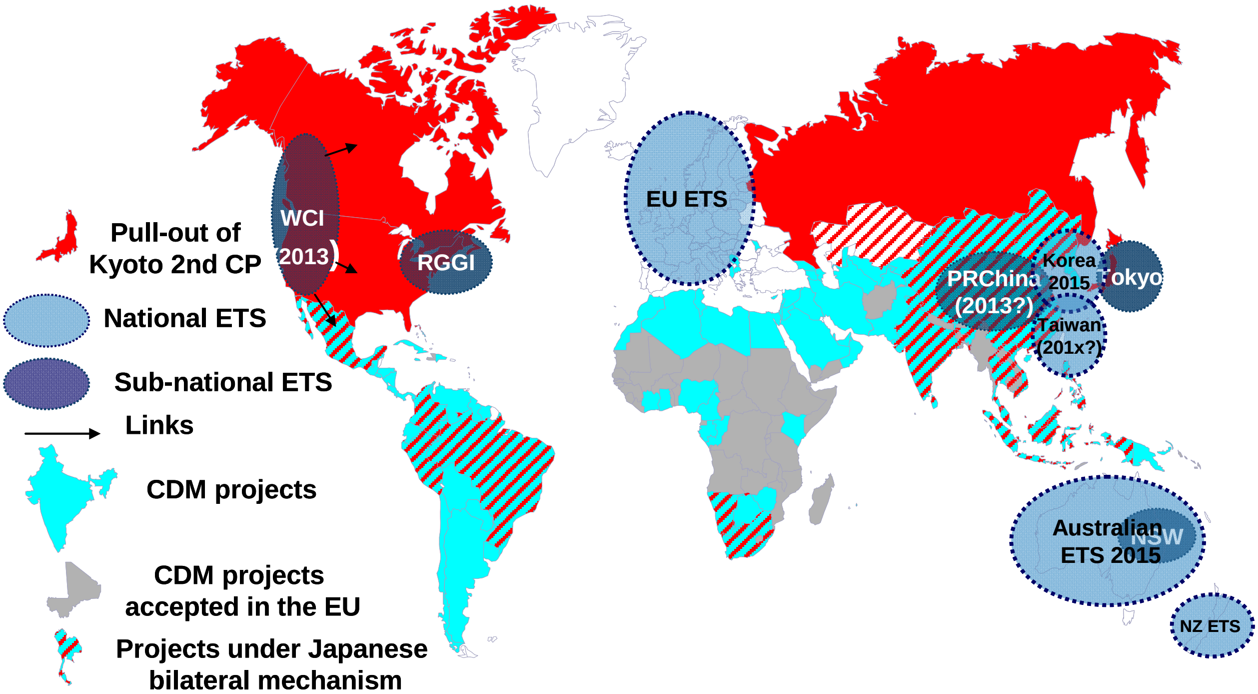


Figure 13.2. Cap and trade schemes and linkages

The only formal *direct* linkage between two trading schemes to date is between the Norwegian Emission Trading Scheme and the EU-ETS. A strong indirect linkage between carbon markets exists through the CDM, whose credits are accepted under the EU-ETS, the Australian Carbon Pricing Scheme, and the New Zealand ETS. Nazifi (2010) finds that EU demand has driven the price for CDM credits, implying that the European Union substantially reduced its costs.

Direct linkages reduce mitigation costs, increase credibility of the price signal, and expand market size and liquidity (N Anger, 2008; Flachsland et al., 2009; J Jaffe et al., 2009; Cason and Gangadharan, 2011). However, direct linkage also raises a variety of concerns (J Jaffe et al., 2009), including that linking can lead to a dilution of mitigation achieved through trading schemes, as linked systems are only as good as the weakest among them (e.g. the one that allows imports of offsets of doubtful quality). Grubb (2009) also warns that countries may be unwilling to accept an increase of carbon prices that would result from linking with an ambitious system. Tuerk et al. (2009) see the biggest challenges to linking in differential stringencies of targets in each system, varying degrees of enforcement, differences in eligible project-based credits, and the existence of cost containment measures, such as price ceilings. Mehling and Haites (2009) stress that only a bilateral link yields the full benefits of linkage, but would entail cumbersome adoption procedures as well as legal and procedural constraints. Reciprocal unilateral links, possibly accompanied by an informal agreement, would be easier to implement and offer more flexibility, and achieve almost the same economic benefits. Possibly more attractive than any of these approaches are indirect linkages among regional, national, or sub-national cap-and-trade systems, an approach that maintains the benefits of linkage without much of the downside (J Jaffe et al., 2009).

13.8 Interactions between climate change mitigation policy and trade

Research on the interactions between climate change mitigation policy and trade indicates a diversity of compatibilities, synergies and conflicts, as well as cooperative arrangements (Brewer, 2003, 2004, 2010; Cosbey, 2007; ICTSD, 2008; Cottier et al., 2009; Epps and A Green, 2010). Trade and climate interact at many levels: multilateral, plurilateral, regional, bilateral and sectoral (Tamiotti et al., 2009; UNEP, 2009; UNCTAD, 2010; World Bank, 2010).

Consideration of specific issues and options needs to take into account the context of the provisions of the principal existing multilateral climate change framework (Yamin and Depledge, 2004) and multilateral trade framework (Hoekman and Kostecki, 2009). The importance and opportunities for international cooperation on climate change-trade interactions are formally recognized, but there is also recognition of the potential for conflict. The UNFCCC (1992) and a Ministerial Decision at the time of the negotiations of the Marrakech Agreement establishing the World Trade Organization (1994) note the potential for policies that can benefit trade, the environment and sustainable development. The Kyoto Protocol (UNFCCC, 1998) notes in Article 2.3 that Annex I Parties "shall strive to implement policies and measures under this Article in such a way as to minimize adverse effects, including … effects on international trade ….".

Within the strictures of these agreements, the search for cooperative arrangements and the avoidance of destructive conflicts takes place in a context in which there are differences among researchers and policymakers in their perspectives on climate change economics and trade economics. These differences include fundamental empirical assumptions and policy preferences concerning the roles of markets and governments. Economic analysis of environmental issues in general, including climate change economic analysis in particular, typically assumes that government measures (including regulations and subsidies) are needed to address the market failures that contribute to the climate change problem and constrain solutions. Economic analysis of trade issues typically assumes that there are gains from free trade based on countries' comparative advantages and that government intervention tends to create inefficiencies, albeit with some exceptions. A central challenge to increasing international cooperation in the interactions of climate change policies and trade, therefore, is to take into account these fundamental differences in the climate and trade research and policy making communities. For instance, trade sanctions or trade enticements could be used to address free-rider problems of international agreements - specifically participation and/or compliance problems (Victor, 2010). Such issues at the intersection of trade and climate change are part of a wider set of issues about governments' participation and compliance in international environmental agreements (Barrett, 2003, 2007, 2008b; Barrett and Stavins, 2003). See sections 13.2-13.3.

13.8.1 WTO-related issues

A central issue for WTO members is whether policies are consistent with principles of non-discrimination: Most Favoured Nation Treatment, which prohibits more favourable treatment of the goods, services, or corporations of any one member as compared with other members, and National Treatment, which prohibits less favourable treatment of foreign relative to domestic goods, services or corporations. Of the more than 60 WTO agreements, annexes, and understandings that apply these principles, many are pertinent to climate change; these include the General Agreement on Tariffs and Trade (GATT), the General Agreement on Trade in Services (GATS), the Agreement on Trade Related Intellectual Property Rights (TRIPs), the Agreement on Trade Related Investment Measures (TRIMs) and the Dispute Settlement Understanding (DSU), as well as agreements on subsidies, technical barriers, government procurement, and agriculture (Brewer, 2003, 2004, 2010; Cottier et al., 2009; Hufbauer et al., 2009; Epps and A Green, 2010). Trade issues concerning CDM projects have received special attention (Werksman et al., 2001; Rechsteiner et al., 2009; Werksman, 2009). Although no trade or investment disputes have arisen yet in connection with CDM projects, there is the possibility that they will in the future as the number and economic significance of CDM projects continue to increase.

Tariffs and non-tariff barriers to transfers of technologies identified by the IPCC (2011a) as potential contributors to climate change mitigation have been issues in the on-going WTO Doha Round negotiations (Tamiotti et al., 2009). In general, non-tariff barriers tend to be more important barriers than tariffs at the climate-trade interface, but tariffs are still high in some industries and countries (Steenblik, 2006; World Bank, 2008a).Domestic subsidies often occur in conjunction with tariffs on imports, especially in agricultural products; and this has been the case with biofuels, which have been at issue in the Doha Round of WTO negotiations.

Government subsidies for renewable energy and energy-efficiency goods and services have become issues in relation to the WTO Agreement on Subsidies and Countervailing Measures as well as the Trade Related Investment Measures agreement. In two instances, such issues have prompted WTO dispute cases - one involving subsidies for producers of wind turbines (WTO, 2010) and the other involving feed-in tariffs (WTO, 2011). Although the application of WTO subsidy rules may retard the development and diffusion of climate-friendly technologies, it is not yet clear that this will happen (Howse and Eliason, 2009; S Bigdeli, 2009; Howse, 2010).

Government procurement restrictions on imports of climate-friendly goods and services have emerged as an issue in the context of national economic stimulus programs. The applicability of the plurilateral WTO Agreement on Government Procurement to such trade issues is limited because many countries have not agreed to it; among those that have, there are many government agencies whose programs are not covered (van Asselt et al., 2006; Hoekman and Kostecki, 2009; Malumfashi, 2009; van Calster, 2009).

Product labelling and standards issues can arise in relation to the WTO Agreement on Technical Barriers to Trade (Appleton, 2009), which could be pertinent to the use of labels concerning “food miles” (ICTSD, 2007; World Bank, 2010). Although long-distance air transport of agricultural products inevitably involves aviation industry GHG emissions, the agricultural practices of many exporting countries are less GHG-intensive than those of the importing countries; determining the relative GHG emissions levels of imported versus domestic products thus requires complete life-cycle analyses of individual products and specific pairs of exporting-importing countries.

Another particularly nettlesome labelling issue in the trade-climate nexus arises from the fact that a proportion of a country’s greenhouse gas emissions resulting from the production of goods and services in one country may be “embedded” in traded products which are consumed in other countries. At issue is whether to attribute the emissions to the producing (exporting) country or consuming (importing) country (Kainuma et al., 2000; Peters and Hertwich, 2008); however, this is an ethical issue that lies beyond the scope of the present chapter (see Chapters 3 and 4 on ethical issues).

Border adjustment measures (BAMs) on imports to offset international differences in costs arising from international differences in measures to address climate change have become one of the most contentious and researched points of interaction (Babiker, 2005; de Cendra, 2006; Cosbey and Tarasofsky, 2007; Ismer and Neuhoff, 2007; Genasci, 2008; Frankel, 2008; Tamiotti and Kulacoglu, 2009; Zhang, 2009; O’Brien, 2009; van Asselt and Brewer, 2010; Tamiotti, 2011). The issues are especially problematic and consequential since they simultaneously involve overlapping issues of (1) international economic competitiveness, (2) the environmental effectiveness of climate change mitigation measures in view of potential international leakage of emissions and (3) free-riding that can undermine international environmental agreements. Econometric studies have tended to find that this is not a significant macro-economic issue, but that there are competitiveness and leakage issues for a few industries which are both greenhouse gas-intensive and trade-intensive (Grubb and Neuhoff, 2006; Houser et al., 2008). There has been less consensus in legal-institutional studies that have examined the question of whether border adjustment measures would be consistent with WTO rules.

Regional and bilateral trade agreements are an integral and important part of the international trade institutional architecture. The number of “regional” agreements - which include bilateral agreements - that had been “notified” to the WTO as of 15 May 2011 was 489, of which 297 were in force. They vary in their institutional arrangements and policies, and thus their relevance to climate change mitigation policy (Chapter 14). The same can be said for the more than 2,000 Bilateral Investment Treaties (Sornarajah, 2010).

13.8.2 Other international venues

Two greenhouse-gas-emitting industries that are centrally involved in international trade as modes of transportation are covered by separate international agreements that are outside the WTO system (see also Chapter 8). International aviation issues are covered by the Chicago Convention and the International Civil Aviation Organisation (ICAO), while international maritime shipping issues have been addressed by the International Maritime Organisation (IMO).

There has been increasing interest in recent years in both ICAO and IMO in industry practices concerning greenhouse gas emissions, with some efforts at international cooperation to address them. However, there has been conflict in ICAO and in other venues about the European Union's inclusion of aviation within the EU ETS. Though studies indicate that the economic impacts are small relative to other airline expenses and ticket prices and that much of the cost can be passed on to consumers (Scheelhaase and Grimme, 2007; A Anger and Köhler, 2010), economic, political and legal issues have nevertheless made international cooperation difficult. See Hepburn and Müller (2010) for a proposal for an international aviation adaptation levy. In the WTO, the GATS includes commitments concerning aviation ground services only, and the Agreement on Trade in Civil Aircraft is a plurilateral agreement that pertains only to manufactured goods in the form of aircraft and parts. Climate change issues in maritime transport have been on the WTO agenda through the Negotiating Group on Maritime Transport Services.

There are other international institutional contexts within which climate change-trade interaction issues have been addressed, namely, the World Bank, G-8, G-20, International Energy Agency, Major Economies Forum, and Organisation for Economic Cooperation and Development (section 13.5).

13.8.3 Implications for policy options

In terms of WTO and/or UNFCCC involvement, there are logically four possible sets of options for institutional architectures at the multilateral level for addressing climate change-trade interactions: WTO-based, UNFCCC-based, joint UNFCCC-WTO, and stand-alone. In addition, there could be hybrid arrangements involving combinations of these four "pure" types. For instance, proposals for Sustainable Energy Trade Agreements (SETAs) could be addressed in a variety of venues (ICTSD, 2011).

Of the four options, WTO-based ones have received the most attention in the literature. Alternatives include making revisions in existing WTO arrangements or undertaking new arrangements (Epps and A Green, 2010). Possible changes in existing WTO arrangements include a "peace clause" (Hufbauer et al., 2009) or waiver agreement (Howse and Eliason, 2009; Howse, 2010), whereby WTO members would agree - within some limits - not to challenge on WTO grounds, respectively, climate policies in general or climate-related subsidies in particular. Although both proposals contribute to discussions of key issues by their intention to reduce uncertainties about the WTO status of climate-related measures, there have been doubts about their potential effectiveness (Epps and A Green, 2010).

An extensive list of other possible changes to existing WTO arrangements has been discussed by Epps and Green (2010), whose suggestions include: change GATT Article XX so that climate measures are explicitly identified as qualifying for exceptional treatment; add a similar provision to the Subsidies Agreement; change the burden of proof or standard of review for the scientific evidence presented in climate change cases to Dispute Settlement panels; change Dispute Appellate Body rules to take into account the scientific uncertainties in climate change cases; establish a notification process for members to inform other members of the adoption of climate policies with trade implications; and establish a Climate Change Committee, which could facilitate conflict resolution without resorting to the Dispute Resolution process.

Many possibilities for a new Climate Change Agreement at the WTO have also been discussed by Epps and Green (2010). The elements of such an agreement could include: establishment of a Climate Change Committee (as above); establishment of a notification procedure for climate change measures (as above); establishment of climate change mitigation as a legitimate objective; development of a ”non-aggression clause” that would prohibit unilateral actions, such as border adjustment measures; adoption of transparency requirements for national climate change policymaking processes to determine their legitimacy in relation to climate change concerns and protect against disguised trade protectionism; adoption of environmental rationales for subsidies; reviews of members' trade-related climate measures to insure that they are substantive responses to climate issues; and clarification of the potential application of "process and production methods" (PPMs) questions to climate change disputes.

UNFCCC-based options have received little attention thus far, though there has been some interest in adopting a prohibition on the use of unilateral trade measures, such as offsetting border measures (Werksman et al., 2009).

A potential joint UNFCCC-WTO agreement has not yet received much attention in the published literature (Epps and A Green, 2010). However, there are already in effect arrangements whereby the UNFCCC is an observer in meetings of the WTO Committee on Trade and Environment (CTE) and is invited on an ad hoc basis to meetings of the Committee overseeing the specific trade and environment negotiations (CTESS) (Cossey and Marceau, 2009). In addition, WTO Secretariat staff members attend the annual UNFCCC COP meetings.

Finally, a stand-alone arrangement could – in principle -- be developed (Epps and A Green, 2010), a possibility that has not yet been analysed in the published literature. Because published analyses of these various options are relatively recent and evolving rapidly, it would be premature to summarize them. Nevertheless, options for one or more such agreements are at the frontiers of the research and policy agendas of both the climate change and trade communities of researchers and policymakers. The agenda includes not only greater cooperation at the multilateral institutional level, but also many issues at other institutional levels.

There are numerous and diverse unexplored opportunities for greater international cooperation in trade-climate policy interactions. While mutually destructive conflicts between the two systems have thus far been avoided, pre-emptive cooperation could protect against such developments in the future. Whether such cooperative arrangements can be most effectively devised within the existing institutional architectures for trade and for climate change or through new architectures is an open issue (section 13.4).

13.9 Mechanisms for technology development, transfer, and diffusion

13.9.1 Rationale

Because of the long-term nature of the climate change problem and the high costs associated with significant emissions-reduction strategies, technological change in mitigation methods and other, related technologies is likely to play an important role in the implementation of future policies.

Policy that has the potential to lower the cost of climate change mitigation may increase the likelihood that countries will commit to reducing their GHG emissions. By lowering the cost of environmentally sound technologies relative to climate-damaging technologies, appropriate public policies can increase incentives for countries to comply with international climate obligations and could therefore play an important role in increasing the robustness of long-run international frameworks (Barrett, 2003).

Technology policy may play an important role in improving the efficiency of existing R&D activities by increasing the international exchange of scientific and technical knowledge and by reducing duplicated R&D effort which could be shared across nations.

In an international climate policy regime, technology policy may also play an important role in aiding developing countries to follow a less GHG-intensive pathway towards development. Technology policies may facilitate access to climate change-mitigating technologies or funding to cover the additional costs of such technologies, thereby increasing incentives for developing country participation in international climate agreements. Further, such policies may also advance goals beyond climate policy such as economic development, local air quality improvement, and energy security.

Therefore, technology-oriented agreements may play a significant role in an international climate policy regime (de Coninck et al., 2008). Such agreements could include activities across the technology life-cycle for knowledge sharing, coordinated or joint research and development of climate change-mitigating technologies, technology transfer, and technology deployment policies (such as technology or performance standards and incentives for technology development or adoption) (RG Newell, 2010).

13.9.2 Modes of international incentive schemes to encourage investment flows

Absent additional market failures, underinvestment in innovative activity below socially-optimal levels can occur due to several well-understood general properties of innovation: indivisibility (i.e. prices of newly innovated projects need to be above the marginal cost of their production if innovators are to be compensated for the costs of R&D), uncertainty in the returns to R&D effort, and inappropriability (i.e. the wedge between the social and private returns to R&D) (Arrow, 1962).

Inappropriability, stemming from the lack of mechanisms in place for firms to capture the full social benefit of their inventions (due to information "spillovers"), tends to be a greater concern the further up the chain of technological change: from development to applied and finally to basic scientific research (IEA, 2008; Henderson and RG Newell, 2011). In particular, when markets for technologies are "missing," as is the case for climate change-mitigating technologies, underinvestment due to inappropriability may be more acute.

A price (whether explicitly created through market-based regulation or implicitly created through non-market-based regulation) on GHGs can create a demand-driven, and therefore profit-based, inventive for the private sector to invest in developing lower-cost technologies for mitigation. This phenomenon, referred to as "demand pull" (Schmookler, 1962) encourages private firms to invest in R&D and other types of innovative activities to bring lower-GHG technologies to market, just as firms do for other products and processes (for surveys see (AB Jaffe et al., 2003; Popp et al., 2010)).

Therefore, national and supra-national policies that provide incentives for climate change mitigation will likely play an essential role in stimulating demand and therefore inducing innovation in the necessary new technologies for climate mitigation goals. Conversely, reducing existing incentives for fossil fuel and related technologies will similarly reduce incentives for innovation in competitors to climate change mitigating technologies, as well as affording broader economic benefits (UNEP, 2008).

International carbon markets, including the flexibility mechanisms they may employ, such as international linkage of domestic emission programs, offsets, and the Clean Development Mechanism (CDM), are potentially effective mechanisms for financing emission reductions in developing countries, transferring technology between nations and regions, and allowing more cost-effective climate change mitigation. Both international agreements and domestic policies can establish clear rules for these markets and their associated flexibility mechanisms and aid in the removal of unnecessary barriers to facilitate technology transfer and create incentives for technology development at a global level (see section 13.13).

Credibility of policy commitments and long-term incentive schemes can be significant factors in inducing private sector investment in innovation. Given the long lifetimes of emission-intensive capital (e.g. power plants may operate for more than 50 years and building shells may last 100 years), long-term credible incentives allow the owners of such capital to form appropriate expectations to structure their investments. Extending the time horizon of climate policy commitments and decreasing the downside uncertainty surrounding the level of incentives will bring about more innovation because firms will expect a market for climate change-mitigating technologies further into the future.

13.9.3 Intellectual property rights and technology development and transfer

Domestic actions for emissions mitigation may be a critical feature of any internationally coordinated response to climate change that induces long-term innovation (see Chapter 15). Nonetheless, transferring the resulting technological knowledge and equipment internationally, and ensuring that technologies are deployed in appropriate national contexts, may require additional actions at an international level. While technology transfer strategies may address typical impediments to technology adoption, such as information availability and technological maturity, they also can address financing barriers specific to developing countries.

The degree of protection afforded to intellectual property rights and other conditions related to the rule of law, regulatory transparency, and market openness may also be important and can present impediments that affect technology transfer rates.

13.9.3.1 Intellectual property rights

Protecting intellectual property (IP) through patents is one of the principal means by which innovators can capture value lost because of the indivisibility of R&D costs and product manufacturing costs and the public good nature of information associated with new GHG-reducing technologies. The literature surveyed in Chapter 15 shows that there is some evidence (clouded by difficulties of establishing the direction of causality) that stronger IP protection in developed countries fosters investment in R&D (and hence presumably innovation) in those countries. Theoretical analysis suggests that this effect should extend so that stronger IP protection in developing countries would similarly increase the incentive for R&D in the developed countries, by extending the protected market for the resulting products (GM Grossman and Lai, 2004). There is, however, no empirical evidence to support this proposition.

Even if stronger IP protection does not foster creation and development of new technologies, it may be beneficial to technology development for mitigation if it fosters transfer of technologies from developed to less developed countries. Theoretically, strong IP protection in developing countries may be necessary to limit the risk for foreign firms that transfer of their technology will lead to imitation and resulting profit erosion. Empirical literature finds a role of strong IP protection in receiving countries in facilitating technology transfer from advanced countries through exports, foreign direct investment (“FDI”), and licensing for: transfers from the OECD (Maskus and Penubarti, 1995); FDI to 16 countries originating in the U.S., Germany and Japan (J-Y Lee and Mansfield, 1996; Mansfield, 2000); and transfers from the U.S. (PJ Smith, 1999). Regarding recipients, Awokuse & Yin (2010) find evidence for transfers to China, and Javorcik (2004) for FDI to twenty-four Eastern European transition economies. Branstetter et al. (2006) assessed FDI to sixteen middle income countries after those countries strengthened their IP protection and found indicators for U.S. technology transfer increasing subsequently.

Overall, there does seem to be consistent evidence that, all else equal, stronger IP protection fosters greater incoming FDI, particularly for middle income countries. It is important to note, however, that IP rules are but one of many factors affecting FDI decisions. Others, particularly more general aspects of the legal and institutional environment that affect the riskiness of investments, may be more significant (Fosfuri, 2004).

The results investigating the effect of IP strength on technology licensing parallel those for FDI. The Branstetter et al. (2006) results discussed above included royalty payments among the measures of technology transfer that increased after IP strengthening. Smith (2001) finds that the association between strong IP and licenses is stronger than the relationship between IP and exports.

In summary, the evidence indicates a systematic impact of IP protection on technology transfer through exports, FDI and technology licensing, particularly for middle-income countries for which the risk of imitation in the absence of such protection is relatively high. It is less clear to what extent these effects extend to the least developed countries whose absorptive capacity and ability to appropriate foreign technology in the absence of strong IP protections is less.

Research to examine the role of IP rights in the specific context of climate-friendly technologies has been limited (Reichman et al., 2008). In an analysis of existing solar, wind, and biofuel technologies, for example, Barton (2007) found that IP protection has elicited innovation without significantly impeding technology transfer, although problems could arise if new, very broad patents were granted that impede the development of future, more efficient technologies.

The two key international institutions for developing and implementing IP policies are the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations that administers numerous intellectual property treaties, and the WTO, through the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). (See Section 13.8)

13.9.3.2 Technology transfer

International trade and foreign direct investment are the primary means by which new know-how and equipment are transferred among countries (World Bank, 2008b), with private-sector investments constituting 86% of global investment and financial flows (UNFCCC, 2007a). In addition to domestic actions that foster a positive environment for technology transfer investments through regulatory flexibility, transparency, and stability, specific international actions could be taken to reduce barriers to trade in environmental goods and services. In particular, the literature has identified tariffs and non-tariff trade barriers as an impediment to the transfer of energy technologies to developing countries (World Bank, 2008a).

The UNFCCC has called on developed countries to finance the transfer of technology to developing countries. This builds on the model established by the Multilateral Fund under the Montreal Protocol to support developing countries' efforts to reduce their emissions of ozone-depleting substances. After a modest record of financial assistance for such activities through the Global Environmental Facility, several developed countries pledged six billion dollars for technology transfer at the Hokkaido Summit in 2008 (IPCC, 2000; Aldy and Stavins, 2008).

13.9.4 International collaboration to encourage knowledge development

13.9.4.1 International agreement on R&D knowledge sharing, coordination, and joint collaboration

The literature offers many possible goals for international R&D collaboration that could be coordinated at an international level. The possibilities include agreements for knowledge sharing and coordination of R&D, joint collaboration and funding of R&D, and commitments to increase domestic R&D funding.

Activities undertaken under knowledge-sharing and coordination agreements can include planning meetings, information exchange, coordinated or harmonized research agendas, measurement standards, and integrated or cooperative R&D (IEA, 2008; de Coninck et al., 2008). Examples of such existing international agreements include the Carbon Sequestration Leadership Forum, the former Asia Pacific Partnership on Clean Development and Climate, and the International Partnership for a Hydrogen Economy. Energy science and technology agreements that feature a higher degree of joint, collaborative R&D have been more frequently implemented in more basic research areas. Examples include the ITER fusion reactor and European Organization for Nuclear Research (CERN) (de Coninck et al., 2008). In addition to expanding the international exchange of scientific and technical information, joint R&D can increase cost-effectiveness through cost sharing and reduced duplication of effort.

Most existing international agreements relevant to climate mitigation technology have been developed as so-called Technology Implementing Agreements under the auspices of the IEA, organized under its Committee on Energy Research and Technology. IEA Implementing Agreements use two primary mechanisms: task sharing and cost sharing. In task sharing, a joint program is pursued within participating countries, but each country funds and implements its own contribution to the project. In cost sharing, participating countries pool funding for a single contractor to perform a research task. There are forty-one existing IEA Implementing Agreements, all of which incorporate task sharing and about half of which have cost sharing (RG Newell, 2010).

13.9.4.2 International agreement on domestic climate technology R&D funding

Public sector investment in energy and climate-related R&D has fallen considerably since the early 1980s, although there has been a rebound in recent years (RG Newell, 2010; P Newell, 2011). An international agreement could include provisions to increase domestic funding of climate technology R&D, analogous to internationally agreed emission targets for each country. Such an agreement could, for example, target a level of climate technology R&D as a percentage of GDP, or as a percentage increase from recent levels to incorporate notions of burden-sharing (RG Newell, 2010). The general idea is not without precedent: In 2002, the European Union set the goal of increasing its level of overall R&D spending—currently at 1.8 percent of GDP (OECD, 2010)—to 3 percent of GDP by 2010.

International coordination of R&D portfolios may reduce the duplication of R&D effort, cover a broader technological base, and enhance the exchange of information gained through national-level R&D processes. This coordination could cover the allocation of effort by government scientists and engineers, the targeting of extramural research funding to specific projects, and public-private partnerships. Engaging developing economies in developing and deploying new technologies may require further technology development to meet the needs of domestic institutions and norms.

Bringing newly-developed technologies to full commercialization often presents challenges, and for some technologies, the private sector may not have sufficient incentives under existing conditions to commercialize new technologies. Since some of the economic risk the private sector faces reflects uncertainty about the incentives future climate policies would create, governments may have a role in financing technology demonstration projects (RG Newell, 2007). The case for such demonstration projects may be even stronger in developing and emerging economies where incomplete capital markets may further undermine investment in commercializing these technologies.

13.10 Capacity building

Technology transfer and financial assistance can be complemented by capacity building efforts in developing countries to promote effective implementation. Although neither the Climate Convention, nor the Kyoto Protocol explicitly mentioned capacity building, Article 10e of the Kyoto Protocol sets the grounds for the further elaboration of capacity building in the COP decisions and the Marrakech Accords.

The literature on capacity building includes lessons on the effectiveness of aid and capacity building, social change and institutional change theories, adaptive capacity theories, and disaster management theories. While capacity building calls for creating an enabling environment, human resource and institutional development, and community participation, capacity building is also seen as complex and intertwined with human values. It is endogenous, involves shifts in power and identity, is uncertain and unpredictable, and influenced by local contexts.

Social change theories argue that those promoting change need to understand systemic learning processes and reflect about how change occurs (Aragón and Giles Macedo, 2010). Capacity building can both empower and disempower (Armitage, 2005; J Barnett, 2008). Aid-effectiveness theory argues that once we are "freed from the delusion that it can accomplish development" (Easterly, 2007, p. 331), it can be effective when the type of aid and capacity building is aligned to the type and needs of the partner country, when there is partner ownership of the projects and conditionality is minimized, when simplistic formulae are not used, when imbalances in the local economy are not caused and when stakeholders are included and mobilized (J Gupta and M Thompson, 2010).

Based on experiences, UNEP and UNDP (2007) argue that mainstreaming environment in development processes calls for finding the right entry point, finding a 'champion', ensuring the commitment of the planning or finance team, providing country-specific evidence, performing integrated policy appraisals, engaging key sector agencies, considering the capacity of environment-agency capacity and acknowledging the need for sustained support. Such processes are not always efficient but may need to be 'clumsy' to allow local actors to redesign and gain ownership of the process (Verweij and M Thompson, 2006) and take gender issues into account (Makhabane, 2002). They need to allow for systemic capacity to develop which can only result from relationships between actors 'who want to make a difference, rather than just resulting from improvements to technique, structure or assets' (Pitpit and Baser, 2010, p. 60). However, although capacity-building agents know what works, they are often driven more by self-interest (James, 2010), prefer linear causal logic, replicable 'best practice' models, the promotion of discrete skills and individual capacity over collective reflection, struggle and engagement with power relations which is critical for change (Clarke and Oswald, 2010; Harvey and Langdon, 2010; Pearson, 2010). The IPCC special report on technology transfer (2000) treated capacity building under the goal of technology transfer.

13.10.1 Mitigation and adaptation

The climate regime provides capacity-building support to create an enabling environment for mitigating and adapting to climate change. Capacity building for adaptation include (i) risk management approaches to address adverse effects of climate change; (ii) maintenance and revision of a database on local coping strategies; and (iii) maintenance and revision of the adaptation practices interface (UNFCCC, 2009a). Adaptation projects at the community level require patience and can be successful if they raise awareness, develop and use partnerships, combine reactive and anticipatory approaches, and are in line with local culture and context and require patience (Dumaru, 2010).

Capacity building for mitigation has focused on helping developing countries participate in the CDM through help in setting up Designated National Authorities (DNAs). Michaelowa (2005) assesses the early capacity building programmes which focused on advanced developing countries, such as the National Strategy Studies programme of the World Bank running from 1998 to 2003. This programme was aimed at a total of 16 CDM and JI host countries. Okubo and Michaelowa (2010) find that since the inception of the CDM, € 45 million have been spent in Africa and LDCs on raising awareness, the establishment of DNAs (including development of sustainability criteria and procedures), the training of private and public personnel, and project support (including assessments of feasibility and the required CDM documentation). Increasingly there is also capacity building to help countries prepare their nationally appropriate mitigation actions (NAMAs).

Monitoring and evaluation activities can play an important role in ensuring effective implementation of a capacity-building framework – they can be used to address gaps and needs in capacity building, promote best practices, and encourage more efficient use of resources (UNFCCC, 2009b).

13.10.2 Institutional development

The United Nations Environment Program (UNEP) and the United Nations Development Program (UNDP) provide activities in support of institutional capacity building for government workers, scientists, and public and private sector practitioners. They do so by helping develop local policies, institutional frameworks, partnerships, and implementation capacities to reshape and refocus policies, investments, and spending on a range of green economic sectors that contribute to climate change mitigation and adaptation (Diakhité, 2009).

Acknowledging that capacity-building is cross-cutting in nature and an integral part of enhanced action on mitigation and adaptation, bilateral and multilateral cooperation activities have evolved, thereby involving governments and a broad range of organizations to build capacities and enhance technical and scientific knowledge in developing countries (UNFCCC, 2011b). There are few scientific assessments of current capacity building approaches in relation to climate change; these support strong scientific networks as a key component (Virji et al., 2012).

13.11 Investment and finance

Investment and finance are important components of policy for mitigation, adaptation, and the development of technology for addressing climate change (RB Stewart et al., 2009; Haites, 2011; A Michaelowa, 2012b). External financial support may be needed by developing countries to make progress in these areas (UNFCCC, 2007a; Narain et al., 2011; Olbrisch et al., 2011). International cooperation and agreements can facilitate investment and finance by motivating and creating both public and private funding channels.

13.11.1 Provision and governance of multilateral finance

13.11.1.1 Financial mechanisms under the UNFCCC

Financial support is provided to developing countries under the auspices of the UNFCCC through four primary channels (UNFCCC, 2012b): the Least Developed Country Fund (LDCF) and Special Climate Change Fund (SCCF), created by decision 7/CP.7 at COP-7 in Marrakech, which operationalize Article 11 in the Convention, focus on adaptation, and are operated by the Global Environmental Facility (GEF); GEF programs, other than the LDCF and SCCF, that implement Article 11, primarily supported by the GEF Trust Fund and focusing on mitigation (GEF, 2011b); the Adaptation Fund, which operationalizes Article 12, par. 8 of the Kyoto Protocol and for which the GEF serves as interim secretariat; and the Green Climate Fund (GCF), established at COP-16 in Cancun under the Convention, which is preparing to begin operations. (A set of pledges known as "Fast Start Financing" received contributions during the period 2010-2012 through existing multilateral and bilateral channels.)

13.11.1.2 Multilateral Development Banks (MDBs)

In addition to the World Bank serving as trustee or interim trustee for all of the funds notes above, a group of MDBs manage and govern the Climate Investment Funds (CIFs)—two trust funds separate from the UNFCCC that are intended to operate through 2012. These are the Clean Technology Fund and the Strategic Climate Fund (Nakhooda, 2010). The UNFCCC is represented in the CIFs' governing bodies as a stakeholder, and the funds acknowledge guidance from UNFCCC principles.

The MDBs were established to promote balanced economic growth and poverty reduction (Nakhooda, 2011). With global environment governance being delegated, in part, to MDBs, they have had to integrate environment considerations into economic development *[This reference does not currently appear in the bibliography: Andersen, 2011]* and hence take an active role on addressing climate change (Arner and Buckley, 2010; P Newell, 2011). However, Tirpak and Adams (2008) see a controversial role for the MDBs in climate finance, with increases in MDBs' funding and shifts to low greenhouse gas technologies being fragile. Michaelowa and Michaelowa (2011) show that the World Bank engagement in the Kyoto mechanisms has at least partially crowded out private sector activities.

13.11.1.3 Governance of multilateral public finance

Governance of institutions implementing or otherwise associated with climate finance and investment may be evaluated on the basis of transparency, effectiveness, efficiency, and equity. In practice, these principles are often embodied in procedures for making decisions about resource allocation. Access to decision making, in turn, depends in large part on how the institution balances interests of donors for accountability (and ultimately willingness to contribute) versus interests of recipients in having more control of project choice and funding levels (Ghosh and Woods, 2009).

Allocation to countries can be formulaic ("performance based allocation")—or discretionary. Access to resources is typically through an implementing or executing agency that has the fiduciary standard and social and environmental safeguards in place to ensure funds are used as intended and without any untoward impacts. These implementing agencies are often large international agencies (especially MDBs), which can have their own interests and agendas (Nakhooda, 2011). There has been a push for increased use of national agencies and NGOs, within the GEF (GEF, 2012) and the GCF. However, these agencies still need to meet relevant standards.

How a board of directors or trustees is chosen pertains closely to questions of allocation and access to decision making. Parties to an agreement may collectively choose the board of a related finance institution, or the board may be independently constituted to represent donors and recipients. The Adaptation Fund and the GEF have a majority of board members from developing countries, while the CIFs' and the Green Climate Fund's boards have equal representation for developing and developed countries. Related issues include the size and groupings (other than developed-developing) for board representation; voting rules; the choice of secretariat (e.g., where the housekeeping is done); and the choice of trustee (e.g., who oversees the finances and ensures funds go where they are supposed to go). Donors may wish to make use of existing capacity (e.g., World Bank), while recipients are often looking for new solutions.

Due to its complex, multilevel structure, the GEF faces the challenge of coordination with UNFCCC decisions (COWI and IIED, 2009; Ayers and Huq, 2009) *[This reference does not currently appear in the bibliography: Andersen and Hey, 2005]*. Unlike the GEF Trust Fund, LDCF, and SCCF, which rely exclusively on donor-country pledges, the Adaptation Fund is financed primarily from a mandatory two percent levy on CERs issued under the CDM—though parties to the Kyoto Protocol have pledged and contributed additional funding (Horstmann, 2011; Ratajczak-Juszko, 2012). Thus, the Adaptation Fund is largely independent from official development assistance (ODA), and it allows eligible countries to receive funding directly through national entities (Horstmann, 2011)—as noted, something now also being piloted by the GEF (GEF, 2011a, p. 4). The Adaptation Fund's unique governance structure avoids many of the issues of ownership and accountability faced by the other funds (Ayers and Huq, 2009).

13.11.2 Bilateral climate finance

ODA plays an important role in broader international cooperation strategies (Persson, 2009). Considerable Fast Start Financing is being provided through bilateral ODA channels. Increasing dissatisfaction about the results of traditional development cooperation and the appeal of climate policy as a new policy field led to a rapid reorientation of aid flows. In the early 2000s, over 7% of aid flows were spent on mitigation (A Michaelowa and K Michaelowa, 2007). Efforts to integrate, or "mainstream," environmental issues in ODA can be seen in different forms and at different decision-making levels (Persson, 2009). However, several studies argue that the use of ODA as a substitute for formal climate financial mechanisms could divert funding away from other important imperatives such as the Millennium Development Goals (A Michaelowa and K Michaelowa, 2007; Ayers and Huq, 2009; J Gupta and van der Grijp, 2010, p. 347).

13.11.3 Market mechanisms and private sector flows

13.11.3.1 International carbon markets

As discussed in section 13.4.1.4 and 13.13.1.1, market mechanisms have become a cornerstone of the current climate finance architecture (Pattberg and Stripple, 2008). Their governance is becoming increasingly complex and spread to multiple levels. The key question of who should govern market mechanisms, such as cap and trade schemes, remains contested (Betsill and Hoffmann, 2011). Governance of market mechanisms can be enhanced by effective monitoring, reporting, and verification (MRV) of emissions and actions (W Hare et al., 2010).

The capacity for investment and finance through carbon markets is potentially much larger than with public funds, and market finance bypasses appropriation processes. On the other hand, both public-finance donors and recipients have limited control over market-based financial flows; funds will flow where they receive the highest return, to the possible determinant of advancing investment or development goals that are otherwise important. A possible solution is constraints – such as EU ETS proposals to limit offsets from all but poorest countries.

13.11.3.2 Private sector flows

Private financing plays a major role in climate finance (Bowen, 2011; P Newell, 2011). There are a number of ways in which public actors seek to govern private finance, while there is also growing evidence of private governance of private finance (P Newell, 2011). In the former case, financing will follow if policy makers continue to focus on climate change (Miller, 2008). In the latter case, to "green" private-sector funds is to ensure that investments made today do not pollute tomorrow (Tirpak and Adams, 2008). An example is "socially responsible investment" (Richardson, 2009).

Private sector initiatives can be driven by public institutions, such as the Overseas Private Investment Corporation and the Export Import bank in the United States, parallel institutions in other developed countries, the MDBs, and by groups of investors. These efforts have the advantage of flexibility and efficiency but lack broad representation and legitimacy.

13.11.4 Sources of finance for mitigation and adaptation

There have been many specific proposals on how to secure financing for developing country action on mitigation, adaptation, and related capacity building, technology transfer and development (AGF, 2010; Pew Center, 2010; Bowen, 2011). Public financial flows may have an important role to play (P Newell, 2011).

There is also an important role for private finance. For example, insurers may play critical roles for both adaptation and mitigation and in this way gain new market opportunities (Linnerooth-Bayer and Amendola, 2000; Dlugolecki and Loster, 2003; Jagers and Stripple, 2003; Dlugolecki, 2008; Linnerooth-Bayer et al., 2009) *[This reference does not currently appear in the bibliography: Dlugolecki, 2000]*. Financing will follow if policy makers continue to focus on climate change (Miller, 2008). At the same time, the potential role of the financial sector as a means to stimulate far-reaching changes is expected (Richardson, 2009). An important governance issue in this area is how to effectively integrate different funding sources for mitigation and adaptation—especially how to integrate both public and private funding sources.

13.12 The role of public and private sectors and public-private partnerships

International responses to climate change depend on private sector action. Large multinational corporations produce about half of global world product and global GHG emissions (Morgera, 2004). Likewise, private companies will generate most of the investment and innovation necessary to pursue a low carbon economy (Forsyth, 2005).

Strategies of international business towards climate change have shifted significantly, from opposition to emissions reductions, such as through the Global Climate Coalition (P Newell, 2000; Lacy, 2005), towards proactive engagement with climate change, sometimes focused on opportunities for low-carbon development (Pulver, 2007; Falkner, 2008; Pinkse and Kolk, 2009). While challenges remain for businesses from the climate regime (regarding, for example, competitiveness issues), some businesses also see opportunities coming from the climate regime. An obvious example are manufacturers of energy-generation equipment and energy-consuming durable goods, the current stocks of both of which will – in general – be rendered prematurely obsolete by higher energy prices. Not surprisingly, given that GHG emissions are an externality, a gap remains between the GHG reduction targets of developed country governments and the commitments of the largest international companies (Knox-Hayes and DL Levy, 2011, p. 97).

13.12.1 Public-private partnerships

Public-private partnerships (PPPs) have grown as international responses to climate change (Bäckstrand, 2008; Pattberg, 2010; Andonova, 2010; Kolk et al., 2010). They involve countries, private sector actors, and sometimes NGOs. Examples include: the Renewable Energy and Energy Efficiency Partnership (Parthan et al., 2010); the Methane to Markets initiative (now renamed the Global Methane Initiative) (de Coninck et al., 2008); the former Asia Pacific Partnership on Climate and Energy (which was largely organized through sector-specific PPPs (Karlsson-Vinkhuyzen and van Asselt, 2009; McGee and Taplin, 2009)); the Global Superior Energy Performance Partnership (taking sector-specific activities from the regional scale to the global scale (Fujiwara, 2012)); the CDM (where some projects can take the character of PPPs (Streck, 2004; JF Green, 2008; P Newell, 2009)); the World Bank Prototype Carbon Fund (Lecocq, 2003; Andonova, 2010); the UN Fund for International Partnerships (39% of whose environmental partnerships are in climate change-related projects (Andonova, 2010, pp. 45–47); the UN Global Compact's "Caring for Climate" initiative (Abbott, 2011); the Green Power Market Development Group (Andonova, 2009); and the Munich Climate Insurance Initiative (Pinkse and Kolk, 2011).

International PPPs tend to focus on specific areas. Some concentrate on the development of specific technologies. Others focus on low-carbon energy development in general. Others centre their attention on carbon market development. Few focus on adaptation, although the insurance sector has been involved in such initiatives (Pinkse and Kolk, 2011).

13.12.2 Private sector governance

Private sector actors have also engaged in direct attempts to govern aspects of climate change transnationally. First, some institutional investors now ask companies to report on their greenhouse gas emissions, strategies to reduce them, and more broadly on climate risk exposures, in order to affect investor behaviour (Kolk et al., 2008; P Newell and Paterson, 2010; Harmes, 2011; MacLeod and Park, 2011). The most important example of this is the Carbon Disclosure Project, whose signatories controlled US$71 trillion in assets in 2011 (Carbon Disclosure Project, 2011).

Second, private sector actors have, like NGOs (see section 13.5.2), developed initiatives to govern carbon markets, either through the development of certification standards for offset markets, or by developing the infrastructure that governs carbon markets – notably the exchanges, registries, and protocols for reporting GHGs (JF Green, 2010; Hoffmann, 2011). Many of the certification schemes are either developed by private sector actors themselves (such as the Voluntary Carbon Standard, developed by the International Emissions Trading Association, the Climate Group, and the World Business Council for Sustainable Development) or by such actors in collaboration with environmental NGOs (such as the Social Carbon standard).

13.12.3 Motivations for public-private sector collaboration and private sector governance

Since direct regulation of firms at the international level is unavailable, states have incentives to pursue partnerships in order to affect transnational private sector activities. International organizations pursue partnerships for similar reasons (Andonova, 2010). For private sector actors, partnerships may create direct economic benefits; through financial support, learning opportunities, or market access (Pinkse, 2007; Perusse et al., 2009). Partnerships or private governance may create club goods for participants (Andonova, 2009). Sometimes, firms are motivated more by concerns for public relations (Pinkse and Kolk, 2009, pp. 55–56).

13.13 Performance assessment on policies and institutions including market mechanisms

13.13.1 Performance assessment of existing cooperation

[Note to Expert Reviewers: The Second Order Draft will include a more thorough survey from the scholarly literature of published ex-ante and ex-post assessments of existing international climate agreements.]

13.13.1.1 Assessment of the UNFCCC Kyoto Protocol in Annex I countries

The United Nations Framework Convention on Climate Change was designed as a broad framework, and the Kyoto Protocol's first commitment period for 2008–2012 was its first step. Both the Convention and the Kyoto Protocol include provisions for possible further steps (see section 13.5).

The emission reductions induced by the first commitment period of the Kyoto Protocol are smaller than originally intended, due to the non-participation of some Annex I countries, the non-compliance of other Annex I countries, the formal withdrawal of some countries, and the rapid economic (and emissions) growth of some of the large non-Annex I countries (without Kyoto commitments).

[*Note to Expert Reviewers: placeholder for literature review of ex ante (and the limited ex-post) performance assessments of the Kyoto Protocol in Annex I countries]*

13.13.1.2 Assessment of the UNFCCC Kyoto Protocol's Clean Development Mechanism

The CDM is one of three market mechanisms under the Kyoto Protocol. Castro (2012) assessed whether the CDM mobilized abatement options with the lowest cost and found that many low-cost opportunities have not been taken up. However, the largest CDM projects that abate the industrial gases HFC-23 and N_2O have relatively lower cost and had been largely ignored before the CDM mobilized them (Wara, 2007). Promising activities in energy efficiency and other sectors have been hampered by regulatory challenges in baseline determination and monitoring (Sirohi and A Michaelowa, 2008; A Michaelowa et al., 2009).

Earlier literature had found that roughly a third of CDM projects involve technology transfer (Haites et al., 2006). Dechezleprêtre et al. (2008) find that the likelihood of technology transfer is higher for CDM projects operated by subsidiaries of companies from industrialized countries and the amounts transferred are larger than average. Projects in Mexico, China and Brazil involve significantly more technology transfer than projects in India. Seres et al. (2009) find that 36% of 3,296 registered and proposed projects accounting for 59% of the annual emission reductions claim to involve technology transfer, confirming Dechezleprêtre et al.'s (2008) results. But all of these technology transfer studies limit themselves to assessment of project documents without rigorous and independent verification. Project developers have the incentive to argue that there is technology transfer, even if there is none. Wang (2010) is an exception, and underpins his analyses of many project documents with background interviews and assesses government policies. He finds that in all but one industrial gas project in China, technology transfer happened, but only in about a quarter of wind and coal mine methane projects. (See also Chapter 16.6.2.1 regarding an overview of the technology transfer component of CDM).

The question of how to differentiate business-as-usual projects from projects that are truly mobilized through the CDM incentive (i.e., yield “additionality”) continued to generate controversies. Schneider (2009) assessed the additionality of CDM and found that key assumptions regarding additionality were often not substantiated with credible, documented evidence. Alexeew et al. (2010) look at a sample of 40 registered projects in India and find a negative correlation between their additionality and contribution to sustainable development (sustainable development being one purpose of the CDM specified in the Kyoto Protocol [12.2], and additionality being one criterion for certification [12.5.c]). Other researchers have provided similar results (Paulsson, 2009; L Schneider, 2009; Lohmann, 2009; Boyd et al., 2009). Others suggest that competition for CDM investment means that Designated National Authorities do not adequately scrutinize the environmental or social benefits of projects, and the success rate of project applications is implausibly high (Sutter and Parreño, 2007; J Gupta et al., 2008; Headon, 2009; Nussbaumer, 2009; Alexeew et al., 2010). However, Lewis (2010) finds a clear contribution of the CDM to the rapid upswing of the renewable energy sector in China.

Olsen (2007) provides a summary of the early literature that did not find significant support of sustainable development by CDM projects. Boyd et al. (2009) see the process of host country responsibility for sustainable development as reason for the lack of sustainability benefits of CDM projects in some countries. Parnphumeesup and Kerr (2011) find that experts and the local population weight sustainability criteria differently in the context of biopower projects in Thailand. Ellis et al (2007) found wide variation in the contribution to local sustainable development by project type, with greater contributions in small-scale renewable energy and energy efficiency than in large-scale industrial CDM projects. Using a sample of 39 projects, Nussbaumer (2009) finds that projects certified by The Gold Standard—referring both to the organization and the certification scheme by that name—slightly outperform “normal” CDM projects with respect to sustainable-development benefits. A similar result is found by Drupp (2011) for a sample of 18 Gold Standard projects compared to 30 projects otherwise certified.

13.13.1.3 Assessment of the UNFCCC Cancún Agreements (including reduction proposals)

UNEP (2010, 2011) and Höhne et al. (2012) summarise the body of literature that assesses the reduction proposals (pledges) for 2020 by countries under the Copenhagen Accord and Cancún Agreements (for example: (Rogelj et al., 2010; European Climate Foundation, 2010; N Stern and Taylor, 2010; Pinkse and Kolk, 2011; den Elzen, Hof, and Roelfsema, 2011)). Large differences are found in the results from the various research groups, owing to uncertainties in current and projected emission estimates and in interpretations of the reduction proposals. Höhne et al. (2012) observe that “regardless of these uncertainties, the pledges for 2020 are expected to deliver emission levels above those that are consistent with a 2°C” increase in global average temperature, over pre-industrial levels (Figure 13.3).

The studies suggest that the emissions gap could be narrowed through implementing more stringent pledges (assuming conditions have been met), minimising the use of “lenient” credits from forests and surplus emission units, avoiding double-counting of offsets, and implementing measures beyond current pledges. Conversely, emission reduction gains from countries moving from their low to high ambition ranges could be more than offset by the use of “lenient” land use, land-use change, and forestry credits and surplus emissions units, if these were used to the maximum. Some studies have analysed the direct costs of the pledges (den Elzen, Hof, Mendoza Beltran, et al., 2011) and macro-economic effects (Mckibbin et al., 2011).

In addition to the emissions gap, analysis has also referred to a “financing gap”: domestic and/or international financing is not available to bridge the emissions gap. Several reports suggest where the additional financial resources could come from (Ballesteros et al., 2010; AGF, 2010; Haites, 2011). (See also Section 13.11.)

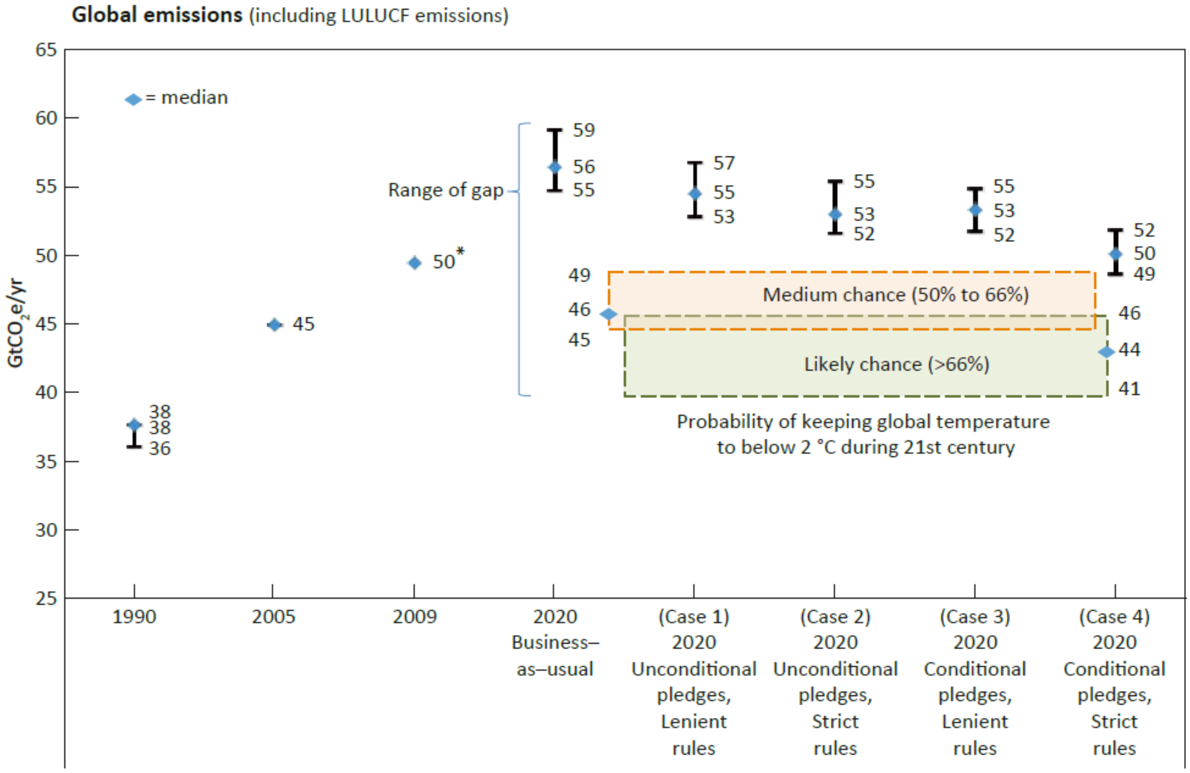


Figure 13.3. Global greenhouse gas emissions by 2020 expected from the business-as-usual projections and pledges found by different modelling groups. Source: UNEP (2011). *[Note to Expert Reviewers: this figure will be redrawn at a later stage and the underlying studies will be referenced.]*

13.13.1.4 Assessment of agreements outside of the UNFCCC

It is unclear whether agreements among non-state (NGOs, private sector) or sub-national actors (transnational city networks) are effective in reducing emissions. Partly this is because of their novelty; and partly because the units of measurement for such effectiveness are considerably more complex than for interstate agreements (Pinkse and Kolk, 2009).

Other measures of “success” do exist. In private sector initiatives, the CDP has high rates of reporting, with about 91% of Global 500 companies surveyed in 2011 disclosing GHG emissions (Carbon Disclosure Project, 2011, p. 7). There is little evidence of substantial changes in investor behaviour, with disagreement as to the potential for such changes in the future (Kolk et al., 2008; Harmes, 2011; MacLeod and Park, 2011).

Regarding the voluntary carbon market (VCM), this has grown to 131 million tCO2-e, with a value of US $424 million in 2010 (Peters-Stanley et al., 2011) and created a varied landscape of offsets providers, registries, and standards (Peters-Stanley et al., 2011). However, Dhanda and Hartman (2011) find that the voluntary market is highly non-transparent and suffers from large swings of demand for specific project types. Offset prices for the same project type differ by up to two orders of magnitude. Competing registries and standard providers proliferate, and additionality of a significant share of projects is doubtful. An earlier assessment by Corbera et al. (2009) concluded that the voluntary market does not perform better than the CDM. However, performance in the VCM seems to improve with the increased use of third-party certification systems (Hamilton et al., 2008; Capoor and Ambrosi, 2009; P Newell and Paterson, 2010). In 2004, virtually no VCM projects underwent third party verified certification, but by 2009, this figure had reached 90% (Peters-Stanley et al., 2011, p. 31). However, some regard certification systems as primarily public relations exercises (Bumpus and Liverman, 2008).

It is difficult to state whether transnational city networks have significantly affected the greenhouse gas emissions of their members, and if the reduction for cities are additional, or just contribute to delivering national pledges. Assessments focus instead on how they promote technology uptake within cities (Hoffmann, 2011, pp. 103–122), or on how they create a combination of competition and learning among member cities.

There is also evidence that the importance of partnerships between the private sector and government depends on their relations to more traditional state-led governance. Partnerships may work once government regulations send strong signals to investors (Pfeifer and Sullivan, 2008). Rules developed in private sector agreements may then become incorporated into government regulations (Knox-Hayes and DL Levy, 2011), and private carbon market offset standards may be introduced into regulated carbon markets (Hoffmann, 2011, pp. 123–150).

13.13.2 Performance assessments of proposed cooperation

13.13.2.1 Assessment of proposed international climate policy architectures

[Note to Expert Reviewers: The Second Order Draft will include a review of published assessments in the scholarly literature of proposed international climate architectures.]

13.13.2.2 Assessment of burden sharing arrangements

[Note to Expert Reviewers: We are still in the process of collecting and synthesizing the literature on potential burden sharing arrangements. The purpose of this section will be to compare GHG emission reduction targets for specific sets of countries across studies in the scholarly literature that analyse approaches for sharing aggregate emission reduction targets. This comparison will identify similarities and differences across studies that utilize a broad range of burden sharing principles to calculate region-specific emission reduction targets. Examples of such principles include: equal per capita allowances, burden proportional to historic responsibility, aggregate cost-effectiveness, and equal cumulative per capita emission budgets.

The challenge of synthesizing this body of literature lies in translating dozens of independent studies to a common language of regional definitions, aggregate emission targets (e.g. some studies report targets in terms of aggregate emissions, CO_2 stabilization levels, or temperature change above pre-industrial levels), timescale, baseline data, scope of greenhouse gases (e.g. some studies assess only CO_2 while others assess all Kyoto gases), and scope of sectors.

Once we have collected data from individual studies, we face the challenge of presenting this multidimensional dataset. The dataset of emission reduction targets will have the following dimensions: region, year, the aggregate emission reduction level, the bibliographic information of the scholarly study, and the burden sharing principle used to calculate emission reduction targets. Tables and figures under consideration show: 1) the range of emission allowances for each region in each of the years 2020, 2030, and 2050 for 4 aggregate emission reduction levels and 2) the emission allowances for each region in only the year 2020, organized by classes of burden sharing principles. We will appreciate feedback from Expert Reviewers on how to present this dataset most effectively.

Finally, we face the challenge of communicating clearly to potential readers that the text and possible figures and tables in this section synthesizes peer-reviewed literature that presents quantitative implications of the adoption of the various principles upon which climate policy might be based. The section does not prescribe the mix of principles that should be employed or the groupings of countries that might be ultimately appropriate in fashioning a burden-sharing approach.]

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