

WG III contribution to the Sixth Assessment Report

List of corrigenda to be implemented

The corrigenda listed below will be implemented in the Chapter during copy-editing.

CHAPTER 14

Document (Chapter, Annex, Supp. Material)	Page (Based on the final pdf FGD version)	Line	Detailed information on correction to make
Chapter 14	81	15	<p>Another aspect is finance; Gallagher et al. (2018) examine the role of national development finance systems, focusing in particular on China. While there has been a great deal of finance devoted to renewable energy, they find the majority of finance devoted to projects associated either with fossil fuel extraction or with fossil fuel-fired power generation.</p> <p>Delete: "focusing in particular on China."</p>
Chapter 14	81	18-19	<p>Ascensão et al. (2018) similarly suggest that activities associated with the Belt and Road Initiative could play a role in slowing down mitigation efforts in developing countries.</p> <p>Delete sentence</p>
Chapter 14	Front	5	Agus P. Sari

Chapter 14: International cooperation

Coordinating Lead Authors: Anthony Patt (Switzerland), Lavanya Rajamani (India)

Lead Authors: Preety Bhandari (India), Antonina Ivanova Boncheva (Mexico), Alejandro Caparrós (Spain), Kamal Djemouai (Algeria), Izumi Kubota (Japan), Jacqueline Peel (Australia), Agus Sari (Indonesia), Detlef F. Sprinz (Germany), Jørgen Wettestad (Norway)

Contributing Authors: Mustafa Babiker (Saudi Arabia), Govindasamy Bala (India), Christopher Bataille (Canada), Paolo Bertoldi (Italy), Felix Creutzig (Germany), Heleen de Coninck (the Netherlands), Navroz K. Dubash (India), Rachael Garrett (Switzerland/the United States of America), Oliver Geden (Germany), Veronika Ginzburg (the Russian Federation), Michael Grubb (United Kingdom), Erik Haites (Canada), Ben Hinder (United Kingdom), Janna Hoppe (Switzerland), Yong-Gun Kim (Republic of Korea), Katharine J. Mach (the United States of America), Gregory Nemet (the United States of America), Kilian Raiser (Germany), Yamina Saheb (France), Sonia I. Seneviratne (Switzerland), Raphael Slade (United Kingdom), Masahiro Sugiyama (Japan), Christopher H. Trisos (Republic of South Africa), Maarten van Aalst (the Netherlands), Harro van Asselt (the Netherlands)

Review Editors: Esther Badiola (Spain), Pasha Carruthers (Cook Islands)

Chapter Scientist: Zyaad Boodoo (Mauritius)

Date of Draft: 1/11/2021

1 Table of Contents

2	Chapter 14: International cooperation	14-1
3	Executive summary.....	14-3
4	14.1 Introduction.....	14-5
5	14.1.1 Key findings from AR5.....	14-5
6	14.1.2 Developments since AR5.....	14-6
7	14.2 Evaluating international cooperation	14-7
8	14.2.1 Framing concepts for assessment of the Paris Agreement.....	14-7
9	14.2.2 Climate clubs and building blocks	14-10
10	14.2.3 Assessment criteria	14-12
11	14.3 The UNFCCC and the Paris Agreement.....	14-14
12	14.3.1 The UN climate change regime.....	14-14
13	14.3.2 Elements of the Paris Agreement relevant to mitigation.....	14-19
14	14.3.3 Effectiveness of the Kyoto Protocol and the Paris Agreement	14-37
15	Cross-Chapter Box 10: Policy Attribution - Methodologies for estimating the macro-level impact	
16	of mitigation policies on indices of GHG mitigation.....	14-42
17	14.4 Supplementary means and mechanisms of implementation	14-45
18	14.4.1 Finance.....	14-46
19	14.4.2 Science, technology and innovation.....	14-50
20	14.4.3 Capacity Building	14-53
21	14.4.4 Cooperative mechanisms and markets.....	14-54
22	14.4.5 International Governance of SRM and CDR	14-55
23	Cross-Working Group Box 4: Solar Radiation Modification (SRM)	14-56
24	14.5 Multi-level, multi-actor governance	14-65
25	14.5.1 International cooperation at multiple governance levels.....	14-66
26	14.5.2 International sectoral agreements and institutions	14-76
27	14.5.3 Civil society and social movements.....	14-84
28	14.5.4 Transnational business and public-private partnerships and initiatives	14-87
29	14.5.5 International co-operation at the sub-national and city levels.....	14-91
30	14.6 Synthesis	14-92
31	14.6.1 Changing nature of international cooperation.....	14-92
32	14.6.2 Overall assessment of international cooperation.....	14-93
33	14.7 Knowledge Gaps.....	14-96
34	Frequently Asked Questions	14-97
35	References.....	14-99
36		
37		

1 **Executive summary**

2 **International cooperation is having positive and measurable results (*high confidence*).** The Kyoto
3 Protocol led to measurable and substantial avoided emissions, including in 20 countries with Kyoto first
4 commitment period targets that have experienced a decade of declining absolute emissions. It also built
5 national capacity for GHG accounting, catalysed the creation of GHG markets, and increased
6 investments in low-carbon technologies (*medium confidence*). Other international agreements and
7 institutions have led to avoided CO₂ emissions from land-use practices, as well as avoided emissions of
8 some non-CO₂ greenhouse gases (*medium confidence*). {14.3, 14.5, 14.6}

9 **New forms of international cooperation have emerged since AR5 in line with an evolving**
10 **understanding of effective mitigation policies, processes, and institutions. Both new and pre-**
11 **existing forms of co-operation are vital for achieving climate mitigation goals in the context of**
12 **sustainable development (*high confidence*).** While previous IPCC assessments have noted important
13 synergies between the outcomes of climate mitigation and achieving sustainable development
14 objectives, there now appear to be synergies between the two processes themselves (*medium*
15 *confidence*). Since AR5, international cooperation has shifted towards facilitating national level
16 mitigation action through numerous channels. Now including both processes established under the
17 UNFCCC regime and through regional and sectoral agreements and organisations. {14.2, 14.3, 14.5,
18 14.6}

19 **Participation in international agreements and transboundary networks is associated with the**
20 **adoption of climate policies at the national and sub-national levels, as well as by non-state actors**
21 **(*high confidence*).** International cooperation helps countries achieve long-term mitigation targets when
22 it supports development and diffusion of low-carbon technologies, often at the level of individual
23 sectors, which can simultaneously lead to significant benefits in the areas of sustainable development
24 and equity (*medium confidence*). {14.2, 14.3, 14.5, 14.6}

25 **International cooperation under the UN climate regime has taken an important new direction**
26 **with the entry into force of the 2015 Paris Agreement, which strengthened the objective of the UN**
27 **climate regime, including its long-term temperature goal, while adopting a different architecture**
28 **to that of the Kyoto Protocol to achieve it (*high confidence*).** The core national commitments under
29 the Kyoto Protocol have been legally binding quantified emission targets for developed countries tied
30 to well-defined mechanisms for monitoring and enforcement. By contrast, the commitments under the
31 Paris Agreement are primarily procedural, extend to all parties, and are designed to trigger domestic
32 policies and measures, enhance transparency, and stimulate climate investments, particularly in
33 developing countries, and to lead iteratively to rising levels of ambition across all countries (*high*
34 *confidence*). Issues of equity remain of central importance in the UN climate regime, notwithstanding
35 shifts in the operationalisation of ‘common but differentiated responsibilities and respective
36 capabilities’ from Kyoto to Paris (*high confidence*). {14.3}

37 **There are conflicting views on whether the Paris Agreement’s commitments and mechanisms will**
38 **lead to the attainment of its stated goals.** Arguments in support of the Paris Agreement are that the
39 processes it initiates and supports will in multiple ways lead, and indeed have already led, to rising
40 levels of ambition over time. The recent proliferation of national mid-century net-zero GHG targets can
41 be attributed in part to the Paris Agreement (*medium confidence*). Moreover, its processes and
42 commitments will enhance countries’ abilities to achieve their stated level of ambition, particularly
43 among developing countries (*medium confidence*). Arguments against the Paris Agreement are that it
44 lacks a mechanism to review the adequacy of individual Parties’ nationally determined contributions
45 (NDCs), that collectively current NDCs are inconsistent in their level of ambition with achieving the
46 Paris Agreement’s temperature goal, that its processes will not lead to sufficiently rising levels of
47 ambition in the NDCs, and that NDCs will not be achieved because the targets, policies and measures

1 they contain are not legally binding at the international level (*medium confidence*). To some extent,
2 arguments on both sides are aligned with different analytic frameworks, including assumptions about
3 the main barriers to mitigation that international cooperation can help overcome (*medium confidence*).
4 The extent to which countries increase the ambition of their NDCs and ensure they are effectively
5 implemented will depend in part on the successful implementation of the support mechanisms in the
6 Paris Agreement, and in turn will determine whether the goals of the Paris Agreement are met (*high*
7 *confidence*). {14.2, 14.3, 14.4}

8 **International cooperation outside the UNFCCC processes and agreements provides critical**
9 **support for mitigation in particular regions, sectors and industries, for particular types of**
10 **emissions, and at the sub- and trans-national levels (*high confidence*).** Agreements addressing ozone
11 depletion, transboundary air pollution, and release of mercury are all leading to reductions in the
12 emissions of specific greenhouse gases (*high confidence*). Cooperation is occurring at multiple
13 governance levels including cities. Transnational partnerships and alliances involving non-state and
14 sub-national actors are also playing a growing role in stimulating low-carbon technology diffusion and
15 emissions reductions (*medium confidence*). Such transnational efforts include those focused on climate
16 litigation; the impacts of these are unclear but promising. Climate change is being addressed in a
17 growing number of international agreements operating at sectoral levels, as well as within the practices
18 of many multilateral organisations and institutions (*high confidence*). Sub-global and regional
19 cooperation, often described as climate clubs, can play an important role in accelerating mitigation,
20 including the potential for reducing mitigation costs through linking national carbon markets, although
21 actual examples of these remain limited (*high confidence*). {14.2, 14.4, 14.5, 14.6}

22 **International cooperation will need to be strengthened in several key respects in order to support**
23 **mitigation action consistent with limiting temperature rise to well below 2°C in the context of**
24 **sustainable development and equity (*high confidence*).** Many developing countries' NDCs have
25 components or additional actions that are conditional on receiving assistance with respect to finance,
26 technology development and transfer, and capacity building, greater than what has been provided to
27 date (*high confidence*). Sectoral and sub-global cooperation is providing critical support, and yet there
28 is room for further progress. In some cases, notably with respect to aviation and shipping, sectoral
29 agreements have adopted climate mitigation goals that fall far short of what would be required to
30 achieve the temperature goal of the Paris Agreement (*high confidence*). Moreover, there are cases where
31 international cooperation may be hindering mitigation efforts, namely evidence that trade and
32 investment agreements, as well as agreements within the energy sector, impede national mitigation
33 efforts (*medium confidence*). International cooperation is emerging but so far fails to fully address
34 transboundary issues associated with solar radiation modification and carbon dioxide removal (*high*
35 *confidence*) {14.2, 14.3, 14.4, 14.5, 14.6}

36

1 **14.1 Introduction**

2 This chapter assesses the role and effectiveness of international cooperation in mitigating climate
3 change. Such cooperation includes multilateral global cooperative agreements among nation states such
4 as the 1992 United Nations Framework Convention on Climate Change (UNFCCC), and its related
5 legal instruments, the 1997 Kyoto Protocol and the 2015 Paris Agreement, but also plurilateral
6 agreements involving fewer states, as well as those focused on particular economic and policy sectors,
7 such as components of the energy system. Moreover, this chapter assesses the role of transnational
8 agreements and cooperative arrangements between non-state and sub-national actors, including
9 municipal governments, private-sector firms and industry consortia, and civil society organisations.
10 This chapter does not assess international cooperation within the European Union, as this is covered in
11 Chapter 13 of this report.

12 Past IPCC assessment reports have discussed the theoretical literature, providing insights into the
13 rationale for international cooperation, as well as guidance as to its structure and implementation. This
14 chapter limits such theoretical discussion primarily to the new developments since AR5. Important
15 developments in this respect include attention to climate clubs (groups of countries and potentially non-
16 state actors that can work together to achieve particular objectives), and the effects of framing the global
17 climate change mitigation challenge as one of accelerating a socio-technical transition or
18 transformation, shifting development pathways accordingly, in addition to (or rather than) solving a
19 global commons problem. This chapter draws from theory to identify a set of criteria by which to assess
20 the effectiveness of existing forms of international cooperation.

21 The rest of this chapter describes existing cooperative international agreements, institutions, and
22 initiatives with a view to clarifying how they operate, what effects they have, and ultimately, whether
23 they work. At the heart of this international institutional architecture lies the Paris Agreement, which
24 sets the overall approach for international cooperation under the UNFCCC at the global level. In many
25 ways, the Paris Agreement reshapes the structure of such cooperation, from one oriented primarily
26 towards target setting, monitoring, and enforcement, to one that is oriented towards supporting and
27 enabling nationally determined actions (including targets), monitoring as well as catalysing non-state
28 and sub-national actions at multiple levels of governance. In addition to the Paris Agreement, many
29 forms of cooperation have taken shape in parallel: those designed to address other environmental
30 problems that have a significant impact on climate mitigation; those operating at the sub-global or
31 sectoral level; and, those where the main participants are non-state actors. The chapter ends with an
32 overall assessment of the effectiveness of current international cooperation and identifies areas that
33 would benefit from improved and enhanced action.

34

35 **14.1.1 Key findings from AR5**

36 AR5 found that two characteristics of climate change make international cooperation essential: that it
37 is a global commons problem that needs to be addressed in a coordinated fashion at the global
38 scale; and that given the global diversity with respect to opportunities for and cost of mitigation, there
39 are economic efficiencies associated with cooperative solutions (13.2.1.1). Consequently, AR5
40 found evidence to suggest that climate policies that are implemented across geographical regions would
41 be more effective in terms of both their environmental consequences and their economic costs (13.13,
42 13.6, 14.4). AR5 also suggested that regional cooperation could offer opportunities beyond what
43 countries may be able to achieve by themselves. These opportunities are due to geographic proximity,
44 shared infrastructure and policy frameworks, trade, and cross-border investments, and examples
45 included renewable energy pools across borders, networks of energy infrastructure and coordinated
46 forestry policies (1.2, 6.6,15.2, 14.2). AR5 also suggested that policy linkages exist across regional,

1 national, and sub-national scales (13.3.1, 13.5.1.3). For these reasons, AR5 suggested that although the
2 UNFCCC remains the primary international forum for climate negotiations, many other institutions
3 engaged at the global, regional, and local levels do and should play an active role
4 (1.3.3.1,13.4.1.4,13.5). AR5 also noted that the inclusion of climate change issues across a variety of
5 forums often creates institutional linkages between mitigation and adaptation (13.3,13.4.13.5). In
6 addition to centralised cooperation and governance, with a primary focus on the UNFCCC and its
7 associated institutions, AR5 noted the emergence of new transnational climate-related institutions of
8 decentralised authority such as public-private sector partnerships, private sector governance initiatives,
9 transnational NGO programs, and city-led initiatives (13.2,13.3.1,13.12). It noted that these have
10 resulted in a multiplicity of cooperative efforts in the form of multilateral agreements, harmonised
11 national policies and decentralised but coordinated national and regional policies (13.4.1, 13.3.2, 14.4).
12 Finally, it suggested that international cooperation may also have a role in promoting active engagement
13 of the private sector in technological innovation and cooperative efforts leading to technology transfer
14 and the development of new technologies (13.3, 13.9, 13.12).

16 **14.1.2 Developments since AR5**

17 ***14.1.2.1 Negotiation of the Paris Agreement***

18 The key development since AR5 has been the negotiation and adoption of the Paris Agreement, which,
19 building on the UNFCCC, introduces a new approach to global climate governance. This new approach,
20 as discussed below (Section 14.3.1.1), is driven by the need to engage developing countries in emissions
21 reductions beyond those they had taken on voluntarily under the Cancun Agreements, extend mitigation
22 commitments to those developed countries that had rejected or withdrawn from the Kyoto Protocol, and
23 to respond to the rapidly changing geopolitical context (Section 14.3.1.2).

24 ***14.1.2.2 2030 Agenda for Sustainable Development and the Sustainable Development Goals***

25 It has long been clear that a failure to mitigate climate change would exacerbate existing poverty,
26 accentuate vulnerability and worsen inequality (IPCC 2014), but there is an emerging attempt to
27 harmonise mitigation actions with those oriented towards social and economic development. A key
28 development since AR5 is the adoption in 2015 of the 2030 Agenda for Sustainable Development,
29 which contains 17 Sustainable Development Goals (SDGs). This Agenda offers an aspirational
30 narrative, coherent framework and actionable agenda for addressing diverse issues of development
31 through goals that balance the economic, social and environmental dimensions of sustainable
32 development as well as issues of governance and institutions (ICSU ISSC 2015). Scholars have noted
33 that these dimensions of sustainable development are inter-dependent (Nilsson et al. 2016), and, as such
34 it is difficult if not impossible to achieve economic and social gains while neglecting environmental
35 concerns, including climate change (Le Blanc 2015). The SDGs are closely linked to the Paris
36 Agreement, adopted a few weeks later. There is a growing body of literature that examines the
37 interlinkages between SDGs, including SDG 13 (taking urgent action to combat climate change) and
38 others, concluding that without a proper response to climate change, success in many of the other SDGs
39 would be difficult if not impossible (Weitz et al. 2018; ICSU ISSC 2015; Le Blanc 2015; Nilsson et al.
40 2016). Likewise, failure to achieve the SDGs will have a detrimental effect on the ability to limit climate
41 change to manageable levels. Initiatives such as The World in 2050 (TWI2050 2018), a large research
42 initiative by a global consortium of research and policy institutions, work on the premise that pursuing
43 climate action and sustainable development in an integrated and coherent way, based on a sound
44 understanding of development pathways and dynamics, is the strongest approach to enable countries to
45 achieve their objectives in both agreements.

46 ***14.1.2.3 IPCC Special Reports***

47 Further key developments since AR5 include the release of three IPCC special reports. The first of these
48 assessed the differential impacts of limiting climate change to 1.5°C global average warming compared

1 to 2°C warming, indicated the emissions reductions necessary and enabling conditions to stay within
2 this limit (IPCC 2018a). While the events that have unfolded since the report are not yet
3 comprehensively documented in literature, arguably the report has led to a renewed perception of the
4 urgency of climate mitigation (Wolf et al. 2019). In particular, the report appears to have crystallised
5 media coverage in some parts of the world around a need to reduce emissions to net zero by 2050
6 (whether of GHGs or CO₂), rather than delaying such reductions until the latter half of the century, as
7 had been previously understood and indicated in the Paris Agreement. Its release is hence one factor
8 explaining the rise in transnational climate mobilisation efforts (Boykoff and Pearman 2019). It has also
9 played a role, in addition to the Paris Agreement (Geden 2016a), in the numerous announcements,
10 pledges and indications by governments, including by all G-7 countries, of their adoption of net zero
11 GHG targets for 2050. The other two special reports focused on ocean and the cryosphere (IPCC 2019),
12 and the potential of land-related responses to contribute to adaptation and mitigation (IPCC 2020).
13 There has been no literature directly tying the publication of these latter two reports to changes in
14 international cooperation. However, the 25th UNFCCC Conference of Parties in Madrid in 2019
15 convened a dialogue on ocean and climate change to consider how to strengthen mitigation and
16 adaptation action in this context (UNFCCC 2019a, para 31).

19 **14.2 Evaluating international cooperation**

20 This section describes recent insights from social-science theory that can shed light on the need for and
21 ideal structure of international cooperation. This section starts by describing developments in framing
22 the underlying problem, move towards a body of theory describing the benefits of multilateral sub-
23 global action, and ends with a theory-based articulation of criteria to assess the effectiveness of
24 international cooperation.

25 **14.2.1 Framing concepts for assessment of the Paris Agreement**

26 Previous IPCC reports have framed international climate cooperation, and indeed climate mitigation
27 more generally, primarily as addressing a global commons problem (Stavins et al. 2014). In this report,
28 by contrast, multiple framings are considered. Chapter 1 introduces four analytic frameworks:
29 aggregated economic approaches such as cost-benefit analysis, which maps onto the global commons
30 framing; ethical approaches; analysis of transitions and transformations; and psychology and politics of
31 changing course. Here, we highlight some of the findings that are of relevance to international
32 cooperation.

33 When applied to the international context, the public good (or global commons) framing stresses that
34 the incentives for mitigation at the global level are greater than they are for any single country, since
35 the latter does not enjoy the benefits of its own mitigation efforts that accrue outside its own borders
36 (Patt 2017; Stavins et al. 2014). This framing does not preclude countries engaging in mitigation, even
37 ambitious mitigation, but it suggests that these countries' level of ambition and speed of abatement
38 would be greater if they were part of a cooperative agreement.

39 Theoretical economists have shown that reaching such a global agreement is difficult, due to countries'
40 incentives to freeride, namely benefit from other countries' abatement efforts while failing to abate
41 themselves (Barrett 1994; Gollier and Tirole 2015). Numerical models that integrate game theoretic
42 concepts, whether based on optimal control theory or on dynamic programming, consistently confirm
43 this insight, at least in the absence of transfers (Germain et al. 2003; Lessmann et al. 2015; Chander
44 2017). Recent contributions suggest that regional or sectoral agreements, or agreements focused on a
45 particular subset of GHGs, can be seen as building blocks towards a global approach (Asheim et al.

1 2006; Froyn and Hovi 2008; Sabel and Victor 2017; Stewart et al. 2017). In a dynamic context, this
2 gradual approach through building blocks can alleviate the free-riding problem and ultimately lead to
3 global cooperation (Caparrós and Péreau 2017). Much of this literature is subsumed under the concept
4 of “climate clubs,” described in the next section. Other developments based on dynamic game theory
5 suggest that the free-riding problem can be mitigated if the treaties do not prescribe countries’ levels of
6 green investment and the duration of the agreement, as countries can credibly threaten potential free-
7 riders with a short-term agreement where green investments will be insufficient due to the hold-up
8 problem (Battaglini and Harstad 2016). Finally, thresholds and potential climate catastrophes have also
9 been shown, theoretically and numerically, to reduce free-riding incentives, especially for countries that
10 may become pivotal in failing to avoid the threshold (Barrett 2013; Emmerling et al. 2020).

11 In addition to mitigation in the form of emissions abatement, innovation in green technologies also has
12 public good features, leading for the same reasons to less innovation than would be globally ideal (Jaffe
13 et al. 2005). Here as well, theory suggests that there are benefits from cooperation on technology
14 development at the regional or sectoral levels, but also that cooperation on technology, especially for
15 breakthrough technologies, may prove to be easier than for abatement (El-Sayed and Rubio 2014; Rubio
16 2017). In a dynamic context, the combination of infrastructure lock-in, network effects with high
17 switching cost, and dynamic market failures suggests that deployment and adoption of clean
18 technologies is path dependent (Acemoglu et al. 2012; Aghion et al. 2014), with a multiplicity of
19 possible equilibria. This implies that no outcome is guaranteed, although the most likely pathway will
20 depend on economic expectations and initial conditions of the innovation process (Krugman 1991).
21 Therefore, the government has a role to play, either by shifting expectations (e.g. credibly committing
22 to climate policy), or by changing initial conditions (e.g. investing in green infrastructure or subsidising
23 clean energy research) (Acemoglu et al. 2012; Aghion et al. 2014). This result is exacerbated by the
24 irreversibility of energy investments and the extremely long periods of operation of the typical energy
25 investment (Caparrós et al. 2015; Baldwin et al. 2020).

26 While the public goods and global commons framing concentrates on free-riding incentives as the
27 primary barrier to mitigation taking place at a pace that would be globally optimal, other factors arise
28 across the four analytic frameworks. For example, within the political framework, Beiser-McGrath and
29 Bernauer (2021) highlight that not just the incentive to free-ride, but also the knowledge that another
30 major emitter is free-riding, could lessen a country’s political incentive to mitigate. Aklin and
31 Mildemberger (2020) present evidence to suggest that distributive conflict within countries, rather than
32 free riding across countries, is the primary barrier to ambitious national level action. Another barrier
33 could be a lack of understanding and experience with particular policy approaches; there is evidence
34 that participation in cooperative agreements could facilitate information exchange across borders and
35 lead to enhanced mitigation policy adoption (Rashidi and Patt 2018).

36 The analytic approach focusing on transitions and transformation focuses on path dependent processes
37 as an impediment to the shift to low-carbon technologies and systems. Cross-chapter box 12 on
38 Transition Dynamics (Chapter 16) summarizes the key points of this literature. This chapter describes
39 how the two framings focus on different indicators of progress, and potentially different types of
40 cooperative action within the international context. This chapter highlights in later sections conflicting
41 views on whether the Paris Agreement is likely to prove effective (section 14.3.3.2). To some extent,
42 the dichotomy of views aligns with the two framings: analysis implicitly aligned with the global
43 commons framing is negative about the Paris architecture, whereas that aligned with the transitions
44 framing is more positive (Kern and Rogge 2016; Roberts et al. 2018; Patt 2017).

45 Within the global commons framing, the primary indicator of progress is the actual level of GHG
46 emissions, and the effectiveness of policies can be measured in terms of whether such emissions rise or
47 fall (Patt 2017; Hanna and Victor 2021). The fact that the sum of all countries’ emissions has continued
48 to grow (IPCC 2018a), even as there has been a global recognition that they should decline, is seen as

1 being consistent with the absence of a strong global agreement. Within this framing, there is
2 traditionally an emphasis on treaties' containing self-enforcing agreements (Olmstead and Stavins
3 2012), ideally through binding commitments, as a way of dealing with the overarching problem of free-
4 ridership (Barrett 1994; Finus and Caparrós 2015; Tulkens 2019). However, as discussed above, the
5 emphasis has now shifted to a gradual cooperation approach, either regional or sectoral, as an alternative
6 way of dealing with free-riding incentives (Caparrós and Péreau 2017; Sabel and Victor 2017; Stewart
7 et al. 2017). The gradual linkage of emission trading systems (discussed in Section 14.4.4), goes in the
8 same direction. There is also literature suggesting that the diversity of the countries involved may in
9 fact be an asset to reduce the free-rider incentive (Pavlova and De Zeeuw 2013; Finus and McGinty
10 2019), which argues in favour of a system where all countries, irrespectively of their income levels, are
11 fully involved in mitigation, unlike the Kyoto Protocol and in line with the Paris Agreement. Finally,
12 recent efforts have discussed potential synergies between mitigation and adaptation efforts in a strategic
13 context (Bayramoglu et al. 2018) (see Section 14.5.1.2) In general, current efforts go beyond
14 considering climate policy as a mitigation-only issue, much in line with the discussion about linkages
15 between climate change and sustainable development policies described in detail in Chapters 1 and 4
16 of this report.

17 In the transitions framing, by contrast, global emissions levels are viewed as the end (and often greatly
18 delayed) result of a large number of transformative processes. International cooperation may be
19 effective at stimulating such processes, even if a change in global emissions is not yet evident, implying
20 that short-term changes in emissions levels may be a misleading indicator of progress towards long-
21 term goals (Patt 2017). Hanna and Victor (2021) suggest a particular focus on technical advances and
22 deployment patterns in niche low carbon technologies, such as wind and solar power, and electric
23 vehicles. However, this is one among many suggestions: the literature does not identify a single clear
24 indicator to use, and there are many metrics of technological progress and transformation, described in
25 Chapter 16, Section 16.3.3 of this report. These can include national level emissions among countries
26 participating in particular forms of cooperation, as well as leading indicators of such emissions such as
27 changes in low-carbon technology deployment and cost.

28 Just as the transition framing highlights indicators of progress other than global emissions, it de-
29 emphasises the importance of achieving cost-effectiveness with respect to global emissions. Hence, this
30 strand of the literature does not generally support the use of international carbon markets, suggesting
31 that these can delay transformative processes within countries that are key drivers of technological
32 change (Cullenward and Victor 2020). For similar reasons, achieving cross-sectoral cost-effectiveness,
33 a goal of many carbon markets, is not seen as a high priority. Instead, within the transitions framing the
34 emphasis with respect to treaty design is often on providing mechanisms to support parties' voluntary
35 actions, such as with financial and capacity-building support for new technologies and technology
36 regimes (Geels et al. 2019). The transitions literature also highlights impediments to transformation as
37 being sector specific, and hence the importance of international cooperation addressing sector-specific
38 issues (Geels et al. 2019). While such attention often starts with promoting innovation and diffusion of
39 low-carbon technologies that are critical to a sector's functioning, it often ends with policies aimed at
40 phasing out the high-carbon technologies once they are no longer needed (Markard 2018). In line with
41 this, many scholars have suggested value in supply-side international agreements, aimed at phasing out
42 the production and use of fossil fuels (Collier and Venables 2014; Piggot et al. 2018; Asheim et al.
43 2019; Newell and Simms 2020).

44 Analytic approaches centred on equity and development figure prominently within this report, with
45 many of the key concepts addressed in Chapter 4. Primarily the focus is on aligning climate policy at
46 the international level with efforts to shift development pathways towards improved quality of life and
47 greater sustainability (see cross chapter box 5 on shifting sustainable development pathways, Chapter
48 4). There are also overlaps between the equity framework and the others. Within the global commons

1 framing, the emphasis is on international carbon markets to reduce the costs from climate policies, and
 2 as way of generating financial flows to developing countries (Michaelowa et al. 2019a). The transitions
 3 framing, while focused empirically primarily on industrialized countries, nevertheless aligns with an
 4 understanding of climate mitigation taking place within a wider development agenda; in many cases it
 5 is a lack of development that creates a barrier to rapid system transformation, which international
 6 cooperation can address (Delina and Sovacool 2018)(see also Cross-chapter Box 12).

8 **14.2.2 Climate clubs and building blocks**

9 A recent development in the literature on international climate governance has been increased attention
 10 to the potential for climate clubs (Victor 2011). Hovi et al. (2016) define these “as any international
 11 actor group that (1) starts with fewer members than the UNFCCC has and (2) aims to cooperate on one
 12 or more climate change-related activities, notably mitigation, adaptation, climate engineering or climate
 13 compensation.” While providing public goods (such as mitigation), they also offer member-only
 14 benefits (such as preferential tariff rates) to entice membership. In practice, climate clubs are sub-global
 15 arrangements, and formal agreement by interstate treaty is not a prerequisite. Actors do not have to be
 16 states, although in the literature on climate clubs states have hitherto dominated. The literature has an
 17 essentially static dimension that focuses on the incentives for actors to join such a club, and a dynamic
 18 one, which focuses on the “building blocks” for global cooperative agreements.

19 The literature focusing on the static aspects of clubs highlight that they represent “coalitions of the
 20 willing” (Falkner 2016a; Gampfer 2016; Falkner et al. 2021), which offer a package of benefits, part of
 21 which are pure public goods (available also to non-club members), and others are club benefits that are
 22 only available to members (Hovi et al. 2016). The members-only or excludable part can be a system of
 23 transfers within the club to compensate the countries with higher costs. For example, the benefit from
 24 participating in the club can be to have access to a common emissions trading system, which in general
 25 is more attractive the larger the diversity of the countries involved, although this is not a general result
 26 as discussed in detail in Doda and Taschini (2017). However, as costs and effort sharing agreements
 27 are unsuccessful in a static context (Barrett 1994), mainly due to free-rider incentives, several studies
 28 have proposed using tariffs on trade or other forms of sanctions to reduce incentives for free-riding
 29 (Helm and Sprinz 2000; Eyland and Zaccour 2012; Anouliès 2015; Nordhaus 2015; Al Khourdajie and
 30 Finus 2020). For example, Nordhaus (2015) uses a coalition formation game model to show that a
 31 uniform percentage tariff on the imports of nonparticipants into the club region (at a relatively low tariff
 32 rate of about 2%) can induce high participation within a range of carbon price values. More recently,
 33 Al Khourdajie and Finus (2020) show that border carbon adjustments and an open membership policy
 34 can lead to a large stable climate agreement, including full participation. Table 14.1 presents a number
 35 of key results related to climate clubs from a static context.

36
 37 **Table 14.1 Key climate club static modelling results**

	Aakre et al. (2018)	(Nordhaus 2015)	(Hovi et al. 2017; Sprinz et al. 2018)	(Sælen et al. 2020; Sælen 2020)
Scope	Transboundary black carbon and methane in the Arctic	Global emissions	Global emissions	Global emissions
Modelling method	TM5-FASST model (“reduced-form air quality and impact evaluation tool”)	C-DICE (coalition formation game based on a static version of the multiregional	Agent-based model	Agent-based model

		DICE-RICE optimisation model)		
Border tax adjustment	No	Yes	No	No
Key results	Black carbon can be more easily controlled than methane, based on self-interest; inclusion of non-Arctic Council major polluters desirable to control pollutants	For non-participants in mitigation efforts, modest tariffs on trade are advised to stabilize coalition formation for emission reductions	Climate clubs can substantially reduce GHG emissions, provided club goods are present. The (potential) departure of a single major actor (e.g., USA) reduces emissions coverage, yet is rarely fatal to the existence of the club	The architecture of the Paris Agreement will achieve the 2°C goal only under a very fortunate constellation of parameters. Potential (e.g., US) withdrawal further reduces these chances considerably

1
2 In a dynamic context, the literature on climate clubs highlights the co-called ‘building blocks’ approach
3 (Stewart et al. 2013a,b, 2017). This is a bottom-up strategy designed to create an array of smaller-scale,
4 specialised initiatives for transnational cooperation in particular sectors and/or geographic areas with a
5 wide range of participants. As part of this literature, Potoski and Prakash (2013) provide a conceptual
6 overview of voluntary environmental clubs, showing that many climate clubs do not require demanding
7 obligations for membership and that a substantial segment thereof are mostly informational (Weischer
8 et al. 2012; Andresen 2014). Also crafted onto the building blocks approach, Potoski (2017)
9 demonstrates the theoretical potential for green certification and green technology clubs. Green (2017)
10 further highlights the potential of “pseudo-clubs” with fluid membership and limited member benefits
11 to promote the diffusion and uptake of mitigation standards. Falkner et al. (2021) suggest a typology of
12 normative, bargaining, and transformational clubs. Before the adoption of the Paris Agreement, some
13 literature suggested that the emergence of climate clubs in parallel to the multilateral climate regime
14 would lead to “forum shopping”, with states choosing the governance arrangement that best suits their
15 interests (McGee and Taplin 2006; van Asselt 2007; Biermann et al. 2009; Oh and Matsuoka 2017).
16 However, more recent literature suggests that climate clubs complement rather than challenge the
17 international regime established by the UNFCCC (van Asselt and Zelli 2014; Draguljić 2019; Falkner
18 2016a).

19 In this dynamic context, one question is whether to negotiate a single global agreement or to start with
20 smaller agreements in the hope that they will eventually evolve into a larger agreement. It has been
21 debated extensively in the context of free trade whether a multilateral (global) negotiating approach is
22 preferable to a regional approach, seen as a building block towards global free trade. Aghion et al.
23 (2007) analysed this issue formally for trade, showing that a leader would always choose to move
24 directly to a global agreement. In the case of climate change, it appears that even the mildest form of
25 club discussed above (an efforts and costs sharing agreement, as in the case of the linkage of emissions
26 trading systems) can yield global cooperation following a building-blocks approach, and that the
27 sequential path relying on building-blocks may be the only way to reach global cooperation over time
28 (Caparrós and Péreau 2017). While the existence of a nearly universal agreement such as the Paris

1 Agreement may arguably have rendered this discussion less relevant, the Paris Agreement co-exists,
2 and will likely continue to do so, with a multitude of sectoral and regional agreements, meaning that
3 this discussion is still relevant for the evolution of these complementary regimes.

4 Results based on an agent-based model suggest that climate clubs results in major emission reductions
5 if there is a sufficiently high provision of the club good and if initial membership by several states with
6 sufficient emissions weight materializes. Such configurations allow the club to grow over time to enable
7 effective global action (Hovi et al. 2017). The departure of a major emitter (specifically the United
8 States) triggered a scientific discussion on the stability of the Paris Agreement. Sprinz et al. (2018)
9 explore whether climate clubs are stable against a leader willing to change its status, e.g., from leader
10 to follower or even completely leaving the climate club, finding in most cases such stability to exist.
11 Related studies on the macroeconomic incentives for climate clubs by Paroussos et al. (2019) show that
12 climate clubs are reasonably stable, both internally and externally (i.e., no member willing to leave and
13 no new member willing to join), and climate clubs that include obligations in line with the 2°C goal
14 combined with financial incentives can facilitate technology diffusion. The authors also show that
15 preferential trade arrangements for low-carbon goods can reduce the macroeconomic effects of
16 mitigation policies. Aakre et al. (2018) show numerically that small groups of countries can limit black
17 carbon in the Arctic, driven mainly for reasons of self-interest, yet reducing methane requires larger
18 coalitions due to its larger geographical dispersal and require stronger cooperation.

19 20 **14.2.3 Assessment criteria**

21 This section identifies a set of criteria for assessing the effectiveness of international cooperation, which
22 is applied later in the chapter. Lessons from the implementation of other multilateral environmental
23 agreements (MEAs) can provide some guidance. There is considerable literature on this topic, most of
24 which predates AR5, and which will therefore not be covered in detail. Issues include ways to enhance
25 compliance, and the fact that a low level of compliance with an MEA does not necessarily mean that
26 the MEA has no effect (Downs et al. 1996; Victor et al. 1998; Weiss and Jacobson 1998). Recent
27 research examines effectiveness from the viewpoint of the extent to which an MEA influences domestic
28 action, including the adoption of implementing legislation and policies (Brandt et al. 2019).

29 Many have pointed to the Montreal Protocol, addressing stratospheric ozone loss, as an example of a
30 successful treaty because of its ultimate environmental effectiveness, and relevance for solving climate
31 change. Scholarship emerging since AR5 emphasises that the Paris Agreement has a greater ‘bottom-
32 up’ character than many other MEAs, including the Montreal or Kyoto Protocols, allowing for more
33 decentralised ‘polycentric’ forms of governance that engage diverse actors at the regional, national and
34 sub-national levels (Ostrom 2010; Jordan et al. 2015; Falkner 2016b; Victor 2016). Given the
35 differences in architecture, lessons drawn from studies of MEA regimes need to be supplemented with
36 assessments of the effectiveness of cooperative efforts at other governance levels and in other forums.
37 Emerging research in this area proposes methodologies for this task (Hsu et al. 2019a). Findings
38 highlight the persistence of similar imbalances between developed and developing countries as at the
39 global level, as well as the need for more effective ways to incentivise private sector engagement in
40 transnational climate governance (Chan et al. 2018).

41 While environmental outcomes and economic performance have been long-standing criteria for
42 assessment of effectiveness, the other elements deserve some note. It is the case that the achievement
43 of climate objectives, such as limiting global average warming to 1.5 – 2°C, will require the transition
44 from high- to low-carbon technologies, and the transformation of the sectors and social environments
45 within which those technologies operate. Such transformations are not linear processes, and hence many
46 of the early steps taken – such as supporting early diffusion of new renewable energy technologies –
47 will have little immediate effect on GHG emissions (Patt 2015; Geels et al. 2017). Hence, activities that

1 contribute to transformative potential include technology transfer and financial support for low-carbon
 2 infrastructure, especially where the latter is not tied to immediate emissions reductions. Assessing the
 3 transformative potential of international cooperation takes these factors into account. Equity and
 4 distributive outcomes are of central importance to the climate change debate, and hence for evaluating
 5 the effects of policies. Equity encompasses the notion of distributive justice which refers to the
 6 distribution of goods, burdens, costs and benefits, as well as procedural-related issues (Kverndokk
 7 2018).

8 Finally, the literature on the performance of other MEAs highlights the importance of institutional
 9 strength, which can include regulative quality, mechanisms to enhance transparency and accountability,
 10 and administrative capacity. Regulative quality includes guidance and signalling (Oberthür et al. 2017),
 11 as well as clear rules and standards to facilitate collective action (Oberthür and Bodle 2016). The
 12 literature is clear that legally binding obligations (which require the formal expression of state consent)
 13 and non-binding recommendations can each be appropriate, depending on the particular circumstances
 14 (Skjærseth et al. 2006), and indeed it has been argued that for climate change non-binding
 15 recommendations may better fit the capacity of global governance organisations (Victor 2011).
 16 Mechanisms to enhance transparency and accountability are essential to collect, protect, and analyse
 17 relevant data about parties' implementation of their obligations, and to identify and address challenges
 18 in implementation (Kramarz and Park 2016; Kinley et al. 2020). Administrative capacity refers to the
 19 strength of the formal bodies established to serve the parties to the regime and help ensure compliance
 20 and goal attainment (Anderl and Behrle 2009; Bauer et al. 2017).

21 In addition to building on the social science theory just described, we recognise that it is also important
 22 to strike a balance between applying the same standards developed and applied to international
 23 cooperation in AR5, and maintaining consistency with other chapters of this report (primarily Chapters
 24 1, 4, 13, and 15). Table 14.2 presents a set of criteria that do this, and which are then applied later in
 25 the chapter.

26
 27 **Table 14.2 Criteria for assessing effectiveness of international cooperation**

Criterion	Description
Environmental outcomes	To what extent does international cooperation lead to identifiable environmental benefits, namely the reduction of economy-wide and sectoral emissions of greenhouse gases from pre-existing levels or 'business as usual' scenarios?
Transformative potential	To what extent does international cooperation contribute to the enabling conditions for transitioning to a zero-carbon economy and sustainable development pathways at the global, national, or sectoral levels?
Distributive outcomes	To what extent does international cooperation lead to greater equity with respect to the costs, benefits, and burdens of mitigation actions, taking into account current and historical contributions and circumstances?
Economic performance	To what extent does international cooperation promote the achievement of economically efficient and cost-effective mitigation activities?
Institutional strength	To what extent does international cooperation create the institutional framework needed for the achievement of internationally agreed-upon goals, and contribute to national, sub-national, and sectoral institutions needed for decentralised and bottom-up mitigation governance?

28

1 **14.3 The UNFCCC and the Paris Agreement**

2 **14.3.1 The UN climate change regime**

3 *14.3.1.1 Instruments & Milestones*

4 The international climate change regime, in evolution for three decades, comprises the 1992 UNFCCC,
5 the 1997 Kyoto Protocol, and the 2015 Paris Agreement. The UNFCCC is a ‘framework’ convention,
6 capturing broad convergence among states on an objective, a set of principles, and general obligations
7 relating to mitigation, adaptation, reporting and support. The UNFCCC categorises parties into Annex
8 I and Annex II. Annex I parties, comprising developed country parties, have a goal to return,
9 individually or jointly, their GHG emissions to 1990 levels by 2000. Annex II parties, comprising
10 developed country parties except for those with economies in transition, have additional obligations
11 relating to the provision of financial and technology support. All parties, including developing country
12 parties, characterised as non-Annex-I parties, have reporting obligations, as well as obligations to take
13 policies and measures on mitigation and adaptation. The UNFCCC also establishes the institutional
14 building blocks for global climate governance. Both the 1997 Kyoto Protocol and the 2015 Paris
15 Agreement are distinct but ‘related legal instruments’ in that only parties to the UNFCCC can be parties
16 to these later instruments.

17 The Kyoto Protocol specifies GHG emissions reduction targets for the 2008-2012 commitment period
18 for countries listed in its Annex B (which broadly corresponds to Annex I to the UNFCCC) (UNFCCC
19 1997, Art. 3 and Annex B). The Kyoto Protocol entered into force in 2005. Shortly thereafter, states
20 began negotiating a second commitment period under the Protocol for Annex B parties, as well as
21 initiated a process under the UNFCCC to consider long-term cooperation among all parties.

22 At COP 13 in Bali in 2007, parties adopted the *Bali Action Plan* that launched negotiations aimed at an
23 agreed outcome enhancing the UNFCCC’s ‘full, effective and sustained implementation’. The agreed
24 outcome was to be adopted at COP 15 in Copenhagen in 2009, but negotiations failed to deliver a
25 consensus document. The result instead was the *Copenhagen Accord*, which was taken note of by the
26 COP. While it was a political agreement with no formal legal status under the UNFCCC, it reflected
27 significant progress on several fronts and set in place the building blocks for the Paris Agreement,
28 namely: setting a goal of limiting global temperature increase to below 2°C; calling on all countries to
29 put forward mitigation pledges; establishing broad new terms for the reporting and verification of
30 countries’ actions; setting a goal of mobilising USD100 billion a year by 2020 from a wide variety of
31 sources, public and private, bilateral and multilateral, including alternative sources of finance; and,
32 calling for the establishment of a new Green Climate Fund and Technology Mechanism (Rogelj et al.
33 2010; Rajamani 2010; UNFCCC 2010a). One hundred and forty states endorsed the Copenhagen
34 Accord, with 85 countries entering pledges to reduce their emissions or constrain their growth by 2020
35 (Christensen and Olhoff 2019).

36 At COP 16 in Cancun in 2010, parties adopted a set of decisions termed the *Cancun Agreements* that
37 effectively formalised the core elements of the Copenhagen Accord, and the pledges states made, under
38 the UNFCCC. The Cancun Agreements were regarded as an interim arrangement through to 2020, and
39 parties left the door open to further negotiations, in line with negotiations launched in 2005, toward a
40 legally binding successor to the Kyoto Protocol (Freestone 2010; Liu 2011a). Collectively the G-20
41 states are on track to meeting the mid-level of their Cancun pledges, although there is uncertainty about
42 some individual pledges. However, there is significant gap between annual emissions expected under
43 full implementation of pledges and the level consistent with the 2°C goal (Christensen and Olhoff 2019).

44 At the 2011 Durban climate conference, parties launched negotiations for ‘a Protocol, another legal
45 instrument or agreed outcome with legal force’ with a scheduled end to the negotiations in 2015
46 (UNFCCC 2012, Dec. 1, para. 2). At the 2012 Doha climate conference, parties adopted a second

1 commitment period for the Kyoto Protocol, running from 2013-2020. The Doha amendment entered
 2 into force in 31 December 2020. Given the subsequent adoption of the Paris Agreement, the Kyoto
 3 Protocol is unlikely to continue beyond 2020 (Bodansky et al. 2017a). At the end of the compliance
 4 assessment period under the Kyoto Protocol, Annex B parties were in full compliance with their targets
 5 for the first commitment period; in some cases through the use of the Protocol’s flexibility mechanisms
 6 (Shishlov et al. 2016).

7 Although both the Kyoto Protocol and Paris Agreement are under the UNFCCC, they are generally seen
 8 as representing fundamentally different approaches to international cooperation on climate change
 9 (Held and Roger 2018; Falkner 2016b). The Paris Agreement has been characterised as a ‘decisive
 10 break’ from the Kyoto Protocol (Keohane and Oppenheimer 2016). Some note that the mitigation
 11 efforts under the Kyoto Protocol take the form of targets that, albeit based on national self-selection,
 12 were part of the multilateral negotiation process, whereas under the Paris Agreement parties make
 13 nationally determined contributions. The different approaches have been characterised by some as a
 14 distinction between a ‘top down’ and ‘bottom up’ approach (Bodansky and Rajamani 2016; Bodansky
 15 et al. 2016; Chan et al. 2016; Doelle 2016) but others disagree with such a characterisation pointing to
 16 continuities within the regime, for example, in terms of rules for reporting and review, and crossover
 17 and use of common institutional arrangements (Depledge 2017; Allan 2019). Some note, in any case,
 18 that the Kyoto Protocol’s core obligations are substantive obligations of result, while many of the Paris
 19 Agreement’s core obligations are procedural obligations, complemented by obligations of conduct
 20 (Rajamani 2016a; Mayer 2018a).

21 The differences between and continuities in the three treaties that comprise the UN climate regime are
 22 summarised in Table 14.3 below. The Kyoto targets apply only to Annex I parties, but the procedural
 23 obligations relating to NDCs in the Paris Agreement apply to all parties, with flexibilities in relation to
 24 some obligations for Least Developed Countries (LDCs), Small Island Developing States (SIDS), and
 25 developing countries that need it in light of their capacities. The Kyoto targets are housed in its Annex
 26 B, therefore requiring a formal process of amendment for revision, whereas the Paris NDCs are located
 27 in an online registry that is maintained by the Secretariat, but to which parties can upload their own
 28 NDCs. The Kyoto Protocol allows Annex B parties to use three market-based mechanisms – the Clean
 29 Development Mechanism (CDM), Joint Implementation and International Emissions Trading – to fulfil
 30 a part of their GHG targets. The Paris Agreement recognizes that parties may choose to cooperate
 31 voluntarily on markets, in the form of cooperative approaches under Article 6.2, and a mechanism with
 32 international oversight under Article 6.4, subject to guidance and rules that are yet to be adopted. These
 33 rules relate to integrity and accounting (La Hoz Theuer et al. 2019). Article 5 also provides explicit
 34 endorsement of REDD+. The Kyoto Protocol contains an extensive reporting and review process,
 35 backed by a compliance mechanism. This mechanism includes an enforcement branch, to ensure
 36 compliance, and sanction non-compliance (through the withdrawal of benefits such as participation in
 37 market-based mechanisms), with its national system requirements, and GHG targets. By contrast, the
 38 Paris Agreement relies on informational requirements and flows to enhance the clarity of NDCs, and to
 39 track progress in the implementation and achievement of NDCs.

40
 41 **Table 14.3 Continuities in and differences between the UNFCCC, Paris Agreement and the Kyoto**
 42 **Protocol**

Feature	UNFCCC	Kyoto Protocol	Paris Agreement
Objective	To stabilize GHGs in the atmosphere at a level that would prevent	Primarily mitigation-focused (although in pursuit of the	Mitigation in line with a long-term temperature goal, adaptation and finance goals, as well as

	dangerous anthropogenic interference with the climate system, in a time frame to protect food security, enable natural ecosystem adaptability and permit economic development in a sustainable manner	UNFCCC objective)	sustainable development and equity (also, in pursuit of the UNFCCC objective)
Architecture	‘Framework’ agreement with agreement on principles such as CDDRRC, division of countries into Annexes, with different groups of countries with differentiated commitments.	Differentiated targets, based on national offers submitted to the multilateral negotiation process, and multilaterally negotiated common metrics	Nationally determined contributions subject to transparency, multilateral consideration of progress, common metrics in inventories and accounting.
Coverage of mitigation-related commitments	Annex I Parties with a GHG stabilization goal, all Parties to take policies and measures	UNFCCC Annex I/Kyoto Annex B parties only	All parties
Targets	GHG stabilization goal for Annex I parties (‘quasi target’)	Legally binding, differentiated mitigation targets inscribed in treaty	Non-binding (in terms of results) contributions incorporated in parties’ NDCs, and provisions including those relating to highest possible ambition, progression and common but differentiated responsibilities and respective capabilities, in light of different national circumstances
Timetable	Aim to return to 1990 levels of GHGs by 2000	Two commitment periods (2008-2012; 2013-2020)	Initial NDCs for timeframes from 2020 running through 2025 or 2030 with new or updated NDCs every five years, and

			encouragement to submit long-term low GHG emission development strategies
Adaptation	Parties to cooperate in preparing for adaptation to the impacts of climate change	Parties to formulate and implement national adaptation measures, share of proceeds from CDM to fund adaptation	Qualitative global goal on adaptation to enhance adaptive capacity and resilience, and reduce vulnerability, parties to undertake national adaptation planning and implementation
Loss and Damage	Not covered	Not covered	Cooperation and facilitation to enhance understanding, action and support for loss and damage, including through the Warsaw International Mechanism on Loss and Damage under the UNFCCC
Transparency	National communications from parties, with differing content and set to differing timeframes for different categories of parties	Reporting and review – Annex B parties only	Enhanced transparency framework and five-yearly global stocktake for a collective assessment of progress towards goals – all parties
Support	Annex II commitments relating to provision of finance, development and transfer of technology to developing countries	Advances UNFCCC Annex II commitments relating to provision of finance, development and transfer of technology to developing countries	Enhances reporting in relation to support, expands the base of donors, and tailors support to the needs and capacities of developing countries
Implementation	National implementation, communication on implementation	Market mechanisms (international emissions trading, joint implementation, CDM)	Voluntary cooperation on mitigation (through market-based and non-market approaches); encouragement of REDD+ (guidance and rules under negotiation)

Compliance	Multilateral consultative process, never adopted	Compliance committee with facilitative and enforcement branches; sanctions for non-compliance	Committee to promote compliance and facilitate implementation; no sanctions
-------------------	--	---	---

1

2 **14.3.1.2 Negotiating Context and Dynamics**

3 The 2015 Paris Agreement was negotiated in a starkly different geopolitical context to that of the 1992
 4 UNFCCC and the 1997 Kyoto Protocol (Streck and Terhalle 2013; Ciplet et al. 2015). The ‘rupturing
 5 binary balance of superpowers’ of the 1980s had given way to a multipolar world with several
 6 distinctive trends: emerging economies began challenging US dominance (Ciplet et al. 2015);
 7 industrialised countries’ emissions peaked in the 2010s and started declining, while emissions from
 8 emerging economies began to grow (Falkner 2019); the EU stretched eastwards and became
 9 increasingly supra-national (Kinley et al. 2020); disparities within the group of developing countries
 10 increased (Ciplet et al. 2015); and the role of non-state actors in mitigation efforts has grown more
 11 salient (Bäckstrand et al. 2017; Kuyper et al. 2018b; Falkner 2019). The rise of emerging powers, many
 12 of whom now have ‘veto power’, however, some noted, did not detract from the unequal development
 13 and inequality at the heart of global environmental politics (Hurrell and Sengupta 2012).

14 In this altered context, unlike in the 1990s when the main cleavages were between the EU and the US
 15 (Hurrell and Sengupta 2012), US-China ‘great power politics’ came to be seen as determinative of
 16 outcomes in the climate change negotiations (Terhalle and Depledge 2013). The US-China joint
 17 announcement (Whitehouse 2014), for instance, before the 2014 Lima climate conference, brokered the
 18 deal on differentiation that came to be embodied in the Paris Agreement (Ciplet and Roberts 2017;
 19 Rajamani 2016a). Others have identified, on the basis of economic standing, political influence, and
 20 emissions levels, three influential groups - the first comprising the US with Japan, Canada, and Russia,
 21 the second comprising the EU and the third comprising China, India and Brazil (Brenton 2013). The
 22 emergence of the Major Economies Fora (MEF), among other climate clubs (discussed in Section
 23 14.2.2) reflects this development (Brenton 2013). It also represents a ‘minilateral’ forum, built on a
 24 recognition of power asymmetries, in which negotiating compromises are politically tested and fed into
 25 multilateral processes (Falkner 2016a).

26 Beyond these countries, in the decade leading up to the Paris climate negotiations, increasing
 27 differences within the group of developing countries divided the 134-strong developing country alliance
 28 of the G-77/China into several interest-based coalitions (Vihma et al. 2011; Bodansky et al. 2017b). A
 29 division emerged between the vulnerable least developed and small island states on the one side and
 30 rapidly developing economies, the BASIC (Brazil, South Africa, India and China) on the other, as the
 31 latter are ‘decidedly not developed but not wholly developing’ (Hochstetler and Milkoreit 2013). This
 32 ‘fissure’ in part led to the High Ambition Coalition in Paris between vulnerable countries and the more
 33 progressive industrialised countries (Ciplet and Roberts 2017). A division also emerged between the
 34 BASIC countries (Hurrell and Sengupta 2012), that each have distinctive identities and positions
 35 (Hochstetler and Milkoreit 2013). In the lead up to the Paris negotiations, China and India formed the
 36 Like-Minded Developing Countries (LMDCs) with OPEC and the Bolivarian Alliance for the Peoples
 37 of our Americas (ALBA) countries, to resist the erosion of differentiation in the regime. Yet, the
 38 ‘complex and competing’ identities of India and China, with differing capacities, challenges and self-
 39 images, have also influenced the negotiations (Rajamani 2017; Ciplet and Roberts 2017). Other
 40 developing countries’ coalitions also played an important role in striking the final deal in Paris. The

1 Alliance of Small Island States (AOSIS), despite their lack of structural power, played a leading role,
2 in particular in relation to the inclusion of the 1.5°C long term temperature goal in the UN climate
3 regime (Agueda Corneloup and Mol 2014; Ourbak and Magnan 2018). The Association of the Latin
4 American and Caribbean Countries (AILAC) that emerged in 2012 also played a decisive role in
5 fostering ambition (Edwards et al. 2017; Watts and Depledge 2018).

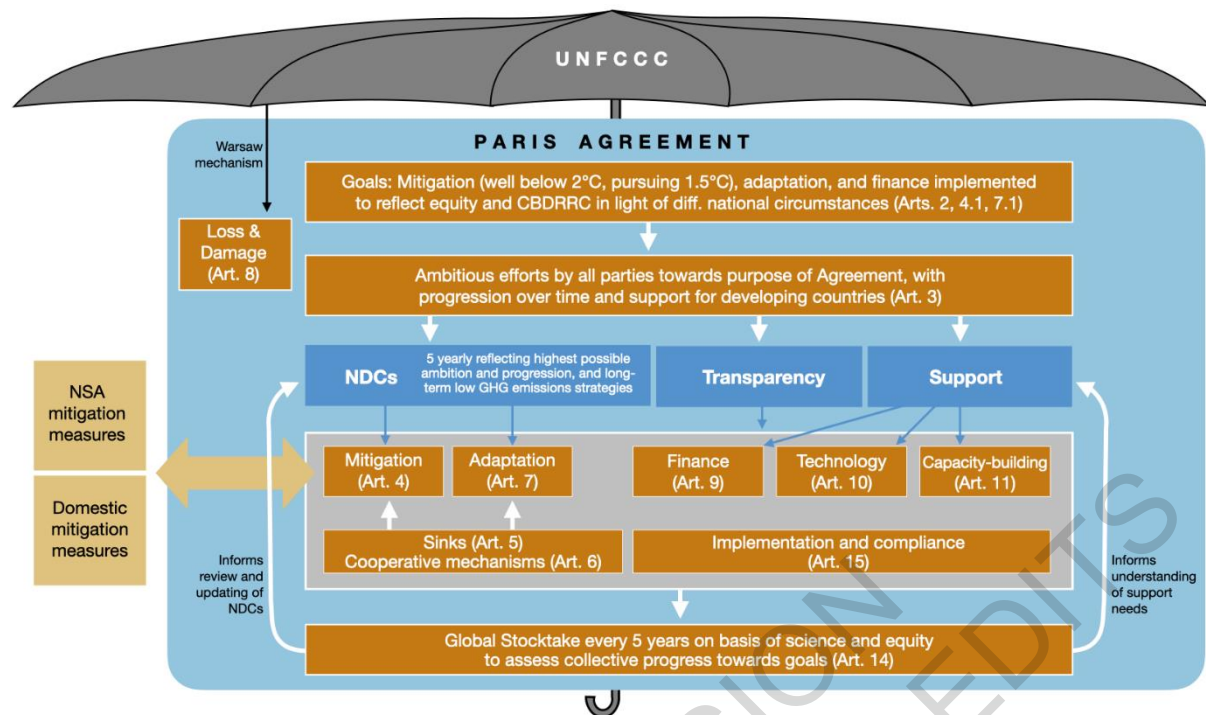
6 Leadership is essential to reaching international agreements and overcoming collective action problems
7 (Parker et al. 2015). The Paris negotiations were faced, as a reflection of the multipolarity that had
8 emerged, with a ‘fragmented leadership landscape’ with the US, EU, and China being perceived as
9 leaders at different points in time and to varying degrees (Parker et al. 2014; Karlsson et al. 2012). Small
10 island states are also credited with demonstrating ‘moral leadership’ (Agueda Corneloup and Mol 2014),
11 and non-state and sub-national actors are beginning to be recognised as pioneers and leaders (Wurzel
12 et al. 2019). There is also a burgeoning literature on the emergence of diffused leadership and the
13 salience of followers (Busby and Urpelainen 2020; Parker et al. 2014).

14 It is in the context of this complex, multipolar and highly differentiated world - with a heterogeneity of
15 interests, constraints and capacities, increased contestations over shares of the carbon and development
16 space, as well as diffused leadership - that the Paris Agreement was negotiated. This context
17 fundamentally influenced the shape of the Paris Agreement in particular on issues relating to its
18 architecture, ‘legalisation’ (Karlsson 2017) and differentiation (Bodansky et al. 2017b; Kinley et al. 2020),
19 all of which are discussed below.

20

21 **14.3.2 Elements of the Paris Agreement relevant to mitigation**

22 The 2015 Paris Agreement to the UNFCCC, which entered into force on 4 November 2016, and has
23 192 Parties as of date, is at the centre of international cooperative efforts for climate change mitigation
24 and adaptation in the post-2020 period. Although its legal form was heavily disputed, especially in the
25 initial part of its four-year negotiating process (Rajamani 2015; Maljean-Dubois and Wemaëre 2016;
26 Klein et al. 2017; Bodansky et al. 2017b), the Paris Agreement is a treaty containing provisions of
27 differing levels of “bindingness” (Bodansky 2016; Rajamani 2016b; Oberthür and Bodle 2016). The
28 legal character of provisions within a treaty, and the extent to which particular provisions lend
29 themselves to assessments of compliance or non-compliance, depends on factors such as the normative
30 content of the provision, the precision of its terms, the language used, and the oversight mechanisms in
31 place (Werksman 2010; Bodansky 2015; Oberthür and Bodle 2016; Rajamani 2016b). Assessed on
32 these criteria, the Paris Agreement contains the full spectrum of provisions, from hard to soft law
33 (Pickering et al. 2019; Rajamani 2016b) and even ‘non-law’, provisions that do not have standard-
34 setting or normative content, but which play a narrative-building and context-setting role (Rajamani
35 2016b). The Paris Agreement, along with the UNFCCC and the Kyoto Protocol, can be interpreted in
36 light of the customary international law principle of harm prevention according to which states must
37 exercise due diligence in seeking to prevent activities within their jurisdiction from causing
38 extraterritorial environmental harm (Mayer 2016a; Maljean-Dubois 2019). The key features of the Paris
39 Agreement are set out in Box 14.1.



1
2 **Figure 14.1 Key features of the Paris Agreement. Arrows illustrate the interrelationship between the**
3 **different features of the Paris Agreement, in particular between the Agreement’s goals, required actions**
4 **(through NDCs, support (finance, technology and capacity-building), transparency framework and global**
5 **stocktake process. The figure also represents points of interconnection with domestic mitigation**
6 **measures, whether taken by state parties or by non-state actors (NSAs). This figure is illustrative rather**
7 **than exhaustive of the features and interconnections.**

8 Figure 14.1 illustrates graphically the key features of the Paris Agreement. The Paris Agreement is
9 based on a set of binding procedural obligations requiring parties to ‘prepare, communicate, and
10 maintain’ ‘nationally determined contributions’ (NDCs) (UNFCCC 2015a, Art. 4.2) every five years
11 (UNFCCC 2015a, Art. 4.9). These obligations are complemented by: (1) an ‘ambition cycle’ that
12 expects parties, informed by five-yearly global stocktakes (Art 14), to submit successive NDCs
13 representing a progression on their previous NDCs (UNFCCC 2015a; Bodansky et al. 2017b), and (2)
14 an ‘enhanced transparency framework’ that places extensive informational demands on parties, tailored
15 to capacities, and establishes review processes to enable tracking of progress towards achievement of
16 NDCs (Oberthür and Bodle 2016). In contrast to the Kyoto Protocol with its internationally inscribed
17 targets and timetable for emissions reduction for developed countries, the Paris Agreement contains
18 nationally determined contributions embedded in an international system of transparency and
19 accountability for all countries (Doelle 2016; Maljean-Dubois and Wemaëre 2016) accompanied by a
20 shared global goal, in particular in relation to a temperature limit.

21 **14.3.2.1 Context and purpose**

22 The preamble of the Paris Agreement lists several factors that provide the interpretative context for the
23 Agreement (Carazo 2017; Bodansky et al. 2017b), including a reference to human rights. The human
24 rights implications of climate impacts garnered particular attention in the lead up to Paris (Duyck 2015;
25 Mayer 2016b). In particular, the Human Rights Council, its special procedures mechanisms, and the
26 Office of the High Commissioner for Human Rights, through a series of resolutions, reports, and
27 activities, advocated a rights-based approach to climate impacts, and sought to integrate this approach
28 in the climate change regime. The Paris Agreement’s preambular recital on human rights recommends
29 that parties, ‘when taking action to address human rights’, take into account ‘their respective obligations
30 on human rights’ (UNFCCC 2015a, preambular recital 14), a first for an environmental treaty (Knox
31 2016). The ‘respective obligations’ referred to in the Paris Agreement could potentially include those

1 relating to the right to life (UNGA 1948, Art. 3, 1966, Art. 6), right to health (UNGA 1966b, Art. 12),
2 right to development, right to an adequate standard of living, including the right to food (UNGA 1966b,
3 Art. 11), which has been read to include the right to water and sanitation (CESCR 2002, 2010), the right
4 to housing (CESCR 1991), and the right to self-determination, including as applied in the context of
5 indigenous peoples (UNGA 1966a,b, Art. 1). In addition, climate impacts contribute to displacement
6 and migration (Mayer and Crépeau 2016; McAdam 2016), and have disproportionate effects on women
7 (Pearse 2017). There are differing views on the value and operational impact of the human rights recital
8 in the Paris Agreement (Adelman 2018; Boyle 2018; Duyck et al. 2018; Rajamani 2018; Savaresi 2018;
9 Knox 2019). Notwithstanding proposals from some parties and stakeholders to mainstream and
10 operationalise human rights in the climate regime post-Paris (Duyck et al. 2018), and references to
11 human rights in COP decisions, the 2018 Paris Rulebook contains limited and guarded references to
12 human rights (Duyck 2019; Rajamani 2019) (see Section 14.5.1.2). In addition to the reference to human
13 rights, the preamble also notes the importance of ‘ensuring the integrity of all ecosystems, including
14 oceans and the protection of biodiversity’ which provides opportunities for integrating and
15 mainstreaming other environmental protections.

16 The overall purpose of international cooperation through the Paris Agreement is to enhance the
17 implementation of the UNFCCC, including its objective of stabilising atmospheric GHG concentrations
18 ‘at a level that would prevent dangerous anthropogenic interference with the climate system’ (UNFCCC
19 1992, Art. 2). The Paris Agreement aims to strengthen the global response to the threat of climate
20 change, in the context of sustainable development and efforts to eradicate poverty, by inter alia
21 ‘[h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels
22 and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels’ (UNFCCC
23 2015a, Art. 2(1)(a)). There is an ongoing structured expert dialogue under the UNFCCC in the context
24 of the second periodic review of the long-term global goal (the first was held between 2013-2015) aimed
25 at enhancing understanding of the long-term global goal, pathways to achieving it, and assessing the
26 aggregate effect of steps taken by parties to achieve the goal.

27 Some authors interpret the Paris Agreement’s temperature goal as a single goal with two inseparable
28 elements, the well below 2°C goal pressing towards 1.5°C (Rajamani and Werksman 2018), but others
29 interpret the goal as a unitary one of 1.5°C with minimal overshoot (Mace 2016). Yet others interpret
30 1.5° C as the limit within the long-term temperature goal, and that it ‘signals an increase in both the
31 margin and likelihood by which warming is to be kept below 2°C (Schleussner et al. 2016). Although
32 having a long-term goal has clear advantages, the literature highlights the issue of credibility, given the
33 lengthy timeframe involved (Urpelainen 2011), and stresses that future regulators may have incentives
34 to relax current climate plans, which could have a significant effect on the achieved GHG stabilisation
35 level (Gerlagh and Michielsen 2015).

36 As the risks of adverse climate impacts, even with a ‘well below’ 2°C increase, are substantial, the
37 purpose of the Paris Agreement extends to increasing adaptive capacity and fostering climate resilience
38 (UNFCCC 2015a, Art. 2(1)(b)), as well as redirecting investment and finance flows (UNFCCC 2015a,
39 Art (2)(1)(c); Thorgeirsson 2017). The finance and adaptation goals are not quantified in the Paris
40 Agreement itself but the temperature goal and the pathways they generate may, some argue, enable a
41 quantitative assessment of the resources necessary to reach these goals, and the nature of the impacts
42 requiring adaptation (Rajamani and Werksman 2018). The decision accompanying the Paris Agreement
43 resolves to set a new collective quantified finance goal prior to 2025 (not explicitly limited to developed
44 countries), with USD100 billion yr⁻¹ as a floor (UNFCCC 2016a, para. 53; Bodansky et al. 2017b).
45 Article 2 also references sustainable development and poverty eradication, and thus implicitly
46 underscores the need to integrate the SDGs in the implementation of the Paris Agreement (Sindico
47 2016).

1 The Paris Agreement's purpose is accompanied by an expectation that the Agreement 'will be'
2 implemented to 'reflect equity and the principle of common but differentiated responsibilities and
3 respective capabilities (CBDRRC), in the light of different national circumstances' (UNFCCC 2015a,
4 Art. 2.2). This provision generates an expectation that parties will implement the agreement to reflect
5 CBDRRC, and is not an obligation to do so (Rajamani 2016a). Further, the inclusion of the term 'in
6 light of different national circumstances' introduces a dynamic element into the interpretation of the
7 CBDRRC principle. As national circumstances evolve, the application of the principle will also evolve
8 (Rajamani 2016a). This change in the articulation of the CBDRRC principle is reflected in the shifts in
9 the nature and extent of differentiation in the climate change regime (Maljean-Dubois 2016; Rajamani
10 2016a; Voigt and Ferreira 2016a), including through a shift towards 'procedurally-oriented
11 differentiation' for developing countries (Huggins and Karim 2016).

12 Although NDCs are developed by individual state parties, the Paris Agreement requires that these are
13 undertaken by parties 'with a view' to achieving the Agreement's purpose and collectively 'represent a
14 progression over time' (UNFCCC 2015a, Art. 3). The Paris Agreement also encourages parties to align
15 the ambition of their NDCs with the temperature goal through the Agreement's 'ambition cycle', thus
16 imparting operational relevance to the temperature goal (Rajamani and Werksman 2018).

17 Article 4.1 contains a further non-binding requirement that parties 'aim' to reach global peaking of
18 GHG 'as soon as possible' and to undertake rapid reductions thereafter to achieve net zero GHG
19 emissions 'in the second half of the century'. Some argue this implies a need to reach net zero GHG
20 emissions in the third quarter of the 21st century (Rogelj et al. 2015; IPCC 2018b; ch2, table 2.4; cross-
21 chapter box 3 on net zero targets). To reach net zero CO₂ around 2050, in the short-term global net
22 human-caused CO₂ emissions would need to fall by about 45% - 60% from 2010 levels by 2030 (IPCC
23 2018b). Achieving the Paris Agreement's Article 4.1 aim potentially implies imply that global warming
24 will peak and then follow a gradually declining path, potentially to below 1.5°C warming (Rogelj et al.
25 2021).

26 Albeit non-binding, Article 4.1 has acted as a catalyst for several national net-zero GHG targets, as well
27 net zero CO₂ and GHG targets across local governments, sectors, businesses, and other actors (Day et
28 al. 2020). There is a wide variation in the targets that have been adopted – in terms of their legal
29 character (policy statement, executive order or national legislation), scope (GHGs or CO₂) and coverage
30 (sectors or economy-wide). National net-zero targets could be reflected in the long-term strategies that
31 states are urged to submit under Article 4.19, but only a few states have submitted such strategies thus
32 far. The Paris Rulebook, agreed at the Agreement's first meeting of the parties in 2018, further
33 strengthens the operational relevance of the temperature goal by requiring parties to provide information
34 when submitting their NDCs on how these contribute towards achieving the objective identified in
35 UNFCCC Article 2, and Paris Agreement Articles 2.1 (a) and 4.1 (UNFCCC 2019b, Annex I, para. 7),
36 Parties could in this context include information on how their short-term actions align with their long-
37 term net zero GHG or CO₂ targets thereby enhancing the credibility of their long-term goals.

38 At last count 131 countries had adopted or had net zero targets (whether of carbon or GHG) in the
39 pipeline, covering 72% of global emissions. If these targets are fully implemented some estimate that
40 this could bring temperature increase down to 2-2.4°C by 2100 as compared to current policies which
41 are estimated to lead to a temperature increase of 2.9–3.2 °C, and NDCs submitted to the Paris
42 Agreement which are estimated to lead to a temperature increase of 2.4-2.9°C (Höhne et al. 2021).

43 It is worth noting that Article 4.1 recognizes that 'peaking will take longer for developing countries'
44 and that the balance between emissions and removals needs to be on the 'basis of equity, and in the
45 context of sustainable development and efforts to eradicate poverty.' This suggests that not all countries
46 are expected to reach net zero GHG emissions at the same time, or in the same manner. If global cost-
47 effective 1.5 °C and 2 °C scenarios from integrated assessment models are taken, without applying an
48 equity principle, the results suggest that domestic net zero GHG and CO₂ emissions would be reached

1 a decade earlier than the global average in Brazil and the USA and later in India and Indonesia (van
2 Soest et al. 2021). By contrast if equity principles are taken into account, countries like Canada and the
3 EU would be expected to phase-out earlier than the cost-optimal scenarios indicate, and countries like
4 China and Brazil could phase out emissions later, as well as other countries with lower per-capita
5 emissions (van Soest et al. 2021). Some suggest that the application of such fairness considerations
6 could bring forward the net zero GHG date for big emitting countries by up to 15 to 35 years as
7 compared to the global least-cost scenarios (Lee et al. 2021b). In any case, reaching net-zero GHG
8 emissions requires to some extent the use of carbon dioxide removal (CDR) methods as there are
9 important sources of non-CO₂ GHGs, such as methane and nitrous oxide, that cannot be fully eliminated
10 resorting to carbon dioxide removal (CDR) methods (IPCC 2018b). However, there are divergent views
11 on different CDR methods, policy choices determine the degree to which and the type of CDR methods
12 that are considered and there is a patchwork of applicable regulatory instruments. There are also
13 uncertainties and governance challenges associated with CDR methods which render tracking progress
14 against net zero GHG emissions challenging (Mace et al. 2021). Researchers have noted that given the
15 key role of CDR in net-zero targets and 1.5 °C compatible pathways, and the fact that it presents
16 ‘significant costs to current and future generations,’ it is important to consider what an equitable
17 distribution of CDR might look like (UNFCCC 2019c; Day et al. 2020; Lee et al. 2021b).

18 **14.3.2.2 NDCs, progression and ambition**

19 Each party to the Paris Agreement has a procedural obligation to ‘prepare, communicate and maintain’
20 successive NDCs ‘that it intends to achieve.’ Parties have a further procedural obligation to ‘pursue
21 domestic mitigation measures’ (UNFCCC 2015a, Art. 4.2). These procedural obligations are coupled
22 with an obligation of conduct to make best efforts to achieve the objectives of NDCs (Rajamani 2016a;
23 Mayer 2018b). Many states have adopted climate policies and laws, discussed in Chapter 13, and
24 captured in databases (LSE 2020).

25 The framing and content of NDCs is thus largely left up to parties, although certain normative
26 expectations apply. These include developed country leadership through these parties undertaking
27 economy-wide absolute emissions reduction targets (UNFCCC 2015a, Art. 4.4), as well as
28 ‘progression’ and ‘highest possible ambition’ reflecting ‘common but differentiated responsibilities and
29 respective capabilities in light of different national circumstances’ (Art 4.3). There is ‘a firm
30 expectation’ that for every five-year cycle a party puts forward a new or updated NDC that is ‘more
31 ambitious than their last’ (Rajamani 2016a). While what represents a party’s highest possible ambition
32 and progression is not prescribed by the Agreement or elaborated in the Paris Rulebook (Rajamani and
33 Bodansky 2019), these obligations could be read to imply a due diligence standard (Voigt and Ferreira
34 2016b).

35 In communicating their NDCs every five years (UNFCCC 2015a, Art. 4.9), all parties have an
36 obligation to ‘provide the information necessary for clarity, transparency and understanding’ (UNFCCC
37 2015a, Art. 4.8). These requirements are further elaborated in the Paris Rulebook (Doelle 2019;
38 UNFCCC 2019b). This includes requirements — for parties’ second and subsequent NDCs — to
39 provide quantifiable information on the reference point e.g. base year, reference indicators and target
40 relative to the reference indicator (UNFCCC 2019b, Annex I, para 1). It also requires parties to provide
41 information on how they consider their contribution ‘fair and ambitious in light of different national
42 circumstances’, and how they address the normative expectations of developed country leadership,
43 progression and highest possible ambition (UNFCCC 2019b, Annex I, para 6). However, parties are
44 required to provide the enumerated information only ‘as applicable’ to their NDC (UNFCCC 2019b,
45 Annex I, para 7). This allows parties to determine the informational requirements placed on them
46 through their choice of NDC. In respect of parties’ first NDCs or NDCs updated by 2020, such
47 quantifiable information ‘may’ be included, ‘as appropriate’, signalling a softer requirement, although
48 parties are ‘strongly encouraged’ to provide this information (UNFCCC 2019b, Annex I, para 9).

1 Parties' first NDCs submitted to the provisional registry maintained by the UNFCCC Secretariat vary
2 in terms of target type, reference year or points, time frames, and scope and coverage of GHGs. A
3 significant number of NDCs include adaptation, and several NDCs have conditional components, for
4 instance, being conditional on the use of market mechanisms or on the availability of support (UNFCCC
5 2016b). There are wide variations across NDCs. Uncertainties are generated through interpretative
6 ambiguities in the assumptions underlying NDCs, (Rogelj et al. 2017). According to the assessment in
7 this report, current policies lead to median global GHG emissions of 63 GtCO₂-eq with a full range of
8 57-70 by 2030 and unconditional and conditional NDCs to 59 (55-65) and 56 (52-61) GtCO₂-eq,
9 respectively (Chapter 4, Table 4.1). Many omit important mitigation sectors, provide little detail on
10 financing implementation, and are not effective in meeting assessment and review needs (Pauw et al.
11 2018). Although, it is estimated that the land-use sector could contribute as much as 20% of the full
12 mitigation potential of all the intended NDC targets (Forsell et al. 2016), there are variations in how
13 the land-use component is included, and the related information provided, leading to large uncertainties
14 on whether and how these will contribute to the achievement of the NDCs (Grassi et al. 2017;
15 Obergassel et al. 2017a; Benveniste et al. 2018; Fyson and Jeffery 2019; Forsell et al. 2016). All these
16 variations make it challenging to aggregate the efforts of countries and compare them to each other
17 (Carraro 2016). Although parties attempted to discipline the variation in NDCs, including whether they
18 could be conditional, through elaborating the 'features' of NDCs in the Rulebook, no agreement was
19 possible on this. Thus, parties continue to enjoy considerable discretion in the formulation of NDCs
20 (Rajamani and Bodansky 2019; Weikmans et al. 2020).

21 There are several approaches to evaluating NDCs incorporating indicators such as CO₂ emissions, GDP,
22 energy intensity of GDP, CO₂ per energy unit, CO₂ intensity of fossil fuels, and share of fossil fuels in
23 total energy use (Peters et al. 2017). However, some favour approaches that use metrics beyond
24 emissions such as infrastructure investment, energy demand, or installed power capacity (Iyer et al.
25 2017; Jeffery et al. 2018). One approach is to combine the comparison of aggregate NDC emissions
26 using Integrated Assessment Model scenarios with modelling of NDC scenarios directly, and carbon
27 budget analyses (Jeffery et al. 2018). Another approach is to engage in a comprehensive assessment of
28 multiple indicators that reflect the different viewpoints of the parties under the UNFCCC (Aldy et al.
29 2017; Höhne et al. 2018). These different approaches are described in greater depth in Chapter 4, section
30 4.2.2.

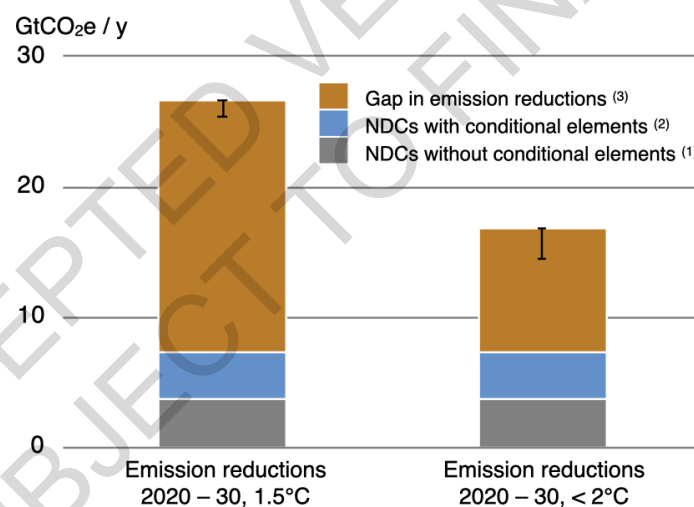
31 It is clear, however, that the NDCs communicated by parties for the 2020-2030 period are insufficient
32 to achieve the temperature goal (den Elzen et al. 2016; Rogelj et al. 2016; Schleussner et al. 2016;
33 Robiou du Pont and Meinshausen 2018; UNEP 2018a; Alcaraz et al. 2019; UNEP 2019, 2020), and the
34 emissions gap is larger than ever (Christensen and Olhoff 2019) (see Chapter 4). The IPCC 1.5°C Report
35 notes that pathways that limit global warming to 1.5°C with no or limited overshoot show up to 40-50%
36 reduction of total GHG emissions from 2010 levels by 2030, and that current pathways reflected in the
37 NDCs are consistent with cost-effective pathways that result in a global warming of about 3°C by 2100
38 ((IPCC 2018b) SPM, D.1.1). Analysis by the UNFCCC Secretariat of the second round of those NDCs
39 submitted until into October 2021 suggests that 'total global GHG emission level, taking into account
40 full implementation of all the latest NDCs (including their conditional elements), implies possibility of
41 global emissions peaking before 2030'. However, such total global GHG emission level in 2030 is still
42 expected to be 15.9% above the 2010 level. This 'implies an urgent need for either a significant increase
43 in the level of ambition of NDCs between now and 2030 or a significant overachievement of the latest
44 NDCs, or a combination of both.' (UNFCCC 2021a).

45 Many NDCs with conditional elements may not be feasible as the conditions are not clearly defined and
46 existing promises of support are insufficient (Pauw et al. 2020). Moreover, 'leadership by conditional
47 commitments' (when some states promise to take stronger commitments if others do so as well), and
48 the system of pledge-and-review, may lead to decreasing rather than deeper contributions over time

1 (Helland et al. 2017). Some note, however, that many of the NDCs are conservative and may be
 2 overachieved, that NDCs may be strengthened over time as expected under the Paris Agreement, and
 3 there are significant non-state actions that have not been adequately captured in the NDCs (Höhne et
 4 al. 2017). Further, if all NDCs with and without conditional elements are implemented, net land use,
 5 land use change and forestry emissions will decrease in 2030 compared to 2010 levels, but large
 6 uncertainties remain on how Parties estimate, project and account for emissions and removals from this
 7 sector (Forsell et al. 2016; Fyson and Jeffery 2019). According to the estimates in Table 4.3 (Chapter
 8 4), communicated unconditional commitments imply about a 7% reduction of world emissions by 2030,
 9 in terms of Kyoto GHGs, compared to a scenario where only current policies are in place. If conditional
 10 commitments are also included, the reduction in world emissions by 2030 would be about 12%.

11 In this context, it should be noted that many NDCs have been formulated with conditional elements,
 12 and such NDCs require international cooperation on finance, technology and capacity-building
 13 (Kissinger et al. 2019), potentially including through Article 6 in the form of bilateral agreements and
 14 market mechanisms (UNFCCC 2016b). More broadly, some argue that there is a ‘policy inconsistency’
 15 between the facilitative, ‘bottom up’ architecture of the Paris Agreement, and both the setting of the
 16 long-term temperature goal, as well as expectations that it will be delivered (Geden 2016b). As Figure
 17 14.2 shows, there is a large share of additional effort needed to reach a 1.5°C compatible path by 2030
 18 (and even a 2°C compatible path). International coordination and cooperation are crucial in enhancing
 19 the ambition of current pledges, as countries will be more willing to increase their ambition if matched
 20 by other countries (coordination) and if cost-minimising agreements between developed and developing
 21 countries, through Article 6 and other means, are fully developed (cooperation) (Sælen 2020).

22



23

24 **Figure 14.2 The role of international cooperation in the reductions in annual emissions by 2030 needed to**
 25 **follow a 1.5°C (respectively < 2°C) cost-effective path from 2020 onwards. The figure represents the**
 26 **additional contribution of pledges included in the NDCs over current policies at the global level, and the**
 27 **remaining gap in emission reductions needed to move from current policies to cost-effective long-term**
 28 **mitigation pathways for limiting warming to 1.5°C with low (<0.1°C) overshoot (50% chance),**
 29 **respectively for limiting warming to 2°C (66% chance). Median values are used, showing the confidence**
 30 **interval for the total effort. See Figure 1 in Cross-Chapter Box 4, and Tables 4.2 and 4.3 for details. (1)**

31 **The grey share represents NDCs with abatement efforts pledged without any conditions (called**
 32 **“unconditional” in the literature). They are based mainly on domestic abatement actions, although**
 33 **countries can use international cooperation to meet their targets. (2) The blue share represents NDCS**
 34 **with conditional components. They require international cooperation, for example bilateral agreements**
 35 **under article 6, financing or monetary and/or technological transfers. (3) The remaining gap in emission**
 36 **reductions – the orange share – can potentially be achieved through national and international actions.**

1 **International coordination of more ambitious efforts promotes global ambition and international**
2 **cooperation provides the cost-saving basis for more ambitious NDCs.**

3
4 **14.3.2.3 NDCs, fairness and equity**

5 The Paris Agreement encourages Parties, while submitting their NDCs, to explain how these are ‘fair
6 and ambitious’ (UNFCCC 2015a, Art. 4.8 read with UNFCCC 2016a, para. 27). The Rulebook obliges
7 Parties to provide information on ‘fairness considerations, including reflecting on equity’ as applicable
8 to their NDC (Rajamani and Bodansky 2019; UNFCCC 2019b paras 7a and 9, Annex, paras 6(a) and
9 (b)). Although equity within nations and between communities is also important, much of the literature
10 on fairness and equity in the context of NDCs focuses on equity between nations.

11 In the first round of NDCs, most Parties declared their NDCs as fair (Robiou du Pont et al. 2017). Their
12 claims, however, were largely unsubstantiated or drawn from analysis by in-country experts (Winkler
13 et al. 2018). At least some of the indicators Parties have identified in their NDCs as justifying the
14 ‘fairness’ of their contributions, such as a ‘small share of global emissions’, ‘cost-effectiveness’ and
15 assumptions that privilege current emissions levels (‘grandfathering’) are not, according to one group
16 of scholars, in accordance with principles of international environmental law (Rajamani et al. 2021).
17 Moreover, the NDCs reveal long-standing institutional divisions and divergent climate priorities
18 between Annex I and non-Annex I Parties, suggesting that equity and fairness concerns remain salient
19 (Stephenson et al. 2019). Fairness concerns also affect the share of carbon dioxide removal (CDR)
20 responsibilities for major emitters if they delay near-term mitigation action (Fyson et al. 2020).

21 It is challenging, however, to determine ‘fair shares’, and address fairness and equity in a world of
22 voluntary climate contributions (Chan 2016a), in particular, since these contributions are insufficient
23 (see above Section 14.3.2.2.). Self-differentiation in contributions has also led to fairness and equity
24 being discussed in terms of individual nationally determined contributions rather than between
25 categories of countries (Chan 2016a). In the climate change regime, one option is for Parties to provide
26 more rigorous information under the Paris Agreement to assess fair shares (Winkler et al. 2018), and
27 another is for Parties to articulate what equity principles they have adopted in determining their NDCs,
28 how they have operationalised these principles, and explain their mitigation targets in terms of the
29 portion of the appropriated global budget (Hales and Mackey 2018).

30 Equity is critical to addressing climate change, including through the Paris Agreement (Klinsky et al.
31 2017), however, since the political feasibility of developing equity principles within the climate change
32 regime is low, the onus is on mechanisms and actors outside the regime to develop these (Lawrence and
33 Reder 2019). Equity and fairness concerns are being raised in national and regional courts that are
34 increasingly being asked to determine if the climate actions pledged by states are adequate in relation
35 to their fair share (The Supreme Court of the Netherlands 2019; European Court of Human Rights 2020;
36 German Constitutional Court 2021), as it is only in relation to such a ‘fair share’ that the adequacy of a
37 state’s contribution can be assessed in the context of a global collective action problem (see chapter
38 13.5.5 for a discussion of national climate litigation). Some domestic courts have stressed that as climate
39 change is a global problem of cumulative impact, all emissions contribute to the problem regardless of
40 their relative size and there is a clear articulation under the UNFCCC and Paris Agreement for
41 developed countries to ‘take the lead’ in addressing GHG emissions (Preston 2020). Given the limited
42 avenues for multilateral determination of fairness, several researchers have argued that the onus is on
43 the scientific community to generate methods to assess fairness (Herrala and Goel 2016; Lawrence and
44 Reder 2019). Peer-to-peer comparisons also potentially create pressure for ambitious NDCs (Aldy et
45 al. 2017).

46 There are a range of options to assess or introduce fairness. These include: adopting differentiation in
47 financing rather than in mitigation (Gajevic Sayegh 2017); adopting a carbon budget approach (Hales

1 and Mackey 2018; Alcaraz et al. 2019), which may occur through the transparency processes (Hales
2 and Mackey 2018); quantifying national emissions allocations using different equity approaches,
3 including those reconciling finance and emissions rights distributions (Robiou du Pont et al. 2017);
4 combining equity concepts in a bottom-up manner using different sovereign approaches (Robiou du
5 Pont and Meinshausen 2018), using data on adopted emissions targets to find an ethical framework
6 consistent with the observed distribution (Sheriff 2019); adopting common metrics for policy
7 assessment (Bretschger 2017); and developing a template for organising metrics on mitigation effort -
8 emission reductions, implicit prices, and costs - for both ex ante and ex post review (Aldy et al. 2017).
9 The burden of agricultural mitigation can also be distributed using different approaches to effort sharing
10 (responsibility, capability, need, equal cumulative per-capita emissions) (Richards et al. 2018). Further,
11 there are temporal (inter-generational) and spatial (inter-regional) dimensions to the distribution of the
12 mitigation burden, with additional emissions reductions in 2030 improving both inter-generational and
13 inter-regional equity (Liu et al. 2016). Some of the equity approaches rely on ‘grandfathering’ as an
14 allocation principle, which some argue has led to ‘cascading biases’ against developing countries
15 (Kantha et al. 2018), and is morally ‘perverse’ (Caney 2011). While no country's NDC explicitly
16 supports the grandfathering approach, many countries describe as ‘fair and ambitious’ NDCs that assume
17 grandfathering as the starting point (Robiou du Pont et al. 2017). It is worth noting that the existence of
18 multiple metrics associated with a range of equity approaches, has implications for how the ambition
19 and ‘fair’ share of each state is arrived at, some average out multiple approaches and indicators (Hof et
20 al. 2012; Meinshausen et al. 2015; Robiou du Pont and Meinshausen 2018), others exclude indicators
21 and approaches that do not, in their interpretation, accord with principles of international environmental
22 law (Rajamani et al. 2021). One group of scholars have suggested that utilitarianism offers a ‘ethically
23 minimal and conceptually parsimonious’ benchmark that promotes equity, climate and development
24 (Budolfson et al. 2021).

25 **14.3.2.4 Transparency and accountability**

26 Although NDCs reflect a ‘bottom-up’, self-differentiated approach to climate mitigation actions, the
27 Paris Agreement couples this to an international transparency framework designed, among other things,
28 to track progress in implementing and achieving mitigation contributions (UNFCCC 2015a, Art. 13).
29 This transparency framework builds on the processes that already exist under the UNFCCC. The
30 transparency framework under the Paris Agreement is applicable to all Parties, although with flexibilities
31 for developing country Parties that need it in light of their capacities (Mayer 2019). Each Party is
32 required to submit a national inventory report, as well as ‘the information necessary to track progress
33 in implementing and achieving’ its NDC, (UNFCCC 2015a, Art. 13.7) biennially (UNFCCC 2016a,
34 para. 90). The Paris Rulebook requires all Parties to submit their national inventory reports using the
35 2006 IPCC Guidelines (UNFCCC 2019b, Annex, para. 20).

36 In relation to the provision of information necessary to track progress towards implementation and
37 achievement of NDCs, the Paris Rulebook allows each party to choose its own qualitative or
38 quantitative indicators (UNFCCC 2019k, Annex, para 65), a significant concession to national
39 sovereignty (Rajamani and Bodansky 2019). The Rulebook phases in common reporting requirements
40 for developed and developing countries (except LDCs and SIDS) at the latest by 2024 (UNFCCC
41 2019k, para. 3), but offers flexibilities in ‘scope, frequency, and level of detail of reporting, and in the
42 scope of the review’ for those developing countries that need it in light of their capacities (UNFCCC
43 2019k, Annex, para. 5). Some differentiation also remains for information on support provided to
44 developing countries (Winkler et al. 2017), with developed country parties required to report such
45 information biennially, while others are only ‘encouraged’ to do so (UNFCCC 2015a, Art. 9.7).

46 The information provided by Parties in biennial transparency reports and GHG inventories will undergo
47 technical expert review, which must include assistance in identifying capacity-building needs for
48 developing country parties that need it in light of their capacities. Each Party is also required to

1 participate in a ‘facilitative, multilateral consideration of progress’ of implementation and achievement
2 of its NDC. Although the aim of these processes is to expose each Party’s actions on mitigation to
3 international review, thus establishing a weak form of accountability for NDCs at the international level,
4 the Rulebook circumscribes the reach of these processes (Rajamani and Bodansky 2019). The technical
5 expert review teams are prohibited in mandatory terms from making ‘political judgments’ or reviewing
6 the ‘adequacy or appropriateness’ of a party’s NDC, domestic actions, or support provided (UNFCCC
7 2019k, Annex, para. 149). This, among other such provisions, has led some to argue that the scope and
8 practice of existing transparency arrangements reflects rather than mediates ongoing disputes around
9 responsibility, differentiation and burden sharing, and thus there is limited answerability through
10 transparency (Gupta and van Asselt 2019). There are also limits to the extent that the enhanced
11 transparency framework will reduce ambiguities, and associated uncertainties, for instance, in how
12 LULUCF is incorporated into the NDCs (Fyson and Jeffery 2019) and lead to increased ambition
13 (Weikmans et al. 2020). More broadly, there has been ‘weak’ translation of transparency norms into
14 accountability (Ciplet et al. 2018). Hence, the Paris Agreement’s effectiveness in ensuring NDCs are
15 achieved will depend on additional accountability pathways at the domestic level involving political
16 processes and civil society engagement (Jacquet and Jamieson 2016; van Asselt 2016; Campbell-
17 Duruflé 2018a; Karlsson-Vinkhuyzen et al. 2018).

18 **14.3.2.5 Global stocktake**

19 The Paris Agreement’s transparency framework is complemented by the global stocktake, which will
20 take place every five years (starting in 2023) and assess the collective progress towards achieving the
21 Agreement’s purpose and long-term goals (UNFCCC 2015a, Art. 14). The scope of the global stocktake
22 is comprehensive – covering mitigation, adaptation and means of implementation and support – and the
23 process is to be facilitative and consultative. The Paris Rulebook outlines the scope of the global
24 stocktake to include social and economic consequences and impacts of response measures, and loss and
25 damage associated with the adverse effects of climate change (UNFCCC 2019f, paras. 8-10).

26 The global stocktake is to occur ‘in the light of equity and the best available science.’ While the focus
27 of the global stocktake is on collective and not individual progress towards the goals of the Agreement,
28 the inclusion of equity in the global stocktake enables a discussion on equitable burden sharing
29 (Rajamani 2016a; Winkler 2020), and for equity metrics to be factored in (Robiou du Pont and
30 Meinshausen 2018). The Paris Rulebook includes consideration of the modalities and sources of inputs
31 for the global stocktake (UNFCCC 2019f, paras 1, 2, 13, 27, 31, 36h and 37g), which arguably will
32 result in equity being factored into the outcome of the stocktake (Winkler 2020). The Rulebook does
33 not, however, some argue, resolve the tension between the collective nature of the assessment that is
34 authorised by the stocktake and the individual assessments required to determine relative ‘fair share’
35 (Rajamani and Bodansky 2019; Zahar 2019).

36 The global stocktake is seen as crucial to encouraging parties to increase the ambition of their NDCs
37 (Huang 2018; Hermwille et al. 2019; Milkoreit and Haapala 2019) as its outcome ‘shall inform Parties
38 in updating and enhancing, in a nationally determined manner, their actions and support’ (Art 14.3)
39 (Rajamani 2016a; Friedrich 2017; Zahar 2019). The Rulebook provides for the stocktake to draw on a
40 wide variety of inputs sourced from a full range of actors, including ‘non-Party stakeholders’ (UNFCCC
41 2019f, para. 37). However, the Rulebook specifies that the global stocktake will be ‘a Party-driven
42 process’ (UNFCCC 2019f, para. 10), will not have an ‘individual Party focus’, and will include only
43 ‘non-policy prescriptive consideration of collective progress’ (UNFCCC 2019f, para. 14).

44 **14.3.2.6 Conservation of sinks and reservoirs, including forests**

45 Article 5 of the Paris Agreement calls for parties to take action to conserve and enhance sinks and
46 reservoirs of greenhouse gases, including biomass in terrestrial, coastal, and marine ecosystems, and
47 encourages countries to take action to support the REDD+ framework under the Convention. The
48 explicit inclusion of land use sector activities, including forest conservation, is potentially, while

1 cautiously, a ‘game changer’ as it encourages countries to safeguard ecosystems for climate mitigation
2 purposes (Grassi et al. 2017). Analyses of parties’ NDCs shows pledged mitigation from land use, and
3 forests in particular, provides a quarter of the emission reductions planned by parties and, if fully
4 implemented, would result in forests becoming a net sink of carbon by 2030 (Forsell et al. 2016; Grassi
5 et al. 2017).

6 A key action endorsed by Article 5 is REDD+, which refers to initiatives established under the
7 UNFCCC for reducing emissions from deforestation and forest degradation and the role of
8 conservation, sustainable management of forests and enhancement of forest carbon stocks in developing
9 countries. It remains an evolving concept and some identified weaknesses are being addressed,
10 including the issues of scale (project-based vs sub-national jurisdictional approach), problems with
11 leakage, reversal, benefit sharing, as well as safeguards against potential impacts on local and
12 indigenous communities. Nevertheless, REDD+ shows several innovations under the climate regime
13 with regard to international cooperation. The legal system for REDD+ manages to reconcile flexibility
14 (creating consensus) and legal security. It shows a high standard of effectiveness (Dellaux 2017).

15 Article 5.2 encourages parties to implement and support the existing framework for REDD+, including
16 through ‘results-based payments’ i.e. provision of financial payments for verified avoided or reduced
17 forest carbon emissions (Turnhout et al. 2017). The existing REDD+ framework set up under decisions
18 of the UNFCCC COP includes the Warsaw Framework for REDD+, which specifies modalities for
19 measuring, reporting and verifying (MRV) greenhouse gas emissions and removals. This provides an
20 essential tool for linking REDD+ activities to results-based finance (Voigt and Ferreira 2015).
21 Appropriate finance support for REDD+ is also considered critical to move from its inclusion in many
22 countries’ NDCs to implementation on the ground (Hein et al. 2018). Since public finance for REDD+
23 is limited, private sector participation is expected by some to leverage REDD+ (Streck and Parker 2012;
24 Henderson et al. 2013; Pistorius and Kiff 2015; Seymour and Busch 2016; Ehara et al. 2019). Article
25 5.2 also encourages parties’ support for ‘alternative policy approaches’ to forest conservation and
26 sustainable management such as ‘joint mitigation and adaptation approaches.’ It reaffirms the
27 importance of incentivising, as appropriate, non-carbon benefits associated with such approaches (e.g.
28 improvements in the livelihoods of forest-dependent communities, facilitating poverty reduction and
29 sustainable development). This provision, along with the support for non-market mechanisms in Article
30 6 (discussed below), is seen as an avenue for cooperative joint mitigation-adaptation and non-market
31 REDD+ activities with co-benefits for biodiversity conservation (Gupta and Dube 2018).

32 **14.3.2.7 Cooperative approaches**

33 Article 6 of the Paris Agreement provides for voluntary cooperative approaches. Its potential
34 importance in terms of project-based cooperation should be viewed against the background of key
35 lessons from the market-based mechanisms under the Kyoto Protocol, particularly the Clean
36 Development Mechanism (CDM). The CDM has been used for implementing bilateral strategies and
37 unilateral (non-market) actions for instance in India (Phillips and Newell 2013), hence arguably
38 covering all the mechanisms now included in Article 6 of the Paris Agreement. As we describe in
39 section 14.3.3.1, below, ex-post evaluation of the Kyoto market mechanisms, in particular the CDM,
40 have been at-best mixed. However, Article 6 goes beyond the project-based approach followed by the
41 CDM, as hinted by the emerging landscape of activities based on Article 6 (Greiner et al. 2020), such
42 as the bilateral treaty signed under the framework of Article 6 in October 2020 by Switzerland and Peru
43 (see section 14.4.4).

44 This experience from the CDM is relevant to the implementation of Article 6 (4) of the Paris Agreement.
45 It addresses a number of specific types of cooperative approaches, including those involving the use of
46 internationally transferred mitigation outcomes (ITMOs) towards NDCs, a ‘mechanism to contribute to
47 mitigation and support sustainable development’, and a framework for non-market approaches such as
48 many aspects of REDD+.

1 Article 6.1 recognises the role that cooperative approaches can play, on a voluntary basis, in
2 implementing parties' NDCs 'in order to allow for higher ambition' in their mitigation actions and to
3 promote sustainable development and environmental integrity. Article 6.2 indicates that ITMOs can
4 originate from a variety of sources, and that parties using ITMOs to achieve their NDCs shall promote
5 sustainable development, ensure environmental integrity, ensure transparency, including in governance,
6 and apply 'robust accounting' in accordance with CMA guidance to prevent double counting. While
7 this provision, unlike Article 17 of the Kyoto Protocol, does not create an international carbon market,
8 it enables parties to pursue this option should they choose to do so, for example, through the linking of
9 domestic or regional carbon markets (Marcu 2016; Müller and Michaelowa 2019). Article 6.2 could
10 also be implemented in other ways, including direct transfers between governments, linkage of
11 mitigation policies across two or more parties, sectoral or activity crediting mechanisms, and other
12 forms of cooperation involving public or private entities, or both (Howard 2017).

13 Assessments of the potential of Article 6.2 generally find that ITMOs are likely to result in cost
14 reductions in achieving mitigation outcomes, with the potential for such reductions to enhance ambition
15 and accelerate parties' progression of mitigation pledges across NDC cycles (Fujimori et al. 2016; Gao
16 et al. 2016; Mehling 2019). However, studies applying insights from the CDM highlight environmental
17 integrity risks associated with using ITMOs under the Paris Agreement given the challenges that the
18 diverse scope, metrics, types and timeframes of NDC targets pose for robust accounting (Schneider and
19 La Hoz Theuer 2019) and the potential for transfers of 'hot air' as occurred under the Kyoto Protocol
20 (La Hoz Theuer et al. 2019). These studies collectively affirm that robust governance on accounting for
21 ITMOs, and for reporting and review, will be critical to ensuring the environmental integrity of NDCs
22 making use of them (Mehling 2019; Müller and Michaelowa 2019).

23 Article 6.4 concerns the mitigation mechanism, with some similarities to the Kyoto Protocol's CDM.
24 Unlike the CDM, there is no restriction on which parties can host mitigation projects and which parties
25 can use the resulting emissions reductions towards their NDCs (Marcu 2016). This central mechanism
26 will operate under the authority and guidance of the CMA, and is to be supervised by a body designated
27 by the CMA (Marcu 2016).

28 The Article 6.4 central mechanism is intended to promote mitigation while fostering sustainable
29 development. The decision adopting the Paris Agreement specifies experience with Kyoto market
30 mechanisms as a basis for the new mitigation mechanism (UNFCCC 2016a, para. 37(f)). Compared
31 with the CDM under the Kyoto Protocol, the central mechanism has a more balanced focus on both
32 climate and development objectives, and a stronger political mandate to measure sustainable
33 development impact and to verify that the impacts are 'real, measurable, and long-term' (Olsen et al.
34 2018). There are also opportunities to integrate human rights into the central mechanism (Oberghassel et
35 al. 2017b; Calzadilla 2018). It is further subject to the requirement that it must deliver 'an overall
36 mitigation in global emissions,' which is framed by the general objectives of Article 6 for cooperation
37 to enhance ambition (Kreibich 2018).

38 Negotiations over rules to operationalise Article 6 have thus far proven intractable, failing to deliver
39 both at COP-24 in Katowice in 2018, where the rest of the Paris Rulebook was agreed, and in COP-25
40 in Madrid in 2019. Ongoing points of negotiation have included: whether to permit the carryover and
41 use of Kyoto CDM credits and AAUs into the Article 6.4 mechanism, whether to impose a mandatory
42 share of proceeds on Article 6.2 mechanism to fund adaptation, like for Article 6.4; and whether and
43 how credits generated under Article 6.4 should be subject to accounting rules under Article 6.2
44 (Michaelowa et al. 2020a).

45 **14.3.2.8 Finance flows**

46 Finance is the first of three means of support specified under the Paris Agreement to accomplish its
47 objectives relating to mitigation (and adaptation) (UNFCCC 2015a, Art. 14.1). This sub-section
48 discusses the provision made in the Paris Agreement for international cooperation on finance. Section

1 14.4.1 below considers broader cooperative efforts on public and private finance flows for climate
2 mitigation, including by multilateral development banks and through instruments such as green bonds.

3 As highlighted above, the objective of the Paris Agreement includes the goal of ‘[m]aking finance flows
4 consistent with a pathway towards low greenhouse gas emissions and climate-resilient development’
5 (UNFCCC 2015a, Art 2.1(c)). Alignment of financial flows, and in some cases provision of finance
6 will be critical to the achievement of many parties’ NDCs, particularly those that are framed in
7 conditional terms (Zhang and Pan 2016; Kissinger et al. 2019) (see further Chapter 15 on investment
8 and finance).

9 International cooperation on climate finance represents ‘a complex and fragmented landscape’ with a
10 range of different mechanisms and forums involved (Pickering et al. 2017; Roberts and Weikmans
11 2017). These include entities set up under the international climate change regime, such as the UNFCCC
12 financial mechanism, with the Global Environment Facility (GEF) and Green Climate Fund (GCF) as
13 operating entities; special funds, such as the Special Climate Change Fund, the Least Developed
14 Countries Fund (both managed by the GEF), and the Adaptation Fund established under the Kyoto
15 Protocol; the Standing Committee on Finance, a constituted body which assists the COP in exercising
16 its functions with respect to the UNFCCC financial mechanism; and other bodies outside of the
17 international climate change regime, such as the Climate Investment Funds (CIF) administered through
18 multilateral development banks (the role of these banks in climate finance is discussed further in Section
19 14.4.1 below).

20 Pursuant to decisions adopted at the Paris and Katowice conferences, parties agreed that the operating
21 entities of the financial mechanism – GEF and GCF – as well as the Special Climate Change Fund, the
22 Least Developed Countries Fund, the Adaptation Fund and the Standing Committee on Finance, all
23 serve the Paris Agreement (UNFCCC 2016a, paras 58 and 63, 2019e,g). The GCF, which became
24 operational in 2015, is the largest dedicated international climate change fund and plays a key role in
25 channelling financial resources to developing countries (Antimiani et al. 2017; Brechin and Espinoza
26 2017).

27 Much of the current literature on climate finance and the Paris Agreement focuses on the obligations of
28 developed countries to provide climate finance to assist the implementation of mitigation and adaptation
29 actions by developing countries. The principal provision on finance in the Paris Agreement is the
30 binding obligation on developed country parties to provide financial resources to assist developing
31 country parties (UNFCCC 2015a, Art 9.1). This provision applies to both mitigation and adaptation and
32 is in continuation of existing developed country parties’ obligations under the UNFCCC. This signals
33 that the Paris Agreement finance requirements must be interpreted in light of the UNFCCC (Yamineva
34 2016). The novelty introduced by the Paris Agreement is a further expansion in the potential pool of
35 donor countries as Article 9.2 encourages ‘other parties’ to provide or continue to provide such support
36 on a voluntary basis. However, ‘as part of the global effort, developed countries should continue to take
37 the lead in mobilising climate finance’, with a ‘significant role’ for public funds, and an expectation
38 that such mobilisation of finance ‘should represent a progression beyond previous efforts’ Beyond this
39 there are no new recognised promises (Ciplet et al. 2018). In the Paris Agreement parties formalized
40 the continuation of the existing collective mobilization goal to raise 100 billion a year through 2025 in
41 the context of meaningful mitigation actions and transparency on implementation. The Paris Agreement
42 decision also provided for the CMA by 2025 to set a new collective quantified goal from a floor of
43 USD100 billion yr, taking into account the needs and priorities of developing countries (UNFCCC
44 2016a, para. 53). This new collective goal on finance is not explicitly limited to developed countries
45 and could therefore encompass finance flows from developing countries’ donors (Bodansky et al.
46 2017b). Deliberations on setting a new collective quantified goal on finance is expected to be initiated
47 at COP26 in 2021 (UNFCCC 2019g,e; Zhang 2019).

1 It is widely recognised that the USD100 billion yr⁻¹ figure is a fraction of the broader finance and
2 investment needs of mitigation and adaptation embodied in the Paris Agreement (Peake and Ekins
3 2017). One estimate, based on a review of 160 (I)NDCs, suggests the financial demand for both
4 mitigation and adaptation needs of developing countries could reach USD474 billion yr⁻¹ by 2030
5 (Zhang and Pan 2016). The OECD reports that climate finance provided and mobilised by developed
6 countries was USD79.6 billion in 2019. This finance included four components: bilateral public,
7 multilateral public (attributed to developed countries), officially supported export credits and mobilised
8 private finance (OECD 2021) (See also Chapter 15.3.2, and Box 15.4).

9 More broadly, there is recognition of the need for better accounting, transparency and reporting rules
10 to allow evaluation of the fulfilment of finance pledges and the effectiveness of how funding is used
11 (Xu et al. 2016; Roberts et al. 2017; Jachnik et al. 2019; Roberts et al. 2021; Gupta and van Asselt
12 2019). There is also a concern about climate finance being new and additional though the Paris
13 Agreement does not make an explicit reference to it, nor is there a clear understanding of what
14 constitutes new and additional (UNFCCC 2018; Carty et al. 2020; Mitchell et al. 2021). Some authors
15 see the ‘enhanced transparency framework’ of the Paris Agreement (see Section 14.3.2.4 above), and
16 the specific requirements for developed countries to provide, biennially, indicative quantitative and
17 qualitative information as well as report on financial support and mobilisation efforts (Articles 9.5 and
18 9.7), as promising marked improvements (Weikmans and Roberts 2019), including for the fairness of
19 effort-sharing on climate finance provision (Pickering et al. 2015). Others offer a more circumspect
20 view of the transformative capability of these transparency systems (Ciplet et al. 2018).

21 The more limited literature focusing on the specific finance needs of developing countries, particularly
22 those expressed in NDCs conditional on international climate finance, suggests that once all countries
23 have fully costed their NDCs, the demand for (public and private) finance to support NDC
24 implementation is likely to be orders of magnitude larger than funds available from bilateral and
25 multilateral sources. For some sectors, such as forestry and land-use, this could leave ‘NDC ambitions
26 ... in a precarious position, unless more diversified options are pursued to reach climate goals’
27 (Kissinger et al. 2019). In addition, there is a need for fiscal policy reform in developing countries to
28 ensure international climate finance flows are not undercut by public and private finance supporting
29 unsustainable activities (Kissinger et al. 2019). During the 2018 Katowice conference, UNFCCC Parties
30 requested the Standing Committee on Finance to prepare, every four years, a report on the determination
31 of the needs of developing country Parties related to implementing the Convention and the Paris
32 Agreement, for consideration by parties at COP26 (UNFCCC 2019c).

33 **14.3.2.9 Technology development and transfer**

34 Technology development and transfer is the second of three ‘means of implementation and support’
35 specified under the Paris Agreement to accomplish its objectives relating to mitigation (and adaptation)
36 (UNFCCC 2015a, Art. 14.1). This sub-section discusses the provision made in the Paris Agreement for
37 international cooperation on technology development and transfer. Section 14.4.2 below considers
38 broader cooperative efforts on technology development and transfer under the UNFCCC. Both sections
39 complement the discussion in Chapter 16.6 on the role of international cooperation in fostering
40 transformative change.

41 The importance of technology as a means of implementation for climate mitigation obligations under
42 the Paris Agreement is evident from parties’ NDCs. Of the 168 NDCs submitted as of June 2019, 109
43 were expressed as conditional upon support for technology development and transfer, with 70 parties
44 requesting technological support for both mitigation and adaptation, and 37 parties for mitigation only
45 (Pauw et al. 2020). Thirty-eight LDCs (79%) and 29 SIDS made their NDCs conditional on technology
46 transfer, as did 50 middle-income countries (Pauw et al. 2020).

47 While technology is seen as a key means of implementation and support for Paris Agreement
48 commitments, the issue of technology development and the transfer of environmentally sound

1 technologies for climate mitigation was heavily contested between developed and developing countries
2 in the Paris negotiations, and these differences are likely to persist as the Paris Agreement is
3 implemented (Oh 2019). Contestations continued in negotiations for the Paris Rulebook, particularly
4 regarding the meaning of technological innovation, which actors should be supported, and how support
5 should be provided by the UNFCCC (Oh 2020a).

6 Article 10 of the Paris Agreement articulates a shared ‘long-term vision on the importance of fully
7 realising technology development and transfer in order to improve resilience to climate change and to
8 reduce greenhouse gas emissions’ (UNFCCC, 2015, Art. 10.1). All parties are required ‘to strengthen
9 cooperative action on technology development and transfer’ (UNFCCC, 2015, Art. 10.2). In addition,
10 support, including financial support, ‘shall be provided’ to developing country parties for the
11 implementation of Article 10, ‘including for strengthening cooperative action on technology
12 development and transfer at different stages of the technology cycle, with a view to achieving a balance
13 between support for mitigation and adaptation’ (UNFCCC, 2015, Art. 10.6). Available information on
14 efforts related to support on technology development and transfer for developing country parties is also
15 one of the matters to be taken into account in the global stocktake (UNFCCC, 2015, Art. 10.6) (see
16 Section 14.3.2.5 above).

17 The Paris Agreement emphasises that efforts to accelerate, encourage and enable innovation are ‘critical
18 for an effective long-term global response to climate change and promoting economic growth and
19 sustainable development’ and urges that they be supported, as appropriate, by the Technology
20 Mechanism and Financial Mechanism of the UNFCCC (UNFCCC, 2015, Art. 10.5). This support
21 should be directed to developing country parties ‘for collaborative approaches to research and
22 development, and facilitating access to technology, in particular for early stages of the technology cycle’
23 (UNFCCC, 2015, Art. 10.5). Inadequate support for R&D, particularly in developing countries, has
24 been identified in previous studies of technology interventions by international institutions as a key
25 technology innovation gap that might be addressed by the Technology Mechanism (Coninck and Puig
26 2015).

27 To support parties’ cooperative action, the Technology Mechanism, established in 2010 under the
28 UNFCCC (see further Section 14.4.2 below), will serve the Paris Agreement, subject to guidance of a
29 new ‘technology framework’ (UNFCCC, 2015, Art. 10.4). The latter was strongly advocated by the
30 African group in the negotiations for the Paris Agreement (Oh 2020a), and was adopted in 2018 as part
31 of the Paris Rulebook, with implementation entrusted to the component bodies of the Technology
32 Mechanism. The guiding principles of the framework are coherence, inclusiveness, a results-oriented
33 approach, a transformational approach and transparency. Its ‘key themes’ include innovation,
34 implementation, enabling environment and capacity-building, collaboration and stakeholder
35 engagement, and support (UNFCCC 2019e, Annex). A number of ‘actions and activities’ are elaborated
36 for each thematic area. These include: enhancing engagement and collaboration with relevant
37 stakeholders, including local communities and authorities, national planners, the private sector and civil
38 society organisations, in the planning and implementation of Technology Mechanism activities;
39 facilitating parties undertaking, updating and implementing technology needs assessments (TNAs) and
40 aligning these with NDCs; and enhancing the collaboration of the Technology Mechanism with the
41 Financial Mechanism for enhanced support for technology development and transfer. As regards TNAs,
42 while some developing countries have already used the results of their TNA process in NDC
43 development, other countries might benefit from following the TNA process, including its stakeholder
44 involvement, and multi-criteria decision analysis methodology, to strengthen their NDCs (Hofman and
45 van der Gaast 2019).

46 ***14.3.2.10 Capacity-building***

47 Together with finance, and technology development and transfer, capacity-building is the third of ‘the
48 means of implementation and support’ specified under the Paris Agreement (see UNFCCC 2015a, Art.

1 14.1). Capacity-building has primarily been implemented through partnerships, collaboration and
2 different cooperative activities, inside and outside the UNFCCC. This sub-section discusses the
3 provision made in the Paris Agreement for international cooperation on capacity-building. Section
4 14.4.3 below considers broader cooperative efforts on capacity-building within the UNFCCC.

5 In its annual synthesis report for 2018, the UNFCCC secretariat stressed the importance of capacity-
6 building for the implementation of the Paris Agreement and NDCs, with a focus on measures already
7 in place, regional and cooperative activities, and capacity-building needs for strengthening NDCs
8 (UNFCCC 2019h). Of the 168 NDCs submitted as of June 2019, capacity-building was the most
9 frequently requested type of support (113 of 136 conditional NDCs) (Pauw et al. 2020). The focus of
10 capacity-building activities is on enabling developing countries to take effective climate change action,
11 given that many developing countries continue to face significant capacity challenges, undermining
12 their ability to effectively or fully carry out the climate actions they intend to pursue (Dagnet et al.
13 2016). Content analysis of NDCs shows that capacity-building for adaptation is prioritised over
14 mitigation for developing countries, with the element of capacity-building most indicated in NDCs
15 being research and technology (Khan et al. 2020). In addition, developing countries' needs for
16 education, training and awareness-raising for climate change mitigation and adaptation feature
17 prominently in NDCs, particularly those of LDCs (Khan et al. 2020). Differences are evident though
18 between capacity-building needs expressed in the NDCs of LDCs (noting that Khan et al.'s review was
19 limited to NDCs in English) compared with those of upper-middle income developing countries as
20 categorised by the World Bank (World Bank 2021); the latter have more focus on mitigation with an
21 emphasis on technology development and transfer (Khan et al. 2020).

22 The Paris Agreement urges all parties to cooperate to enhance the capacity of developing countries to
23 implement the Agreement (UNFCCC 2015a, Art. 11.3), with a particular focus on LDCs and SIDS
24 (UNFCCC 2015a, Art. 11.1). Developed country parties are specifically urged to enhance support for
25 capacity-building actions in developing country Parties (UNFCCC 2015a, Art. 11.3). Article 12 of the
26 Paris Agreement addresses cooperative measures to enhance climate change education, training, public
27 awareness, public participation and public access to information, which can also be seen as elements of
28 capacity-building (Khan et al. 2020). Under the Paris Rulebook, efforts related to the implementation
29 of Article 12 are referred to as 'Action for Climate Empowerment' and parties are invited to develop
30 and implement national strategies on this topic, taking into account their national circumstances
31 (UNFCCC 2019i, para. 6). Actions to enhance climate change education, training, public awareness,
32 public participation, public access to information, and regional and international cooperation may also
33 be taken into account by parties in the global stocktake process under Article 14 of the Paris Agreement
34 (UNFCCC 2019i, para. 9).

35 Under the Paris Agreement, capacity-building can take a range of forms, including: facilitating
36 technology development, dissemination and deployment; access to climate finance; education, training
37 and public awareness; and the transparent, timely and accurate communication of information
38 (UNFCCC 2015a, Art. 11.1; see also 14.3.2.4 on 'Transparency' above). Principles guiding capacity-
39 building support are that it should be: country-driven; based on and responsive to national needs;
40 fostering country ownership of parties at multiple levels; guided by lessons learned; and an effective,
41 iterative process that is participatory, cross-cutting and gender-responsive (UNFCCC 2015a, Art. 11.2).
42 Parties undertaking capacity-building for developing country parties must 'regularly communicate on
43 these actions or measures.' Developing countries parties have a soft requirement ('should') to
44 communicate progress made on implementing capacity-building plans, policies, actions or measures to
45 implement the Paris Agreement (UNFCCC 2015a, Art. 11.4).

46 Article 11.5 provides that capacity-building activities 'shall be enhanced through appropriate
47 institutional arrangements to support the implementation of this Agreement, including the appropriate
48 institutional arrangements established under the Convention that serve this Agreement'. The COP

1 decision accompanying the Paris Agreement established the Paris Committee on Capacity-building,
2 with the aim to ‘address gaps and needs, both current and emerging, in implementing capacity-building
3 in developing country Parties and further enhancing capacity-building efforts, including with regard to
4 coherence and coordination in capacity-building activities under the Convention’ (UNFCCC 2016a,
5 para. 71). The activities of the Committee are discussed further in Section 14.4.3 below. The relevant
6 COP decision also established the Capacity Building Initiative for Transparency (UNFCCC 2016a,
7 para. 84), which is managed by the GEF and designed to support developing country parties in meeting
8 the reporting and transparency requirements under Article 13 of the Paris Agreement (Robinson 2018).

9 Studies on past capacity-building support for climate mitigation offer some lessons for ensuring
10 effectiveness of arrangements under the Paris Agreement. For example, Umemiya et al. (2020) suggest
11 the need for a common monitoring system at the global level, and evaluation research at the project
12 level to achieve more effective capacity building support. Khan et al. (2020) articulate ‘four key pillars’
13 of a sustainable capacity-building system for implementation of NDCs in developing countries:
14 universities in developing countries as institutional hubs; strengthened civil society networks and
15 partnerships; long-term programmatic finance support; and consideration of a capacity-building
16 mechanism under the UNFCCC – paralleling the Technology Mechanism – to marshal, coordinate and
17 monitor capacity-building activities and resources.

18 **14.3.2.11 Implementation and compliance**

19 The Paris Agreement establishes a mechanism to facilitate implementation and promote compliance
20 under Article 15. This mechanism is to operate in a transparent, non-adversarial and non-punitive
21 manner (Voigt 2016; Campbell-Duruflé 2018b; Oberthür and Northrop 2018) that distinguishes it from
22 the more stringent compliance procedures of the Kyoto Protocol’s Enforcement branch. The Paris
23 Rulebook elaborated the modalities and procedures for the implementation and compliance mechanism,
24 specifying the nature and composition of the compliance committee, the situations triggering its
25 procedures, and the facilitative measures it can apply, which include a ‘finding of fact’ in limited
26 situations, dialogue, assistance and recommendations (UNFCCC 2019e). The compliance committee is
27 focused on ensuring compliance with a core set of binding procedural obligations (UNFCCC 2019j,
28 Annex, Para. 22). This compliance committee, characterised as ‘one of its kind’ and an ‘an important
29 cornerstone’ of the Agreement’s legitimacy, effectiveness and longevity (Zihua et al. 2019), is designed
30 to facilitate compliance rather than penalise non-compliance.

32 **START BOX 4.1 HERE**

33 **Box 14.1 Key features of the Paris Agreement relevant to mitigation.**

34 The Paris Agreement’s overall aim is to strengthen the global response to the threat of climate change,
35 in the context of sustainable development and efforts to eradicate poverty. This aim is explicitly linked
36 to enhancing implementation of the UNFCCC, including its objective in Article 2 of stabilising
37 greenhouse gas emissions at a level that would ‘prevent dangerous anthropogenic interference with the
38 climate system’. The Agreement sets three goals:

- 39 1. *Temperature*: holding the global average temperature increase to well below 2°C above pre-
40 industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial
41 levels.
- 42 2. *Adaptation and climate resilience*: increasing the ability to adapt to the adverse impacts of climate
43 change and foster climate resilience and low greenhouse gas emissions development, in a manner
44 that does not threaten food production.

1 3. *Finance*: making finance flows consistent with a pathway towards low greenhouse gas emissions
2 and climate-resilient development.

3 In order to achieve the long-term temperature goal, parties aim to reach global peaking of emissions as
4 soon as possible, recognising that peaking will take longer for developing countries, and then to
5 undertake rapid reductions in accordance with the best available science. This is designed to reach
6 global net zero GHG emissions in the second half of the century, with the emissions reductions effort
7 to be determined on the basis of equity and in the context of sustainable development and efforts to
8 eradicate poverty. In addition, implementation of the Agreement as a whole is expected to reflect equity
9 and parties' common but differentiated responsibilities and respective capabilities, in light of different
10 national circumstances.

11 The core mitigation commitments of parties under the Paris Agreement centre on preparing,
12 communicating and maintaining successive 'nationally determined contributions' (NDCs), the contents
13 of which countries determine for themselves. All parties must have NDCs and pursue domestic
14 mitigation measures with the aim of achieving the objectives of their NDCs, but parties NDCs are
15 neither subject to a review of adequacy (at an individual level) nor to legally binding obligations of
16 result. The compliance mechanism is correspondingly facilitative.

17 The Paris Agreement establishes a global goal on adaptation, and recognises the importance of averting,
18 minimising and addressing loss and damage associated with the adverse effects of climate change.

19 The efficacy of the Paris Agreement in achieving its goals is therefore dependent upon at least three
20 additional elements:

21 1. *Ratcheting of NDCs*: Parties must submit a new or updated NDC every 5 years that is in line with
22 the Paris Agreement's expectations of progression over time and the party's highest possible
23 ambition, reflecting common but differentiated responsibilities and respective capabilities in light
24 of different national circumstances.

25 2. *Enhanced transparency framework*: Parties' actions to implement their NDCs are subject to
26 international transparency and review requirements, which will generate information that may also
27 be used by domestic constituencies and peers to pressure governments to increase the ambition of
28 their NDCs.

29 3. *Collective global stocktake*: The global stocktake undertaken every 5 years, starting in 2023, will
30 review the collective progress of countries in achieving the Paris Agreement's goals, in light of
31 equity and best available science. The outcome of the global stocktake informs parties in updating
32 and enhancing their subsequent NDCs.

33 These international processes establish an iterative ambition cycle for the preparation, communication,
34 implementation and review of NDCs.

35 For developing countries, the Paris Agreement recognises that increasing mitigation ambition and
36 realising long-term low-emissions development pathways can be bolstered by the provision of financial
37 resources, capacity building, and technology development and transfer. In continuation of existing
38 obligations under the Convention, developed countries are obliged to provide financial assistance to
39 developing countries with respect to mitigation and adaptation. The Paris Agreement also recognizes
40 that Parties may choose to voluntarily cooperate in the implementation of their NDCs to allow for higher
41 ambition in their mitigation and adaptation actions and to promote sustainable development and
42 environmental integrity.

43 **END BOX 4.1 HERE**

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

14.3.3 Effectiveness of the Kyoto Protocol and the Paris Agreement

14.3.3.1 Ex-post assessment of the Kyoto Protocol's effects

Previous assessment reports have assessed the Kyoto Protocol with respect to each of the criteria identified in this chapter. However, at the time of AR5, it was premature to assess the impact of Kyoto on emissions, as this data had not been entirely compiled yet. Since AR5, a number of studies have done so. Chapter 2 of this report lists 24 countries that have sustained absolute emissions reductions for at least a decade, of which 20 are countries that had Kyoto targets for the first commitment period. Most studies have concluded that Kyoto did cause emissions reductions. Such studies find a positive, statistically significant impact on emission reductions in Annex I countries (Kim et al. 2020), Annex B countries (Grunewald and Martínez-Zarzoso 2012; Kumazawa and Callaghan 2012; Grunewald and Martínez-Zarzoso 2016; Maamoun 2019), or all countries respectively (Aichele and Felbermayr 2013; Iwata and Okada 2014). Overall, countries with emission reduction obligations emit on average less CO₂ than similar countries without emission reduction obligations – with estimates ranging from 3-50% (Grunewald and Martínez-Zarzoso 2012, 2016). Maamoun (2019) estimates that the Kyoto Protocol reduced GHG emissions of Annex B countries by 7% on average below a no-Kyoto scenario over 2005 - 2012. Aichele and Felbermayr (2013) conclude that Kyoto reduced CO₂ and GHG emissions by 10% compared to the counterfactual. By contrast, Almer and Winkler (2017) find no evidence for binding emission targets under Kyoto inducing significant and lasting emission reductions for any of the Annex B or non-Annex B countries. The authors identify both negative and positive associations between Kyoto and emissions for several countries in several years, but no coherent picture emerges. Hartl (2019) calculates a Kyoto leakage share in global carbon dioxide trade of 4.3% for 2002-2009.

In terms of transformative potential, the Kyoto Protocol has been found to increase international patent applications for renewable energy technologies, especially in the case of solar energy technologies and especially in countries with more stringent emission reduction targets, and has even led to an increase in patent applications in developing countries not obliged to reduce emissions under Kyoto (Miyamoto and Takeuchi 2019). Kyoto also had a positive and statistically significant impact on the cost-effectiveness of renewable energy projects, as well as renewable energy capacity development as it stimulated the introduction of domestic renewable energy policies (Liu et al. 2019).

The issue of institutional strength of Kyoto has been analysed by many authors, and much of this has been assessed in previous assessment reports. Since AR5, several papers question the environmental efficacy of the Kyoto Protocol based on its institutional design (Rosen 2015; Kuriyama and Abe 2018). Particular attention has focused on Kyoto's market mechanisms (Erickson et al. 2014; Kollmuss et al. 2015).

As described in previous IPCC reports and above, the 1997 Kyoto Protocol included three international market-based mechanisms. These operated among Annex I Parties (i.e. International Emissions Trading and Joint Implementation) and between Annex I Parties and non-Annex I countries (i.e. the CDM) (Grubb et al. 2014; World Bank 2018). Joint Implementation led to limited volumes of emissions credit transactions, mostly from economies in transition but also some Western European countries; International Emissions Trading also led only to limited transaction volumes (Shishlov et al. 2016).

Of the Kyoto Protocol's mechanisms, the CDM market has led to a greater amount of activity, with a 'gold rush' period between 2005 and 2012. The main buyer of CDM credits were private companies surrendering them within the European Union (EU) Emissions Trading System (ETS). Once the EU tightened its rules and restricted the use of CDM credits in 2011, there was a sharp drop in the price of CDM credits in 2012. This price never recovered, as the demand for CDM was very weak after 2012, in part because of the difficulties encountered in securing the entry into force of the Doha Amendment (Michaelowa et al. 2019b).

1 Assessing the effectiveness of Kyoto's market mechanisms is challenging, and the results have been
2 mixed. (Aichele and Felbermayr 2013; Iwata and Okada 2014; Kuriyama and Abe 2018). Kuriyama
3 and Abe (2018) assessed emission reduction quantities taking into account heightened criteria for
4 additionality. They identified annual energy-related emissions reductions of 49 MtCO₂e y⁻¹ flowing
5 from the CDM, and non-energy related emissions reductions of 177 MtCO₂e y⁻¹. Others have pointed
6 to issues associated with non-energy related emission reductions that suggest the latter estimate may be
7 of questionable reliability, while also noting that regulatory tightening led later CDM projects to
8 perform better with respect to the additionality criterion (Michaelowa et al. 2019b). The CDM's
9 contribution to capacity building in some developing countries has been identified as possibly its most
10 important achievement (Spalding-Fecher et al. 2012; Gandenberger et al. 2015; Murata et al. 2016;
11 Dong and Holm Olsen 2017; Lindberg et al. 2018; Xu et al. 2016). There is evidence that the CDM
12 lowered compliance costs for Annex 1 countries by at least USD3.6 billion (Spalding-Fecher et al.
13 2012). In host countries, the CDM led to the establishment of national approval bodies and the
14 development of an ecosystem of consultants and auditors (Michaelowa et al. 2019b) .

15 On the negative side, there are numerous findings that the CDM, especially at first, failed to lead to
16 additional emissions cuts in host countries, meaning that the overall effect of CDM projects was to raise
17 global emissions. Cames et al. (2016) concluded that over 70% of CDM projects led to emissions
18 reductions that were likely less than projected, including the absence of additional reductions, while
19 only 7% of projects led to actual additional emissions reductions that had a high likelihood of meeting
20 or exceeding the ex-ante estimates. The primary reason the authors gave was the associated with the
21 low price for CDM credits; this meant that the contribution of the CDM to project finance was
22 negligible, suggesting that most CDM projects would have been built anyway. A meta-analysis of ex-
23 post studies of global carbon markets, which include the CDM, found net combined effects on emission
24 to be negligible (Green 2021). Across, the board, CDM projects have been criticised for lack of
25 'additionality', problems of baseline determination, uneven geographic coverage (Michaelowa and
26 Michaelowa 2011a; Cames et al. 2016; Michaelowa et al. 2019b), as well as failing to address human
27 rights concerns (Schade and Obergassel 2014).

28 ***14.3.3.2 Effectiveness of the Paris Agreement***

29 Given the comparatively recent conclusion of the Paris Agreement, evidence is still being gathered to
30 assess the effectiveness of the Paris Agreement in practice, in particular, since its long-term
31 effectiveness hinges on states communicating more ambitious nationally determined contributions in
32 successive cycles over time. Assessments of the Paris Agreement on paper are necessarily speculative
33 and limited by the lack of credible counterfactuals. Despite these limitations, numerous assessments
34 exist of the potential for international cooperation under the Paris Agreement to advance climate change
35 mitigation.

36 These assessments are mixed and reflect uncertainty over the outcomes the Paris Agreement will
37 achieve (Christoff 2016; Cléménçon 2016; Young 2016; Dimitrov et al. 2019; Raiser et al. 2020;
38 Keohane and Oppenheimer 2016). There is a divide between studies that do not expect a positive
39 outcome from the Paris Agreement and those that do. The former base this assessment on factors such
40 as: a lack of clarity in the expression of obligations and objectives; a lack of concrete plans collectively
41 to achieve the temperature goal; extensive use of soft law (i.e. non legally-binding) provisions; limited
42 incentives to avoid free-riding; and the Agreement's weak enforcement provisions (Allan 2019), as well
43 as US non-cooperation under the Trump administration and the resulting gap in mitigation, finance and
44 governance (Bang et al. 2016; Spash 2016; Tulkens 2016; Chai et al. 2017; Lawrence and Wong 2017;
45 Thompson 2017; Barrett 2018; Kemp 2018). Studies expecting a positive outcome emphasise factors
46 such as: the breadth of participation enabled by self-differentiated NDCs; the 'logic' of domestic climate
47 policies driving greater national ambition; the multiplicity of actors engaged by the Paris Agreement's
48 facilitative architecture; the falling cost of low-carbon technologies; provision for financial, technology

1 and capacity-building support to developing country parties; possibilities for voluntary cooperation on
2 mitigation under Article 6; and the potential for progressive ratcheting up of parties' pledges over time
3 fostered by transparency of reporting and international scrutiny of national justifications of the
4 'fairness' of contributions (Caparrós 2016; Morgan and Northrop 2017; Urpelainen and Van de Graaf
5 2018; Hale 2020; Tørstad 2020; Chan 2016a; Falkner 2016b; Victor 2016). Turning to the assessment
6 criteria articulated in this chapter, the following preliminary assessments of the Paris Agreement can be
7 made.

8 In relation to the criterion of *environmental effectiveness*, the Paris Agreement exceeds the Kyoto
9 Protocol in terms of coverage of GHGs and participation of states in mitigation actions. In terms of
10 coverage of GHGs, the Kyoto Protocol limits its coverage to a defined basket of gases identified in its
11 Annex A (Carbon dioxide (CO₂), Methane (CH₄), Nitrous oxide (N₂O), Hydrofluorocarbons (HFCs),
12 Perfluorocarbons (PFCs), Sulphur hexafluoride (SF₆), as well as nitrogen trifluoride (NF₃)). The Paris
13 Agreement does not specify the coverage of gases, thus parties may cover the full spectrum of GHGs
14 in their NDCs as encouraged by the accounting provisions in Annex II to Decision 18/CMA.1 (or
15 conversely choose to exclude important mitigation sectors) and there is also the possibility to include
16 other pollutants such as short-lived climate forcers like black carbon. Article 4.4 calls on developed
17 countries to undertake economy-wide emissions reduction targets with the expectation that developing
18 country parties will also move to introduce these over time. Moreover, the Paris Agreement makes
19 express reference to Parties taking action to conserve and enhance 'sinks and reservoirs of greenhouse
20 gases' (Article 5). As under the UNFCCC and Kyoto Protocol, this allows for coverage of AFOLU
21 emissions, both CO₂ and emissions of other Kyoto Annex A gases, as well as other forms of carbon
22 dioxide removal, including methane (Pekkarinen 2020). A few countries, particularly LDCs, include
23 quantified non-CO₂ emissions reductions from the agricultural sector in their NDCs, and many others
24 include agriculture in their economy-wide targets (Richards et al. 2018). Some studies find that
25 agricultural development pathways with mitigation co-benefits can deliver 21–40% of needed
26 mitigation for the 'well below 2°C' limit, thus necessitating 'transformative technical and policy
27 options' (Wollenberg et al. 2016). Other studies indicate that broader 'natural climate solutions,
28 including forests, can provide 37% of the cost-effective CO₂ mitigation needed through 2030 for a more
29 than 66% chance of holding warming to below 2°C' (Griscom et al. 2017).

30 As the estimates in Table 4.3 (Chapter 4) demonstrate, communicated unconditional NDCs, if achieved,
31 lead to a reduction of about 7% of world emissions by 2030 in relation to the Kyoto GHGs, and NDCs
32 with conditional elements increase this reduction to about 12% (den Elzen et al. 2016). Although there
33 are uncertainties in the extent to which countries will meet the conditional elements of their NDCs, the
34 experience with the Cancun pledges has been positive, as countries will collectively meet their pledges
35 by 2020, and even individual pledges will be met in most cases, although arguably helped by the
36 COVID-19 pandemic (UNEP 2020). In any case, the main challenge that remains is to close the
37 emissions gap, the difference between what has been pledged and what is needed to achieve by 2030 to
38 reach a 1.5° C compatible path (respectively 2° C) (Roelfsema et al. 2020; UNEP 2020, see also Cross-
39 chapter Box 4 in Chapter 4). In terms of participation of states in mitigation actions, the Paris
40 Agreement performs better than the Kyoto Protocol. The latter contains mitigation targets only for
41 developed countries listed in its Annex B, while the Paris Agreement extends binding procedural
42 obligations in relation to mitigation contributions to all states. It is noted, however, that the Paris
43 Agreement represented a weakening of commitments for those industrialised countries that were parties
44 to the Kyoto Protocol, although a strengthening for those that were not, and for developing countries
45 (Oberthür and Groen 2020). Finally, some analysts have suggested that the recent proliferation of
46 national mid-century net-zero targets – currently 127 countries have considered or adopted such targets
47 – can be attributed, at least in part, to participation in the Paris Agreement and having agreed to its
48 Article 4 (Climate Action Tracker 2020a; Day et al. 2020).

1 In relation to the criterion of *transformative potential*, there is, as yet, limited empirical data or
2 theoretical analysis on which to assess the Paris Agreement's transformative potential. The IPCC's
3 1.5°C report concluded that pathways limiting global warming to 1.5°C would require systems
4 transitions that are 'unprecedented in terms of scale' (IPCC 2018b). There is limited evidence to suggest
5 that this is underway, although there are arguments made that Paris has the right structure to achieve
6 this. The linking of the UNFCCC financial apparatus, including the GCF, to the Paris Agreement, and
7 the provisions on technology support and capacity-building, provide potential avenues for promoting
8 increased investment flows into low-carbon technologies and development pathways, as (Labordena et
9 al. 2017) show in the case of solar energy development in Africa. Similarly, Kern and Rogge (2016)
10 argue that the Paris Agreement's global commitment towards complete decarbonisation may play a
11 critical role in accelerating underlying system transitions, by sending a strong signal as to the actions
12 needed by national governments and other international support. Victor et al. (2019) argue that
13 international cooperation that enhances transformative potential needs to operate at the sectoral level,
14 as the barriers to transformation are highly specific to each sector; the Paris Agreement's broad
15 consensus around a clear level of ambition sends a strong signal on what is needed in each sector, but
16 on its own will do little unless bolstered with sectoral-specific action (Geels et al. 2019). On the less
17 optimistic side, it is noted that the extent of the 'investment signal' sent by the Agreement to business
18 is unclear (Kemp 2018), and it is also unclear to what extent the Paris Agreement is fostering investment
19 in break-through technologies. United States non-cooperation from 2017 to 2020 posed a significant
20 threat to adequate investment flows through the GCF (Chai et al. 2017; Urpelainen and Van de Graaf
21 2018).

22 In relation to the criterion of *distributive outcomes*, the Paris Agreement performs well in some respects
23 but less well in others, and its performance relative to the Kyoto Protocol is arguably lower in respect
24 of some indicators such as industrialised country leadership, and differentiation in favour of developing
25 countries. While the Kyoto Protocol implemented a multilaterally agreed burden sharing arrangement
26 set out in the UNFCCC and reflected in Annex-based differentiation in mitigation obligations, the Paris
27 Agreement relies on NDCs, accompanied by self-assessments of the fairness of these contributions;
28 some of these do not accord with equity principles of international environmental law, although it is
29 worth noting that the Kyoto Protocol was also not fully consistent with such principles. At present,
30 mechanisms in the Paris Agreement for promoting equitable burden-sharing and evaluating the fairness
31 of parties' contributions are undefined, although numerous proposals have been developed in the
32 literature (Ritchie and Reay 2017; Herrala and Goel 2016; Robiou du Pont et al. 2017; Alcaraz et al.
33 2019; Sheriff 2019) (discussed in Section 14.3.2.3, above). Zimm and Nakicenovic (2020) analysed the
34 first set of NDCs, and concluded that they would result in a decrease in the inequality of per capita
35 emissions across countries. In relation to other indicators such as the provision of support, the
36 distributive outcomes of the Paris Agreement are dependent on the availability of support through
37 mechanisms such as the GCF to meet the mitigation and adaptation financing needs of developing
38 countries (Antimiani et al. 2017; Chan et al. 2018). One study suggests that the implementation of the
39 emissions reduction objectives stated in the NDCs implies trade-offs with poverty reduction efforts
40 needed to achieve SDGs (Campagnolo and Davide 2019), while other studies offer evidence that the
41 immediate economic, environmental, and social benefits of mitigation in line with developing countries'
42 NDCs exceed those NDCs' costs, and ultimately align the the SDGs (Antwi-Agyei et al. 2018; Vandyck
43 et al. 2018; Caetano et al. 2020) (see Chapter 17). In relation to the promotion of co-benefits the Paris
44 Agreement has enhanced mechanisms for promoting co-benefits (e.g. in some cases for biodiversity
45 conservation through the endorsement of REDD+ initiatives and activities) and linkages to sustainable
46 development (e.g. through the Article 6.4 mechanism). Finally, in its preambular text the Paris
47 Agreement endorses both a human rights perspective and the concept of just transitions, creating
48 potential hooks for further elaboration and expansion of these principles in mitigation actions.

1 On the criterion of *economic performance*, the Paris Agreement’s performance is potentially enhanced
2 by the capacity for parties to link mitigation policies, therefore improving aggregate cost-effectiveness.
3 Voluntary cooperation under Article 6 of the Paris Agreement could facilitate such linkage of mitigation
4 policies (Chan et al. 2018). A combination of common accounting rules and the absence of restrictive
5 criteria and conditions on the use of ITMOs could accelerate linkage and increase the latitude of parties
6 to scale up the ambition of their NDCs. However, significant question marks remain over how the
7 environmental integrity of traded emissions reductions can be ensured (Mehling 2019). The ability of
8 Article 6 to contribute to the goal of the Paris Agreement will depend on the extent to which the rules
9 ensure environmental integrity and avoid double counting, while utilising the full potential of
10 cooperative efforts (Schneider et al. 2019; Michaelowa et al. 2019a).

11 In relation to the criterion of *institutional strength*, the Paris Agreement’s signalling and guidance
12 function is, however, arguably high. The Paris Agreement has the potential to interact with
13 complementary approaches to climate governance emerging beyond it (Held and Roger 2018). It may
14 also be used by publics – organised and mobilised in many countries and transnationally – as a point of
15 leverage in domestic politics to encourage countries to take costly mitigation actions (Keohane and
16 Oppenheimer 2016). More broadly, the Paris Agreement’s architecture provides flexibility for
17 decentralised forms of governance (Jordan et al. 2015; Victor 2016) (see further Section 14.5 below).
18 The Agreement has served a catalytic and facilitative role in enabling and facilitating climate action
19 from non-state and sub-state actors (Chan et al. 2015; Hale 2016; Chan et al. 2016; Bäckstrand et al.
20 2017; Kuyper et al. 2018b). Such action could potentially ‘bridge’ the ambition gap created by
21 insufficient NDCs from parties (Hsu et al. 2019b). The 2018 UNEP Emissions Gap Report estimates
22 that if ‘cooperative initiatives are scaled up to their fullest potential’, the impact of non-state and sub-
23 national actors could be up to 15-23 GtCO₂eq yr⁻¹ by 2030 compared to current policy, which could
24 bridge the gap (Lui et al. 2021). However, at present such a contribution is limited (Michaelowa and
25 Michaelowa 2017; UNEP 2018a). Non-state actors are also playing a role in enhancing the ambition of
26 individual NDCs by challenging their adequacy in national courts (see Chapter 13 and Section 14.5.3
27 below).

28 The Paris Agreement’s institutional strength in terms of ‘rules and standards to facilitate collective
29 action’ is disputed given the current lack of comparable information in NDCs (Peters et al. 2017; Pauw
30 et al. 2018; Mayer 2019; Zihua et al. 2019), and the extent to which its language, as well as that of the
31 Rulebook, strikes a balance in favour of discretion over prescriptiveness (Rajamani and Bodansky
32 2019). Similarly, in terms of ‘mechanisms to enhance transparency and accountability’, although
33 detailed rules relating to transparency have been developed under the Paris Rulebook, these rules permit
34 parties considerable self-determination in the extent and manner of application (Rajamani and
35 Bodansky 2019), and may not lead to further ambition (Weikmans et al. 2020). Further the Paris
36 Agreement’s compliance committee is facilitative and designed to ensure compliance with the
37 procedural obligations in the Agreement, rather than with the NDCs themselves, which are not subject
38 to obligations of result. The Paris Agreement does, however, seek to support the building of
39 transparency-related capacity of developing countries, potentially triggering institutional capacity-
40 building at the national, sub-national and sectoral level (see 14.3.2.7).

41 Ultimately, the overall effectiveness of the Paris Agreement depends on its ability to lead to ratcheting
42 up of collective climate action to meet the long-term global temperature goal (Bang et al. 2016; Christoff
43 2016; Young 2016; Dimitrov et al. 2019; Gupta and van Asselt 2019). As noted above, there is some
44 evidence that this is already occurring. The design of the Paris Agreement, with ‘nationally determined’
45 contributions at its centre, countenances an initial shortfall in collective ambition in relation to the long-
46 term global temperature goal on the understanding and expectation that Parties will enhance the
47 ambition of their NDCs over time (Article 4). This is essential given the current shortfall in ambition.
48 The pathways reflecting current NDCs, according to various estimates, imply global warming in the

1 range of 3°C by 2100 (UNFCCC 2016b; UNEP 2018a) (Chapter 4, Box 3). NDCs will need to be
2 substantially scaled up if the temperature goal of the Paris Agreement is to be met (Rogelj et al. 2018,
3 2016; Höhne et al. 2017, 2018; UNEP 2020). The Paris Agreement’s ‘ambition cycle’ is designed to
4 trigger such enhanced ambition over time. Some studies find that like-minded climate mitigation clubs
5 can deliver substantial emission reductions (Hovi et al. 2017) and are reasonably stable despite the
6 departure of a major emitter such as the United States (Sprinz et al. 2018), other studies find that
7 conditional commitments in the context of a pledge and review mechanism are unlikely to substantially
8 increase countries’ contributions to emissions reductions (Helland et al. 2017), and hence need to be
9 complemented by the adoption of instruments designed differently from the Paris Agreement (Barrett
10 and Dannenberg 2016). In any case, high (but not perfect) levels of mean compliance rates with the
11 Paris Agreement have to be assumed for reaching the ‘well below 2°C’ temperature goal (Sælen 2020;
12 Sælen et al. 2020). This is by no means assured.

13 In conclusion, it remains to be seen whether the Paris Agreement will deliver the collective ambition
14 necessary to meet the temperature goal. While the Paris Agreement does not contain strong and stringent
15 obligations of result for major emitters, backed by a demanding compliance system, it establishes
16 binding procedural obligations, lays out a range of normative expectations, and creates mechanisms for
17 regular review, stock taking, and revision of NDCs. In combination with complementary approaches to
18 climate governance, engagement of a wide range of non-state and sub-national actors, and domestic
19 enforcement mechanisms, these have the potential to deliver the necessary collective ambition and
20 implementation. Whether it will do so, remains to be seen.

21

22 **START CROSS-CHAPTER BOX 10 HERE**

23 **Cross-Chapter Box 10: Policy Attribution - Methodologies for estimating the macro-level** 24 **impact of mitigation policies on indices of GHG mitigation**

25 **Authors:** Mustafa Babiker (Saudi Arabia), Paolo Bertoldi (Italy), Christopher Bataille (Canada), Felix
26 Creutzig (Germany), Navroz K. Dubash (India), Michael Grubb (United Kingdom), Erik Haites
27 (Canada), Ben Hinder (United Kingdom), Janna Hoppe (Switzerland), Yong-Gun Kim (Republic of
28 Korea), Gregory Nemet (the United States of America), Anthony Patt (Switzerland), Yamina Saheb
29 (France), Raphael Slade (United Kingdom)

30 This report notes both a growing prevalence of mitigation policies over the past quarter century (Chapter
31 13), and ‘signs of progress’ including various quantified indices of GHG mitigation (Chapter 2, Table
32 2.4). Even though policies implemented and planned to date are clearly insufficient for meeting the
33 Paris long-term temperature goals, a natural question is to what extent the observed macro-level changes
34 (global, national, sectoral, technological) can be attributed to policy developments. This Assessment
35 Report is the first to address that question. This box describes the methods for conducting such
36 ‘attribution analysis’ as well as its key results, focusing on the extent to which policies have affected
37 three main types of ‘outcome indices’:

38 • **GHG emissions:** emissions volumes and trends at various levels of governance including sub- and
39 supra-national levels, and within and across sectors.

40 • **Proximate emission drivers:** trends in the factors that drive emissions, distinguished through
41 decomposition analyses, notably: energy/GDP intensity and carbon/energy intensity (for energy-related
42 emissions); indices of land use such as deforestation rates (for LULUCF/AFOLU); and more sector-
43 specific component drivers such as the floor area per capita, or passenger kilometres per capita.

44 • **Technologies:** developments in key low-carbon technologies that are likely to have a strong influence
45 on future emissions trends, notably levels of new investment and capacity expansions, as well as
46 technology costs, with a focus on those highlighted in Chapter 2 Figure 2.30.

1 *Policy attribution* examines the extent to which emission-relevant outcomes on these indices – charted
2 for countries, sectors and technologies, particularly in Chapter 2 and the sectoral chapters – may be
3 reasonably attributed to policies implemented prior to the observed changes. Such policies include
4 regulatory instruments such as energy efficiency programmes or technical standards and codes, carbon
5 pricing, financial support for low-carbon energy technologies and efficiency, voluntary agreements, and
6 regulation of land use practices. The sectoral chapters give more detail along with some accounts of
7 policy, whilst trends in mitigation policy adoption are summarised in Chapter 13.

8 In reviewing hundreds of scientific studies cited in this report, the impacts of adopted policies on
9 observed outcomes were assessed. The vast majority of these studies examine particular instruments in
10 particular contexts, as covered in the sectoral chapters and Chapter 13; only a few have appraised global
11 impacts of policies, directly or plausibly inferred (the most significant are cited in the figure in this
12 box). Typically, studies consider ‘mitigation policies’ to be those adopted with either a primary
13 objective of reducing GHG emissions or emissions reductions as one among multiple objectives.

14 Policies differ in design, scope, and stringency, may change over time as they require amendments or
15 new laws, and often partially overlap with other instruments. Overall, the literature indicates that policy
16 mixes are, theoretically and empirically, more effective in reducing emissions, stimulating innovation,
17 and inducing behavioural change than stand-alone policy instruments (Chapter 5 section 5.6; Chapter
18 13, section 13.7) (Rosenow et al. 2017; Sethi et al. 2020; Best and Burke 2018). Nevertheless, these
19 factors complicate analysis, because they give rise to the potential for double counting emissions
20 reductions that have been observed, and which separate studies can attribute to different policy
21 instruments.

22 Efforts to attribute observed outcomes to a policy or policy mix is also greatly complicated by the
23 influence of many exogenous factors, including fossil fuel prices and socio-economic conditions.
24 Likewise, technological progress can result from both exogenous causes, such as ‘spillover’ from other
25 sectors, and policy pressure. Further, other policies, such as fossil fuel subsidies as well as trade-related
26 policies, can partially counteract the effect of mitigation policies by increasing the demand for energy
27 or carbon-intensive goods and services. In some cases, policies aimed at development, energy security,
28 or air quality have climate co-benefits, while others increase emissions.

29 Studies have applied a number of methods to identify the actual effects of mitigation policies in the
30 presence of such confounding factors. These include statistical attribution methodologies, including
31 experimental and quasi-experimental design, instrumental variable approaches, and simple correlational
32 methods. Typically, the relevant mitigation metric is the outcome variable, while measures of policies
33 and other factors act as explanatory variables. Other methodologies include aggregations and
34 extrapolations from micro-level data evaluation, and inference from combining multiple lines of
35 analysis, including expert opinion. Additionally, the literature contains reviews, many of them
36 systematic in nature, that assess and aggregate multiple empirical studies.

37 With these considerations in mind, multiple lines of evidence, based upon the literature, support a set
38 of high-level findings, as illustrated in the figure in this box, as follows.

39 **1. GHG Emissions.** There is robust evidence with a high level of agreement that mitigation policies
40 have had a discernible impact on emissions. Several lines of evidence indicate that mitigation policies
41 have led to avoided global emissions to date by several billion tonnes CO₂-eq annually. The figure in
42 this box shows a selection of results giving rise to this estimate.

43 As a starting point, one methodologically sophisticated econometric study links global mitigation
44 policies (defined as climate laws and executive orders) to emission outcomes; it estimates emission
45 savings of 5.9 GtCO₂ yr⁻¹ in 2016 compared to a no-policy world (Eskander and Fankhauser 2020, see
46 Chapter 13.6.2).

1 A second line of evidence derives from analyses of the Kyoto Protocol. Countries which took on Kyoto
2 Protocol targets accounted for about 24% of global emissions during the first commitment period (2008-
3 12). The most recent robust econometric assessment (Maamoun 2019) estimates that these countries cut
4 GHG emissions by about 7% on average over 2005-2012, rising over the period to around 12% (1.3
5 GtCO_{2e} yr⁻¹) *relative to a no-Kyoto scenario*. This is consistent with estimates of Grunewald and
6 Martinez (2016) of about 800 MtCO_{2e} yr⁻¹ averaged to 2009. Developing countries emission reduction
7 projects through the CDM (defined in article 12 of the Kyoto Protocol) were certified as growing to
8 over 240 MtCO_{2e} yr⁻¹ by 2012 (UNFCCC 2021c). With debates about the full extent of ‘additionality’,
9 academic assessments of savings from the CDM have been slightly lower with particular concerns
10 around some non-energy projects (see Chapter 14.3.3.1).

11 A third line of evidence derives from studies that identify policy-related, absolute reductions from
12 historical levels in particular countries and sectors through decomposition analyses (e.g., Lamb et al.
13 2021; Le Quéré et al. 2019), or evaluate the impact of particular policies, such as carbon pricing systems.
14 From a wide range of estimates in the literature (see Chapters 2.8.2.2 and 13.6), many evaluations of
15 the EU ETS suggest that it has reduced emissions by around 3% to 9% relative to unregulated firms
16 and/or sectors (Schäfer 2019; Colmer et al. 2020), whilst other factors, both policy (energy efficiency
17 and renewable support) and exogenous trends, played a larger role in the overall reductions seen (Haites
18 2018).

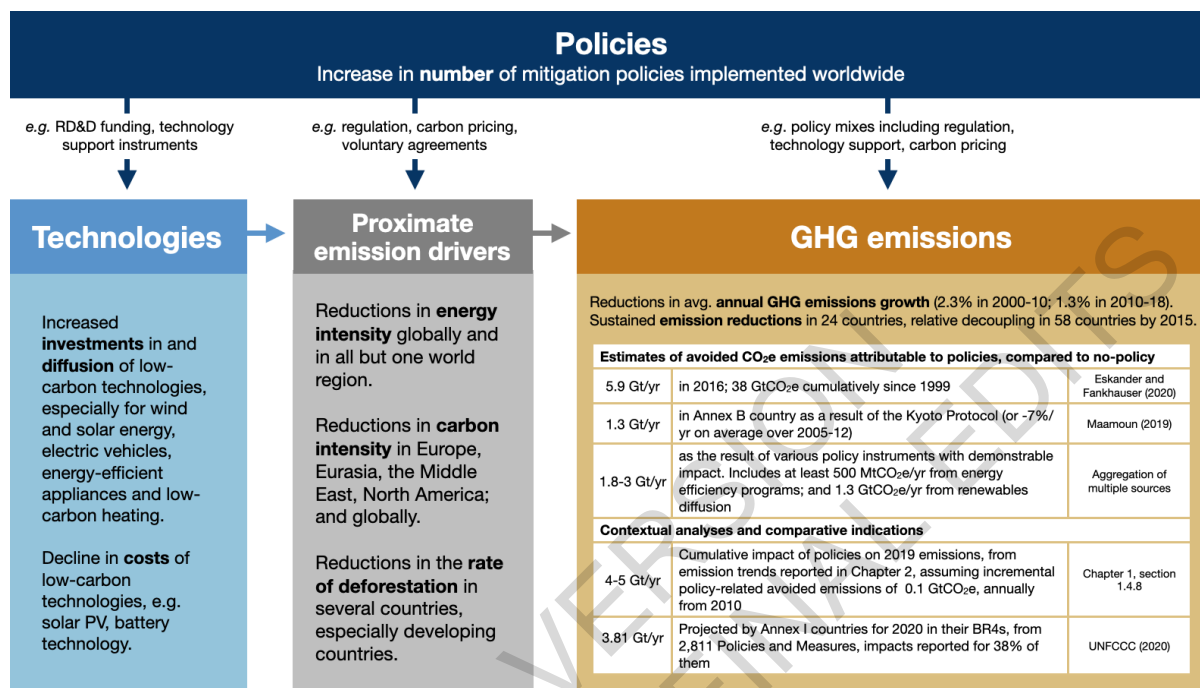
19 These findings derived from the peer-reviewed literature are also consistent with two additional sets of
20 analysis. The first set concerns trends in emissions, drawing directly from Chapters 6-11 and Chapter
21 2, showing that global annual emission growth has slowed as evidenced by annual emission increments
22 of 0.55 GtCO_{2e} yr⁻¹ between 2011 and 2019 compared to 1.014 GtCO_{2e} yr⁻¹ in 2000-08. This suggests
23 avoided emissions of 4-5 Gt yr⁻¹ (see also Chapter 1, Figure 1.1d). The second set concerns emissions
24 reductions projected by Annex I governments for 2020 in their fourth biennial reports to the UNFCCC.
25 It is important to note that these are mostly projected annual savings from implemented policies (not
26 *ex-post* evaluations), and there are considerable differences in countries’ estimation methodologies.
27 Nevertheless, combining estimates from 38% of the total of 2,811 reported policies and measures yields
28 an overall estimate of 3.81GtCO_{2e} yr⁻¹ emission savings (UNFCCC 2020d).

29 **2. Proximate emission drivers.** With less overt focus on emissions, studies of trends in energy
30 efficiency, carbon intensity, or deforestation often point to associated policies. The literature s includes
31 an increasing number of studies on demonstrable progress in developing countries. For example, South
32 and South-East Asia have seen energy intensity in buildings improving at ca. 5 – 6% yr⁻¹ since 2010
33 (Chapter 2, Figure 2.22). In India alone, innovative programmes in efficient air conditioning, LED
34 lighting, and industrial efficiency are reported as saving around 25 Mtoe in 2019-2020, thus leading to
35 avoided emissions of over 150 MtCO₂ yr⁻¹ (see Chapter 16, box 16.3; Malhotra et al. 2021). Likewise,
36 reductions in deforestation rates in several South and Central American and Asian countries are at least
37 partly attributable to ecosystem payments, land use regulation, and internal efforts (Chapter 7.6.2).
38 Finally, the policy-driven displacement of fossil fuel combustion by renewables in energy has led to
39 reductions in carbon intensity in several world regions (Chapters 2 and 6).

40 **3. Technologies.** The literature indicates unambiguously that the rapid expansion of low-carbon energy
41 technologies is substantially attributable to policy (Chapter 6.7.5, Chapter 16.5). Technology-specific
42 adoption incentives have led to a greater use of less carbon-intensive (e.g. renewable electricity) and
43 less energy-intensive (especially in transport and buildings) technologies. As Chapters 2 and 6 of this
44 report note, modern renewable energy sources currently satisfy over 9% of global electricity demand,
45 and this is largely attributable to policy. There are no global-level studies estimating the avoided
46 emissions due to renewable energy support policies, but there are methods that have been developed to
47 link renewable energy penetration to avoided emissions, such as that of IRENA (2021). Using that
48 method, and assuming that 70% of modern renewable energy expansion has been policy-induced, yields

1 an estimate of avoided emissions of 1.3 GtCO₂e yr⁻¹ in 2019. Furthermore, observed cost reductions
 2 are the result of policy-driven capacity expansion as well as publicly funded R&D, in individual
 3 countries and globally. These correspond with induced effects on number of patents, ‘learning curve’
 4 correlations with deployed capacity, and cost component and related case study analyses (Kavlak et al.
 5 2018; Nemet 2019; Popp 2019; Grubb et al. 2021).

6



7

8 **Cross-Chapter Box 10, Figure 1: Policy impacts on key outcome indices: GHG emissions, proximate**
 9 **emission drivers, and technologies, including several lines of evidence on GHG abatement attributable to**
 10 **policies.**

11 **END CROSS-CHAPTER BOX 10 HERE**

12

13 14.4 Supplementary means and mechanisms of implementation

14 As discussed above, the Paris Agreement sets in place a new framework for international climate policy
 15 albeit one that is embedded in the wider climate regime complex (Coen et al. 2020). Whereas
 16 international governance had earlier assumed centre stage, the Paris Agreement recognises the salience
 17 of domestic politics in the governance of climate change (Kinley et al. 2020). The new architecture also
 18 provides more flexibility for recognising the benefits of working in diverse forms and groups and allows
 19 for more decentralised “polycentric” forms of governance (Jordan et al. 2015; Victor 2016). The next
 20 two sections address this complementarity between the Paris Agreement and other agreements and
 21 institutions.

22 The Paris Agreement identifies a number of pathways, or means of implementation, towards
 23 accomplishing rapid mitigation and the achieving of its temperature goal: finance; capacity building;
 24 technology and innovation; and, cooperative approaches and markets (see sections 14.3.2.7-14.3.2.10
 25 above). In this section, we examine each of these means and mechanisms of implementation, and the
 26 agreements and institutions lying outside of the Paris Agreement that contribute to each. In the
 27 following Section, 14.5, we examine the agreements and institutions playing other governance roles:
 28 regulating activities in particular sectors; linking climate mitigation with other activities such as
 29 adaptation; and, stimulating and coordinating the actions of non-state actors at a global scale.

1 Figure 14.3 maps out the interlinkages described in the text of the sections 14.4 and 14.5. It is an
 2 incomplete list, but illustrates clearly that across multiple types of governance, there are multiple
 3 instruments or organisations with activities connected to the different governance roles associated with
 4 the Paris Agreement and the UNFCCC more generally.

Type	Instrument / Organization	Mitigation	Transparency	Sinks	Markets	Finance	Technology	Capacity building
Global treaties	Montreal Protocol	14.5.1.1				14.5.1.1		
	CBD	14.5.1.1		14.5.2.1				
	UNCCD			14.5.2.1				14.5.2.1
	Minimata Mercury Convention	14.5.1.1						
United Nations Programmes and Specialised Agencies	UN REDD+ programme	14.5.1.1		14.5.2.1		14.5.2.1		14.4.3
	UNEP	14.5.1.1						14.4.3
	UNDP							14.4.3
	UNIDO							14.4.1.2
	UNOSSC							14.4.1.2
	FAO			14.5.2.1				14.4.1.2
	ICAO	14.5.2.3			14.5.2.3		14.5.2.3	
Other global organisations	IMO	14.5.2.3	14.5.2.3				14.5.2.3	
	IEA						14.5.2.2	
	IRENA					14.5.2.2	14.5.2.2	14.5.2.2
	MDBs	14.4.1.2	14.4.1.2	14.5.4	14.4.4	14.4.1.2		14.4.3
Regional, multi- and bilateral agreements	LRTAP	14.5.1.1						
	MIGA					14.5.2.2		
	PPCA	14.5.2.2						
	Regional trade agreements	14.5.1.3			14.5.1.3		14.5.1.3	
	Bilateral development programs				14.4.4	14.4.1.1	14.4.1.1	14.4.3
	International science programmes						14.4.2	
Non-state transnational actors	South South Cooperation					14.5.1.4	14.5.1.4	14.4.3
	Global city networks	14.5.5		14.5.5		14.5.5	14.5.5	14.5.5
	Environmental NGOs	14.5.2.2	14.5.4			14.5.3		
	Social movements	14.5.3		14.5.3				
	Business partnerships	14.5.4	14.5.4			14.5.4	14.5.4	14.5.4

5
 6 **Figure 14.3 Climate governance beyond the UNFCCC. The figure shows those relationships, marked in**
 7 **blue, between international governance activities, described in the text, that relate to activities of the**
 8 **UNFCCC and Paris Agreement.**

9 14.4.1 Finance

10 International cooperation on climate finance is underpinned by various articles of the UNFCCC
 11 including Articles 4.3, 4.4, 4.5, 4.7 and 11.5 (UNFCCC 1992). This was further amplified through the
 12 commitment by developed countries in the Copenhagen Accord and the Cancun Agreements to mobilise
 13 jointly through various sources USD100 billion yr⁻¹ by 2020 to meet the needs of the developing
 14 countries (UNFCCC 2010b). This commitment was made in the context of meaningful mitigation action
 15 and transparency of implementation. As mentioned earlier in Section 14.3.2.8, in the Paris Agreement
 16 the binding obligation on developed country parties to provide financial resources to assist developing
 17 country parties applies to both mitigation and adaptation (UNFCCC 2015a, Art. 9.1). In 2019, climate
 18 finance provided and mobilised by developed countries was in the order of USD79.6 billion, coming
 19 from different channels including bilateral and multilateral channels, and also through mobilisation of
 20 the private sector attributable to these channels (OECD 2021). A majority (two-thirds) of these flows
 21 targeted mitigation action exclusively (see also Chapter 15). These estimates, however, have been
 22 criticised on various grounds, including that they are an overestimate and do not represent climate
 23 specific net assistance only; that in grant equivalence terms the order of magnitude is lower; and the
 24 questionable extent of transparency of information on mobilised private finance, as well as the direction
 25 of these flows (Carty et al. 2020). On balance, such assessments need to be viewed in the context of the
 26 original commitment, the source of the data and the evolving guidance, and modalities and procedures
 27 from the UNFCCC processes. As mentioned in Chapter 15, the measurement of climate finance flows
 28 continues to face definitional, coverage and reliability issues despite progress made by various data
 29 providers and collators (see section 15.3.2 in Chapter 15).

1 The multiplicity of actors providing financial support has resulted in a fragmented international climate
2 finance architecture as indicated in Section 14.3.2.8. It is also seen as a system which allows for speed,
3 flexibility and innovation (Pickering et al. 2017). However, the system is not yet delivering adequate
4 flows given the needs of developing countries (see Section 14.3.2.8). An early indication of these self-
5 assessed needs is provided in the conditional NDCs. Of the 136 conditional NDCs submitted by June
6 2019, 110 have components or additional actions conditioned on financing support for mitigation and
7 79 have components or additional actions for support for adaptation (Pauw et al. 2020). While the Paris
8 Agreement did not explicitly countenance conditionality for actions in developing countries, it is
9 generally understood that the ambition and effectiveness of climate ambition in these countries is
10 dependent on financial support (Voigt and Ferreira 2016b).

11 **14.4.1.1 Bilateral finance**

12 The Paris Agreement and the imperative for sustainable development reinforce the need to forge strong
13 linkages between climate and development (Fay et al. 2015). This in turn has highlighted the urgent
14 need for greater attention to the relationship between development assistance and finance, and climate
15 change (Steele 2015).

16 The UNFCCC website cites some 20 bilateral development agencies providing support to climate
17 change programs in developing countries (UNFCCC 2020a). These agencies provide a mix of
18 development cooperation, policy advice and support and financing for climate change projects. Since
19 the year 2000, the OECD Development Assistance Committee has been tracking trends in climate-
20 related development finance and assistance. The amount of bilateral development finance with climate
21 relevance has increased substantially since 2000 (OECD 2019a). For 2019, it was reported to be
22 USD28.8 billion in direct finance and USD2.6 billion through export credit agencies. Further, another
23 USD34.1 billion of the climate finance provided through multilateral channels is attributable to the
24 developed countries (OECD 2021). The OECD methodology has been critiqued as it uses Rio markers
25 the limitations of which could lead to erroneous reporting and assessment of finance provided as well
26 as the mitigation outcome (Michaelowa and Michaelowa 2011b; Weikmans and Roberts 2019). This
27 issue is to be addressed through the modalities, procedures and guidance under the Enhanced
28 Transparency Framework of the Paris Agreement (see Section 14.3.2.4), through the mandate to
29 Subsidiary Body for Scientific and Technological Advice (SBSTA) to develop Common Tabular
30 Formats (CTFs) for the reporting of information on, *inter alia*, financial support provided, mobilised
31 and received (UNFCCC 2019k). Until then, the Biennial Assessment Report prepared by the Standing
32 Committee on Finance provides the best available information on financial support.

33 **14.4.1.2 Multilateral finance**

34 Multilateral Development Banks (MDBs) comprise six global development banks that include the
35 European Investment Bank (EIB), International Fund for Agricultural Development (IFAD),
36 International Investment Bank (IIB), New Development Bank (NDB), OPEC Fund for International
37 Development (OFID), and the World Bank Group, six regional development banks that include the
38 African Development Bank (AfDB), Asian Development Bank (AsDB), Asian Infrastructure
39 Investment Bank (AIIB), European Bank for Reconstruction and Development (EBRD), Inter-
40 American Development Bank (IADB), and the Islamic Development Bank (IsDB), and thirteen sub-
41 regional development banks that include the Arab Bank for Economic Development in Africa
42 (BADEA), Arab Fund for Economic and Social Development (AFESD), Black Sea Trade and
43 Development Bank (BSTDB), Caribbean Development Bank (CDB), Central American Bank for
44 Economic Integration (CABEI), Development Bank of the Central African States (BDEAC),
45 Development Bank of Latin America (CAF), East African Development Bank (EADB), Eastern and
46 Southern African Trade and Development Bank (TDB), Economic Cooperation Organization Trade and
47 Development Bank (ETDB), ECOWAS Bank for Investment and Development (EBID), Eurasian
48 Development Bank (EADB), and the West African Development Bank (BOAD). Together they play a key

1 role in international cooperation at the global, regional and sub-regional level because of their growing
2 mandates and proximity to policymakers (Engen and Prizzon 2018). For many, climate change is a
3 growing priority and for some, because of the needs of the regions, or sub-regions in which they operate,
4 climate change is embedded in many of their operations.

5 In 2015, twenty representative MDBs and members of the International Development Finance Club
6 unveiled five voluntary principles to mainstream climate action in their investments, including
7 commitment to climate strategies, managing climate risks, promoting climate smart objectives,
8 improving climate performance and accounting for their own actions (World Bank 2015a; Institute for
9 Climate Economics 2017). The members subscribing to these principles have since grown to 44 in
10 January 2020. Arguably, it is only through closer linkages between climate and development that
11 significant inroads can be made in addressing climate change. MDBs can play a major role through the
12 totality of their portfolios (Larsen et al. 2018).

13 The MDBs as a cohort have been collaborating and coordinating in reporting on climate financing since
14 2012 following a commitment made in 2012 at the Rio +20 summit (MDB 2012). This has engendered
15 other forms of collaboration among the MDBs, including: commitments to collectively total at least
16 USD65 billion annually by 2025 in climate finance, with USD50 billion for low and middle income
17 economies; to mobilise a further USD40 billion annually by 2025 from private sector investors,
18 including through the increased provision of technical assistance, use of guarantees, and other de-
19 risking instruments; and to commit to helping clients deliver on the goals of the Paris Agreement;
20 building a transparency framework on impact of MDBs' activities and enabling clients to move away
21 from fossil fuels (Asian Development Bank 2019). While the share of MDBs in direct climate financing
22 is small, their role in influencing national development banks and local financial institutions, and
23 leveraging and crowding in private investments in financing sustainable infrastructure, is widely
24 recognised (NCE 2016). However, with this recognition there is also an exhortation to do more to align
25 with the goals of the Paris Agreement, including a comprehensive examination of their portfolios
26 beyond investments that directly support climate action to also enabling the long-term net zero GHG
27 emissions trajectory (Cochran and Pauthier 2019; Larsen et al. 2018). Further, a recent assessment has
28 shown that MDBs perform relatively better in mobilising other public finance than private co- financing
29 (Thwaites 2020). In addition, the banks have launched or are members of significant initiatives such as
30 the Climate and Clean Air Coalition (CCAC) to reduce short lived climate pollutants, the Carbon
31 Pricing Leadership Coalition (CPLC), the Coalition for Climate Resilient Investment (CCRI) and the
32 Coalition of Finance Ministers for climate action. These help to spur action at different levels, from
33 economic analysis, to carbon financing and convenors of finance and development ministers for climate
34 action, with leadership of many of these initiatives led by the World Bank.

35 The multilateral climate funds also have a role in the international climate finance architecture. This
36 includes, as mentioned in Section 14.3.2.8, those established under the UNFCCC's financial
37 mechanism, its operating entities, the Global Environment Facility (GEF), which also manages two
38 special funds, the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund
39 (LDCF); the Green Climate Fund (GCF), also an operating entity of the financial mechanism which in
40 2015, was given a special role in supporting the Paris Agreement. The GCF aims to provide funding at
41 scale, balanced between mitigation and adaptation, using various financial instruments including grants,
42 loans, equity, guarantees or others to activities that are aligned with the priorities of the countries
43 compatible with the principle of country ownership (GCF 2011). The GCF faces many challenges.
44 While some see the GCF as an opportunity to transform and rationalise what is now a complex and
45 fragmented climate finance architecture with insufficient resources and overlapping remits (Nakhoda
46 et al. 2014), others see it as an opportunity to address the frequent tensions which arise between
47 mitigation-focused transformation and national priorities of countries. This tension is at the heart of the
48 principle of country ownership and the need for transformational change (Winkler and Dubash 2016).

1 Leveraging private funds and investments by the public sector, taking risks to unlock climate action are
2 also expressed strategic aims of the GCF.

3 The UN system is also supporting climate action through much needed technical assistance and capacity
4 building, which is complementary to the financial flows insofar as it enables countries with relevant
5 tools and methodologies to assess their needs, develop national climate finance roadmaps, establish
6 relevant institutional mechanisms to receive support and track it, enhance readiness to access financing,
7 and include climate action across relevant national financial planning and budgeting processes (UN
8 2017a). The United Nations Development Programme (UNDP) is the largest implementer of climate
9 action among the UN Agencies, with others, such as the Food and Agriculture Organisation (FAO),
10 United Nations Environment Programme (UNEP), United Nations Industrial Development
11 Organisation (UNIDO), and United Nations Office for South-South Cooperation (UNOSSC), providing
12 relevant support.

13 The current architecture of climate finance is one that is primarily based on north-south, developed-
14 developing country dichotomies. The Paris Agreement, however, has clearly recognised the role of
15 climate finance flows across developing countries, thereby enhancing the scope of international
16 cooperation (Voigt and Ferreira 2016b). Estimates of such flows, though, are not readily available.
17 According to one estimate in 2020 the flows among non-OECD countries were of the order of USD29
18 billion (CPI 2021).

19 **14.4.1.3 Private sector financing**

20 There is a growing recognition of the importance of mobilising private sector financing including for
21 climate action (World Bank 2015b; Michaelowa et al. 2020b). An early example of the mobilisation of
22 the private sector in a cooperative mode for mitigation outcomes is evidenced from the Clean
23 Development Mechanism of the Kyoto Protocol and the linking with the European Union's Emissions
24 Trading Scheme, both triggered by relevant provisions in the Kyoto Protocol (see Section 14.4.4) and
25 lessons learnt from this are relevant for development of market mechanisms in the post Paris Agreement
26 period (Michaelowa et al. 2019b). In 2019/2020, on an average for the two years, public and private
27 climate financing was on the order of USD632 billion, of which USD310 billion originated from the
28 private sector. However, as much as 76% of the (overall) finance stayed in the country of origin. This
29 trends holds true also for private finance (CPI 2021). Figure 14.4 depicts the international climate
30 finance flows totalling USD161 billion reported in 2020, about 19% were private flows. For
31 (international) mitigation financing flows of USD116 billion, the share provided by private sources was
32 24%.

33

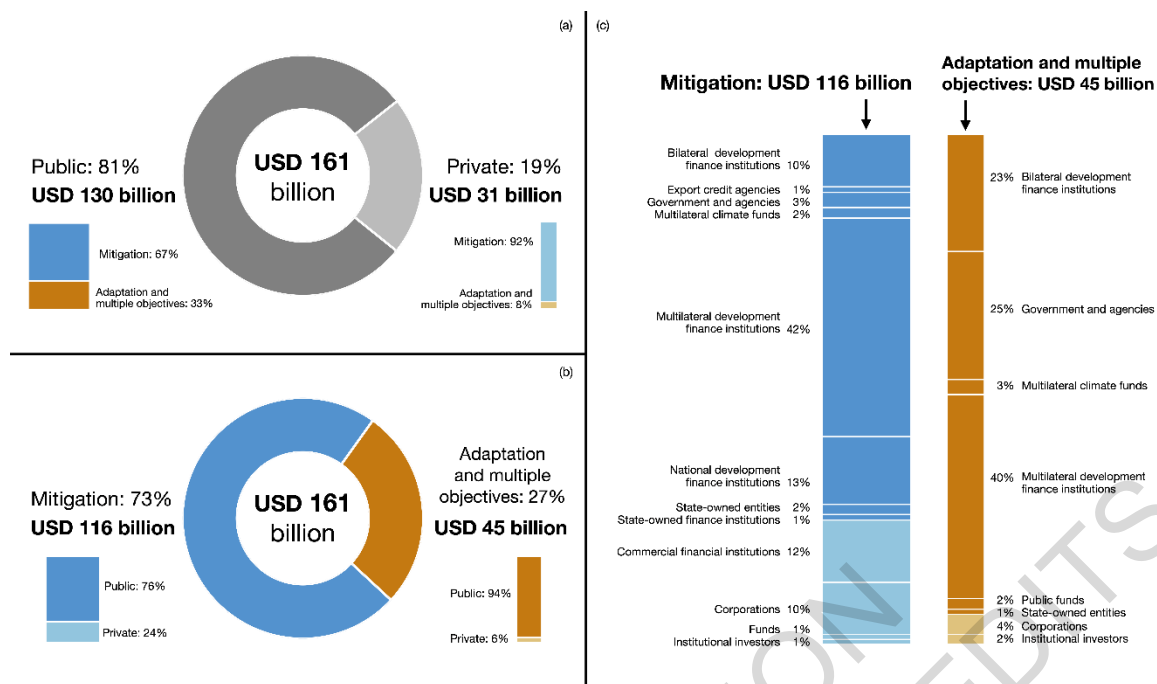


Figure 14.4 International Finance Flows. Total international climate financial flows for 2020 were USD161 billion. By comparison, public sector bilateral and multilateral finance in 2017 for fossil fuel development, including gas pipelines, was roughly USD4 billion. Part (a) disaggregates total financial flows according to public and private sources, and indicates the breakdown between mitigation on the one hand, and adaptation and multiple objectives on the other, within each source. Part (b) disaggregates total financial flows according to intended purpose, namely mitigation or adaptation and multiple objectives, and disaggregates each type according to source. Part (c) provides additional detail on the relative contributions of different public and private sources. Sources: (CPI 2021; OECD 2021).

Foreign direct investments and its greening is seen as a channel for increasing cooperation. An assessment of the greenfield foreign direct investment in different sectors shows the growing share of renewable energy at USD92.2 billion (12% of the volume and 38% of the number of projects) (FDI Intelligence 2020). Coal, oil and gas sectors maintain the top spot for capital investments globally. Over the last decade there is growing issuance of green bonds with non-financial private sector issuance gaining ground (Almeida 2020). While it is questionable if green bonds have a significant impact on shifting capital from non-sustainable to sustainable investments, they do incentivise the issuing organisations to enhance their green ambition and have led to an appreciation within capital markets of green frameworks and guidelines and signalling new expectations (Maltais and Nykvist 2020). In parallel, institutional investors including pension funds are seeking investments that align with the Paris Agreement (IIGCC 2020). However, the readiness of institutional investors to make this transition is arguable (OECD 2019b; Ameli et al. 2020). This evidence suggests that international private financing could play an important role but this potential is yet to be realised (see Chapter 15).

14.4.2 Science, technology and innovation

Science, technology and innovation are essential for the design of effective measures to address climate change and, more generally, for economic and social development (de Coninck and Sagar 2015a). The OECD finds that single countries alone often cannot provide effective solutions to today's global challenges, as these cross national borders and affect different actors (OECD 2012). Madani (2020) shows how conflict, including international sanctions, can reduce science and innovation capacity,

1 which is not evenly distributed, particularly across the developed and the developing world. For this
2 reason, many countries have introduced strategies and policies to enhance international cooperation in
3 science and technology (Chen et al. 2019). Partnerships and international cooperation can play a role in
4 establishing domestic innovation systems, which enable more effective science and technology
5 innovation (de Coninck and Sagar 2015b,a).

6 International cooperation in science and technology occurs across different levels, with a growing
7 number of international cooperation initiatives aimed at research and collaborative action in technology
8 development. (Weart 2012) finds that such global efforts are effective in advancing climate change
9 science due to the international nature of the challenge. Global research programmes and institutions
10 have also provided the scientific basis for major international environmental treaties. For example, the
11 Long-Range Transboundary Air Pollution Convention and the Montreal Protocol were both informed
12 by scientific assessments based on collaboration and cooperation of scientists across several
13 geographies (Andresen et al. 2000). Furthermore, the Global Energy Assessment (GEA 2012) provided
14 the scientific basis and evidence for the 2030 Agenda for Sustainable Development, in particular SDG7
15 to ensure access to affordable, reliable and sustainable modern energy for all. The GEA drew on the
16 expertise of scientists from over 60 countries and institutions. Several other platforms exist to provide
17 scientists and policymakers an opportunity for joint research and knowledge sharing, such as The World
18 in 2050, an initiative that brings together scientists from some 40 institutions from around the world to
19 provide the science for SDG and Paris Agreement implementation (TWI2050 2018).

20 Non-state actors are also increasingly collaborating internationally. Such collaborations, referred to as
21 international cooperative initiatives (ICIs), bring together multi-stakeholder groups across industry,
22 communities, and regions, and operate both within and outside the UNFCCC process. Lui et al. (2021)
23 find that such initiatives could make a major contribution to global emissions reduction, Bakhtiari
24 (2018) finds that the impact on greenhouse gas reduction of these initiatives is hindered due to a lack
25 of coordination between ICIs, overlap with other activities conducted by the UNFCCC and
26 governments, and a lack of monitoring system to measure impact. Increasing the exchange of
27 information between ICIs, enhancing monitoring systems, and increasing collaborative research in
28 science and technology would help address these issues (Boekholt et al. 2009; Bakhtiari 2018).

29 At the level of research institutes, there has been a major shift to a more structured and global type of
30 cooperation in research; Wagner et al. (2017) found significant increases in both the proportion of
31 papers written by author teams from multiple countries, and in the number of countries participating in
32 such collaboration, over the time period 1990 - 2013. Although only a portion of these scientific papers
33 address the issue of climate change specifically, this growth of scientific collaboration across borders
34 provides a comprehensive view of the conducive environment in which climate science collaboration
35 has grown.

36 However, there are areas in which international cooperation can be strengthened. Both the Paris
37 Agreement and the 2030 Agenda for Sustainable Development call for more creative forms of
38 international cooperation in science that help bridge the science and policy interface, and provide
39 learning processes and places to deliberate on possible policy pathways across disciplines on a more
40 sustainable and long-lasting basis. Scientific assessments, such as the IPCC and IPBES offer this
41 possibility, but processes need to be enriched for this to happen more effectively (Kowarsch et al. 2016)

42 A particular locus for international cooperation on technology development and innovation is found
43 within institutions and mechanisms of the UN climate regime. The UNFCCC, in Article 4.1(c), calls on
44 'all parties' to 'promote and cooperate in the development, application and diffusion, including transfer,
45 of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of
46 greenhouse gases' and places responsibility on developed country parties to 'take all practicable steps
47 to promote, facilitate and finance, as appropriate, the transfer of, or access to environmentally sound
48 technologies and know-how to other parties, particularly developing country parties, to enable them to

1 implement the provisions of the Convention’ (UNFCCC 1992, Art. 4.5). The issue of technology
2 development and transfer has continued to receive much attention in the international climate policy
3 domain since its initial inclusion in the UNFCCC in 1992 – albeit often overshadowed by dominant
4 discourses around market-based mechanisms – and its role in reducing GHG emissions and adapting to
5 the consequences of climate change ‘is seen as becoming ever more critical’ (de Coninck and Sagar
6 2015a). Milestones in the development of international cooperation on climate technologies under the
7 UNFCCC have included: (1) the development of a technology transfer framework and establishment of
8 the Expert Group on Technology Transfer (EGTT) under the Subsidiary Body for Scientific and
9 Technological Advice (SBSTA) in 2001; (2) recommendations for enhancing the technology transfer
10 framework put forward at the Bali Conference of the Parties in 2007 and creation of the Poznan strategic
11 program on technology transfer under the Global Environmental Facility (GEF); and (3) the
12 establishment of the Technology Mechanism by the Conference of the Parties in 2010 as part of the
13 Cancun Agreements (UNFCCC 2010b). The Technology Mechanism is presently the principal avenue
14 within the UNFCCC for facilitating cooperation on the development and transfer of climate
15 technologies to developing countries (UNFCCC 2015b). As discussed in Section 14.3.2.9 above, the
16 Paris Agreement tasks the Technology Mechanism also to serve the Paris Agreement (UNFCCC 2015b,
17 Art. 10.3).

18 The Technology Mechanism consists of the Technology Executive Committee (TEC) (replacing the
19 EGTT), as its policy arm, and the Climate Technology Centre and Network (CTCN), as its
20 implementation arm (UNFCCC 2015b). The TEC focuses on identifying and recommending policies
21 that can support countries in enhancing and accelerating the development and transfer of climate
22 technologies (UNFCCC 2020b). The CTCN facilitates the transfer of technologies through three core
23 services: (1) providing technical assistance at the request of developing countries; (2) creating access
24 to information and knowledge on climate technologies; and (3) fostering collaboration and capacity-
25 building (CTCN 2020a). The CTCN ‘network’ consists of a diverse set of climate technology
26 stakeholders from academic, finance, non-government, private sector, public sector, and research
27 entities, together with more than 150 National Designated Entities, which serve as CTCN national focal
28 points. Through its network, the CTCN seeks to mobilise policy and technical expertise to deliver
29 technology solutions, capacity-building and implementation advice to developing countries (CTCN
30 2020b). At the Katowice UNFCCC Conference of the Parties in 2018, the TEC and CTCN were
31 requested to incorporate the technology framework developed pursuant to Article 10 of the Paris
32 Agreement into their respective workplans and programmes of work (UNFCCC 2019f).

33 The Joint Annual Report of the TEC and CTCN for 2019 indicated that, as of July 2019, the CTCN had
34 engaged with 93 developing country parties regarding a total of 273 requests for technical assistance,
35 including 11 multi-country requests. Nearly three-quarters (72.9%) of requests received by the CTCN
36 had a mitigation component, with two-thirds of those mitigation requests related to either renewable
37 energy or energy efficiency. Requests for decision-making or information tools are received most
38 frequently (28% of requests), followed by requests for technology feasibility studies (20%) and
39 technology identification and prioritisation (18%) (TEC and CTCN 2019).

40 The CTCN is presently funded from ‘various sources, ranging from the [UNFCCC] Financial
41 Mechanism to philanthropic and private sector sources, as well as by financial and in-kind contributions
42 from the co-hosts of the CTCN and from participants in the Network’ (TEC and CTCN 2019, para. 97).
43 Oh (2020b) describes the institution as ‘mainly financially dependent on bilateral donations from
44 developed countries and multilateral support’. Nevertheless, inadequate funding of the CTCN poses a
45 problem for its effectiveness and capacity to contribute to implementation of the Paris Agreement. A
46 2017 independent review of the CTCN identified ‘limited availability of funding’ as a key constraint
47 on its ability to deliver services at the expected level and recommended that ‘[b]etter predictability and
48 security over financial resources will ensure that the CTCN can continue to successfully respond to its

1 COP mandate and the needs and expectations of developing countries’ (Ernst & Young 2017, para. 84).
2 The 2019 Joint Report of the TEC and CTCN indicates that resource mobilisation for the Network
3 remains a challenge (TEC and CTCN 2019, pp. 23-24).

4 The importance of ‘financial support’ for strengthening cooperative action on technology development
5 and transfer was recognised in Article 10.6 of the Paris Agreement. The technology framework
6 established by the Paris Rulebook specifies actions and activities relating to the thematic area of
7 ‘support’ as including: (a) enhancing the collaboration of the Technology Mechanism with the Financial
8 Mechanism; (b) identifying and promoting innovative finance and investment at different stages of the
9 technology cycle; (c) providing enhanced technical support to developing country parties, in a country-
10 driven manner, and facilitating their access to financing for innovation, enabling environments and
11 capacity-building, developing and implementing the results of TNAs, and engagement and
12 collaboration with stakeholders, including organisational and institutional support; and (d) enhancing
13 the mobilisation of various types of support, including pro bono and in-kind support, from various
14 sources for the implementation of actions and activities under each key theme of the technology
15 framework.

16 Notwithstanding the technology framework’s directive for enhanced collaboration of the Technology
17 and Financial Mechanisms of the UNFCCC, linkages between them, and particularly to the GCF,
18 continue to engender political contestation between developing and developed countries (Oh 2020b).
19 Developing countries sought to address concerns over the unsustainable funding status of the CTCN by
20 advocating linkage through a funding arrangement or financial linkage, whereas developed countries
21 favour the design of an institutional linkage maintaining the different and separate mandates of the
22 CTCN and the GCF (Oh 2020a,b). With no resolution reached, the UNFCCC COP requested the
23 Subsidiary Body for Implementation, at its fifty-third session, to take stock of progress in strengthening
24 the linkages between the Technology Mechanism and the Financial Mechanism with a view to
25 recommending a draft decision for consideration and adoption by the Glasgow COP, scheduled for 2021
26 (UNFCCC 2019).

28 **14.4.3 Capacity Building**

29 International climate cooperation has long focused on supporting developing countries in building
30 capacity to implement climate mitigation actions. While there is no universally agreed definition of
31 capacity-building and the UNFCCC does not define the term (Khan et al. 2020), elements of capacity-
32 building can be discerned from the Convention’s provisions on education and training programmes
33 (UNFCCC 1992, Art. 6), as well as the reference in Article 9(2)(d) of the UNFCCC to the Subsidiary
34 Body for Scientific and Technological Advice (SBSTA) providing support for ‘endogenous capacity-
35 building in developing countries.’

36 Capacity-building is generally conceived as taking place at three levels: individual (focused on
37 knowledge, skills and training), organisational/institutional (focusing on organisational performance
38 and institutional cooperation) and systemic (creating enabling environments through regulatory and
39 economic policies (Khan et al. 2020; UNFCCC 2021b). In its annual synthesis report for 2018, the
40 UNFCCC secretariat compiled information submitted by parties on the implementation of capacity-
41 building in developing countries, highlighting cooperative and regional activities on NDCs, including
42 projects to build capacity for implementation, workshops related to transparency under the Paris
43 Agreement and collaboration to provide coaching and training (UNFCCC 2019h). A number of
44 developing country Parties also highlighted their contributions to South–South cooperation (discussed
45 further in Section 14.5.1.4 below), and identified capacity-building projects undertaken with others (e.g.
46 capacity-building for risk management in Latin America and the Caribbean, improving capacity for

1 measurement, reporting and verification (MRV) through the Alliance of the Pacific and a climate action
2 package launched by Singapore).

3 Beyond the UNFCCC, other climate cooperation and partnership activities on capacity building include
4 climate-related bilateral cooperation and those organised by the OECD, IFDD (Francophonie Institute
5 for Sustainable Development), UNDP-NCSP programme, UNEP and the World Bank.

6 Climate-related bilateral cooperation provides important human and institutional capacity building
7 supports for climate change actions and activities in developing countries, particularly through
8 developed countries' bilateral cooperation structures, such as the French Development Agency (AFD),
9 the German Development Agency (The Deutsche Gesellschaft für Internationale Zusammenarbeit –
10 GIZ), the Japanese International Cooperation Agency (JICA) and others.

11 There are also a number of regional cooperative structures with capacity-building components,
12 including ClimaSouth, Euroclima+, the UN-REDD Programme, the Caribbean Regional Strategic
13 Programme for Resilience, the Caribbean Climate Online Risk and Adaptation Tool, a project on
14 accelerating low carbon and resilient society realisation in the Southeast Asian region, the World Health
15 Organisation's Global Salm-Surv network, the Red Iberoamericana de Oficinas de Cambio Climático
16 network and the Africa Adaptation Initiative. Many climate-related capacity-building initiatives,
17 including those coordinated or funded by international or regional institutions, are implemented at the
18 national and sub-national level, often with the involvement of universities, consultancy groups and civil
19 society actors.

20 It is also noted that comprehensive support is provided by the GCF to developing countries (GCF,
21 2020). This support is made available and accessible for all developing countries through three different
22 GCF tools: the Readiness Programme, the Project Preparation Facility, and the funding of
23 transformative projects and programmes. The goal of the Readiness Programme is to strengthen
24 institutional capacities, governance mechanisms, and planning and programming competencies in
25 support of developing countries' transformational long-term climate policies (GCF, 2020). Despite a
26 decades-long process of capacity-building efforts under many development and environmental regimes,
27 including the UNFCCC, progress has been uneven and largely unsuccessful in establishing institution-
28 based capacity in developing countries (Robinson 2018). In an effort to improve capacity-building
29 efforts within the UNFCCC, in 2015, the Paris Committee on Capacity-building (PCCB) was
30 established by the COP decision accompanying the Paris Agreement as the primary body for enhancing
31 capacity-building efforts, including by improving coherence and coordination in capacity-building
32 activities (UNFCCC 2016a, para. 71). The activities of the Committee include the provision of guidance
33 and technical support on climate change training and capacity building, raising awareness and sharing
34 climate information and knowledge. During 2020, the PCCB was able, despite the Covid-19 situation,
35 to hold its 4th meeting, implement and assess its 2017-2020 work plan, and develop and agree on its
36 future roadmap (2021-2024) (UNFCCC Subsidiary Body for Implementation 2020). Non-governmental
37 organisations such as the Coalition on Paris Agreement Capacity-building provide expert input to the
38 PCCB.

39 Quantifying the contribution of capacity-building efforts to climate mitigation is acknowledged to be
40 'difficult, if not impossible' (Hsu et al. 2019a). Nonetheless, such activities 'may play a valuable role
41 in building a foundation for future reductions' by providing 'necessary catalytic linkages between
42 actors' (Hsu et al. 2019a).

43

44 **14.4.4 Cooperative mechanisms and markets**

45 In theory, trading carbon assets can reduce the costs of global climate mitigation, by helping facilitate
46 abatement of greenhouse gases at least-cost locations. This could help countries ratchet up their

1 ambitions more than in a situation without such mechanisms (Mehling et al. 2018), particularly if
2 mechanisms are scaled up from projects and programmes (Michaelowa et al. 2019b). Progress as to
3 developing such mechanisms has however so far been moderate and uneven.

4 Of the three international market-based mechanisms under the 1997 Kyoto Protocol discussed in
5 Section 14.3.2.7, and in previous IPCC reports, only the CDM or a similar mechanism may have a role
6 to play under the Paris Agreement, although the precise terms are yet to be decided.

7 Article 6, also discussed in Section 14.3.2.7, is the main framework to foster enhanced cooperation
8 within the Paris Agreement. Although there is an emerging global landscape of activities based on
9 Article 6 (Greiner et al. 2020), such as the bilateral treaty signed under the framework of Article 6 in
10 October 2020 by Switzerland and Peru, the possibilities of bilateral cooperation are yet to be fully
11 exploited. As discussed above, adequate accounting rules are key to the success of Article 6. Sectoral
12 agreements are also a promising cooperative mechanism, as discussed in Section 14.5.2. In fact, both
13 bilateral and sectoral agreements have the potential to enhance the ambition of the parties involved and
14 can eventually serve as building blocks towards more comprehensive agreements (see the discussion in
15 Section 14.2.2).

16 A relevant and promising new development is the international linkage of existing regional or national
17 emission trading systems. Several emission trading systems are now operational in different
18 jurisdictions, including the EU, Switzerland, China, South Korea, New Zealand, Kazakhstan and several
19 US states and Canadian provinces (Wettestad and Gulbrandsen 2018). More systems are in the pipeline,
20 including Mexico and Thailand (ICAP 2019). The link between the EU and Switzerland entered into
21 force in January 2020 and other linkages are being negotiated. Scholars analyse the potential benefits
22 of these multilateral linkages and demonstrate that these can be significant (Doda et al. 2019; Doda and
23 Taschini 2017). Over time, the linkages of national emission trading systems can be seen as building
24 blocks to a strategic enlargement of international cooperation (Caparrós and Péreau 2017; Mehling
25 2019). The World Bank has emerged as an important lynchpin and facilitator of knowledge-building
26 and sharing of lessons about the design and linking of carbon markets, through initiatives such as the
27 Partnership for Market Readiness, Networked Carbon Markets and the Carbon Pricing Leadership
28 Coalition (Wettestad et al. 2021).

29 However, it is important to distinguish between theory and practice. The practice of ETS linking so far
30 demonstrates a few attempts that did not result in linkages due to shifts of governments and political
31 preferences (for instance the process between the EU and Australia, and Ontario withdrawing from the
32 WCI) (Bailey and Inderberg 2018). It is worth noting that the linking of carbon markets raises problems
33 of distribution of costs and loss of political control and hence does not offer a politically easy alternative
34 route to a truly international carbon market. Careful, piece-meal and incremental linking may be the
35 most feasible approach forward (Green et al. 2014; Gulbrandsen et al. 2019). It is premature for any
36 serious assessment of the practice of ETS linking to be conducted. Environmental effectiveness,
37 transformative potential, economic performance, institutional strength and even distributional outcomes
38 can potentially be significant and positive if linking is done carefully (Doda and Taschini 2017; Mehling
39 et al. 2018; Doda et al. 2019), but are all marginal if one focuses on existing experiences (Haïtes 2016;
40 Schneider et al. 2017; Spalding-Fecher et al. 2012; La Hoz Theuer et al. 2019; Schneider et al. 2019).

41 42 **14.4.5 International Governance of SRM and CDR**

43 While Solar Radiation Modification (SRM) and Carbon Dioxide Removal (CDR) were often referred
44 to as ‘geoengineering’ in earlier IPCC reports and in the literature, IPCC SR1.5 started to explore SRM
45 and CDR more thoroughly and to highlight the differences between – but also within – both approaches
46 more clearly. This section assesses international governance of both SRM and CDR, recognizing that
47 CDR, as a mitigation option, is covered elsewhere in this report, whereas SRM is not. Chapter 12 of

1 this report covers the emerging national, sub-national and non-state governance of CDR, while chapters
2 6, 7 and 12 also assess the mitigation potential, risks and co-benefits of some CDR options. Chapters 4
3 and 5 of the WGI Report assess the physical climate system and biogeochemical responses to different
4 SRM and CDR methods. The Cross Working Group Box 5 on SRM (WGII, Chapter 16 and Cross-
5 Working Group Box 4 in WGIII below) gives a brief overview of solar radiation modification methods,
6 risks, benefits, ethics and governance.

9 **START CROSS-WORKING GROUP BOX 4 HERE**

11 *Cross-Working Group Box in WGII and Cross-Working Group Box 4 in WGIII*

13 **Cross-Working Group Box 4: Solar Radiation Modification (SRM)**

14 Authors: Govindasamy Bala (India), Heleen de Coninck (the Netherlands), Oliver Geden (Germany),
15 Veronika Ginzburg (the Russian Federation), Katharine J. Mach (the United States of America),
16 Anthony Patt (Switzerland), Sonia I. Seneviratne (Switzerland), Masahiro Sugiyama (Japan),
17 Christopher H. Trisos (Republic of South Africa), Maarten van Aalst (the Netherlands)

18 *Proposed Solar Radiation Modification Schemes*

19 This cross-working group box assesses Solar Radiation Modification (SRM) proposals, their potential
20 contribution to reducing or increasing climate risk, as well as other risks they may pose (categorised as
21 risks from responses to climate change in the IPCC AR6 risk definition in 1.2.1.1), and related
22 perception, ethics and governance questions.

23 SRM refers to proposals to increase the reflection of shortwave radiation (sunlight) back to space to
24 counteract anthropogenic warming and some of its harmful impacts (de Coninck et al. 2018) (Cross-
25 Working Group Box 4; WGI Chapter 4 and Chapter 5). A number of SRM options have been proposed,
26 including: Stratospheric Aerosol Interventions (SAI), Marine Cloud Brightening (MCB), Ground-
27 Based Albedo Modifications (GBAM), and Ocean Albedo Change (OAC). Although not strictly a form
28 of SRM, Cirrus Cloud Thinning (CCT) has been proposed to cool the planet by increasing the escape
29 of longwave thermal radiation to space and is included here for consistency with previous assessments
30 (de Coninck et al. 2018). SAI is the most-researched proposal. Modeling studies show SRM could
31 reduce surface temperatures and potentially ameliorate some climate change risks (with more
32 confidence for SAI than other options), but SRM could also introduce a range of new risks.

33 There is high agreement in the literature that for addressing climate change risks SRM cannot be the
34 main policy response to climate change and is, at best, a supplement to achieving sustained net zero or
35 net negative CO₂ emission levels globally (de Coninck et al. 2018; MacMartin et al. 2018; Buck et al.
36 2020; National Academies of Sciences Engineering and Medicine 2021). SRM contrasts with climate
37 change mitigation activities, such as emission reductions and CDR, as it introduces a ‘mask’ to the
38 climate change problem by altering the Earth’s radiation budget, rather than attempting to address the
39 root cause of the problem, which is the increase in GHGs in the atmosphere. In addition, the effects of
40 proposed SRM options would only last as long as a deployment is maintained—e.g. requiring ca. yearly
41 injection of aerosols in the case of SAI as the lifetime of aerosols in the stratosphere is 1-3 years
42 (Niemeier et al. 2011) or continuous spraying of sea salt in the case of MCB as the lifetime of sea salt
43 aerosols in the atmosphere is only about 10 days—which contrasts with the long lifetime of CO₂ and
44 its climate effects, with global warming resulting from CO₂ emissions likely remaining at a similar level
45 for a hundred years or more (MacDougall et al. 2020) and long-term climate effects of emitted CO₂
46 remaining for several hundreds to thousands of years (Solomon et al. 2009).

47 *Which scenarios?*

1 The choice of SRM deployment scenarios and reference scenarios is crucial in assessment of SRM risks
 2 and its effectiveness in attenuating climate change risks (Keith and MacMartin 2015; Honegger et al.
 3 2021a). Most climate model simulations have used scenarios with highly stylized large SRM forcing to
 4 fully counteract large amounts of warming in order to enhance the signal-to-noise ratio of climate
 5 responses to SRM (Kravitz et al. 2015; Sugiyama et al. 2018a; Krishnamohan et al. 2019).

6 The effects of SRM fundamentally depend on a variety of choices about deployment (Sugiyama et al.
 7 2018b), including: its position in the portfolio of human responses to climate change (e.g., the
 8 magnitude of SRM used against the background radiative forcing), governance of research and potential
 9 deployment strategies, and technical details (latitude, materials, and season, among others, see WGI
 10 Chapter 4.6.3.3). The plausibility of many SRM scenarios is highly contested and not all scenarios are
 11 equally plausible because of socio-political considerations (Talberg et al. 2018), as with, for example,
 12 CDR (Fuss et al. 2014, 2018). Development of scenarios and their selection in assessments should
 13 reflect a diverse set of societal values with public and stakeholder inputs (Sugiyama et al. 2018a; Low
 14 and Honegger 2020), as depending on the focus of a limited climate model simulation, SRM could look
 15 grossly risky or highly beneficial (Pereira et al. 2021).

16 In the context of reaching the long-term global temperature goal of the Paris Agreement, there are
 17 different hypothetical scenarios of SRM deployment: early, substantial mitigation with no SRM, more
 18 limited or delayed mitigation with moderate SRM, unchecked emissions with total reliance on SRM,
 19 and regionally heterogeneous SRM. Each scenario presents different levels and distributions of SRM
 20 benefits, side effects, and risks. The more intense the SRM deployment, the larger is the likelihood for
 21 the risks of side effects and environmental risks (e.g., Heutel et al., 2018). Regional disparities in climate
 22 hazards may result from both regionally-deployed SRM options such as GBAM, and more globally
 23 uniform SRM such as SAI (Jones et al. 2018; Seneviratne et al. 2018). There is an emerging literature
 24 on smaller forcings of SAI to reduce global average warming, for instance, to hold global warming to
 25 1.5°C or 2°C alongside ambitious conventional mitigation (Jones et al. 2018; MacMartin et al. 2018),
 26 or bring down temperature after an overshoot (Tilmes et al. 2020). If emissions reductions and CDR
 27 are deemed insufficient, SRM may be seen by some as the only option left to ensure the achievement
 28 of the Paris Agreement's temperature goal by 2100.

29 **Cross-Working Group Box 4, Table 1: SRM options and their potential climate and non-climate impacts.**
 30 **Description, potential climate impacts, potential impacts on human and natural systems, and termination**
 31 **effects of a number of SRM options: Stratospheric Aerosol Interventions (SAI), Marine Cloud**
 32 **Brightening (MCB), Ocean Albedo Change (OAC), Ground-Based Albedo Modifications (GBAM), and**
 33 **Cirrus Cloud Thinning (CCT).**
 34

SRM option	SAI	MCB	OAC	GBAM	CCT
Description	Injection of reflective aerosol particles directly into the stratosphere or a gas which then converts to aerosols that reflect sunlight	Spraying sea salt or other particles in marine clouds, making them more reflective	Increase surface albedo of the ocean (e.g., by creating microbubbles or placing reflective foam on the surface)	Whitening roofs, changes in land use management (e.g., no-till farming, bioengineering to make crop leaves more reflective), desert albedo enhancement, covering glaciers with reflective sheeting	Seeding to promote nucleation of cirrus clouds, reducing optical thickness and cloud lifetime to allow more outgoing longwave radiation to escape to space
Potential climate impacts <i>other</i>	Change precipitation and runoff	Change in land-sea contrast in	Change in land-sea contrast in	Changes in regional precipitation	Changes in temperature and

<i>than reduced warming</i>	pattern; reduced temperature and precipitation extremes; precipitation reduction in some monsoon regions; decrease in direct and increase in diffuse sunlight at surface; changes to stratospheric dynamics and chemistry; potential delay in ozone hole recovery; changes in surface ozone and UV radiation	temperature and precipitation, regional precipitation and runoff changes	temperature and precipitation, regional , precipitation and runoff changes.	pattern, regional extremes and regional circulation	precipitation pattern, altered regional water cycle, increase in sunlight reaching the surface
Potential impacts on human and natural systems	Changes in crop yields, changes in land and ocean ecosystem productivity, acid rain (if using sulphate), reduced risk of heat stress to corals	Changes in regional ocean productivity, changes in crop yields, reduced heat stress for corals, changes in ecosystem productivity on land, sea salt deposition over land	Unresearched	Altered photosynthesis, carbon uptake and side effects on biodiversity	Altered photosynthesis and carbon uptake
Termination effects	Sudden and sustained termination would result in rapid warming, and abrupt changes to water cycle. Magnitude of termination depends on the degree of warming offset.	Sudden and sustained termination would result in rapid warming, and abrupt changes to water cycle. Magnitude of termination depends on the degree of warming offset.	Sudden and sustained termination would result in rapid warming. Magnitude of termination depends on the degree of warming offset.	GBAM can be maintained over several years without major termination effects because of its regional scale of application. Magnitude of termination depends on the degree of warming offset.	Sudden and sustained termination would result in rapid warming. Magnitude of termination depends on the degree of warming offset.
References (also see main text of this box)	(Vioni et al. 2017) Tilmes et al. (2018) Simpson et al. (2019)	Latham et al. (2012) Ahlm et al. (2017) Stjern et al. (2018)	Evans et al. (2010) Crook et al. (2015)	Davin et al. (2014) Crook et al. (2015) Zhang et al. (2016)	Storelvmo and Herger (2014) Crook et al. (2015)

				Field et al. (2018) Seneviratne et al. (2018)	Jackson et al. (2016) Duan et al. (2020) Gasparini et al. (2020)
--	--	--	--	--	--

1

2 ***SRM risks to human and natural systems and potential for risk reduction***

3 Since AR5, hundreds of climate modelling studies have simulated effects of SRM on climate hazards
4 (Kravitz et al. 2015; Tilmes et al. 2018). Modelling studies have shown SRM has the potential to offset
5 some effects of increasing GHGs on global and regional climate, including the increase in frequency
6 and intensity of extremes of temperature and precipitation, melting of Arctic sea ice and mountain
7 glaciers, weakening of Atlantic meridional overturning circulation, changes in frequency and intensity
8 of tropical cyclones, and decrease in soil moisture (WGI, Chapter 4). However, while SRM may be
9 effective in alleviating anthropogenic climate warming either locally or globally, it would not maintain
10 the climate in a present-day state nor return the climate to a pre-industrial state (climate averaged over
11 1850-1900, See WGI Chapter 1, Box 1.2) in all regions and in all seasons even when used to fully offset
12 the global mean warming (*high confidence*); WGI Chapter 4}. This is because the climate forcing and
13 response to SRM options are different from the forcing and response to GHG increase. Because of these
14 differences in climate forcing and response patterns, the regional and seasonal climates of a world with
15 a global mean warming of 1.5 or 2°C achieved via SRM would be different from a world with similar
16 global mean warming but achieved through mitigation (MacMartin et al. 2018). At the regional scale
17 and seasonal timescale there could be considerable residual climate change and/or overcompensating
18 change (e.g., more cooling, wetting or drying than just what's needed to offset warming, drying or
19 wetting due to anthropogenic greenhouse gas emissions), and there is low confidence in understanding
20 of the climate response to SRM at the regional scale (WGI, Chapter 4).

21 SAI implemented to partially offset warming (e.g., offsetting half of global warming) may have
22 potential to ameliorate hazards in multiple regions and reduce negative residual change, such as drying
23 compared to present-day climate, that are associated with fully offsetting global mean warming (Irvine
24 and Keith 2020), but may also increase flood and drought risk in Europe compared to unmitigated
25 warming (Jones et al. 2021). Recent modelling studies suggest it is conceptually possible to meet
26 multiple climate objectives through optimally designed SRM strategies (WGI, Chapter 4). Nevertheless,
27 large uncertainties still exist for climate processes associated with SRM options (e.g. aerosol-cloud-
28 radiation interaction) (WGI, Chapter 4) (Kravitz and MacMartin 2020).

29 Compared with climate hazards, many fewer studies have examined SRM risks—the potential adverse
30 consequences to people and ecosystems from the combination of climate hazards, exposure and
31 vulnerability—the potential for SRM to reduce risk (Curry et al. 2014; Irvine et al. 2017). Risk
32 analyses have often used inputs from climate models forced with stylized representations of SRM, such
33 as dimming the sun. Fewer have used inputs from climate models that explicitly simulated injection of
34 gases or aerosols into the atmosphere, which include more complex cloud-radiative feedbacks. Most
35 studies have used scenarios where SAI is deployed to hold average global temperature constant despite
36 high emissions.

37 There is *low confidence* and large uncertainty in projected impacts of SRM on crop yields due in part
38 to a limited number of studies. Because SRM would result in only a slight reduction in CO₂
39 concentrations relative to the emission scenario without SRM (Chapter 5, WGI), the CO₂ fertilization
40 effect on plant productivity is nearly the same in emissions scenarios with and without SRM.
41 Nevertheless, changes in climate due to SRM are likely to have some impacts on crop yields. A single

1 study indicates MCB may reduce crop failure rates compared to climate change from a doubling of CO₂
2 pre-industrial concentrations (Parkes et al. 2015). Models suggest SAI cooling would reduce crop
3 productivity at higher latitudes compared to a scenario without SRM by reducing the growing season
4 length, but benefit crop productivity in lower latitudes by reducing heat stress (Pongratz et al. 2012; Xia
5 et al. 2014; Zhan et al. 2019). Crop productivity is also projected to be reduced where SAI reduces
6 rainfall relative to the scenario without SRM, including a case where reduced Asian summer monsoon
7 rainfall causes a reduction in groundnut yields (Xia et al. 2014; Yang et al. 2016). SAI will increase the
8 fraction of diffuse sunlight, which is projected to increase photosynthesis in forested canopy, but will
9 reduce the direct and total available sunlight, which tends to reduce photosynthesis. As total sunlight is
10 reduced, there is a net reduction in crop photosynthesis with the result that any benefits to crops from
11 avoided heat stress may be offset by reduced photosynthesis, as indicated by a single statistical
12 modeling study (Proctor et al. 2018). SAI would reduce average surface ozone concentration (Xia et al.
13 2017) mainly as a result of aerosol-induced reduction in stratospheric ozone in polar regions, resulting
14 in reduced downward transport of ozone to the troposphere (Pitari et al. 2014; Tilmes et al. 2018). The
15 reduction in stratospheric ozone also allows more UV radiation to reach the surface. The reduction in
16 surface ozone, together with an increase in surface UV radiation, would have important implications
17 for crop yields but there is *low confidence* in our understanding of the net impact.

18 Few studies have assessed potential SRM impacts on human health and wellbeing. SAI using sulfate
19 aerosols is projected to deplete the ozone layer, increasing mortality from skin cancer, and SAI could
20 increase particulate matter due to offsetting warming, reduced precipitation and deposition of SAI
21 aerosols, which would increase mortality, but SAI also reduces surface-level ozone exposure, which
22 would reduce mortality from air pollution, with net changes in mortality uncertain and depending on
23 aerosol type and deployment scenario (Effiong and Neitzel 2016; Eastham et al. 2018; Dai et al. 2020).
24 However, these effects may be small compared to changes in risk from infectious disease (e.g.,
25 mosquito-borne illnesses) or food security due to SRM influences on climate (Carlson et al. 2020).
26 Using volcanic eruptions as a natural analog, a sudden implementation of SAI that forced the ENSO
27 system may increase risk of severe cholera outbreaks in Bengal (Trisos et al. 2018; Pinke et al. 2019).
28 Considering only mean annual temperature and precipitation, SAI that stabilizes global temperature at
29 its present-day level is projected to reduce income inequality between countries compared to the highest
30 warming pathway (RCP8.5) (Harding et al. 2020). Some integrated assessment model scenarios have
31 included SAI (Arino et al. 2016; Emmerling and Tavoni 2018; Heutel et al. 2018; Helweggen et al. 2019;
32 Rickels et al. 2020) showing the indirect costs and benefits to welfare dominate, since the direct
33 economic cost of SAI itself is expected to be relatively low (Moriyama et al. 2017; Smith and Wagner
34 2018). There is a general lack of research on the wide scope of potential risk or risk reduction to human
35 health, wellbeing and sustainable development from SRM and on their distribution across countries and
36 vulnerable groups (Carlson et al. 2020; Honegger et al. 2021a).

37 SRM may also introduce novel risks for international collaboration and peace. Conflicting temperature
38 preferences between countries may lead to counter-geoengineering measures such as deliberate release
39 of warming agents or destruction of deployment equipment (Parker et al. 2018). Game-theoretic models
40 and laboratory experiments indicate a powerful actor or group with a higher preference for SRM may
41 use SAI to cool the planet beyond what is socially optimal, imposing welfare losses on others although
42 this cooling does not necessarily imply excluded countries would be worse off relative to a world of
43 unmitigated warming (Ricke et al. 2013; Weitzman 2015; Abatayo et al. 2020). In this context counter-
44 geoengineering may promote international cooperation or lead to large welfare losses (Helweggen et al.
45 2019; Abatayo et al. 2020).

46 Cooling caused by SRM would increase the global land and ocean CO₂ sinks (*medium confidence*), but
47 this would not stop CO₂ from increasing in the atmosphere or affect the resulting ocean acidification
48 under continued anthropogenic emissions (*high confidence*) (WGI Chapter 5).

1 Few studies have assessed potential SRM impacts on ecosystems. SAI and MCB may reduce risk of
2 coral reef bleaching compared to global warming with no SAI (Latham et al. 2013; Kwiatkowski et al.
3 2015), but risks to marine life from ocean acidification would remain, because SRM proposals do not
4 reduce elevated levels of anthropogenic atmospheric CO₂ concentrations. MCB could cause changes in
5 marine net primary productivity by reducing light availability in deployment regions, with important
6 fishing regions off the west coast of South America showing both large increases and decreases in
7 productivity (Partanen et al. 2016; Keller 2018).

8 There is large uncertainty in terrestrial ecosystem responses to SRM. By decoupling increases in
9 atmospheric greenhouse gas concentrations and temperature, SAI could generate substantial impacts on
10 large-scale biogeochemical cycles, with feedbacks to regional and global climate variability and change
11 (Zarnetske et al. 2021). Compared to a high CO₂ world without SRM, global-scale SRM simulations
12 indicate reducing heat stress in low latitudes would increase plant productivity, but cooling would also
13 slow down the process of nitrogen mineralization which could decrease plant productivity (Glienke et
14 al. 2015; Duan et al. 2020). In high latitude and polar regions SRM may limit vegetation growth
15 compared to a high CO₂ world without SRM, but net primary productivity may still be higher than pre-
16 industrial climate (Glienke et al. 2015). Tropical forests cycle more carbon and water than other
17 terrestrial biomes but large areas of the tropics may tip between savanna and tropical forest depending
18 on rainfall and fire (Beer et al. 2010; Staver et al. 2011). Thus, SAI-induced reductions in precipitation
19 in Amazonia and central Africa are expected to change the biogeography of tropical ecosystems in ways
20 different both from present-day climate and global warming without SAI (Simpson et al. 2019;
21 Zarnetske et al. 2021). This would have potentially large consequences for ecosystem services (Chapter
22 2 and Chapter 9). When designing and evaluating SAI scenarios, biome-specific responses need to be
23 considered if SAI approaches are to benefit rather than harm ecosystems. Regional precipitation change
24 and sea salt deposition over land from MCB may increase or decrease primary productivity in tropical
25 rainforests (Muri et al. 2015). SRM that fully offsets warming could reduce the dispersal velocity
26 required for species to track shifting temperature niches whereas partially offsetting warming with SAI
27 would not reduce this risk unless rates of warming were also reduced (Trisos et al. 2018; Dagon and
28 Schrag 2019). SAI may reduce high fire risk weather in Australia, Europe and parts of the Americas,
29 compared to global warming without SAI (Burton et al. 2018). Yet SAI using sulfur injection could
30 shift the spatial distribution of acid-induced aluminum soil toxicity into relatively undisturbed
31 ecosystems in Europe and North America (Vioni et al. 2020). For the same amount of global mean
32 cooling, SAI, MCB, and CCT would have different effects on gross and net primary productivity
33 because of different spatial patterns of temperature, available sunlight, and hydrological cycle changes
34 (Duan et al. 2020). Large-scale modification of land surfaces for GBAM may have strong trade-offs
35 with biodiversity and other ecosystem services, including food security (Seneviratne et al. 2018).
36 Although existing studies indicate SRM will have widespread impacts on ecosystems, risks and
37 potential for risk reduction for marine and terrestrial ecosystems and biodiversity remain largely
38 unknown.

39 A sudden and sustained termination of SRM in a high CO₂ emissions scenario would cause rapid climate
40 change (*high confidence*; WGI Chapter 4). More scenario analysis is needed on the potential likelihood
41 of sudden termination (Kosugi 2013; Irvine and Keith 2020). A gradual phase-out of SRM combined
42 with emission reduction and CDR could avoid these termination effects (*medium confidence*)
43 (MacMartin et al. 2014; Keith and MacMartin 2015; Tilmes et al. 2016). Several studies find that large
44 and extremely rapid warming and abrupt changes to the water cycle would occur within a decade if a
45 sudden termination of SAI occurred (McCusker et al. 2014; Crook et al. 2015). The size of this
46 ‘termination shock’ is proportional to the amount of radiative forcing being masked by SAI. A sudden
47 termination of SAI could place many thousands of species at risk of extinction, because the resulting
48 rapid warming would be too fast for species to track the changing climate (Trisos et al. 2018).

1 ***Public perceptions of SRM***

2 Studies on the public perception of SRM have used multiple methods: questionnaire surveys,
3 workshops, and focus group interviews (Burns et al. 2016; Cummings et al. 2017). Most studies have
4 been limited to Western societies with some exceptions. Studies have repeatedly found that respondents
5 are largely unaware of SRM (Merk et al. 2015). In the context of this general lack of familiarity, the
6 publics prefer carbon dioxide removal (CDR) to SRM (Pidgeon et al. 2012), are very cautious about
7 SRM deployment because of potential environmental side effects and governance concerns, and mostly
8 reject deployment for the foreseeable future. Studies also suggest conditional and reluctant support for
9 research, including proposed field experiments, with conditions of proper governance (Sugiyama et al.
10 2020). Recent studies show that the perception varies with the intensity of deliberation (Merk et al.
11 2019), and that the public distinguishes different funding sources (Nelson et al. 2021). Limited studies
12 for developing countries show a tendency for respondents to be more open to SRM (Visschers et al.
13 2017; Sugiyama et al. 2020), perhaps because they experience climate change more directly (Carr and
14 Yung 2018). In some Anglophone countries, a small portion of the public believes in chemtrail
15 conspiracy theories, which are easily found in social media (Tingley and Wagner 2017; Allgaier 2019).
16 Since researchers rarely distinguish different SRM options in engagement studies, there remains
17 uncertainty in public perception.

18 ***Ethics***

19 There is broad literature on ethical considerations around SRM, mainly stemming from philosophy or
20 political theory, and mainly focused on SAI (Flegal et al. 2019). There is concern that publicly debating,
21 researching and potentially deploying SAI could involve a ‘moral hazard’, with potential to obstruct
22 ongoing and future mitigation efforts (Morrow 2014; Baatz 2016; McLaren 2016), while empirical
23 evidence is limited and mostly at the individual, not societal, level (Burns et al. 2016; Merk et al. 2016,
24 2019). There is low agreement whether research and outdoors experimentation will create a ‘slippery
25 slope’ toward eventual deployment, leading to a lock-in to long-term SRM, or can be effectively
26 regulated at a later stage to avoid undesirable outcomes (Hulme 2014; Parker 2014; Callies 2019;
27 McKinnon 2019). Regarding potential deployment of SRM, procedural, distributive and recognitional
28 conceptions of justice are being explored, (Svoboda and Irvine 2014; Svoboda 2017; Preston and Carr
29 2018; Hourdequin 2019). With the SRM research community’s increasing focus on distributional
30 impacts of SAI, researchers have started more explicitly considering inequality in participation and
31 inclusion of vulnerable countries and marginalized social groups (Flegal and Gupta 2018; Whyte 2018;
32 Táíwò and Talati 2021), including considering stopping research (Stephens and Surprise 2020; National
33 Academies of Sciences Engineering and Medicine 2021). There is recognition that SRM research has
34 been conducted predominantly by a relatively small number of experts in the Global North, and that
35 more can be done to enable participation from diverse peoples and geographies in setting research
36 agendas and research governance priorities, and undertaking research, with initial efforts to this effect
37 (e.g., Rahman et al. 2018), noting unequal power relations in participation could influence SRM
38 research governance and potential implications for policy (Winickoff et al. 2015; Frumhoff and
39 Stephens 2018; Whyte 2018; Biermann and Möller 2019; McLaren and Corry 2021; National
40 Academies of Sciences Engineering and Medicine 2021; Táíwò and Talati 2021).

41 ***Governance of research and of deployment***

42 Currently, there is no dedicated, formal international SRM governance for research, development,
43 demonstration, or deployment (see WGIII Chapter 14). Some multilateral agreements—such as the UN
44 Convention on Biological Diversity or the Vienna Convention on the Protection of the Ozone Layer—
45 indirectly and partially cover SRM, but none is comprehensive and the lack of robust and formal SRM
46 governance poses risks (Ricke et al. 2013; Talberg et al. 2018; Reynolds 2019a). While governance
47 objectives range broadly, from prohibition to enabling research and potentially deployment (Sugiyama
48 et al. 2018b; Gupta et al. 2020), there is agreement that SRM governance should cover all interacting

1 stages of research through to any potential, eventual deployment with rules, institutions, and norms
2 (Reynolds 2019b). Accordingly, governance arrangements are co-evolving with respective SRM
3 technologies across the interacting stages of research, development, demonstration, and—potentially—
4 deployment (Rayner et al. 2013; Parker 2014; Parson 2014). Stakeholders are developing governance
5 already in outdoors research; for example, for MCB and OAC experiments on the Great Barrier Reef
6 (McDonald et al. 2019). Co-evolution of governance and SRM research provides a chance for
7 responsibly developing SRM technologies with broader public participation and political legitimacy,
8 guarding against potential risks and harms relevant across a full range of scenarios, and ensuring that
9 SRM is considered only as a part of a broader portfolio of responses to climate change (Stilgoe 2015;
10 Nicholson et al. 2018). For SAI, large-scale outdoor experiments even with low radiative forcing could
11 be transboundary and those with deployment-scale radiative forcing may not be distinguished from
12 deployment, such that (MacMartin and Kravitz 2019) argue for continued reliance on modeling until a
13 decision on whether and how to deploy is made, with modeling helping governance development. For
14 further discussion of SRM governance see Chapter 14, WGIII.

15 **END CROSS-WORKING GROUP BOX 4 HERE**

17 ***14.4.5.1 Global governance of solar radiation modification and associated risks***

18 Solar Radiation Modification, in the literature also referred to as ‘solar geoengineering’, refers to the
19 intentional modification of the Earth's shortwave radiative budget, such as by increasing the reflection
20 of sunlight back to space, with the aim of reducing warming. Several SRM options have been proposed,
21 including Stratospheric Aerosol Injection (SAI), Marine Cloud Brightening (MCB), Ground-Based
22 Albedo Modifications, and Ocean Albedo Change (OAC). SRM has been discussed as a potential
23 response option within a broader climate risk management strategy, as a supplement to emissions
24 reduction, carbon dioxide removal and adaptation (Crutzen 2006; Shepherd 2009; Caldeira and Bala
25 2017; Buck et al. 2020), for example as a temporary measure to slow the rate of warming (Keith and
26 MacMartin 2015) or address temperature overshoot (MacMartin et al. 2018; Tilmes et al. 2020). SRM
27 assessments of potential benefits and risks still primarily rely on modelling efforts and their underlying
28 scenario assumptions (Sugiyama et al. 2018a), for example in the context of the Geoengineering Model
29 Intercomparison Project GeoMIP6 (Kravitz et al. 2015). Recently, small-scale MCB and OAC
30 experiments started to take place on the Great Barrier Reef (McDonald et al. 2019).

31 Stratospheric aerosol intervention (SAI) – the most researched SRM method – poses significant
32 international governance challenges since it could potentially be deployed uni- or unilaterally and alter
33 the global mean temperature much faster than any other climate policy measure, at comparatively low
34 direct costs (Parson 2014; Nicholson et al. 2018; Smith and Wagner 2018; Sugiyama et al. 2018b;
35 Reynolds 2019a). While being dependent on the design of deployment systems, both geophysical
36 benefits and adverse effects would potentially be unevenly distributed (WGI Chapter 4). Perceived local
37 harm could exacerbate geopolitical conflicts, not the least depending on which countries are part of a
38 deployment coalition (Maas and Scheffran 2012; Zürn and Schäfer 2013), but also because immediate
39 attribution of climatic impacts to detected SAI deployment would not be possible. Uncoordinated or
40 poorly researched deployment by a limited number of states, triggered by perceived climate
41 emergencies, could create international tensions (Corry 2017; Lederer and Kreuter 2018). An additional
42 risk is that of rapid temperature rise following an abrupt end of SAI activities (Parker and Irvine 2018;
43 Rabitz 2019).

44 While there is room for national and even sub-national governance of SAI – for example on research
45 (differentiating indoor from open-air) (Jinnah et al. 2018; Hubert 2020) and public engagement
46 (Bellamy and Lezaun 2017; Flegal et al. 2019) – international governance of SAI faces the challenge
47 that comprehensive institutional architectures designed too far in advance could prove either too
48 restrictive or too permissive in light of subsequent political, institutional, geophysical and technological
49 developments (Sugiyama et al. 2018a; Reynolds 2019a). Views on governance encompass a broad

1 range, from aiming to restrict to wanting to enable research and potentially deployment; in between
2 these poles, other suggest authors stress the operationalization of the precautionary approach:
3 preventing deployment until specific criteria regarding scientific consensus, impact assessments and
4 governance issues are met (Tedsen and Homann 2013; Wieding et al. 2020). Many scholars suggest
5 that governance arrangements ought to co-evolve with respective SRM technologies (Parker 2014),
6 including that it stay at least one step ahead of research, development, demonstration, and—
7 potentially—deployment (Rayner et al. 2013; Parson 2014). With the modelling community's
8 increasing focus on showing that, and in what ways, SAI could help to minimise climate change impacts
9 in the Global South, the SRM governance literature has come to include considerations of how SAI
10 could contribute to global equity (Horton and Keith 2016; Flegal and Gupta 2018; Hourdequin 2018).

11 Given that risks and potential benefits of SRM proposals differ substantially and their large-scale
12 deployment is highly speculative, there is a wide array of concrete proposals for near-term anticipatory
13 or adaptive governance. Numerous authors suggest a wide range of governance principles; (Nicholson
14 et al. 2018) encapsulate most of these in suggesting a list of four: (1) Guard against potential risks and
15 harm; (2) Enable appropriate research and development of scientific knowledge; (3) Legitimise any
16 future research or policymaking through active and informed public and expert community engagement;
17 (4) Ensure that SRM is considered only as a part of a broader, mitigation-centred portfolio of responses
18 to climate change. Regarding international institutionalisation, options range from formal integration
19 into existing UN bodies like the UNFCCC (Nicholson et al. 2018) or the Convention on Biological
20 Diversity (CBD) (Bodle et al. 2014) to the creation of specific, but less formalised global fora (Parson
21 and Ernst 2013) to forms of club governance (Lloyd and Oppenheimer 2014; Bodansky 2013). Recent
22 years have also seen the emergence of transnational non-state actors focusing on SRM governance,
23 primarily expert networks and NGOs (Horton and Koremenos 2020).

24 Currently, there is no targeted international law relating to SRM, although some multilateral
25 agreements—such as the Convention on Biological Diversity, the UN Convention on the Law of the
26 Sea, the Environmental Modification Convention, or the Vienna Convention on the Protection of the
27 Ozone Layer and its Montreal Protocol—contain provisions applicable to SRM (Jinnah and Nicholson
28 2019; Bodansky 2013; Reynolds 2019a).

29 **14.4.5.2 Carbon Dioxide removal**

30 Carbon dioxide removal refers to a cluster of technologies, practices, and approaches that remove and
31 sequester carbon dioxide from the ocean and atmosphere and durably store it in geological, terrestrial,
32 or ocean reservoirs, or in products (see Table 12.6). In contrast to SRM, CDR does not necessarily
33 impose transboundary risks, except insofar as misleading accounting of its use and deployment could
34 give a false picture of countries' overall mitigation efforts. CDR is clearly a form of climate change
35 mitigation, and as described in chapter 12 is needed to counterbalance residual GHG emissions that
36 may prove hard to abate (e.g., from industry, aviation or agriculture) in the context of reaching net zero
37 emissions both globally – in the context of Article 4 of the Paris Agreement – and nationally. CDR
38 could also later be used for reducing atmospheric CO₂ concentrations by providing net negative
39 emissions on the global level (Fuglestvedt et al. 2018; Bellamy and Geden 2019). Despite the common
40 feature of removing carbon dioxide, technologies like afforestation/reforestation, soil carbon
41 sequestration, bioenergy with carbon capture and storage (BECCS), direct air capture with carbon
42 storage, enhanced weathering, ocean alkalinity enhancement or ocean fertilisation are very different, as
43 are the governance challenges. Chapter 12 highlights the sustainable development risks associated with
44 land and water use that are connected to the biological approaches to CDR. As a public good which
45 largely lacks incentives to be pursued as a business case, most types of CDR require a suite of dedicated
46 policy instruments that address both near-term needs as well as long-term continuity at scale (Honegger
47 et al. 2021b).

1 CDR methods other than afforestation/reforestation and soil carbon sequestration have only played a
2 minor role in UNFCCC negotiations so far (Fridahl 2017; Rumpel et al. 2020). To accelerate, and indeed
3 better manage CDR globally, stringent rules and practices regarding emissions accounting, MRV and
4 project-based market mechanisms have been proposed (Honegger and Reiner 2018; Mace et al. 2018).
5 Given their historic responsibility, it can be expected that developed countries would carry the main
6 burden of researching, developing, demonstrating and deploying CDR, or finance such projects in other
7 countries (Poza et al. 2020; Fyson et al. 2020). McLaren et al. (2019) suggest that there is a rationale
8 for separating the international commitments for net negative emissions from those for emission
9 reductions.

10 Specific regulations CDR options have been limited to those posing transboundary risks, namely the
11 use of ocean fertilization. In a series of separate decisions from 2008 - 13, the London Convention /
12 Protocol parties limited ocean fertilization activities to only those of a research character, and in 2012
13 the CBD made a non-legally binding decision to do the same, further requiring such research activities
14 to be limited scale, and carried out under controlled conditions, until more knowledge is gained to be
15 able to assess the risks (GESAMP 2019; Burns and Corbett 2020). In doing so they have taken a
16 precautionary approach (Sands & Peel, 2018). The London Convention/Protocol has also developed an
17 Assessment Framework for Scientific Research Involving Ocean Fertilisation (London
18 Convention/Protocol 2010) and in 2013 adopted amendments (which are not yet in force) to regulate
19 marine carbon dioxide removal activities, including ocean fertilisation.

22 **14.5 Multi-level, multi-actor governance**

23 The Paris Agreement sets in place a new framework for international climate policy (Paroussos et al.
24 2019), which some cite as evidence of ‘hybrid multilateralism’ (Savaresi 2016; Christoff 2016;
25 Bäckstrand et al. 2017). While a trend of widening involvement of non-state actors was evident prior to
26 conclusion of the Paris Agreement, particularly at UNFCCC COPs, the ‘new landscape of international
27 climate cooperation’ features an ‘intensified interplay between state and non-state actors,’ including
28 civil society and social movements, business actors, and subnational or substate actors, such as local
29 governments and cities (Bäckstrand et al. 2017, p. 562). This involvement of other actors beyond states
30 in international climate cooperation is facilitated by the Paris Agreement’s ‘hybrid climate policy
31 architecture’ (Bodansky et al. 2016) (Section 14.3.1.1 above), which acknowledges the primacy of
32 domestic politics in climate change and invites the mobilisation of international and domestic pressure
33 to make the Agreement effective (Falkner 2016b). In this landscape, there is greater flexibility for more
34 decentralised ‘polycentric’ forms of climate governance and recognition of the benefits of working in
35 diverse forms and groups to realise global climate mitigation goals (Oberthür 2016; Jordan et al. 2015)
36 (see also Chapter 1, 1.9) .

37 Increasing attention has focused on the role of multi-level, multi-actor cooperation among actors,
38 groupings and agreements beyond the UNFCCC climate regime as potential ‘building blocks’ towards
39 enhanced international action on climate mitigation (Falkner 2016a; Caparrós and Péreau 2017; Potoski
40 2017; Stewart et al. 2017). This can include agreements on emissions and technologies at the regional
41 or sub-global level; what scholars often refer to as climate club’ (Nordhaus 2015; Hovi et al. 2016;
42 Green 2017; Sprinz et al. 2018). One forum through which such agreements are often discussed, in
43 support of UNFCCC objectives, are high-level meetings of political leaders, such of the G7 and G20
44 states (Livingston 2016). It also includes cooperation on narrower sets of issues than are found within
45 the Paris Agreement; for instance, other international environmental agreements dealing with a
46 particular subset of GHGs; linkages with, or leveraging of, efforts or agreements in other spheres such

1 as adaptation, human rights or trade; agreements within particular economic sectors; or transnational
2 initiatives involving global cooperative efforts by different types of non-state actors. Cooperative efforts
3 in each of these forums are reviewed in the following sections of the chapter. Section 14.5.1 discusses
4 international cooperation at multiple governance levels (global, sub-global and regional); Section 14.5.2
5 discusses cooperation with international sectoral agreements and institutions such as in the forestry,
6 energy and transportation sectors; and Sections 14.5.3-14.5.5 discuss transnational cooperation across
7 civil society and social movements, business partnerships and investor coalitions, and between sub-
8 national entities and cities, respectively.

9 A key idea underpinning this analysis is that decomposition of the larger challenge of climate mitigation
10 into ‘smaller units’ may facilitate more effective cooperation (Sabel and Victor 2017) and complement
11 cooperation in the UN climate regime (Stewart et al. 2017). However, it is recognised that significant
12 uncertainty remains over the feasibility and costs of these efforts (Sabel and Victor 2017), as well as
13 whether they ultimately strengthen progress on climate mitigation in the multilateral climate arena
14 (Falkner 2016a).

15 16 **14.5.1 International cooperation at multiple governance levels**

17 *14.5.1.1 Role of other environmental agreements*

18 International cooperation on climate change mitigation takes place at multiple governance levels,
19 including under a range of multilateral environmental agreements (MEAs) beyond those of the
20 international climate regime.

21 The 1987 Montreal Ozone Protocol is the leading example of a non-climate MEA with significant
22 implications for mitigating climate change (Barrett 2008). The Montreal Protocol regulates a number
23 of substances that are both ozone depleting substances (ODS) and GHGs with a significant global
24 warming potential (GWP), including chlorofluorocarbons, halons and hydrochlorofluorocarbons
25 (HCFCs). As a result, implementation of phase-out requirements for these substances under the
26 Montreal Protocol has made a significant contribution to mitigating climate change (Molina et al. 2009)
27 (See also Section 9.9.7.1). Velders et al. (2007) found that over the period from 1990 to 2010, the
28 reduction in GWP100-weighted ODS emissions expected with compliance to the provisions of the
29 Montreal Protocol was 8 GtCO₂eq yr⁻¹, an amount substantially greater than the first commitment period
30 Kyoto reduction target. Young et al. (2021) suggest that the Montreal Protocol may also be helping to
31 mitigate climate change through avoided decreases in the land carbon sink.

32 The 2016 Kigali Amendment to the Montreal Protocol applies to the production and consumption of
33 hydrofluorocarbons (HFCs). HFCs, which are widely used as refrigerants (Abas et al. 2018), have a
34 high GWP100 of 14600 for HFC-23, and are not ODS (See also Section 9.9.7.1). The Kigali
35 Amendment addresses the risk that the phase-out of HCFCs under the Montreal Protocol and their
36 replacement with HFCs could exacerbate global warming (Akanle 2010; Hurwitz et al. 2016),
37 especially with the predicted growth in HFC usage for applications like air conditioners (Velders et al.
38 2015). In this way it creates a cooperative rather than a conflictual relationship between addressing
39 ozone depletion and the climate protection goals of the UNFCCC regime (Hoch et al. 2019). The Kigali
40 Amendment requires developed country parties to phase down HFCs by 85% from 2011-2013 levels
41 by 2036. Developing country parties are permitted longer phase-down periods (out to 2045 and 2047),
42 but must freeze production and consumption between 2024 and 2028 (Ripley and Verkuil 2016; UN
43 2016). A ban on trade in HFCs with non-parties will come into effect from 1 January 2033. For HFC-
44 23, which is a by-product of HCFC production rather than an ODS, parties are required to report
45 production and consumption data, and to destroy all emissions of HFC-23 occurring as part of HCFCs
46 or HFCs to the extent practicable from 2020 onwards using approved technologies (Ripley and Verkuil
47 2016).

1 Full compliance with the Kigali Amendment is predicted to reduce HFC emissions by 61% of the global
2 baseline by 2050 (Höglund-Isaksson et al. 2017), with avoided global warming in 2100 due to HFCs
3 from a baseline of 0.3-0.5°C to less than 0.1°C (WMO 2018). Examining the interplay of the Kigali
4 Amendment with the Paris Agreement, Hoch et al. (2019) show how the Article 6 mechanisms under
5 the Paris Agreement could generate financial incentives for HFC mitigation and related energy
6 efficiency improvements. Early action under Article 6 of the Paris Agreement could drive down
7 baseline levels of HFCs for developing countries (calculated in light of future production and
8 consumption in the early and mid-2020s) thus generating long-term mitigation benefits under the Kigali
9 Amendment (Hoch et al. 2019). However, achievement of the objectives of the Kigali Amendment is
10 dependent on its ratification by key developed countries, such as the United States, and the provision
11 of funds by developed countries through the Protocol's Multilateral Fund to meet developing countries
12 agreed incremental costs of implementation (Roberts 2017). The Kigali Amendment came into force
13 on 1 January 2019 and has been ratified by 118 of the 198 parties to the Montreal Protocol.

14 MEAs dealing with transboundary air pollution, such as the Convention on Long-Range Transboundary
15 Air Pollution (CLRTAP) and its implementing protocols, which regulate non-GHGs like particulates,
16 nitrogen oxides and ground-level ozone, can also have potential benefits for climate change mitigation
17 (Erickson 2017). Studies have indicated that rigorous air quality controls targeting short-lived climate
18 forcers, like methane, ozone and black carbon, could slow global mean temperature rise by about 0.5°C
19 by mid-century (Schmale et al. 2014). Steps in this direction were taken with 2012 amendments to the
20 CLRTAP Gothenburg Protocol (initially adopted in 1999) to include black carbon, which is an
21 important driver of climate change in the Arctic region (Yamineva and Kulovesi 2018). The amended
22 Protocol, which has 28 parties including the US and EU, entered into force in October 2019. However,
23 its limits on black carbon have been criticised as insufficiently ambitious in light of scientific
24 assessments (Khan and Kulovesi 2018). There is still a non-negligible uncertainty in the assessment of
25 radiative forcing of each Short-Lived Climate Forcers (SLCFs), and the results of AR6-WGI have been
26 updated since AR5. For example, the assessment of Emission-based Radiative Forcing from Black
27 Carbon emissions was revised downward in AR6 (AR6-WGI-6.4.2). When discussing co-benefits with
28 MEAs related to transboundary air pollution, attention should be paid to the uncertainty in radiative
29 forcing of SLCFs and the update of relevant scientific knowledge.

30 Another MEA that may play a role in aiding climate change mitigation is the 2013 Minamata Mercury
31 Convention, which came into force on 16 August 2017. Coal burning for electricity generation
32 represents the second largest source (behind artisanal and small-scale gold mining) of anthropogenic
33 mercury emissions to air (UNEP 2013). Efforts to control and reduce atmospheric emissions of mercury
34 from coal-fired power generation under the Minamata Convention may reduce GHG emissions from
35 this source (Eriksen and Perrez 2014; Selin 2014). For instance, Giang et al. (2015) have modelled the
36 implications of the Minamata Convention for mercury emissions from coal-fired power generation in
37 India and China, concluding that reducing mercury emissions from present-day levels in these countries
38 is likely to require 'avoiding coal consumption and transitioning toward less carbon-intensive energy
39 sources' (Giang et al. 2015). Parties to the Minamata Convention include five of the six top global CO₂
40 emitters – China, the United States, the EU, India and Japan (Russia has not ratified the Convention).
41 The Minamata Convention also establishes an Implementation and Compliance Committee to review
42 compliance with its provisions on a 'facilitative' basis (Eriksen and Perrez 2014).

43 MEAs that require state parties to conserve habitat (such as the Convention on Biological Diversity) or
44 to protect certain ecosystems like wetlands (such as the Ramsar Wetlands Convention) may also have
45 co-benefits for climate change mitigation through the adoption of well-planned conservation policies
46 (Phelps et al. 2012; Gilroy et al. 2014). At a theoretical level, REDD+ activities have been identified as
47 a particular opportunity for achieving climate mitigation objectives while also conserving tropical forest
48 biodiversity and ecosystem services. Elements of REDD+ that promise greatest effectiveness for

1 climate change mitigation (*e.g.* greater finance combined with reference levels which reduce leakage
2 by promoting broad participation across countries with both high and low historical deforestation rates)
3 also offer the greatest benefits for biodiversity conservation (Busch et al. 2011). However, actual
4 biodiversity and ecosystem service co-benefits are dependent on the design and implementation of
5 REDD+ programmes (Ehara et al. 2014; Panfil and Harvey 2016), with limited empirical evidence to
6 date of emissions reductions from these programmes (Newton et al. 2016; Johnson et al. 2019), and
7 concerns about whether they meet equity and justice considerations (Schroeder and McDermott 2014)
8 (See also Chapter 7, section 7.6.1).

9 ***14.5.1.2 Linkages with sustainable development, adaptation, loss and damage, and human rights***

10 As discussed in Chapter 1, the emerging framing for the issue of climate mitigation is that it is no longer
11 to be considered in isolation but rather in the context of its linkages with other areas. Adaptation, loss
12 and damage, human rights and sustainable development are all areas where there are clear or potential
13 overlaps, synergies, and conflicts with the cooperation underway in relation to mitigation.

14 The IPCC defines adaptation as: 'in human systems, the process of adjustment to actual or expected
15 climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems,
16 the process of adjustment to actual climate and its effect; human intervention may facilitate adjustment
17 to expected climate and its effects' (See Annex I: Glossary).

18 Adaptation involves actions to lessen the harm associated with climate change, or take advantage of
19 potential gains (Smit and Wandel 2006). It can seek to reduce present and future exposure to specific
20 climate risks (Adger et al. 2003), mainstream climate information into existing planning efforts (Gupta
21 et al. 2010; van der Voorn et al. 2012, 2017), and reduce vulnerability (or increase resilience) of people
22 or communities to the effects of climate change (Kasperson and Kasperson 2001). There is a body of
23 literature highlighting potential synergies and conflicts between adaptation actions – in any of the three
24 areas above – and mitigation actions - and potential strategies for resolving them (Locatelli et al. 2011;
25 Casado-Asensio and Steurer 2014; Duguma et al. 2014; Suckall et al. 2015; Watkiss et al. 2015; van
26 der Voorn et al. 2020). In a strategic context, this issue has been analyzed in Bayramoglu et al. (2018),
27 Eisenack and Kähler (2016) and Ingham et al. (2013), among others. Bayramoglu et al. (2018) analyze
28 the strategic interaction between mitigation, as a public good, and adaptation, essentially a private good,
29 showing that the fear that adaptation will reduce the incentives to mitigate carbon emissions may not
30 be justified. On the contrary, adaptation can reduce free-rider incentives (lead to larger self-enforcing
31 agreements), yielding higher global mitigation levels and welfare, if adaptation efforts cause mitigation
32 levels between different countries to be complements instead of strategic substitutes (on the conditions
33 for adaptation and mitigation to be substitutes or complements, see (Ingham et al. 2013).

34 Distinct from project or programmatic level activities, however, international cooperation for adaptation
35 operates to provide finance and technical assistance (Bouwer and Aerts 2006). In most cases it involves
36 transboundary actions, such as in the case of transboundary watershed management (Wilder et al. 2010;
37 Milman et al. 2013; van der Voorn et al. 2017). In others it involves the mainstreaming of climate
38 change projections into existing treaties, such as for the protection of migratory species (Trouwborst et
39 al. 2012).

40 International cooperation in mitigation and adaptation share many of the same challenges, including the
41 need for effective institutions. The UNFCCC, for example, addresses international financial support for
42 adaptation and for mitigation in the same general category, and subjects them to the same sets of
43 institutional constraints (Peterson and Skovgaard 2019). Sovacool and Linnér (2016) argue that the
44 history of the UNFCCC and its sub-agreements has been shaped by an implicit bargain that developing
45 countries participate in global mitigation policy in return for receiving financial and technical assistance
46 for adaptation and development from industrialised countries and international green funds. Khan and
47 Roberts (2013) contend that this played out poorly under the Kyoto framework: the Protocol's basic
48 architecture, oriented around legally binding commitments, was not amenable to merging the issues of

1 adaptation and mitigation. Kuyper et al. Kuyper et al. (2018a) argue that the movement from Kyoto to
2 Paris represents a shift in this regard; Paris was designed not primarily as a mitigation policy instrument,
3 but rather one encompassing mitigation, adaptation, and development concerns. While this argument
4 suggests that the Paris architecture, involving voluntary mitigation actions and a greater attention to
5 issues of financial support and transparency, functions better to leverage adaptation support into
6 meaningful mitigation actions, there are only few papers that examine this issue. Stua (2017a,b)
7 explores the relevance of the so-called 'share of proceeds' included in Article 6 of the Paris Agreement
8 as a key tool for leveraging adaptation through mitigation actions.

9 There are recognised limits to adaptation (Dow et al. 2013), and exceeding these limits results in loss
10 and damage, a topic that is gathering salience in the policy discourse. Roberts et al. (2014) focused on
11 'loss and damage', essentially those climate change impacts which cannot be avoided through
12 adaptation. The Paris Agreement contains a free-standing article on loss and damage (UNFCCC 2015a),
13 focused on cooperation and facilitation, under which parties have established a clearing house on risk
14 transfer, and a task force on displacement (UNFCCC 2016a). The COP decision accompanying the
15 Paris Agreement specifies that 'Article 8 does not involve or provide a basis for any liability or
16 compensation' (UNFCCC 2016a). There is range of views on the treatment of loss and damage in the
17 Paris Agreement, how responsibility for loss and damage should be allocated (Lees 2017; McNamara
18 and Jackson 2019), and how it could be financed (Gewirtzman et al. 2018; Roberts et al. 2017). Some
19 scholars argue that there are continuing options to pursue compensation and liability in the climate
20 change regime (Mace and Verheyen 2016; Gsottbauer et al. 2018). There have also been efforts to
21 establish accountability of companies—particularly 'carbon majors'—for climate damage in domestic
22 courts (Ganguly et al. 2018; Benjamin 2021). For states that have suffered loss and damage there is also
23 the option to pursue 'state responsibility' claims under customary international law and international
24 human rights law (Wewerinke-Singh 2018; Wewerinke-Singh and Salili 2020).

25 One scholar argues that climate impacts are 'incremental violence structurally over-determined by
26 international relations of power and control' that affect most those who have contributed the least to
27 GHG emissions (Dehm 2020). Calls for compensation or reparation for loss and damage are therefore
28 a demand for climate justice (Dehm 2020). Many small island states entered declarations on acceptance
29 of the UNFCCC and Paris Agreement that they continue to have rights under international law regarding
30 state responsibility for the adverse effects of climate change, and that no provision in these treaties can
31 be interpreted as derogating from any claims or rights concerning compensation and liability due to the
32 adverse effects of climate change.

33 The adoption in 2013 of the Warsaw International Mechanism on Loss and Damage as part of the United
34 Nations Framework Convention on Climate Change (UNFCCC) occurred despite the historic
35 opposition of the United States to this policy. Vanhala and Hestbaek (2016) examine the roles of 'frame
36 contestation' (contestations over different framings of loss and damage, whether as 'liability and
37 compensation' or 'risk management and insurance' or other) and ambiguity in accounting for the
38 evolution and institutionalisation of the loss and damage norm within the UNFCCC. However, there is
39 little international agreement on the scope of loss and damage programmes, and especially how they
40 would be funded and by whom (Gewirtzman et al. 2018). Moreover, non-economic loss and damage
41 (NELD) forms a distinct theme that refers to the climate-related losses of items both material and
42 non-material that are not commonly traded in the market, but whose loss is still experienced as such
43 by those affected. Examples of NELD include loss of cultural identity, sacred places, human health
44 and lives (Serdeczny 2019). The Santiago Network is part of the Warsaw International Mechanism, to
45 catalyse the technical assistance of relevant organisations, bodies, networks and experts, for the
46 implementation of relevant approaches to avert, minimise and address loss and damage at the local,
47 national and regional level, in developing countries that are particularly vulnerable to the adverse effects
48 of climate change (UNFCCC 2020c).

1 There are direct links between climate mitigation efforts, adaptation and loss and damage - the higher
2 the collective mitigation ambition and the likelihood of achieving it, the lower the scale of adaptation
3 ultimately needed and the lower the scale of loss and damage anticipated. The liability of states, either
4 individually or collectively, for loss and damage is contested, and no litigation has yet been successfully
5 launched to pursue such claims. The science of attribution, however, is developing (Otto et al. 2017;
6 Skeie et al. 2017; Marjanac and Patton 2018; Patton 2021) and while it has the potential to address the
7 thorny issue of causation, and thus compensation (Stuart-Smith et al. 2021), it could also be used to
8 develop strategies for climate resilience (James et al. 2014).

9 There are also direct links between mitigation and sustainable development. The international agendas
10 for mitigation and sustainable development have shaped each other, around concepts such as common
11 but differentiated responsibilities and respective capabilities, as well as the distinction – in the UNFCCC
12 and later the Kyoto Protocol – between Annex I and non-Annex I countries (Victor 2011; Patt 2015).
13 The same implicit bargain that developing countries would support mitigation efforts in return for
14 assistance with respect to adaptation also applies to support for development (Sovacool and Linnér
15 2016). That linkage between mitigation and sustainable development has become even more specific
16 with the Paris Agreement and the 2030 Agenda for Sustainable Development, each of which explicitly
17 pursues a set of goals that encompass both mitigation and development (Schmieg et al. 2017), reflecting
18 the recognition that achieving sustainable development and climate mitigation goals are mutually
19 dependent (Gomez-Echeverri 2018). It is well-accepted that the long-term effects of climate mitigation
20 will benefit sustainable development. A more contested finding is whether the mitigation actions
21 themselves promote or hinder short-term poverty alleviation. One study, analysing the economic effects
22 of developing countries' NDCs, finds that mitigation actions slow down poverty reduction efforts
23 (Campagnolo and Davide 2019). Other studies suggest possible synergies between low-carbon
24 development and economic development (Hanger et al. 2016; Labordena et al. 2017; Dzebo et al. 2019).
25 These studies typically converge on the fact that financial assistance flowing from developed to
26 developing countries enhances any possible synergies or lessens the conflicts. However, mitigation
27 measures can also have negative impacts on gender equality, and peace and justice (Dzebo et al. 2019).
28 The IMF has also taken on board the climate challenge and is examining the role of fiscal and
29 macroeconomic policies to address the climate challenge for supporting its members with appropriate
30 policy responses.

31 The literature also identifies institutional synergies at the international level, related to the importance
32 of addressing climate change and development in an integrated, coordinated and comprehensive manner
33 across constituencies, sectors and administrative and geographical boundaries (Le Blanc 2015). The
34 literature also stresses the important role that robust institutions have in making this happen, including
35 in international cooperation in key sectors for climate action as well for development (Waage et al.
36 2015). Since the publication of AR5, which emphasised the need for a type of development that
37 combines both mitigation and adaptation as a way to strengthen resilience, much of the literature has
38 focused on ways to address these linkages and the role institutions play in key sectors that are often the
39 subject of international cooperation – for example, environmental and soil degradation, climate, energy,
40 water resources, forestry (Hogl et al. 2016). An assessment of thematic policy coherence between the
41 voluntary domestic contributions regarding the Paris Agreement and the 2030 Agenda should be
42 integrated in national policy cycles for sustainable and climate policy-making to identify overlaps, gaps,
43 mutual benefits and trade-offs in national policies (Janetschek et al. 2020).

44 It is only since 2008 that the relationship between climate change and human rights has become a focus
45 of international law and policy making. It is not just climate impacts that threaten the enjoyment of
46 human rights but also the mitigation responses to climate change that affect human rights (Shi et al.
47 2017). The issue of human rights–climate change linkages was first taken up by the UN Human Rights
48 Council (HRC) in 2008, but has since rapidly gained ground with UN human rights treaty bodies issuing

1 comments (e.g. (Human Rights Committee 2018)), recommendations (e.g. (Committee on the
2 Elimination of Discrimination against Women 2018)) and even a joint statement (e.g. (Office of the
3 High Commissioner for Human Rights 2019)) on the impacts of climate change on the enjoyment of
4 human rights. Climate change effects and related disasters have the potential to affect human rights
5 broadly, for instance, by giving rise to deaths, disease or malnutrition (right to life, right to health),
6 threatening food security or livelihoods (right to food), impacting upon water supplies and
7 compromising access to safe drinking water (right to water), destroying coastal settlements through
8 storm surge (right to adequate housing), and in some cases forcing relocation as traditional territories
9 become uninhabitable (UNGA 2019). In addition, the right to a healthy environment, recognized in
10 2021 as an autonomous right at the international level by the Human Rights Council (UN Human Rights
11 Council 2021), arguably extends to a right to a ‘safe climate’ shaped in part by the Paris Agreement
12 (UNGA 2019).

13 As the intersections between climate impacts and human rights have become increasingly clear, litigants
14 have begun to use human rights arguments, with a growing receptivity among courts towards such
15 arguments in climate change cases (Peel and Osofsky 2018; Savaresi and Auz 2019; Macchi and van
16 Zeben 2021). In the landmark Urgenda climate case in 2019, the Dutch Supreme Court interpreted the
17 European Convention on Human Rights in light of customary international law and the UN climate
18 change regime and ordered the state to reduce greenhouse gas emissions by 25% by 2020 compared to
19 1990 (The Supreme Court of the Netherlands 2019). In the Neubauer case in 2021, the German Federal
20 Constitutional Court ordered the German legislature, in light of its obligations, including on rights
21 protections, to set clear provisions for reduction targets from 2031 onward by the end of 2022 (German
22 Constitutional Court 2021). There are cases in the Global South as well (Peel and Lin 2019; Setzer and
23 Benjamin 2020), with the Supreme Court in Nepal in its 2018 decision in Shrestha, ordering the
24 government to amend its existing laws and introduce a new consolidated law to address climate
25 mitigation and adaptation as this would protect the rights to life, food, and a clean environment, and
26 give effect to the 2015 Paris Agreement (The Supreme Court of Nepal 2018). There are dozens of
27 further cases in national and regional courts, increasingly based on human rights claims. and this trend
28 is only likely to grow (Beauregard et al. 2021; Shi et al. 2017; Peel and Osofsky 2018). These cases
29 face procedural hurdles, such as standing, as well as substantive difficulties, for instance, with regard
30 to the primarily territorial scope of state obligations to protect human rights (Mayer 2021; Boyle 2018),
31 however, there are increasing instances of successful outcomes across the world.

32 *14.5.1.3 Trade agreements*

33 As discussed in AR5, policies to open up trade can have a range of effects on GHG emissions, just as
34 mitigation policies can influence trade flows among countries. Trade rules may impede mitigation
35 action by limiting countries’ discretion in adopting trade-related climate policies, but they also have the
36 potential to stimulate the international adoption and diffusion of mitigation technologies and policies
37 (Droege et al. 2017).

38 The mitigation impacts of trade agreements are difficult to ascertain, and the limited evidence is mixed.
39 Examining the effects of three free trade agreements (FTAs) – Mercosur, the North American Free
40 Trade Agreement (NAFTA) and the Australia-United States Free Trade Agreement – on GHG
41 emissions, (Nemati et al. 2019) find that these effects depend on the relative income levels of the
42 countries involved, and that FTAs between developed and developing countries may increase emissions
43 in the long run. However, studies also suggest that FTAs incorporating specific environmental or
44 climate-related provisions can help reduce GHG emissions (Baghdadi et al. 2013; Sorgho and Tharakan
45 2020).

46 Investment agreements, which are often integrated in FTAs, seek to encourage the flow of foreign
47 investment through investment protection. While international investment agreements hold potential to
48 increase low-carbon investment in host countries (PAGE 2018), these agreements have tended to protect

1 investor rights, constraining the latitude of host countries in adopting environmental policies (Miles
2 2019). Moreover, international investment agreements may lead to ‘regulatory chill’, which may lead
3 to countries refraining from or delaying the adoption of mitigation policies, such as phasing out fossil
4 fuels (Tienhaara 2018). More contemporary investment agreements seek to better balance the rights and
5 obligations of investors and host countries, and in theory offer greater regulatory space to host countries
6 (UNCTAD 2019), although it is unclear to what extent this will hold true in practice.

7 In their NDCs, parties mention various trade-related mitigation measures, including import bans,
8 standards and labelling schemes, border carbon adjustments (BCAs; see also Chapter 13), renewable
9 energy support measures, fossil fuel subsidy reform, and the use of international market mechanisms
10 (Brandi 2017). Some of these ‘response measures’ (Chan 2016b) may raise questions concerning their
11 consistency with trade agreements of the World Trade Organisation (WTO). Non-discrimination is one
12 of the foundational rules of the WTO. This means, among others, that ‘like’ imported and domestic
13 products are not treated differently (‘national treatment’) and that a WTO member should not
14 discriminate between other members (‘most-favoured-nation treatment’). These principles are
15 elaborated in a set of agreements on the trade in goods and services, including the General Agreement
16 on Tariffs and Trade (GATT), the General Agreement on Trade in Services (GATS), the Agreement on
17 Technical Barriers to Trade (TBT), and the Agreement on Subsidies and Countervailing Measures
18 (ASCM).

19 Several measures that can be adopted as part of carbon pricing instruments to address carbon leakage
20 concerns have been examined in the light of WTO rules. For instance, depending on the specific design,
21 the free allocation of emissions allowances under an ETS could be considered a subsidy inconsistent
22 with the ASCM (Rubini and Jegou 2012; Ismer et al. 2021). The WTO compatibility of another measure
23 to counter carbon leakage, BCAs, has also been widely discussed (Box 14.2). Alternatives to BCAs,
24 such as consumption charges on carbon-intensive materials (Pollitt et al. 2020), can be consistent with
25 WTO law, as they do not involve discrimination between domestic and foreign products based on their
26 carbon intensity (Ismer and Neuhoff 2007; Tamiotti 2011; Pauwelyn 2013; Holzer 2014; Ismer and
27 Haussner 2016; Cosbey et al. 2019; European Commission 2019; Mehling et al. 2019; Porterfield 2019;
28 Ismer et al. 2020).

29

30 **START BOX 14.2 HERE**

31 **Box 14.2 Border carbon adjustments and international climate and trade cooperation**

32 Analyses of the WTO compatibility of BCAs (Hillman 2013; Trachtman 2017; Ismer and Neuhoff
33 2007; Tamiotti 2011; Pauwelyn 2013; Holzer 2014; Cosbey et al. 2019; Mehling et al. 2019; Porterfield
34 2019) gained new currency following the legislative proposal to introduce a ‘carbon border adjustment
35 mechanism’ in the EU (European Commission 2021). BCAs can in principle be designed and
36 implemented in accordance with international trade law, but the details matter (Tamiotti et al. 2009).
37 To increase the likelihood that a BCA will be compatible with international trade law, studies suggest
38 that it would need to: have a clear environmental rationale (i.e. reduce carbon leakage); apply to imports
39 and exclude exports; consider the actual carbon intensity of foreign producers; account for the
40 mitigation efforts by other countries; and provide for fairness and due process in the design and
41 implementation (Trachtman 2017; Pauwelyn 2013; Cosbey et al. 2019; Mehling et al. 2019).

42 BCAs may also raise concerns regarding their consistency with international climate change agreements
43 (Hertel 2011; Davidson Ladly 2012; Ravikumar 2020). To mitigate these concerns, BCAs could include
44 special provisions (e.g. exemptions) for LDCs, or channel revenues from the BCA to developing
45 countries to support low-carbon and climate-resilient development (Grubb 2011; Springmann 2013;
46 Mehling et al. 2019). Moreover, international dialogue on principles and best practices guiding BCAs

1 could help to ensure that such measures do not hinder international cooperation on climate change and
2 trade (Bernasconi-Osterwalder and Cosbey 2021).

3 **END BOX 14.2 HERE**

4

5 Other regulatory measures may also target the GHG emissions associated with the production of goods
6 (Dobson 2018). These measures include bans on carbon-intensive materials, emissions standards for
7 the production process of imported goods, and carbon footprint labels (Kloeckner 2012; Holzer and
8 Lim 2020; Gerres et al. 2021). The compatibility of such measures with trade agreements remains
9 subject to debate. While non-discriminatory measures targeting the emissions from a product itself (e.g.
10 fuel efficiency standards for cars) are more likely to be allowed than measures targeting the production
11 process of a good (Green 2005), some studies suggest that differentiation between products based on
12 their production process may be compatible with WTO rules (Benoit 2011; McAusland and Najjar
13 2015). (Mayr et al. 2020) find that sustainability standards targeting the emissions from indirect land-
14 use change associated with the production of biofuels may be inconsistent with the TBT Agreement.
15 Importantly, trade rules express a strong preference for the international harmonisation of standards
16 over unilateral measures (Delimatsis 2016).

17 Renewable energy support measures may be at odds with the ASCM, the GATT, and the WTO
18 Agreement on Trade-Related Investment Measures. In WTO disputes, measures adopted in Canada,
19 India, and the United States to support clean energy generation were found to be inconsistent with WTO
20 law due to the use of discriminatory local content requirements, such as the requirement to use
21 domestically produced goods in the production of renewable energy (Cosbey and Mavroidis 2014;
22 Kulovesi 2014; Lewis 2014; Wu and Salzman 2014; Charnovitz and Fischer 2015; Shadikhodjaev 2015;
23 Espa and Marín Durán 2018).

24 Some measures may both lower trade barriers and potentially bring about GHG emission reductions.
25 An example is the liberalisation of trade in environmental goods (Hu et al. 2020). In 2012, the APEC
26 economies agreed to reduce tariffs for a list of 54 environmental goods (including e.g. solar cells; but
27 excluding e.g. biofuels or batteries for electric vehicles). However, negotiations on an Environmental
28 Goods Agreement under the WTO stalled in 2016 due in part to disagreement over which goods to
29 include (de Melo and Solleder 2020). Another example is fossil fuel subsidy reform, which may reduce
30 GHG emissions (Jewell et al. 2018; Chepeliev and van der Mensbrugge 2020; Erickson et al. 2020)
31 and lower trade distortions (Burniaux et al. 2011; Moerenhout and Irschlinger 2020). However, fossil
32 fuel subsidies have largely remained unchallenged before the WTO due to legal and political hurdles
33 (Asmelash 2015; De Bièvre et al. 2017; Meyer 2017; Steenblik et al. 2018; Verkuijl et al. 2019).

34 With limited progress in the multilateral trading system, some studies suggest that regional FTAs hold
35 potential for strengthening climate governance. In some cases, climate-related provisions in such FTAs
36 can go beyond provisions in the Kyoto Protocol and Paris Agreement, addressing for instance
37 cooperation on carbon markets or electric vehicles (Gehring et al. 2013; van Asselt 2017; Morin and
38 Jinnah 2018; Gehring and Morison 2020). However, Morin and Jinnah (2018) find that these provisions
39 are at times vaguely formulated, not subject to third-party dispute settlement, and without sanctions or
40 remedy in case of violations. Moreover, such provisions are not widely used in FTAs, and they are not
41 adopted by the largest GHG emitters. For instance, the 2019 United States-Mexico-Canada Agreement,
42 NAFTA's successor, does not include any specific provisions on climate change, although it could
43 implement cooperative mitigation actions through its Commission for Environmental Cooperation
44 (Laurens et al. 2019).

45 A trend in international economic governance has been the adoption of 'mega-regional' trade
46 agreements involving nations responsible for a substantial share of world trade, such as the
47 Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), the EU-Canada

1 Comprehensive Economic and Trade Agreement (CETA), and the Regional Comprehensive Economic
2 Partnership (RCEP) in East Asia. Given the size of the markets covered by these agreements, they hold
3 potential to diffuse climate mitigation standards (Meltzer 2013; Holzer and Cottier 2015). While CETA
4 includes climate-related provisions and parties have made a broad commitment to implement the Paris
5 Agreement (Laurens et al. 2019), and the CPTPP includes provisions promoting cooperation on clean
6 energy and low-emissions technologies, the RCEP does not include specific provisions on climate
7 change.

8 Studies have discussed various options to minimise conflicts, and strengthen the role of trade
9 agreements in climate action, although the mitigation benefits and distributional effects of these options
10 have yet to be assessed. Some options require multilateral action, including: (1) the amendment of
11 WTO agreements to accommodate climate action; (2) the adoption of a ‘climate waiver’ that
12 temporarily relieves WTO members from their obligations; (3) a ‘peace clause’ through which members
13 commit to refraining from challenging each other’s measures; (4) an ‘authoritative interpretation’ by
14 WTO members of ambiguous WTO provisions; (5) improved transparency of the climate impacts of
15 trade measures; (6) the inclusion of climate expertise in WTO disputes; and (7) intensified institutional
16 coordination between the WTO and UNFCCC (Hufbauer et al. 2009; Epps and Green 2010; Bacchus
17 2016; Droege et al. 2017; Das et al. 2019). In addition, issue-specific suggestions have been put forward,
18 such as reinstating an exception for environmentally motivated subsidies under the ASCM (Horlick and
19 Clarke 2017).

20 Options can also be pursued at the plurilateral and regional level. Several studies suggest that climate
21 clubs (see Section 14.2.2) could employ trade measures, such as lower tariffs for climate-related goods
22 and services, or BCAs, to attract club members (Nordhaus 2015; Brewer et al. 2016; Keohane et al.
23 2017; Stua 2017a; Banks and Fitzgerald 2020). Another option is to negotiate a new agreement
24 addressing both climate change and trade. Negotiations between six countries (Costa Rica, Fiji, Iceland,
25 New Zealand, Norway, Switzerland) were launched in 2019 on a new Agreement on Climate Change,
26 Trade and Sustainability (ACCTS), which, if successfully concluded, would liberalise trade in
27 environmental goods and services, create new rules to remove fossil fuel subsidies, and develop
28 guidelines for voluntary eco-labels (Steenblik and Droege 2019). At the regional level, countries could
29 further opt for the inclusion of climate provisions in the (re)negotiation of FTAs (Yamaguchi 2020;
30 Morin and Jinnah 2018). Moreover, the conduct of climate impact assessments of FTAs could help
31 identify options to achieve both climate and trade objectives (Porterfield et al. 2017). In their assessment
32 of the feasibility of various options for reform, Das et al. (2019) find that the near-term feasibility of
33 options that require consensus at the multilateral level (notably amendments of WTO agreements) is
34 low. By contrast, options involving a smaller number of parties, as well as options that can be
35 implemented by WTO members on a voluntary basis, face fewer constraints.

36 For international investment agreements, various other suggestions have been put forward to
37 accommodate climate change concerns. These include incorporating climate change through ongoing
38 reform processes, such as reform of investor-state dispute settlement under the UN Commission on
39 International Trade Law (UNCITRAL); modernisation of the Energy Charter Treaty; the (re)negotiation
40 of international investment agreements; and the adoption of a specific treaty to promote investment in
41 climate action (Brauch et al. 2019; Tienhaara and Cotula 2020; Yamaguchi 2020; Cima 2021).

42 **14.5.1.4 South-South cooperation**

43 South-South (SSC) and triangular (TrC) cooperation are bold, innovative, and rapidly developing means
44 of strengthening cooperation for the achievement of the SDGs (FAO 2018). SSC is gaining momentum
45 in achieving sustainable development and climate actions in developing countries (UN 2017b). Through
46 SSC, countries are able to map their capacity needs and knowledge gaps and find sustainable, cost-
47 effective, long-lasting and economically viable solutions (FAO 2019). In the UN Climate Change

1 Engagement Strategy 2017 (UNOSC 2017), South-South Cooperation Action Plan is identified as a
2 substantive pillar to support.

3 In 2019, the role of South-South and triangular cooperation was further highlighted with the BAPA+40
4 Outcome document (UN 2019), noting outstanding contributions to alleviating global inequality,
5 promoting sustainable development and climate actions, promoting gender equality and enriching
6 multilateral mechanisms. Furthermore, the role of triangular cooperation was explicitly recognized in
7 the document reflecting its increasingly relevant role in the implementation of the SDGs (UN 2019).

8 There has been a recent resurgence of South-South cooperation. Gray and Gills (Gray and Gills 2016),
9 signalled inter alia by the South-South Cooperation Action Plan adopted by the UN as a substantive
10 pillar to support the implementation of the UN Climate Change Engagement Strategy 2017 (UNOSC
11 2017). (Liu et al. 2017a) explored prospects for South–South cooperation for large-scale ecological
12 restoration, which is an important solution to mitigate climate change. Emphasis is given to experience
13 and expertise sharing, co-financing, and co-development of new knowledge and know-how for more
14 effective policy and practice worldwide, especially in developing and newly industrialised countries.

15 Janus et al. (2014) explore evolving development cooperation and its future governance architecture
16 based on The Global Partnership for Effective Development Cooperation (GPEDC) and The United
17 Nations (UN) Development Cooperation Forum (DCF). Drawing on evidence from the hydropower,
18 solar and wind energy industry in China, Urban (2018) introduces the concept of ‘geographies of
19 technology transfer and cooperation’ and challenges the North-South technology transfer and
20 cooperation paradigm for low carbon innovation and climate change mitigation. While North-South
21 technology transfer and cooperation (NSTT) for low carbon energy technology has been implemented
22 for decades, South-South technology transfer and cooperation (SSTT) and South-North technology
23 transfer and cooperation (SNTT) have only recently emerged. Kirchherr and Urban (2018) provide a
24 meta-synthesis of the scholarly writings on NSTT, SSTT and SNTT from the past 30 years. The
25 discussion focuses on core drivers and inhibitors of technology transfer and cooperation, outcomes as
26 well as outcome determinants. A case study of transfer of low-carbon energy innovation and its
27 opportunities and barriers, based on first large Chinese-funded and Chinese-built dam in Cambodia is
28 presented by Hensengerth (2017).

29 Hensengerth (2017) explore the role that technology transfer/cooperation from Europe played in
30 shaping firm level wind energy technologies in China and India and discuss the recent technology
31 cooperation between the Chinese, Indian, and European wind firms. The research finds that firm-level
32 technology transfer/cooperation shaped the leading wind energy technologies in China and to a lesser
33 extent in India. Thus, the technology cooperation between China, India, and Europe has become multi-
34 faceted and increasingly Southern-led.

35 Rampa et al. (2012) focus on the manner in which African states understand and approach new
36 opportunities for cooperation with emerging powers, especially China, India and Brazil, including the
37 crucial issue of whether they seek joint development initiatives with both traditional partners and
38 emerging powers. UN (2018) presents and analyses case studies of SSTT in Asia-Pacific and Latin
39 America and Caribbean regions. Illustrative case studies on TrC can be consulted in Shimoda and
40 Nakazawa (2012), and specific cases on biofuel SSC and TrC in UNCTAD (2012).

41 The central argument in the majority of these case studies is that South–South cooperation, which is
42 value-neutral, is contributing to sustainable development and capacity building (Rampa et al. 2012;
43 Shimoda and Nakazawa 2012; UN 2018). An important new development in SSC is that in relation to
44 some technologies the cooperation is increasingly led by Southern countries (for instance, wind energy
45 between Europe, India and China), challenging the classical North–South technology cooperation
46 paradigm. More broadly, parties should ensure the sustainability of cooperation, rather than focusing
47 on short-term goals (Eyben 2013). The Belt and Road Initiative (BRI) is a classic example of a recent

1 SSC Initiative led by China. According to a joint study by Tsinghua University and Vivid Economics
2 the 126 countries in the BRI region, excluding China, currently account for about 28% of global GHG
3 emissions, but this proportion may increase to around 66% by 2050 if the carbon intensity of these
4 economies only decreases slowly (according to historical patterns shown by developing countries). In
5 this context it is important to highlight that China has already outlined a vision for a green BRI, and
6 recently increased its commitment through the Green Investment Principles (GIP) initiative, announcing
7 a new international coalition to improve sustainability and promote green infrastructure (Jun and Zadek
8 2019).

9 Information on triangular cooperation is more readily available than on South-South cooperation though
10 some UN organisations such as UNDP and FAO have established platforms for the latter which also
11 includes climate projects. Further, although there are many South-South cooperation initiatives
12 involving the development and transfer of climate technologies the understanding of the motivations,
13 approaches and designs is limited and not easily accessible. There is no dedicated platform for South-
14 South and triangular cooperation on climate technologies. Hence, it is still too early to fully assess the
15 achievements in the field of climate action (UNFCCC and UNOSSC 2018). In order to maximise its
16 unique contribution to Agenda 2030, southern providers recognise the benefits of measuring and
17 monitoring South–South cooperation, and there is a clear demand for better information from partner
18 countries. Di Ciommo (2017) argues that ‘better data could support monitoring and evaluation, improve
19 effectiveness, explore synergies with other resources, and ensure accountability’ to a diverse set of
20 stakeholders. Besharati et al. (2017) present a framework of 20 indicators, organised in five dimensions
21 that researchers and policy makers can use to assess the quality and effectiveness of SSC and its
22 contribution to sustainable development.

23 The global landscape of development cooperation has changed dramatically in recent years, with
24 countries of the South engaging in collaborative learning models to share innovative, adaptable and
25 cost-efficient solutions to their development and socio-economic-environmental challenges, ranging
26 from poverty and education to climate change. The proliferation of new actors and cross-regional
27 modalities had enriched the understanding and practice of development cooperation and generated
28 important changes in the global development architecture towards a more inclusive, effective, and
29 horizontal development agenda. South-South cooperation will grow in the future, while it is
30 complimentary to North-South cooperation. However, there are knowledge gaps in relation to the
31 precise volume, impact, effectiveness and quality of development cooperation from emerging
32 development partners. This gap needs to be plugged, and evidence on such cooperation strengthened.

34 **14.5.2 International sectoral agreements and institutions**

35 Sectors refer to distinct areas of economic activity, often subject to their own governance regimes;
36 examples include energy production, mobility, and manufacturing. A sectoral agreement could include
37 virtually any type of commitment with implications for mitigation. It could establish sectoral emission
38 targets, on either an absolute or an indexed basis. It could also require states (or particular groups of
39 states, if commitments are differentiated) to adopt uniform or harmonised policies and measures for a
40 sector, such as technology-based standards, taxes, or best-practice standards, as well as providing for
41 cooperation on technology research or deployment.

42 **14.5.2.1 Forestry, land-use and REDD+**

43 Since 2008, several, often overlapping, voluntary and non-binding international efforts and agreements
44 have been adopted to reduce net emissions from the forestry sector. These initiatives have varying levels
45 of private sector involvement and different objectives, targets, and timelines. Some efforts focus on
46 reducing emissions from deforestation and degradation, while other focus on the enhancement of sinks
47 through restoration of cleared or degraded landscapes. These initiatives do not elaborate specific

1 policies, procedures, or implementation mechanisms. They set targets, frameworks, and milestones,
2 aiming to catalyse further action, investment, and transparency in conservation and consolidate
3 individual country efforts.

4 After the UN-sponsored Tropical Forestry Action Plan (Winterbottom 1990; Seymour and Busch 2016),
5 among the longest standing programs in the forestry sector are the World Bank-sponsored F Forest
6 Carbon Partnership Facility in 2007, which helps facilitate funding for REDD+ readiness and specific
7 projects, in addition to preparing countries for results-based payments and future carbon markets while
8 securing local communities' benefits managed sub-nationally, and the UN REDD+ Programme
9 initiated in 2008, which aims to reduce forest emissions and enhance carbon stocks in forests while
10 contributing to national sustainable development in developing countries, after the 2007 COP13 in Bali
11 formally adopted REDD+ in the UNFCCC decisions and incorporated it in the Bali Plan of Action. As
12 discussed above, Article 5 of the Paris Agreement encourages parties to take action to implement and
13 support REDD+. These efforts tend to focus on reducing emissions through the creation of protected
14 areas, payments for ecosystem services, and/or land tenure reform (Pirard et al. 2019). The UNREDD+
15 programme supports national REDD+ efforts, inclusion of stakeholders in relevant dialogues, and
16 capacity building toward REDD+ readiness in partner countries. To date the conservation and emissions
17 impacts of REDD+ remain misunderstood (Pirard et al. 2019), but while existing evidence suggests that
18 reductions in deforestation from subnational REDD+ initiatives have been limited (Bos et al. 2017) it
19 shows an increasing prominence (Maguire et al. 2021). Additionally, the Green Climate Fund has
20 carried out results-based payments within REDD+. Eight countries have so far received significant
21 funding (GCF 2021). The shift in the REDD+ focus from ecosystem service payment to domestic policy
22 realignments and incentive structure has changed the way REDD+ was developed and implemented
23 (Brockhaus et al. 2017). Large-scale market resources have not fully materialised as a global carbon
24 market system that explicitly integrates REDD+ remains under development (Angelsen 2017). Public
25 funding for REDD+ is also limited (Climate Focus 2017). Leading up to the adoption of the Paris
26 Agreement, the governments of Germany, Norway, and the United Kingdom formed a partnership in
27 2014 called 'GNU' to support results-based financing for REDD+, with Norway emerging as one of, if
28 not the single largest major donor for REDD+ through its pledge in 2007 of approximately USD3 billion
29 annually. Norway pledged USD1 billion for Brazil in 2008 and the same for Indonesia in 2010
30 (Schroeder et al. 2020). Meanwhile, REDD+ Early Movers was established with support from
31 Germany, and the Central African Forest Initiative (CAFI), a collaborative partnership between the
32 European Union, Germany, Norway, France, and the United Kingdom. It supports six central African
33 countries in fighting deforestation.

34 More recently, the Lowering Emissions by Accelerating Forest Finance (LEAF) Coalition was
35 established, consisting of the governments of Norway, the UK, and the US and initially nine companies
36 in accelerating REDD+ with a jurisdictional approach. LEAF uses the Architecture for REDD+
37 Transaction, The REDD+ Environmental Excellence Standard (ART-TREES), is coordinated by
38 Emergent, a non-profit intermediary between tropical countries and the private sector. Three
39 jurisdictions in Brazil and two countries have already submitted concept notes to ART to receive results-
40 based payments. REDD+ initiatives with a jurisdictional approach have also been adopted in various
41 markets, such as the CORSIA (Maguire 2021). In addition to Brazil, Indonesia has attracted significant
42 interest as a host country for REDD+. Indonesia ranks second, after Brazil, as the largest producer of
43 deforestation-related GHG emissions (Zarin et al. 2016), but it has committed to a large reduction of
44 deforestation in its NDC (Government of Indonesia 2016). Australia has collaborated on scientific
45 research and emission reduction monitoring (Tacconi 2017). It took a while, however, before emission
46 reductions were witnessed (Meehan et al. 2019). The expansion of commodity plantations, however,
47 conflict with reduction ambitions (Anderson et al. 2016; Irawan et al. 2019) In addition to
48 implementation at the site and jurisdictional levels, legal enforcement (Tacconi et al. 2019) as well as
49 policy and regulatory reforms (Ekawati et al. 2019) appears to be needed.

1 Another relevant initiative is one under the 2015 United Nations Convention to Combat Desertification
2 (UNCCD), which targets land degradation neutrality i.e., ‘a state whereby the amount and quality of
3 land resources, necessary to support ecosystem functions and services and enhance food security,
4 remains stable or increases within specified temporal and spatial scales and ecosystems’ (Orr et al.
5 2017). This overarching goal was recognised as also being critical to reaching the more specific avoided
6 deforestation and degradation and restoration goals of the UNFCCC and UNCBD. The Land
7 Degradation Neutrality (LDN) initiative from UNCCD includes target setting programmes (TSP) that
8 assist countries by providing practical tools and guidance for the establishment of the voluntary targets
9 and formulate associated measures to achieve LDN and accelerate implementation of projects (Chasek
10 et al. 2019). Today, 124 countries have committed to their LDN national targets (UNCCD 2015). The
11 LDN Fund is an investment vehicle launched in UNCCD COP 13 in 2017, which exists to provide long-
12 term financing for private projects and programmes for countries to achieve their LDN targets.
13 According to the UNCCD, most of the funds will be invested in developing countries.

14 Recent efforts towards the enhancement of sinks from the forestry sector have the overarching goal of
15 reaching zero *gross* deforestation globally, i.e., eliminating the clearing of all natural forests. The New
16 York Declaration on Forests (NYDF) was the first international pledge to call for a halving of natural
17 forest loss by 2020 and the complete elimination of natural forest loss by 2030 (Climate Focus 2016).
18 It was endorsed at the United Nations Climate Summit in September 2014. By September 2019 the list
19 of NYDF supporters included over 200 actors: national governments, sub-national governments, multi-
20 national companies, groups representing indigenous communities, and non-government organisations.
21 These endorsers have committed to doing their part to achieve the NYDF’s ten goals, which include
22 ending deforestation for agricultural expansion by 2020, reducing deforestation from other sectors,
23 restoring forests, and providing financing for forest action (Forest Declaration 2019). These goals are
24 assessed and tracked through the NYDF Progress Assessment, which includes NYDF Assessment
25 Partners that collect data, generate analysis, and release the finding based on the NYDF framework and
26 goals.

27 The effectiveness of these agreements, which lack binding rules, can only be judged by the
28 supplementary actions they have catalysed. The NYDF contributed to the development of several other
29 zero-deforestation pledges, including the Amsterdam Declarations by seven European nations to
30 achieve fully sustainable and deforestation-free agro-commodity supply chains in Europe by 2020 and
31 over 150 individual company commitments to not source products associated with deforestation
32 (Donofrio et al. 2017; Lambin et al. 2018). Recent studies indicate that these efforts currently lack the
33 potential to achieve wide-scale reductions in clearing and associated emissions due to weak
34 implementation (Garrett et al. 2019), although in some cases in Indonesia and elsewhere the commodity
35 supply chain sustainability drive appears to contribute to lowering deforestation (Wijaya et al. 2019;
36 Chain Reaction Research 2020; Schulte et al. 2020). The NYDF may have triggered small additional
37 reductions in deforestation in some areas, particularly for soy, and to a lesser extent cattle, in the
38 Brazilian Amazon (Lambin et al. 2018), but these effects were temporary, as efforts are being actively
39 reversed and deforestation has increased again significantly. Deforestation rates have escalated in
40 Brazil, with the rate in June 2019 (the first dry-season month in the new administration) up 88% over
41 the 2018 rate in the same month (INPE 2019). Curtis et al. (2018) find global targets are clearly not
42 being met. More recent increase in deforestation rate remains to be assessed. NYDF confirms that the
43 initiative did not reach its zero-deforestation goal (NYDF Assessment Partners 2020).

44 In 2010, the parties to the CBD adopted the Strategic Plan for Biodiversity 2011–2020 which included
45 20 targets known as the Aichi Biodiversity targets (Marques et al. 2014). Of relevance to the forestry
46 sector, Aichi Target 15 sets the goal of enhancing ecosystem resilience and the contribution of
47 biodiversity to carbon stocks through conservation and restoration, including ‘restoration of at least 15%
48 of degraded ecosystems’ (UNCBD 2010). The plan elaborates milestones, including the development

1 of national plans for potential restoration levels and contributions to biodiversity protection, carbon
2 sequestration, and climate adaptation to be integrated into other national strategies, including REDD+.
3 In 2020, however, the CBD found that while progress was evident for the majority of the Aichi
4 Biodiversity Targets, it was not sufficient for the achievement of the targets by 2020 (CBD 2020).

5 Recent efforts toward negative emissions through restoration include the Bonn Challenge, the African
6 Forest Landscape Restoration Initiative (AFR 100) and Initiative 20X20. The Bonn Challenge, initiated
7 in 2011 by the Government of Germany and the IUCN, is intended to catalyse the existing international
8 AFOLU commitments. It aims to bring 150 million hectares (Mha) of the world's deforested and
9 degraded land into restoration by 2020, and 350 Mha by 2030. AFR has the goal of restoring 100 Mha
10 specifically in Africa (AUDA-NEPAD 2019), while 20X20 aims to restore 20 Mha in Latin America
11 and the Caribbean (Anderson and Peimbert 2019). Increasing commitments for restoration have created
12 momentum for restoration interventions (Chazdon et al. 2017; Mansourian et al. 2017; Djenontin et al.
13 2018). To date 97 Mha has been pledged in NDCs. Yet only a small part of this goal has been achieved.
14 The Bonn Challenge Barometer – a progress-tracking framework and tool to support pledgers - indicates
15 that 27 Mha (InfoFLR 2018) are currently being restored, equivalent to 1.379 GtCO₂eq sequestered
16 (Dave et al. 2019). A key challenge in scaling up restoration has been to mobilise sufficient financing
17 (Liagre et al. 2015; Djenontin et al. 2018). This underscores the importance of building international
18 financing for restoration (equivalent to the Forest Carbon Partnership Facility focused on avoided
19 deforestation and degradation).

20 In sum, existing international agreements have had a small impact on reducing emissions from the
21 AFOLU sector and some success in achieving the enhancement of sinks through restoration. However,
22 these outcomes are nowhere near levels required to meet the Paris Agreement temperature goal –which
23 would require turning land use and forests globally from a net anthropogenic source during 1990-2010
24 to a net sink of carbon by 2030, and providing a quarter of emission reductions planned by countries
25 (Grassi et al. 2017). The AFOLU sector has so far contributed only modestly to net mitigation (see
26 Chapter 7).

27 **14.5.2.2 Energy sector**

28 International cooperation on issues of energy supply and security has a long and complicated history.
29 There exists a plethora of institutions, organisations, and agreements concerned with managing the
30 sector. There have been efforts to map the relevant actors, with authors in one case identifying six
31 primary organisations (Kérébel and Keppler 2009), in another sixteen (Lesage et al. 2010), and in a
32 third fifty (Sovacool and Florini 2012). At the same time, very little of that history has had climate
33 mitigation as its core focus. Global energy governance has encompassed five broad goals – security of
34 energy supply and demand, economic development, international security, environmental
35 sustainability, and domestic good governance – and as only one of these provides an entry point for
36 climate mitigation, effort in this direction has often been lost (van de Graaf and Colgan 2016). To take
37 one example, during the 1980s and 1990s a combination of bilateral development support and lending
38 practices from multilateral development banks pushed developing countries to adopt power market
39 reforms consistent with the Washington Consensus: towards liberalised power markets and away from
40 state-owned monopolies. The goals of these reforms did not include an environmental component, and
41 among the results was new investment in fossil-fired thermal power generation (Foster and Rana 2020).

42 As Goldthau and Witte (2010) document, the majority of governance efforts, outside of oil and gas
43 producing states, was oriented towards ensuring reliable and affordable access for oil and gas imports.
44 For example, the original rationale for the creation of the International Energy Agency (IEA), during
45 the oil crisis of 1973-74, was to manage a mechanism to ensure importing countries' access to oil (van
46 de Graaf and Lesage 2009). On the other side of the aisle, oil exporting countries created the
47 international institution of OPEC to enable them to influence oil output, thereby stabilising prices and
48 revenues for exporting countries (Fattouh and Mahadeva 2013). For years, energy governance was seen

1 as a zero-sum game between these poles (Goldthau and Witte 2010). The only international governance
2 agency focusing on low carbon energy sources was the International Atomic Energy Agency, with a
3 dual mission of promoting nuclear energy and nuclear weapons non-proliferation (Scheinman 1987).

4 More recently, however, new institutions have emerged, and existing institutions have realigned their
5 missions, in order to promote capacity building and global investment in low carbon energy
6 technologies. Collectively, these developments may support the emergence of a nascent field of global
7 sustainable energy governance, in which a broad range of global, regional, national, sub-national and
8 non-state actors, in aggregate, shape, direct and implement the low carbon transition through climate
9 change mitigation activities, which produce concomitant societal benefits (Bruce 2018). Beginning in
10 the 1990s, for example, the IEA began to broaden its mission from one concerned primarily with
11 security of oil supplies, which encompassed conservation of energy resources, to one also concerned
12 with the sustainability of energy use, including work programs on energy efficiency and clean energy
13 technologies and scenarios (van de Graaf and Lesage 2009). Scholars have suggested that it was the
14 widespread perception that the IEA was primarily interested in promoting the continued use of fossil
15 fuels, and underplaying the potential role of renewable technologies, that led a number of IEA member
16 states to successfully push for the creation of a parallel organisation, the International Renewable
17 Energy Agency (IRENA), which was then established in 2009 (van de Graaf 2013). An assessment of
18 IRENA's activities in 2015 suggested that the agency has a positive effect related to three core activities:
19 offering advisory services to member states regarding renewable energy technologies and systems;
20 serving as a focal point for data and analysis for renewable energy; and, mobilising other international
21 institutions, such as multilateral development banks, promoting renewable energy (Urpelainen and Van
22 de Graaf 2015). The United Nations, including its various agencies such as the Committee on
23 Sustainable Energy within the United Nations Economic Commission for Europe, has also played a role
24 in the realignment of global energy governance towards mitigation efforts. As a precursor to SDG 7,
25 the United Nations initiated in 2011 the *Sustainable Energy for All* initiative, which in addition to
26 aiming for universal access to modern energy services, included the goals of doubling the rate of
27 improvement in energy efficiency, and doubling by 2030 the share of renewable energy in the global
28 energy mix (Bruce 2018).

29 Sub-global agreements have also started to emerge, examples of issue-specific climate clubs. In 2015,
30 seventy solar-rich countries signed a framework agreement dedicated towards promoting solar energy
31 development (ISA 2015). In 2017 the Powering Past Coal Alliance was formed, uniting a set of states,
32 businesses, and non-governmental organisations around the goal of eliminating coal-fired power
33 generation by 2050 (Jewell et al. 2019; Blondeel et al. 2020). Scholars have argued that greater attention
34 to supply-side agreements such as this – focusing on reducing and ultimately eliminating the supply of
35 carbon-intensive energy sources – would strengthen the UNFCCC and Paris Agreement (Collier and
36 Venables 2014; Piggot et al. 2018; Asheim et al. 2019; Newell and Simms 2020). Chapter 6 of this
37 report, on energy systems, notes the importance of regional cooperation on electric grid development,
38 seen as necessary to enable higher shares of solar and wind power penetration (RGI 2011). Finally, a
39 number of transnational organisations and activities have emerged, such as *REN21*, a global community
40 of renewable energy experts (REN21 2019), and *RE100*, an NGO led initiative to enlist multilateral
41 companies to shift towards 100% renewable energy in their value chains (RE100 2019).

42 Whether a result of the above activities or not, multilateral development banks' lending practices have
43 shifted in the direction of renewable energy (Delina 2017), a point also raised in Chapter 15 of this
44 Assessment Report. Activities include new sources of project finance, concessional loans, as well as
45 loan guarantees, the latter through the Multilateral Investment Guarantee Agency (Multilateral
46 Investment Guarantee Agency 2019). This appears to matter. For example, Frisari and Stadelmann
47 (2015) find concessional lending by multilateral development banks to solar energy projects in Morocco
48 and India to have reduced overall project costs, due to more attractive financing conditions from

1 additional lenders, as well as reducing the costs to local governments. Labordena et al. (2017) projected
2 these results into the future, and found that with the drop in financing costs, renewable energy projects
3 serving all major demand centres in sub-Saharan Africa could reach cost parity with fossil fuels by
4 2025, whereas without the drop in financing costs associated with concessional lending, this would not
5 be the case. Similarly, Creutzig et al. (2017) suggest that greater international attention to finance could
6 be instrumental in the full development of solar energy.

7 Despite improvements in the international governance of energy, it still appears that a great deal of this
8 is still concerned with promoting further development of fossil fuels. One aspect of this is the
9 development of international legal norms. A large number of bilateral and multilateral agreements,
10 including the 1994 Energy Charter Treaty, include provisions for using a system of investor-state
11 dispute settlement (ISDS) designed to protect the interests of investors in energy projects from national
12 policies that could lead their assets to be stranded. Numerous scholars have pointed to ISDS being able
13 to be used by fossil-fuel companies to block national legislation aimed at phasing out the use of their
14 assets (Bos and Gupta 2019; Tienhaara 2018). Another aspect is finance; Gallagher et al. (2018)
15 examine the role of national development finance systems, focusing in particular on China. While there
16 has been a great deal of finance devoted to renewable energy, they find the majority of finance devoted
17 to projects associated either with fossil fuel extraction or with fossil fuel-fired power generation.
18 Ascensão et al. (2018) similarly suggest that activities associated with the Belt and Road Initiative could
19 play a role in slowing down mitigation efforts in developing countries.

20 Given the complexity of global energy governance, it is impossible to make a definitive statement about
21 its overall contribution to mitigation efforts. Three statements, do however, appear to be robust. First,
22 prior to the emergence of climate change on the global political agenda, international cooperation in the
23 area of energy was primarily aimed at expanding and protecting the use of fossil energy, and these goals
24 were entrenched in a number of multilateral organisations. Second, since the 1990s, international
25 cooperation has gradually taken climate mitigation on board as one of its goals, seeing a realignment of
26 many pre-existing organisations priorities, and the formation of a number of new international
27 arrangements oriented towards the development renewable energy resources. Third, the realignment is
28 far from complete, and there are still examples of international cooperation having a chilling effect on
29 climate mitigation, particularly through financing and investment practices, including legal norms
30 designed to protect the interests of owners of fossil assets.

31 **14.5.2.3 Transportation**

32 The transportation sector has been a particular focus of cooperative efforts on climate mitigation that
33 extend beyond the sphere of the UNFCCC climate regime. A number of these cooperative efforts
34 involve transnational public-private partnerships, such as the European-based Transport
35 Decarbonisation Alliance, which brings together countries, regions, cities and companies working
36 towards the goal of a 'net-zero emission mobility system before 2050' (TDA 2019). Other efforts are
37 centred in specialised UN agencies, such as the International Civil Aviation Organisation (ICAO) and
38 the International Maritime Organisation (IMO).

39 Measures introduced by the ICAO and IMO have addressed CO₂ emissions from international shipping
40 and aviation. Emissions from these parts of the transportation sector are generally excluded from
41 national emissions reduction policies and NDCs because the 'international' location of emissions
42 release makes allocation to individual nations difficult (Bows-Larkin 2015; Lyle 2018; Hoch et al.
43 2019). The measures adopted by ICAO take the form of standards and recommended practices that are
44 adopted in national legislation. IMO publishes 'regulations' but does not have a power of enforcement,
45 with non-compliance a responsibility of flag states that issue a ship's 'MARPOL' certificate.

46 As discussed in Chapter 2 and Figure SPM.4, international aviation currently accounts for
47 approximately 1% of global GHG emissions, with international shipping contributing 1.2% of global
48 GHG emissions. These international transport emissions are projected to be between approximately 60-

1 220% of global emissions of CO₂ in 2050, as represented by the four main illustrative model pathways
2 in SR1.5 (Rogelj et al. 2018; UNEP 2020) Notably, however, the climate impact of aviation emissions
3 is estimated to be 2-4 times higher due to non-CO₂ effects (Terrenoire et al. 2019; Lee et al. 2021a).
4 Increases in trans-Arctic shipping and tourism activities with sea ice loss are also forecast to have strong
5 regional effects due to ships' gas and particulate emissions (Stephenson et al. 2018).

6 The Kyoto Protocol required Annex I parties to pursue emissions reductions from aviation and marine
7 bunker fuels by working through IMO and ICAO (UNFCCC 1997, Art. 2.2). Limited progress was
8 made by these organisations on emissions controls in the ensuing decades (Liu 2011b), but greater
9 action was prompted by conclusion of the SDGs and Paris Agreement (Martinez Romera 2016),
10 together with unilateral action, such as the EU's inclusion of aviation emissions in its Emissions Trading
11 Scheme (ETS) (Dobson 2020).

12 The Paris Agreement neither explicitly addresses emissions from international aviation and shipping,
13 nor repeats the Kyoto Protocol's provision requiring parties to work through ICAO/IMO to address
14 these emissions (Hoch et al. 2019). This leaves unclear the status of the Kyoto Protocol's article 2.2
15 directive after 2020 (Martinez Romera 2016; Dobson 2020), potentially opening up scope for more
16 attention to aviation and shipping emissions under the Paris Agreement (Doelle and Chircop 2019).
17 Some commentators have suggested that emissions from international aviation and shipping should be
18 part of the Paris Agreement (Gençsü and Hino 2015; Traut et al. 2018), and shipping and aviation
19 industries themselves may prefer emissions to be treated under an international regime rather than a
20 nationally-oriented one (Gilbert and Bows 2012). In the case of shipping emissions, there is nothing in
21 the Paris Agreement to prevent a party from including international shipping in some form in its NDC
22 (Doelle and Chircop 2019) Under the Paris Rulebook, parties "should report international aviation and
23 marine bunker fuel emissions as two separate entries and should not include such emissions in national
24 totals but report them distinctly, if disaggregated data are available" (UNFCCC 2019d).

25 ICAO has an overarching climate goal to "limit or reduce the impact of aviation greenhouse gas
26 emissions on the global climate" with respect to international aviation. In order to achieve this, ICAO
27 has two global aspirational goals for the international aviation sector, of 2% annual fuel efficiency
28 improvement through 2050 and carbon neutral growth from 2020 onwards (ICAO 2016). In order to
29 achieve these global aspirational goals, ICAO is pursuing a 'basket' of mitigation measures for the
30 aviation sector consisting of technical and operational measures, such as a CO₂ emissions standard for
31 new aircraft adopted in 2016, measures on sustainable alternative fuels and a market-based measure,
32 known as the Carbon Offset and Reduction Scheme for International Aviation (CORSIA), which the
33 triennial ICAO Assembly of 193 Member States resolved to establish in 2016 (ICAO 2016). In line
34 with the 2016 ICAO Assembly Resolution that established CORSIA, in mid-2018, the ICAO's 36-
35 member state governing Council adopted a series of Standards and Recommended Practices (SARPs),
36 now contained in Annex 16, Volume IV of the Chicago Convention (1944), as a common basis for
37 CORSIA's implementation and enforcement by each state and its aeroplane operators. From 1 January
38 2019, the CORSIA SARPs require states and their operators to undertake an annual process of
39 monitoring, verification, and reporting of emissions from all international flights, including to establish
40 CORSIA's emissions baseline (ICAO 2019).

41 Based on this emissions data, CORSIA's carbon offsetting obligations commence in 2021, with 3-year
42 compliance cycles, including a pilot phase in 2021-2023. States have the option to participate in the
43 pilot phase and the subsequent voluntary 3-year cycle in 2024-2026. CORSIA becomes mandatory from
44 2027 onwards for states whose share in the total international revenue tonnes per kilometre (RTK) is
45 above a certain threshold (Hoch et al. 2019). Under CORSIA, aviation CO₂ emissions are not capped,
46 but rather emissions that exceed the CORSIA baseline are compensated through use of 'offset units'
47 from emissions reduction projects in other industries (Erling 2018). However, it is unclear whether the
48 goal of carbon neutral growth and further CO₂ emissions reduction in the sector will be sufficiently

1 incentivised solely through the use of such offsets in combination with ICAO's manufacturing
2 standards, programs, and state action plans, without additional measures being taken, for example,
3 constraints on demand (Lyle 2018). If countries such as China, Brazil, India and Russia do not
4 participate in CORSIA's voluntary offsetting requirements this could significantly undermine its
5 capacity to deliver fully on the sectoral goal by limiting coverage of the scheme to less than 50% of
6 international aviation CO₂ emissions in the period 2021-2026 (Climate Action Tracker 2020b; Hoch et
7 al. 2019). In addition, a wide range of offsets are approved as 'eligible emissions units' in CORSIA,
8 including several certified under voluntary carbon offset schemes, which may go beyond those
9 eventually agreed under the Paris Agreement Article 6 mechanism (Hoch et al. 2019). It is noted,
10 however, that ICAO applies a set of 'Emissions Unit Eligibility Criteria' agreed in March 2019, which
11 specify required design elements for eligible programs. In June 2020, the ICAO Council decided to
12 define 2019 emissions levels, rather than an average of 2019 and 2020 emissions, as the baseline year
13 for at least the first three years of CORSIA, although there were significant reductions (45-60%) in
14 aviation CO₂ emissions in 2020 compared with 2019 as a result of reductions in air travel associated
15 with the COVID-19 pandemic (Climate Action Tracker 2020b).

16 Other measures adopted by ICAO include an aircraft CO₂ emissions standard that applies to new aircraft
17 type designs from 2020, and to aircraft type designs already in production as of 2023 (Smith and Ahmad
18 2018). Overall, CORSIA and regional measures, such as the EU ETS, are estimated to reduce aviation
19 carbon emissions by only 0.8% per year from 2017-2030 (noting, however, that 'if non-CO₂ emissions
20 are included in the analysis, then emissions will increase') (Larsson et al. 2019). Accordingly, pathways
21 consistent with the temperature goal of the Paris Agreement are likely to require more stringent
22 international measures for the aviation sector (Larsson et al. 2019).

23 Similar to ICAO, the IMO has a stated vision of remaining committed to reducing greenhouse gas
24 emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as
25 possible in this century. IMO has considered a range of measures to monitor and reduce shipping
26 emissions. In 2016, the IMO's Marine Environment Protection Committee (MEPC) approved an
27 amendment to the MARPOL Convention Annex VI for the introduction of a Mandatory Global Data
28 Collection scheme for fuel oil consumption of ships (Dobson 2020). Other IMO measures have focused
29 on energy efficiency (Martinez Romera 2016). The IMO's Energy Efficiency Design Index (EEDI),
30 which is mandatory for new ships, is intended, over a ten-year period, to improve energy efficiency by
31 up to 30% in several categories of ships propelled by diesel engines (Smith and Ahmad 2018). In May
32 2019, the MEPC approved draft amendments to the MARPOL Convention Annex VI, which if adopted,
33 will bring forward the entry into force of the third phase of the EEDI requirements to 2022 instead of
34 2025 (IMO 2019; Joung et al. 2020).

35 However, it is unlikely that the EEDI and other IMO technical and operational measures will be
36 sufficient to produce 'the necessary emissions reduction because of the future growth in international
37 seaborne trade and world population' (Shi and Gullett 2018). Consequently, in 2018, the IMO adopted
38 an initial strategy on reduction of GHG emissions from ships (IMO 2018). This includes a goal for
39 declining carbon intensity of the sector by reducing CO₂ emissions per transport work, as an average
40 across international shipping, by at least 40% by 2030, and pursuing efforts towards 70% by 2050,
41 compared to 2008 levels (IMO 2018, para. 3.1). The strategy also aims for peaking of total annual GHG
42 emissions from international shipping as soon as possible and a reduction by at least 50% by 2050
43 compared to 2008 levels, whilst pursuing efforts towards phasing them out 'as soon as possible in this
44 century' as a point 'on a pathway of CO₂ emissions reduction consistent with the Paris Agreement
45 temperature goals' (IMO 2018, para. 2, 3.1). The shipping industry is on track to overachieve the 2030
46 carbon intensity target but not its 2050 target (Climate Action Tracker 2020c). The initial IMO strategy
47 is to be kept under review by the MEPC with a view to adoption of a revised strategy in 2023.

1 The IMO's initial strategy identifies a series of candidate short-term (2018-2023), medium-term (2023-
2 2030) and long-term (beyond 2030) measures for achieving its emissions reduction goals, including
3 possible market-based measures in the medium-to-long term (IMO 2018, paras. 4.7-4.9). Further
4 progress on market-based measures faces difficulty in light of conflicts between the CDRRC principle
5 of the climate regime and the traditional non-discrimination approach and principle of no more
6 favourable treatment enshrined in MARPOL and other IMO conventions (Zhang 2016). Both the
7 CDRRC and non-discrimination principles are designated as 'principles guiding the initial strategy'
8 (IMO 2018, para. 3.2). The challenges encountered in introducing global market-based measures for
9 shipping emissions under the IMO have prompted regional initiatives such as the proposed extension
10 of the EU ETS to emissions from maritime activities (Christodoulou et al. 2021), which was announced
11 on 14 July 2021 by the EU Commission as part of its 'Fit for 55' legislative package (European
12 Commission 2021).

13 While the IMO strategy is viewed as a reasonable first step that is ambitious for the shipping industry,
14 achieving the 'vision' of alignment with the temperature goals of the Paris Agreement requires concrete
15 implementation measures and strengthened targets in the next iteration in 2023 (Doelle and Chircop
16 2019; Climate Action Tracker 2020c). As a step towards this, in 2020, the IMO's MEPC put forward
17 draft amendments to the MARPOL convention that would require ships to combine a technical and an
18 operational approach to reduce their carbon intensity. These amendments were formally adopted by the
19 Committee at its session in June 2021.

20

21 **14.5.3 Civil society and social movements**

22 Transnationally organised civil society actors have had long-standing involvement in international
23 climate policy, with a particular focus on consulting or knowledge-sharing where they are present in
24 transnational climate governance initiatives (Michaelowa and Michaelowa 2017). The term 'civil
25 society' generally denotes 'the voluntary association of individuals in the public sphere beyond the
26 realms of the state, the market and the family' (de Bakker et al. 2013, p. 575). Whereas civil society
27 organisations are usually involved in lobbying or advocacy activities in a public arena, social
28 movements focus on mobilisation and action for social change (Daniel and Neubert 2019). Examples
29 of civil society groups involved in international climate policy include non-governmental organisations
30 (NGOs) such as Greenpeace International, the World Wide Fund for Nature, the Environmental
31 Defence Fund, the World Resources Institute, Friends of the Earth and Earthjustice among many others,
32 as well as NGO networks such as the Climate Action Network (CAN), which has over 1300 NGO
33 members in more than 130 countries, working to promote government and individual action to limit
34 human-induced climate change to ecologically sustainable levels (Climate Action Network
35 International 2020). The influence of civil society engagement in global climate governance is well-
36 acknowledged, with these organisations' globally dispersed constituencies and non-state status offering
37 perspectives that differ in significant ways from those of many negotiating states (Derman 2014).

38 Historically, the issue of climate change did not give rise to intense, organised transnational protest
39 characteristic of social movements (McAdam 2017). During the 1990s and early 2000s, the activities
40 of the global climate movement were concentrated in developed countries and largely sought to exercise
41 influence through participation in UNFCCC COPs and side events (Almeida 2019). The mid-2000s
42 onwards, however, saw the beginnings of use of more non-institutionalised tactics, such as simultaneous
43 demonstrations across several countries, focusing on a grassroots call for climate justice that grew out
44 of previous environmental justice movements (Almeida 2019). Groups representing Indigenous, youth,
45 women, and labour rights brought to the fore new tools of contention and new issues in the UNFCCC,
46 such as questions of a just transition and gender equity (Allan 2020).

1 Climate justice has been variously defined, but centres on addressing the disproportionate impacts of
2 climate change on the most vulnerable populations and calls for community sovereignty and functioning
3 (Schlosberg and Collins 2014; Tramel 2016). Contemporary climate justice groups mobilise multiple
4 strands of environmental justice movements from the Global North and South, as well as from distinct
5 indigenous rights and peasant rights movements, and are organised as a decentralised network of
6 semiautonomous, coordinated units (Claeys and Delgado Pugley 2017; Tormos-Aponte and García-
7 López 2018). The climate justice movement held global days of protest in most of the world's countries
8 in 2014 and 2015, and mobilised another large campaign in 2018 (Almeida 2019). The polycentric
9 arrangement of the global climate movement allows simultaneous influence on multiple sites of climate
10 governance, from the local to the global levels (Tormos-Aponte and García-López 2018).

11 Prominent examples of new climate social movements that operate transnationally are Extinction
12 Rebellion and Fridays for Future, which collectively held hundreds of coordinated protests across the
13 globe in 2019-2021, marking out 'the transnational climate justice movement as one of the most
14 extensive social movements on the planet' (Almeida 2019). Fridays for Future is a children's and youth
15 movement that began in August 2018, inspired by the actions of then 15-year old Greta Thunberg who
16 pledged to strike in front of the Swedish parliament every Friday to protest against a lack of action on
17 climate change in line with the Paris Agreement targets (Fridays for Future 2019). Fridays for Future
18 events worldwide encompass more than 200 countries and millions of strikers. The movement is
19 unusual for its focus on children and the rights of future generations, with children's resistance having
20 received little previous attention in the literature. Fridays for the Future is regarded as a progressive
21 resistance movement that has quickly achieved global prominence (for example, Thunberg was invited
22 to address governments at the UN Climate Summit in New York in September 2019) and is credited
23 with helping to support the discourse about the responsibility of humanity as a whole for climate change
24 (Holmberg and Alvinus 2019). Whereas Fridays for Future has focused on periodic protest action,
25 Extinction Rebellion has pursued a campaign based on sustained non-violent direct citizen action that
26 is focused on three key demands: declaration of a 'climate emergency', acting now to halt biodiversity
27 loss and reduce greenhouse gas emissions to net zero by 2025, and creation of a citizen's assembly on
28 climate and ecological justice (Booth 2019; Extinction Rebellion 2019). The movement first arose in
29 the United Kingdom (UK) – where it claimed credit for adoption of a climate emergency declaration
30 by the UK government – but now has a presence in 45 countries with some 650 groups having formed
31 globally (Gunningham 2019).

32 The Paris Agreement's preamble explicitly recognises the importance of engaging "various actors" in
33 addressing climate change, and the decision adopting the Agreement created the Non-State Actor Zone
34 for Climate Action platform to aid in scaling up these efforts. Specific initiatives have also been taken
35 to facilitate participation of particular groups, such as the UNFCCC's Local Communities and
36 Indigenous Peoples Platform, which commenced work in Katowice in 2019. Climate movements based
37 in the Global South, as well as in Indigenous territories, are playing an increasingly important role in
38 transnational negotiations through networks such as the Indigenous Peoples Platform. These groups
39 highlight the voices and perspectives of communities and peoples particularly affected by climate
40 change. For instance, the Pacific Climate Warriors is a grassroots network of young people from various
41 countries in the Pacific Islands region whose activities focus on resisting narratives of future
42 inevitability of their Pacific homelands disappearing, and re-envisioning islanders as warriors defending
43 rights to homeland and culture (McNamara and Farbotko 2017). Youth global climate activism,
44 particularly involving young Indigenous climate activists, is another notable recent development.
45 Although there remains little published literature on Indigenous youth climate activism (MacKay et al.
46 2020), analysis of online sources indicates the emergence of several such groups, including the Pacific
47 Climate Warriors and Te Ara Whatu from Aotearoa New Zealand (Ritchie 2021), as well as Seed Mob
48 in Australia.

1 Transnational civil society organisations advocating for climate justice in global governance have
2 articulated policy positions around rights protections, responsibility-based approaches to climate
3 finance, and the need for transparency and accountability (Derman 2014). Another recent area of
4 activity, which overlaps with that of emerging investor alliances (discussed further in Section 14.5.4),
5 is the sustainability of capital investment in fossil fuel assets. Efforts to shift away from fossil fuels led
6 by civil society include the Beyond Coal Campaign (in the US and Europe) and the organisation for a
7 Fossil Fuel Non-proliferation Treaty. 350.org has supported mobilisation of youth and university
8 students around a campaign of divestment that has grown into a global movement (Gunningham 2019).
9 As Mormann (2020) notes, as of November 2020 ‘more than 1,200 institutional investors managing
10 over USD14 trillion of assets around the world have committed to divest some or all of their fossil fuel
11 holdings’ (Mormann 2020). Studies suggest that the direct impacts of the divestment movement have
12 so far been small, given a failure to differentiate between different types of fossil fuel companies, a lack
13 of engagement with retail investors, and a lack of guidance for investors on clean energy re-investment
14 (Osofsky et al. 2019; Mormann 2020). The movement has had a more significant impact on public
15 discourse by raising the profile of climate change as a financial risk for investors (Bergman 2018).
16 Blondeel et al. (2019) also find that broader appeal of the divestment norm was achieved when moral
17 arguments were linked to financial ones, through the advocacy of economic actors, such as Bank of
18 England’s governor.

19 Climate justice campaigns by transnational civil society organisations increasingly embrace action
20 through the courts. Chapter 13 discusses the growth and policy impact of such ‘climate litigation’
21 brought by civil society actors in domestic courts, which is attracting increasing attention in the
22 literature (Setzer and Vanhala 2019; Peel and Osofsky 2020). Transnational and international court
23 actions focused on climate change, by contrast, have been relatively few in number (Peel and Lin 2019).
24 This reflects—at least in part—the procedural hurdles to bringing such claims, as in many international
25 courts and tribunals (outside of the area of human rights or investor-state arbitration) litigation can only
26 be brought by states (Bruce 2017). However, there have been active discussions about seeking an
27 advisory opinion from the International Court of Justice (ICJ) on states’ international obligations
28 regarding the reduction of greenhouse gas emissions (Sands 2016; Wewerinke-Singh and Salili 2020),
29 or bringing a case to the International Tribunal for the Law of the Sea on marine pollution harms caused
30 by climate change (Boyle 2019). In September 2021 the Government of Vanuatu announced a campaign
31 to seek an advisory opinion from the ICJ. The aim of climate litigation more generally is to supplement
32 other regulatory efforts by filling gaps and ensuring that interpretations of laws and policies are aligned
33 with climate mitigation goals (Osofsky 2010).

34 The overall impact of transnationally-organised civil society action and social movements for
35 international cooperation on climate change mitigation has not been comprehensively evaluated in the
36 literature. This may reflect the polycentric organisation of the movement, which poses challenges for
37 coordinating between groups operating in different contexts, acting with different strategies and around
38 multiple issues, and lobbying multiple decision-making bodies at various levels of government in a
39 sustainable way (Tormos-Aponte and García-López 2018). There is some literature emerging on
40 environmental defenders and their need for protection against violence and repression, particularly in
41 the case of Indigenous environmental defenders who face significantly higher rates of violence
42 (Scheidel et al. 2020). Scheidel et al. (2020) also find that combining strategies of preventive
43 mobilisation, protest diversification and litigation can enhance rates of success for environmental
44 defenders in halting environmentally destructive projects. In the area of climate litigation,
45 commentators have noted the potential for activists and even researchers to suffer retaliation through
46 the courts as a result of “strategic lawsuits against public participation” (SLAPP) and lawsuits against
47 researchers brought by fossil fuel interests (Setzer and Byrnes 2019; Setzer and Benjamin 2020).
48 Influence of social movements may be enhanced through taking advantage of ‘movement spillover’
49 (the involvement of activists in more than one movement) (Hadden 2014) and coordination of activities

1 with a range of ‘non-state governors,’ including cities, sub-national governments, and investor groups
2 (Gunningham 2019). Studies of general societal change suggest that once 3.5% of the population are
3 mobilised on an issue, far-reaching change becomes possible (Gladwell 2002; Chenoweth and
4 Belgioioso 2019) – a tipping point that may be approaching in the case of climate change (Gunningham
5 2019). As noted in Chapter 5, in the particular case of low-carbon technologies, ‘if 10-30% of the
6 population were to demonstrate commitment to low-carbon technologies, behaviours, and lifestyles,
7 new social norms would be established.’

9 **14.5.4 Transnational business and public-private partnerships and initiatives**

10 Combined national climate commitments fall far short of the Paris Agreement's long term temperature
11 goals. Similar political ambition gaps persist across various areas of sustainable development. Many
12 therefore argue that actions by nonstate actors, such as businesses and investors, cities and regions, and
13 nongovernmental organizations (NGOs), are crucial. However, nonstate climate and sustainability
14 actions may not be self-reinforcing but may heavily depend on supporting mechanisms. Governance
15 risk-reduction strategies can be combined to maximize nonstate potential in sustainable and climate-
16 resilient transformations (Chan et al. 2019).

17 An important feature of the evolving international climate policy landscape of the recent years is the
18 entrepreneurship of UN agencies such as UNEP and UNDP, as well as international organizations such
19 as the World Bank in initiating public-private partnerships (PPPs). Andonova (2017) calls this
20 ‘governance entrepreneurship’. Such partnerships can be defined as ‘voluntary agreements between
21 public actors (IOs, states, or sub-state public authorities) and non-state actors (non-governmental
22 organizations (NGOs), companies, foundations, etc.) on a set of governance objectives and norms, rules,
23 practices, and/or implementation procedures and their attainment across multiple jurisdictions and
24 levels of governance’ (Andonova 2017). Partnerships may carry out different main functions: first,
25 *policy development*, establishing new agreements on norms, rules, or standards among a broader set of
26 governmental and non-governmental actors; second, *enabling implementation and delivery of services*,
27 by combining resources from governmental and non-governmental actors; and, third, *knowledge*
28 *production and dissemination*, to e.g. the evolution of relevant public policies.

29 An example of a prominent PPP in the area of climate mitigation is the Renewable Energy Network
30 (REN21 2019), which is a global multi-stakeholder network focused on promoting renewable energy
31 policies in support of the transition to renewable energy through knowledge, established 2004. It
32 includes members from industry, NGOs, intergovernmental organizations, and science and academia.
33 Another example is the Green Economy Coalition founded in 2009 to bring to bear the perspectives of
34 workers, business, poor people, the environment community, and academics in the transition to greener
35 and more sustainable economy. Another example is that in 2015 Peru in collaboration with France and
36 the UNFCCC Secretariat launched the ‘Non-State Actor Zone for Climate Action’ (NAZCA), an online
37 platform to showcase commitments to climate action by companies, cities, regions and investors (Chan
38 et al. 2016; Bertoldi et al. 2018). More recently, the UNFCCC ‘Race to Zero’ initiative led by High-
39 level Climate Champions Nigel Topping and Gonzalo Muñoz seeks to mobilize actors beyond national
40 governments to join the Climate Ambition Alliance and pursue net zero CO₂ targets. Its membership
41 includes 454 cities, 23 regions, 1,391 businesses, 74 of the biggest investors, and 569 universities.

42 PPPs may also be developed to assist with implementation and support of states’ climate mitigation
43 commitments. For instance, UNEP has initiated a number of PPPs for climate change finance. These
44 are designed to increase financing for the purposes of disseminating low-carbon technologies to tackle
45 climate change and promote clean energy in many parts of developing countries (UNEP 2018b;
46 Charlery and Traerup 2019).

1 In the same vein, in 2010 FAO delivered the Framework for Assessing and Monitoring Forest
2 Governance. The Framework draws on several approaches currently in use or under development in
3 major forest governance-related processes and initiatives, including the World Bank's Framework for
4 Forest Governance Reform. The Framework builds on the understanding that governance is both the
5 context and the product of the interaction of a range of actors and stakeholders with diverse interests
6 (FAO 2010). For example, UNFCCC and UN-REDD program focus on REDD+ and UNEP focus on
7 TEEB (a global initiative focusing on the economics of ecosystems and biodiversity) institutional
8 mechanisms have been conceptualized as a 'win-win-win' for mitigating climate, protecting
9 biodiversity and conserving indigenous culture by institutionalizing payments on carbon sequestration
10 and biodiversity conservation values of ecosystems services from global to local communities. These
11 mechanisms include public-private partnership, and non-governmental organization participation.
12 REDD+ and TEEB allocation policies will be interventions in a highly complex system, and will
13 inevitably involve trade-offs; therefore, it is important to question the 'win-win-win' discourse (Zia and
14 Kauffman 2018; Goulder et al. 2019). The initial investment and the longer periods of recovery of
15 investment are sometimes barriers to private investment. In this sense, it is important to have
16 government incentives and encourage public-private investment (Ivanova and Lopez 2013).

17
18 The World Bank has also established several partnerships since 2010, mainly in the field of carbon
19 pricing. Prominent examples are the Networked Carbon Markets initiative (established 2013; spanning
20 both governmental actors and experts; now entering a phase II) and the Carbon Pricing Leadership
21 Coalition, established in 2015 and spanning a wide range of governmental and non-governmental
22 actors, not least within business (World Bank 2018, 2019; Wettestad et al. 2021). These partnerships
23 deal with knowledge production and dissemination and seek to enable implementation of carbon pricing
24 policies. The leadership role of the international 'heavyweight' World Bank gives these partnerships
25 additional comparative political weight, meaning also a potentially greater involvement of powerful
26 finance ministries/ministers generally involved in Bank matters and meetings.

27 PPPs for cooperation on climate mitigation goals have emerged at multiple levels of governance beyond
28 the realm of international organizations. For example, PPP funding for cities expanded rapidly in the
29 1990s and outpaced official external assistance almost tenfold. Most of the PPP infrastructure
30 investment has been aimed at telecommunications, followed by energy. However, with the exception
31 of the telecommunications sector, PPP investments have generally bypassed low-income countries
32 (Ivanova 2017). It is therefore not surprising that PPPs have added relatively little to the financing of
33 urban capital in developing countries over the past two decades (Bahl and Linn 2014). Liu and Waibel
34 (2010) argue that the inherent risk of urban investment is the main obstacle to increasing the flow of
35 private capital. Nevertheless, there have been cases where PPP investments have exceeded official
36 external aid flows even for water and sanitation, and highly visible projects have been funded with PPPs
37 in selected metropolitan areas of developing countries, including urban rail projects in Bangkok, Kuala
38 Lumpur, and Manila (Liu and Waibel 2010).

39 Local governments are also creating cross-sector social partnerships (CSSPs) at the sub-national level;
40 entities created for addressing social, economic, and/or environmental issues with partner organizations
41 from the public, private and civil society sectors (Crane and Seitanidi 2014). In particular, with support
42 from international networks such as ICLEI Local Governments for Sustainability, C40, Global
43 Covenant of Mayors, and Global 100% Renewable Energy, local governments around the world are
44 committing to aggressive carbon reduction targets for their cities (Ivanova et al. 2015; Clarke and
45 Ordonez-Ponce 2017; Kona et al. 2018). Research on CSSPs implementing community sustainability
46 plans shows that climate change is one of the four most common issues, after waste, energy and water
47 (which are also highly relevant to climate mitigation) (MacDonald et al. 2017).

1 Community climate action plans consider all GHGs emitted within the local geographic boundaries,
2 including from industry, home heating, burning fuel in vehicles, etc. It is these community plans that
3 require large multi-stakeholder partnerships to be successful. Partners in these partnerships generally
4 include the local government departments, other government departments, utilities, large businesses,
5 Chamber of Commerce, some small and medium sized enterprises, universities, schools, and local civil
6 society groups (Clarke and MacDonald 2016). Research shows that the partnership's structural features
7 enable the achievement of plan outcomes, such as reducing GHG emissions, while also generating value
8 for the partners (Austin and Seitanidi 2012; Clarke and MacDonald 2016; Clarke and Ordonez-Ponce
9 2017). Stua (2017b) explores the Mitigation Alliances (MAs) on the national level. The internal
10 governance model of MAs consists of overarching authorities mandated to harmonize the overall
11 organizational structure. These authorities guarantee an effective, equitable and transparent functioning
12 of the MA's pillars (the demand, supply, and exchange of mitigation outcomes), in line with the
13 principles and criteria of the Paris Agreement. This hybrid governance model relies upon its unique
14 links with international climate institutions (Stua 2017a).

15 Transnational business partnerships are a growing feature of the landscape of multi-level, multi-actor
16 governance of climate change. Many business leaders embraced the ethos of "business cannot succeed
17 in societies that fail". Examples of this line of reasoning are: poverty limits consumer spending,
18 political instability disrupts business activity, and climate change threatens the production and
19 distribution of goods and services. Such situations endanger MNE investments, global asset
20 management funds, and the core business of international insurance companies and pension funds (van
21 Tulder et al. 2021).

22 A leading example is the World Business Council on Sustainable Development (WBCSD), a global,
23 CEO-led organization of over 200 leading businesses working together to accelerate the transition to a
24 sustainable world. Member companies come from all business sectors and all major economies,
25 representing a combined revenue of more than USD8.5 trillion and with 19 million employees. The
26 WBCSD aims to enhance 'the business case for sustainability through tools, services, models and
27 experiences'. It includes a Global Network of almost 70 national business councils across the globe.
28 The overall vision is to create a world where more than 9 billion people are all living well and within
29 the boundaries of our planet, by 2050. Vision 2050, released in 2010, explored what a sustainable world
30 would look like 2050, how such a world could be realized, and the role that business can play in making
31 that vision a reality. A few years later, Action2020 took that Vision and translated it into a roadmap of
32 necessary business actions and solutions (WBCSD 2019). WBCSD focuses on those areas where
33 business operates and can make an impact. They identify six transformation systems that are critical in
34 this regard: Circular Economy, Climate and Energy, Cities and Mobility, Food and Nature, People and
35 Redefining Value. All have an impact on climate. An important initiative launched in September of
36 2008 – the 'natural climate solutions', has the objective of leveraging business investment to capture
37 carbon out of the atmosphere. This initiative has built strong cross-sectoral partnerships and is intended
38 to tap into this immense emissions reduction solution potential through natural methods with the help
39 of private investment.

40 The Global Methane Initiative is a multilateral partnership launched in 2010 by the United States
41 Environmental Protection Agency along with thirty-six other countries to generate a voluntary, non-
42 binding agenda for global collaboration to decrease anthropogenic methane releases. The GMI builds
43 on the Methane to Market (M2M) Partnership, an international partnership launched in 2004. In addition
44 to the GMI's own financial assistance, the initiative receives financial backing from the Global Methane
45 Fund (GMF) for methane reduction projects. The GMF is a fund created by governments and private
46 donors (Leonard 2014).

47 Another potentially influential type of transnational business partnership is investor coalitions or
48 alliances formed for the purpose of pushing investee companies to adopt stronger measures for stranded

1 asset management and climate change mitigation. MacLeod & Park (2011, p. 55) argue that these
2 transnational groups ‘attempt to re-orient and “regulate” the behaviour of business by holding
3 corporations accountable via mechanisms of information sharing, monitoring of environmental impacts,
4 and disclosure of activities related to the corporate climate footprint’. This favours a theory of active
5 ownership (investor engagement with corporate boards) over capital divestment as the optimal pathway
6 to shape the behaviour of corporate actors on climate risk (Kruitwagen et al. 2017; Krueger et al. 2020).

7 Transnational cooperative action by investors on climate mitigation has been facilitated by international
8 standard-setting on issues of climate risk and disclosure. For example, in 2017 the Financial Stability
9 Board’s Taskforce on Climate-related Financial Disclosures (TCFD) adopted international
10 recommendations for climate risk disclosure (TCFD 2017). These recommendations, which apply to all
11 financial-sector organizations, including banks, insurance companies, asset managers, and asset owners,
12 have received strong support from investor coalitions globally, including Climate Action 100+ (with
13 300 investors with more than USD33 trillion in assets under management), the Global Investor
14 Coalition on Climate Change (a coalition of regional investor groups across Asia, Australia, Europe and
15 North America) and the Institutional Investors Group on Climate Change (IIGCC). One of the key
16 recommendations of the TCFD calls for stress-testing of investment portfolios taking into consideration
17 different climate-related scenarios, including a 2° C or lower scenario. Broad adoption of the TCFD
18 recommendations could provide a basis for decisions by investors to shift assets away from climate-
19 risk exposed assets such as fossil fuel extraction projects (Ososky et al. 2019). There is strong evidence
20 showing the urgent need for scaling-up climate finance to mitigate greenhouse gases in line with pursuit
21 of limiting the temperature increase to 1.5 °C above pre-industrial levels, and to support adaptation to
22 safeguard the international community from the consequences of a changing climate. While public
23 actors have a responsibility to deploy climate finance, it is clear that the contribution from the private
24 sector needs to be significant (Gardiner et al. 2016).

25 As most of these partnerships are of recent vintage an assessment of their effectiveness is premature.
26 Instead, partnerships can be assessed on the basis of the three main functions introduced earlier. Starting
27 with policy development, i.e. establishing new agreements on norms, rules, or standards among a
28 broader set of governmental and non-governmental actors, this is not the most prominent aspect of
29 partnerships so far, although both the cities’ networks and risk disclosure recommendations include
30 some elements of this. The second element, enabling implementation and delivery of services, by
31 combining resources from governmental and non-governmental actors, seems to be a more prominent
32 part of the partnerships (Ivanova et al. 2020). Both UNEP financing, the World Business Council on
33 Sustainable Development (WBCSD), the REDD+ and TEEB mechanisms, and PPP funding for cities
34 are examples here. Finally, the third element, knowledge production and dissemination, for example,
35 contributing to the evolution of relevant public policies, is the most prominent part of these partnerships,
36 with the majority including such activities.

37 There is a relatively large volume of literature that assesses PPPs in general. Much of this applies to
38 partnerships which, either by design or not, advance climate goals. This literature provides a good
39 starting point for assessing these partnerships as they become operational. These can help assess
40 whether such partnerships are worth the effort in terms of their performance and effectiveness (Liu et
41 al. 2017b), their economic and social value added (Quélin et al. 2017), their efficiency (Estache and
42 Saussier 2014) and the possible risks associated with them (Darrin, Grimsey and Mervyn 2002).

43 What is less common, but gradually growing, is an important and more relevant literature on criteria to
44 assess sustainability and impact on climate and development goals. Michaelowa and Michaelowa assess
45 109 trans-national partnerships and alliances based on four design criteria: existence of mitigation
46 targets; incentives for mitigation; definition of a baseline; and existence of a monitoring, reporting, and
47 verification procedure (Michaelowa and Michaelowa 2017). About half of the initiatives do not meet
48 any of these criteria, and not even 15% satisfy three or more. A recent study using a systematic review

1 of business and public administration literature on PPPs concludes that research in the past rarely
2 incorporates sustainability concepts. The authors propose a research agenda and a series of success
3 factors that, if appropriately managed can contribute to sustainable development, and in so doing
4 contribute to a more solid scientific evaluation of PPPs (Pinz et al. 2018). There is evidence that with
5 the adoption of the Sustainable Development Goals (SDGs), many of which are directly linked to
6 climate goals, PPPs will become even more prominent as they will be called upon to provide resources,
7 knowledge, expertise, and implementation support in a very ambitious agenda. PPT in the developing
8 world needs to take into account different cultural and social decision making processes, language
9 differences, and unfamiliar bureaucracy (Gardiner et al. 2016). Having more evidence on what norms
10 and standards in relation to sustainability are used and their governance is essential (Axel 2019). The
11 issue of double counting should be revised. GHGs are accounted both at the national and sub-national
12 level or company level (Schneider et al. 2014). Some recent studies aim to provide systems to assess
13 the impact of PPPs beyond the much-used notion of value for money. One of these recent studies
14 proposes a conceptual model that addresses six dimensions relevant to economic, social and
15 environmental progress. These include resilience and environment, access of services to the population,
16 scalability and replicability, economic impact, inclusiveness, and finally, degree of engagement of
17 stakeholders (Berrone et al. 2019). These systems will most likely continue to evolve.

19 **14.5.5 International co-operation at the sub-national and city levels**

20 Local and regional governments have an important role to play in global climate action, something
21 recognised by the Paris Agreement, and also assessed in Chapter 13 of this report, sections 13.3.2 and
22 13.3.4. There are several ways they can be useful. First, subnational governments can contribute insights
23 and experience that provide valuable lessons to national governments, as well as offering needed
24 implementation capacity (GIZ 2017; Leffel 2018). A great deal of policymaking has occurred at the
25 level of city governments in particular. Cities have been responsible for more than 70% of global
26 greenhouse gas (GHG) emissions and generate over 80% of global income (World Bank 2010), and
27 many of them have started to take their own initiative in enacting and developing mitigation policies
28 (CDP 2015). Most of these activities aim at the reduction of GHG emissions in the sectors of energy,
29 transportation, urban land use and waste (Bulkeley 2010; Xuemei 2007), and are motivated by concerns
30 not only over climate, but also a consideration of local co-benefits (Rashidi et al. 2017, 2019). Second,
31 sub-national governments can fill the void in policy leadership in cases where national governments are
32 ineffectual, even to the point of claiming leadership and authority with respect to foreign affairs (Leffel
33 2018). International cooperation plays a role in such action. Several international networks , such as
34 C40, ICLEI, Mayors for Climate Protection, and the Covenant of Mayors have played an important role
35 in defining and developing climate-policy initiatives at the city level (Fünfgeld 2015). While the
36 networks differ from each other, they generally are voluntary and non-hierarchical, intended to support
37 the horizontal diffusion of innovative climate policies through information sharing platforms linked to
38 specific goals that member cities make (Kern and Bulkeley 2009). The literature has addressed the
39 questions of why cities join the networks (Betsill and Bulkeley 2004; Pitt 2010), what recognition
40 benefits cities can expect (Buis 2009; Kern and Bulkeley 2009), and how memberships can provide
41 visibility to leverage international funding (Betsill and Bulkeley 2004; Heinrichs et al., 2013).
42 Membership in the networks has been found to be a significant predictor of cities' adoption of mitigation
43 policies, even when controlling for national-level policies that may be in place (Rashidi and Patt 2018).
44 Kona et al. (2018) find that cities belonging to the Covenant of Mayors are engaging in emissions
45 reductions at a rate consistent with achieving a 2°C global temperature target. Kona et al. (2021)
46 document this trend continuing.

47 With respect to their role in formal international cooperation, however, it is unclear what authority, as
48 a non-state actor, they actually have. Cities, for example, are members of transnational initiatives aimed

1 at non-state actors, such as Global Climate Action, originally the Non-state Actor Zone for Climate
2 Action, under the UNFCCC. While there is reason to believe that such membership can add value to
3 mitigation efforts, one study suggests that the environmental effects have yet to be reliably quantified
4 (Hsu et al. 2019a). By contrast, Kuramochi et al. (2020) provide evidence that non-state actors are
5 leading to significant emission reductions beyond what countries would otherwise be achieving. In
6 terms institutional strength, Michaelowa and Michaelowa (2017) suggest that few such networks fulfil
7 governance criteria, and hence challenge their effectiveness. Several researchers suggest that their role
8 is important in informal ways, given issues about the legitimacy of non-state actors (Nasiritousi et al.
9 2016; Chan et al. 2016). Bäckstrand et al. (2017) advance the concept of ‘hybrid multilateralism’ as a
10 heuristic to capture this intensified interplay between state and non-state actors in the new landscape of
11 international climate cooperation. The effectiveness of such non-state government actors should be
12 measured not only by their contribution to mitigation, but also by their success to enhance the
13 accountability, transparency and deliberative quality of the UNFCCC and the Paris Agreement (Busby
14 2016; Hale et al. 2016; Chan et al. 2015). In the post-Paris era, effectiveness also revolves around how
15 to align non-state and intergovernmental action in a comprehensive framework that can help achieve
16 low carbon futures (Chan et al. 2016). Stua (2017b) suggests that networks involving non-state actors
17 can play an important role in enhancing transparency. Such effectiveness has to be complemented also
18 by *normative questions*, applying a set of democratic values: participation, deliberation, accountability,
19 and transparency (Bäckstrand and Kuyper 2017). Such concepts of polycentric governance offer new
20 opportunities for climate action, but it has been argued that it is too early to judge its importance
21 and effects (Jordan et al. 2015).

24 14.6 Synthesis

25 14.6.1 Changing nature of international cooperation

26 The main development since AR5 in terms of international climate cooperation has been the shift from
27 the Kyoto Protocol to the Paris Agreement as the primary multilateral driver of climate mitigation policy
28 worldwide (Section 14.3). Most *ex-post* assessments of the Kyoto Protocol suggest that it did lead to
29 emissions reductions in countries with binding targets, in addition to changing investment patterns in
30 low-carbon technologies. As noted earlier, the Paris Agreement is tailored to the evolving understanding
31 of the climate mitigation challenge as well as shifting political imperatives and constraints. Whether the
32 Paris Agreement will in fact be effective in supporting global action sufficient to achieve its objectives
33 is contested, with competing arguments in the scientific literature supporting different views. To some
34 extent these views align with the different analytic frameworks (Section 14.2.1): the Paris Agreement
35 does not address the free-riding issue seen as important within the global commons framing, but may
36 provide the necessary incentives and support mechanisms viewed as important under the political and
37 transitions framings, respectively. The strongest critique of the Paris Agreement is that current NDCs
38 themselves fail by a wide margin to add up to the level of aggregate emissions reductions necessary to
39 achieve the objectives of holding global average warming well below 2°C, much less 1.5°C (see Section
40 14.3.3 and Figure 14.2), and that there is no legally binding obligation to achieve the NDCs. Arguments
41 in support of Paris are that it puts in place the processes, and generates normative expectations, that
42 nudge NDCs to become progressively more ambitious over time, including in developing countries.
43 The growing number of countries with mid-century net zero GHG or CO₂ targets, consistent with
44 Article 4 of Paris, lends support to this proposition, although there is as yet no empirical literature
45 drawing an unambiguous connection. The collective quantified goal from a floor of USD100 billion a
46 year in transfers to developing countries, the Green Climate Fund and other provisions on finance in
47 the Paris Agreement have also been recognised as key to cooperation (Sections 14.3.2.8 and 14.4.1).

1 But then these arguments are met with counter arguments, that even with Paris processes in place, given
2 the logic of iterative, rising levels of ambition over time, this is unlikely to happen within the narrow
3 window of opportunity that exists to avert dangerous levels of global warming (Section 14.3.3). The
4 degree to which countries are willing to increase the ambition and secure the achievement of their NDCs
5 over time will be an important indicator of the success of the Paris Agreement; evidence of this was
6 expected by the end of 2020, but the COVID-19 pandemic has delayed the process of updating NDCs.

7 An increasing role is also played by other cooperative agreements, in particular (potentially) under
8 Article 6 (Sections 14.3.2.10 and 14.4.4), trans-national partnerships, and the institutions that support
9 them. This fits both a transitions narrative that cooperation at the sub-global and sectoral levels is
10 necessary to enable specific system transformations, and a recent emphasis in the public goods literature
11 on club goods and a gradual approach to cooperation, also referred to as building blocks or incremental
12 approach (Sections 14.2 and 14.5.1.4). There has been little analysis of whether these other agreements
13 are of sufficient scale and scope to ensure that transformations happen quickly enough. This chapter,
14 appraising them together, concludes that they are not. First, many agreements, such as those related to
15 trade, may stand in the way of bottom-up mitigation efforts (Section 14.5.1.3). Second, many sectoral
16 agreements aimed at decarbonisation – such as within the air travel sector – have not yet adopted targets
17 comparable in scale, scope or legal character to those adopted under the Paris Agreement (Section
18 14.5.2.3). Third, there are many sectors for which there are no agreements in place. At the same time,
19 there are some important bright spots, many in the area of trans-national partnerships. A growing
20 number of cities have committed themselves to adopting urban policies that will place them on a path
21 to rapid decarbonisation, while learning from each other how to implement successful policies to realise
22 climate goals (Section 14.5.5). An increasing number of large corporations have committed to
23 decarbonising their industrial processes and supply chains (Section 14.5.4). And, an ever-increasing
24 number of non-state actors are adopting goals and initiating mitigation actions (Section 14.5.3). These
25 goals and actions, some argue, could bridge the mitigation gap created by inadequate NDCs, although
26 the empirical literature to date challenges this, suggesting that there is less transparency and limited
27 accountability for such actions, and mitigation targets and incentives are also not clear (Sections 14.3.3
28 and 14.5).

30 **14.6.2 Overall assessment of international cooperation**

31 This section provides an overall assessment of international cooperation, taking into account the
32 combined effects of cooperation within the UNFCCC process, other global agreements, as well as
33 regional, sectoral, and transnational processes. Recent literature consistent with the transitions framing
34 highlights that cooperation can be particularly effective when it addresses issues on a sector-by-sector
35 basis (Geels et al. 2019). Table 14.4 below summarises the effects of international cooperation on
36 mitigation efforts in each of the sectoral areas covered in Chapter 5 – 12 of this Assessment Report. As
37 it indicates, there are some strong areas of sectoral-specific cooperation, but also some important
38 weaknesses. Formal agreements and programs, both multilateral and bilateral, are advancing mitigation
39 efforts in energy, AFOLU, and transportation, while transnational networks and partnerships are
40 addressing issues in urban systems, industry, and buildings. Although many of the concerns relevant
41 for buildings may be embedded in the energy sector with respect to their operation, and the industrial
42 sector with respect to their materials, reinforcing the networks with more formal agreements could be
43 vital to putting these sectors on a pathway to net zero GHG or CO₂ emissions. Several of the sectors
44 have very little formal cooperation at the international level, and a common theme across many of them
45 is a need for increased financial flows to achieve particular objectives.

1

Table 14.4 Effects of international cooperation on sectoral mitigation efforts

Sector	Key strengths	Key gaps and weaknesses
Demand, services, social aspects	Adoption of SDGs addressing social inequities and sustainable development in the context of mitigation.	Little international attention to demand-side mitigation issues.
Energy	Greater incorporation of climate goals into sectoral agreements and institutions; formation of new specialised agencies (e.g. IRENA, SE4All) devoted to climate-compatible energy.	Need for enhanced financial support to place low-carbon energy sources on an equal footing with carbon emitting energy in developing countries; investor-state dispute settlement mechanisms designed to protect the interests of companies engaged in high-carbon energy supply from national policies; ensuring just transition; and, addressing stranded assets.
AFOLU	Bilateral support for REDD+ activities; transnational partnerships disincentivising use of products from degraded lands.	Need for increased global finance for forest restoration projects and REDD+ activities; failure of national governments to meet internationally agreed upon targets with respect to deforestation and restoration; no cooperative mechanisms in place to address agricultural emissions
Urban systems	Transnational partnerships enhancing the capacity of municipal governments to design and implement effective policies.	Need for increased financial support for climate compatible urban infrastructure development.
Buildings	Transnational initiative aimed at developing regional roadmaps.	Need for formal international cooperation to enhance mitigation activities in buildings.
Transport	Sectoral agreements in aviation and shipping begin to address climate concerns.	Need to raise the level of ambition in sectoral agreements consistent with the Paris Agreement and complete decarbonisation, especially as emissions from international aviation and shipping continue to grow, unaccounted for in NDCs.
Industry	Transnational partnerships and networks encouraging the adoption of zero emission supply chain targets.	No formal multilateral or bilateral cooperation to address issues of decarbonisation in industry.
Cross-sectoral, including CDR and SRM	International agreements addressing risks of ocean-based CDR	Lack of cooperative mechanisms addressing risks and benefits of SRM; lack of cooperative mechanisms addressing financial and governance aspects of land- and technology-based CDR.

2

3 Table 14.5 provides examples of mechanisms addressing each of the assessment criteria identified in
4 Section 14.2.3. The effects of different forms of international cooperation are separated out, including
5 not only UNFCCC and other multilateral processes, but also sub-global and sectoral agreements.
6 Several points stand out. First, the Paris Agreement has the potential to significantly advance the UN

1 climate regime's transformative potential. Second, the international market mechanisms under Article
 2 6 – should an agreement on implementation deals be reached – allow a shift from projects and programs
 3 to policy-based and sectoral generation of emissions credits. Moreover, the sectoral agreement CORSIA
 4 also makes use of such credits. Third, there is a lack of attention to both distributive outcomes and
 5 institutional support within sectoral agreements, representing a serious gap in efforts to harmonise
 6 mitigation with equity and sustainable development. Fourth, there are transnational partnerships and
 7 initiatives, representing the actions of non-state actors, addressing each of the assessment criteria, with
 8 the exception of economic effectiveness.

9
 10 **Table 14.5 Illustrative examples of multi-level governance addressing criteria of effectiveness**

	Environmental effectiveness	Transformative potential	Distributive Outcomes	Economic effectiveness	Institutional strength
UNFCCC	Stabilisation goal, and quasi-targets for industrialised countries	Financial mechanism; technology mechanism, provisions for capacity building	Financial mechanism, transfers from developed to developing; leadership role for industrialised countries listed in Annex 1		Reporting requirements; capacity building for national climate change offices.
Kyoto Protocol	Binding national targets for industrialised countries		Adaptation Fund; targets restricted to industrialised countries	Market-based mechanisms	Emissions accounting and reporting requirements, institutional capacity building
Paris Agreement	NDCs and the global stocktake	Mechanisms for capacity building and technology development and transfer	Furthering financial commitments under the UNFCCC, including enhanced transparency on finance	Voluntary cooperation	Mechanism for enhanced transparency
Other multilateral agreements (Montreal protocol, and SDG 7, etc)	Phase out of Ozone depleting substances (ODS) with high global warming potential - significant effects on GHG mitigation	Ozone Fund, technology transfer; development and sharing of knowledge and expertise	SDGs embedding mitigation in sustainable development		Processes for adjustment and amendment, reporting requirements

Multilateral and regional economic agreements and institutions	Harmonised lending practices of MDBs; mainstreaming climate change into IMF practices; liberalisation of trade in climate-friendly goods and services; negative effect from regulatory chill		Concessional financing agreements	Potentially negative results from dispute settlement processes
Sectoral agreements and institutions	Climate mitigation targets and actions in AFOLU, energy, and transport	Institutions devoted to developing and deploying zero-carbon energy technologies (e.g. IRENA).		Use of carbon offsets to reduce growth in emissions from aviation
Transnational networks and partnerships	Youth climate movement raising mitigation and fossil fuel divestment on political agendas and in financial sector	Non-state actor commitments to renewable energy-based supply chains	Climate justice legal initiatives	City networks providing information exchange and technical support

1

2

3 14.7 Knowledge Gaps

4 Any assessment of the effectiveness of international cooperation is limited by the methodological
5 challenge of observing sufficient variance in cooperation in order to support inference on effects. There
6 is little in the way of cross-sectional variance, given that most of the governance mechanisms assessed
7 here are global in their geographical coverage. One exception is with respect to the effects of the Kyoto
8 Protocol, which we have reported. Time series analysis is also challenging, given that other
9 determinants of climate mitigation, including technology costs and the effects of national and sub-
10 national level policies, are rapidly evolving. Thus, this chapter primarily reviews scholarship that
11 compares observations with theory-based counter-factual scenarios.

12 Many of the international agreements and institutions discussed in this chapter, in particular the Paris
13 Agreement, are new. The logic and architecture of the Paris Agreement, in particular, breaks new
14 ground, and there is limited evaluation of prior experience in the form of analogous treaties to draw on.
15 Such instruments have evolved in response to geo-political and other drivers, that are changing rapidly,
16 and will continue to shape the nature of international cooperation under it and triggered by it. The Paris
17 Agreement is also, in common with other multilateral agreements, a ‘living instrument’ evolving

1 through interpretative and operationalising rules, and forms of implementation, that parties continue to
2 negotiate at conferences year on year. It is a constant ‘work in progress’ and thus challenging to assess
3 at any given point in time. The Paris Agreement also engages a larger set of variables – given its
4 privileging of national autonomy and politics, integration with the sustainable development agenda, and
5 its engagement with actions and actors at multiple levels – than earlier international agreements, which
6 further complicates the task of tracing causality between observed effects and international cooperation
7 through the Paris Agreement.

8 Understanding of the effectiveness of international agreements and institutions is driven entirely by
9 theory driven prediction of how the world will evolve, both with these agreements in place and without
10 them. The former predictions in particular are problematic, because governance regimes are complex
11 adaptive systems, making it impossible to predict how they will evolve over time, and hence what their
12 effects will be. Time will cure this in part, as it will generate observations of the world with the new
13 regime in place, which we can compare to the counterfactual situation of the new regime’s being absent,
14 which may be a simpler situation to model. But even here our modelling capacity is limited: it may
15 simply never be possible to know with a high degree of confidence whether international cooperation,
16 such as that embodied in the Paris Agreement, is having a significant effect, no matter how much data
17 are accumulated.

18 Given the importance of theory for guiding assessments of the past and likely future impacts of policies,
19 it is important to note that among the alternative theoretical frameworks for analysis, some have been
20 much more extensively developed in the literature than others. This chapter has noted in particular the
21 partial dichotomy between a global-commons framing of climate change and a transitions framing,
22 which include different indicators to be used to evaluate the effectiveness of policies. The latter framing
23 is particularly under-developed. Greater development of theories resting in social science disciplines
24 such as economic geography, sociology, and psychology could potentially provide a more complete
25 picture of the nature and effectiveness of international cooperation.

28 **Frequently Asked Questions**

29 **FAQ 14.1: Is international cooperation working?**

30 Yes, to an extent. Countries’ emissions were in line with their internationally agreed targets: the
31 collective Greenhouse Gas (GHG) mitigation target for Annex I countries in the UNFCCC to return to
32 their 1990 emissions by 2000, and their individual targets in the Kyoto Protocol for 2008-12. Numerous
33 studies suggest that participation in the Kyoto Protocol led to substantial reductions in national GHG
34 emissions, as well increased levels of innovation and investment in low-carbon technologies. In this
35 latter respect, the Kyoto Protocol set in motion some of the transformational changes that will be
36 required to meet the temperature goal of the Paris Agreement. It is too soon to tell whether the processes
37 and commitments embodied in the Paris Agreement will be effective in achieving its stated goals with
38 respect to limiting temperature rise, adaptation, and financial flows. There is, however, evidence that
39 its entry into force has been a contributing factor to many countries’ adopting mid-century targets of
40 net-zero GHG or CO₂ emissions.

41 **FAQ 14.2: What is the future role of international cooperation in the context of the Paris** 42 **Agreement?**

43 Continued international cooperation remains critically important both to stimulate countries’ enhanced
44 levels of mitigation ambition, and through various means of support to increase the likelihood that they
45 achieve these objectives. The latter is particularly the case in developing countries, where mitigation

1 efforts often rely on bilateral and multilateral cooperation on low-carbon finance, technology support,
2 capacity building, and enhanced South-South cooperation. The Paris Agreement is structured around
3 nationally determined contributions (NDCs) that are subject to an international oversight system, and
4 bolstered through international support. The international oversight system is designed to generate
5 transparency and accountability for individual emission reduction contributions, and regular moments
6 for stock-taking of these efforts towards global goals. Such enhanced transparency may instil
7 confidence and trust, and foster solidarity among nations, with theory-based arguments that this will
8 lead to greater levels of ambition. Together with other cooperative agreements at the sub-global and
9 sectoral levels, as well as a growing number of transnational networks and initiatives, the
10 implementation of all of these mechanisms are likely to play an important role in making political,
11 economic, and social conditions more favourable to ambitious mitigation efforts in the context of
12 sustainable development and efforts to eradicate poverty.

13 **FAQ 14.3: Are there any important gaps in international cooperation, which will need to be filled**
14 **in order for countries to achieve the objectives of the Paris Agreement, such as holding**
15 **temperature increase to ‘well below 2°C’ and pursuing efforts towards ‘1.5°C’ above pre-**
16 **industrial levels?**

17 While international cooperation is contributing to global mitigation efforts, its effects are far from
18 uniform. Cooperation has contributed to setting a global direction of travel, and to falling greenhouse
19 gas emissions in many countries and avoided emissions in others. It remains to be seen whether it can
20 achieve the kind of transformational changes needed to achieve the Paris Agreement’s long-term global
21 goals. There appears to be a large potential role for international cooperation to better address sector-
22 specific technical and infrastructure challenges that are associated with such transformational changes.
23 Finalising the rules to pursue voluntary cooperation, such as through international carbon market
24 mechanisms and public climate finance in the implementation of NDCs, without compromising
25 environmental integrity, may play an important role in accelerating mitigation efforts in developing
26 countries. Finally, there is room for international cooperation to more explicitly address transboundary
27 issues associated with Carbon Dioxide Removal (CDR) and Solar Radiation Management (SRM).

1 References

- 2 Aakre, S., S. Kallbekken, R. Van Dingenen, and D. G. Victor, 2018: Incentives for small clubs of Arctic
3 countries to limit black carbon and methane emissions. *Nat. Clim. Chang.*, **8**(1), 85–90,
4 doi:10.1038/s41558-017-0030-8.
- 5 Abas, N. et al., 2018: Natural and synthetic refrigerants, global warming: A review. *Renew. Sustain.*
6 *Energy Rev.*, **90**, 557–569, doi:10.1016/j.rser.2018.03.099.
- 7 Abatayo, A. Lou, V. Bosetti, M. Casari, R. Ghidoni, and M. Tavoni, 2020: Solar geoengineering may
8 lead to excessive cooling and high strategic uncertainty. *Proc. Natl. Acad. Sci.*, **117**(24), 13393–
9 13398, doi:10.1073/pnas.1916637117.
- 10 Acemoglu, D., P. Aghion, L. Bursztyn, and D. Hemous, 2012: The Environment and Directed Technical
11 Change. *Am. Econ. Rev.*, **102**(1), 131–166, doi:10.1257/aer.102.1.131.
- 12 Adelman, S., 2018: Human Rights in the Paris Agreement: Too Little, Too Late? *Transnatl. Environ.*
13 *Law*, **7**(1), 17–36, doi:10.1017/s2047102517000280.
- 14 Adger, W. N., S. Huq, K. Brown, and M. Hulme, 2003: Adaptation to climate change in the developing
15 world. *Prog. Dev. Stud.*, **3**(3), 179–195, doi:10.1191/1464993403ps060oa.
- 16 Aghion, P., P. Antràs, and E. Helpman, 2007: Negotiating free trade. *J. Int. Econ.*, **73**(1), 1–30,
17 doi:10.1016/j.jinteco.2006.12.003.
- 18 Aghion, P., C. Hepburn, A. Teytelboym, and D. Zenghelis, 2014: *Path dependence, innovation and the*
19 *economics of climate change, Working Paper, Centre for Climate Change Economics and*
20 *Policy/Grantham Research Institute on Climate Change and the Environment Policy Paper &*
21 *Contributing paper to New Climate Economy.* 1–17 pp.
22 [https://www.lse.ac.uk/granthaminstitute/wp-](https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2014/11/Aghion_et_al_policy_paper_Nov20141.pdf)
23 [content/uploads/2014/11/Aghion_et_al_policy_paper_Nov20141.pdf](https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2014/11/Aghion_et_al_policy_paper_Nov20141.pdf).
- 24 Agueda Corneloup, I. de, and A. P. J. Mol, 2014: Small island developing states and international
25 climate change negotiations: the power of moral “leadership.” *Int. Environ. Agreements Polit.*
26 *Law Econ.*, **14**(3), 281–297, doi:10.1007/s10784-013-9227-0.
- 27 Ahlm, L. et al., 2017: Marine cloud brightening - As effective without clouds. *Atmos. Chem. Phys.*,
28 **17**(21), 13071–13087, doi:10.5194/acp-17-13071-2017.
- 29 Aichele, R., and G. Felbermayr, 2013: The Effect of the Kyoto Protocol on Carbon Emissions. *J. Policy*
30 *Anal. Manag.*, **32**(4), 731–757, doi:10.1002/pam.21720.
- 31 Akanle, T., 2010: Impact of Ozone Layer Protection on the Avoidance of Climate Change: Legal Issues
32 and Proposals to Address the Problem. *Rev. Eur. Community Int. Environ. Law*, **19**(2), 239–249,
33 doi:10.1111/j.1467-9388.2010.00680.x.
- 34 Aklin, M., and M. Mildemberger, 2020: Prisoners of the Wrong Dilemma: Why Distributive Conflict,
35 Not Collective Action, Characterizes the Politics of Climate Change. *Glob. Environ. Polit.*, **20**(4),
36 4–27, doi:10.1162/glep_a_00578.
- 37 Al Khourdajie, A., and M. Finus, 2020: Measures to enhance the effectiveness of international climate
38 agreements: The case of border carbon adjustments. *Eur. Econ. Rev.*, **124**(103405), 1–18,
39 doi:10.1016/j.euroecorev.2020.103405.
- 40 Alcaraz, O. et al., 2019: The global carbon budget and the Paris agreement. *Int. J. Clim. Chang. Strateg.*
41 *Manag.*, **11**(3), 310–325, doi:10.1108/ijccsm-06-2017-0127.
- 42 Aldy, J. E., W. A. Pizer, and K. Akimoto, 2017: Comparing emissions mitigation efforts across
43 countries. *Clim. Policy*, **17**(4), 501–515, doi:10.1080/14693062.2015.1119098.
- 44 Allan, J. I., 2019: Dangerous Incrementalism of the Paris Agreement. *Glob. Environ. Polit.*, **19**(1), 4–
45 11, doi:10.1162/glep_a_00488.

- 1 Allan, J. I., 2020: *The New Climate Activism: NGO Authority and Participation in Climate Change*
2 *Governance*. University of Toronto Press, Toronto, 226 pp.
- 3 Allgaier, J., 2019: Science and Environmental Communication on YouTube: Strategically Distorted
4 Communications in Online Videos on Climate Change and Climate Engineering. *Front. Commun.*,
5 **4**(36), 1–15, doi:10.3389/fcomm.2019.00036.
- 6 Almeida, M., 2020: *Global Green Bond State of the Market 2019. Climate Bonds Initiative, July 2020.*
7 1–16 pp. https://www.climatebonds.net/system/tdf/reports/cbi_sotm_2019_vol1_04d.pdf
8 (Accessed December 9, 2020).
- 9 Almeida, P., 2019: Climate justice and sustained transnational mobilization. *Globalizations*, **16**(7),
10 973–979, doi:10.1080/14747731.2019.1651518.
- 11 Almer, C., and R. Winkler, 2017: Analyzing the effectiveness of international environmental policies:
12 The case of the Kyoto Protocol. *J. Environ. Econ. Manage.*, **82**(C), 125–151,
13 doi:10.1016/j.jeem.2016.11.003.
- 14 Ameli, N., P. Drummond, A. Bisaro, M. Grubb, and H. Chenet, 2020: Climate finance and disclosure
15 for institutional investors: why transparency is not enough. *Clim. Change*, **160**(4), 565–589,
16 doi:10.1007/s10584-019-02542-2.
- 17 Anderson, W., and N. Peimbert, 2019: About Initiative 20X20. *Initiat. 20X20.*,
18 <https://initiative20x20.org/es/node/386> (Accessed October 29, 2021).
- 19 Anderson, Z. R., K. Kusters, J. McCarthy, and K. Obidzinski, 2016: Green growth rhetoric versus
20 reality: Insights from Indonesia. *Glob. Environ. Chang.*, , doi:10.1016/j.gloenvcha.2016.02.008.
- 21 Andler, L., and S. Behrle, 2009: *Managers of Global Change: The Influence of International*
22 *Environmental Bureaucracies*. [Biermann, F. and B. Siebenhüner, (eds.)]. MIT Press 2009,
23 Cambridge, MA.,
- 24 Andonova, L. B., 2017: *Governance Entrepreneurs - International Organizations and the Rise of*
25 *Global Public-Private Partnerships*. Cambridge University Press, Cambridge.,
- 26 Andresen, S., 2014: Exclusive Approaches to Climate Governance: More Effective than the UNFCCC?
27 In: *Toward A New Climate Agreement: Conflict, Resolution and Governance* [Cherry, T., J. Hovi,
28 and D.M. McEvoy, (eds.)], Routledge, London and New York, pp. 167–181.
- 29 Andresen, S., T. Skodvin, A. Underdal, and J. Wettestad, 2000: *Science and Politics in International*
30 *Environmental Regimes*. [Andresen, S., T. Skodvin, A. Underdal, and J. Wettestad, (eds.)].
31 Manchester University Press, Manchester, 221 pp.
- 32 Angelsen, A., 2017: REDD+ as Result-based Aid: General Lessons and Bilateral Agreements of
33 Norway. *Rev. Dev. Econ.*, **21**(2), 237–264.
- 34 Anouliès, L., 2015: The Strategic and Effective Dimensions of the Border Tax Adjustment. *J. Public*
35 *Econ. Theory*, **17**(6), 824–847, doi:10.1111/jpet.12131.
- 36 Antimiani, A., V. Costantini, A. Markandya, E. Paglialonga, and G. Sforza, 2017: The Green Climate
37 Fund as an effective compensatory mechanism in global climate negotiations. *Environ. Sci.*
38 *Policy*, **77**, 49–68, doi:10.1016/j.envsci.2017.07.015.
- 39 Antwi-Agyei, P., A. J. Dougill, T. P. Agyekum, and L. C. Stringer, 2018: Alignment between nationally
40 determined contributions and the sustainable development goals for West Africa. *Clim. Policy*,
41 **18**(10), 1296–1312, doi:10.1080/14693062.2018.1431199.
- 42 Arino, Y. et al., 2016: Estimating option values of solar radiation management assuming that climate
43 sensitivity is uncertain. *Proc. Natl. Acad. Sci.*, **113**(21), 5886–5891,
44 doi:10.1073/pnas.1520795113.
- 45 Ascensão, F. et al., 2018: Environmental challenges for the Belt and Road Initiative. *Nat. Sustain.*, **1**(5),
46 206–209, doi:10.1038/s41893-018-0059-3.

- 1 Asheim, G. B., C. B. Froyn, J. Hovi, and F. C. Menz, 2006: Regional versus global cooperation for
2 climate control. *J. Environ. Econ. Manage.*, **51**(1), 93–109, doi:10.1016/j.jeem.2005.04.004.
- 3 Asheim, G. B. et al., 2019: The case for a supply-side climate treaty. *Science (80-.)*, **365**(6451), 325–
4 327, doi:10.1126/science.aax5011.
- 5 Asian Development Bank, 2019: *High Level MDB Statement - For Publication at the UNSG Climate*
6 *Action Summit, 22 September 2019*.
- 7 Asmelash, H. B., 2015: Energy Subsidies and WTO Dispute Settlement: Why Only Renewable Energy
8 Subsidies Are Challenged. *J. Int. Econ. Law*, **18**(2), 261–285, doi:10.1093/jiel/jgv024.
- 9 AUDA-NEPAD, 2019: African Forest Landscape Restoration Initiative. *African Union Dev. Agency*,.
- 10 Austin, J. E., and M. M. Seitanidi, 2012: Collaborative Value Creation. *Nonprofit Volunt. Sect. Q.*,
11 **41**(5), 726–758, doi:10.1177/0899764012450777.
- 12 Axel, M., 2019: Public-Private Partnerships for Sustainable Development: Exploring their design and
13 Impact on Effectiveness. *Sustainability*, **11**(1087), doi:10.3390/su11041087.
- 14 Baatz, C., 2016: Can we have it both ways? On potential trade-offs between mitigation and solar
15 radiation management. *Environ. Values*, **25**(1), 29–49,
16 doi:10.3197/096327115x14497392134847.
- 17 Bacchus, J., 2016: *Global Rules for Mutually Supportive and Reinforcing Trade and Climate Regimes*.
18 , Geneva,.
- 19 Bäckstrand, K., and J. W. Kuyper, 2017: The democratic legitimacy of orchestration: the UNFCCC,
20 non-state actors, and transnational climate governance. *Env. Polit.*, **26**(4),
21 doi:10.1080/09644016.2017.1323579.
- 22 Bäckstrand, K., J. W. Kuyper, B.-O. Linnér, and E. Lövbrand, 2017: Non-state actors in global climate
23 governance: from Copenhagen to Paris and beyond. *Env. Polit.*, **26**(4), 561–579,
24 doi:10.1080/09644016.2017.1327485.
- 25 Baghdadi, L., I. Martinez-Zarzoso, and H. Zitouna, 2013: Are RTA agreements with environmental
26 provisions reducing emissions? *J. Int. Econ.*, **90**(2), 378–390,
27 doi:https://doi.org/10.1016/j.jinteco.2013.04.001.
- 28 Bahl, R. W., and J. F. Linn, 2014: *Governing and Financing Cities in the Developing World*. 1–60 pp.
- 29 Bailey, I., and T. H. J. Inderberg, 2018: Australia: domestic politics, diffusion and emissions trading
30 design as a technical and political project. In: *The Evolution of Carbon Markets: Design and*
31 *Diffusion* [Wettestad, J.; Gulbrandsen, L.H., (ed.)], Routledge, pp. 124–144.
- 32 Bakhtiari, F., 2018: International cooperative initiatives and the United Nations Framework Convention
33 on Climate Change. *Clim. Policy*, **18**(5), 655–663, doi:10.1080/14693062.2017.1321522.
- 34 Baldwin, E., Y. Cai, and K. Kuralbayeva, 2020: To build or not to build? Capital stocks and climate
35 policy. *J. Environ. Econ. Manage.*, **100**, 102235, doi:10.1016/j.jeem.2019.05.001.
- 36 Bang, G., J. Hovi, and T. Skodvin, 2016: The Paris Agreement: Short-Term and Long-Term
37 Effectiveness. *Polit. Gov.*, , doi:10.17645/pag.v4i3.640.
- 38 Banks, G. D., and T. Fitzgerald, 2020: A sectoral approach allows an artful merger of climate and trade
39 policy. *Clim. Change*, **162**(2), 165–173, doi:10.1007/s10584-020-02822-2.
- 40 Barrett, S., 1994: Self-Enforcing International Environmental Agreements. *Oxf. Econ. Pap.*, **46**, 878–
41 894.
- 42 Barrett, S., 2008: Climate treaties and the imperative of enforcement. *Oxford Rev. Econ. Policy*, ,
43 doi:10.1093/oxrep/grn015.
- 44 Barrett, S., 2013: Climate treaties and approaching catastrophes. *J. Environ. Econ. Manage.*, **66**(2),
45 235–250, doi:10.1016/j.jeem.2012.12.004.

- 1 Barrett, S., 2018: Choices in the climate commons. *Science (80-.)*, **362**(6420), 1217 LP – 1217,
2 doi:10.1126/science.aaw2116.
- 3 Barrett, S., and A. Dannenberg, 2016: An experimental investigation into ‘pledge and review’ in climate
4 negotiations. *Clim. Change*, **138**(1–2), 339–351, doi:10.1007/s10584-016-1711-4.
- 5 Battaglini, M., and B. Harstad, 2016: Participation and Duration of Environmental Agreements. *J. Polit.*
6 *Econ.*, **124**(1), 160–204, doi:10.1086/684478.
- 7 Bauer, M. W., C. Knill, and S. Eckhard, 2017: *International Bureaucracy: Challenges and Lessons for*
8 *Public Administration Research*. Palgrave Macmillan UK,.
- 9 Bayramoglu, B., M. Finus, and J.-F. Jacques, 2018: Climate agreements in a mitigation-adaptation
10 game. *J. Public Econ.*, **165**, 101–113, doi:10.1016/j.jpubeco.2018.07.005.
- 11 Beauregard, C., D. Carlson, S. Robinson, C. Cobb, and M. Patton, 2021: Climate justice and rights-
12 based litigation in a post-Paris world. *Clim. Policy*, **21**(5), 652–665,
13 doi:10.1080/14693062.2020.1867047.
- 14 Beer, C. et al., 2010: Terrestrial Gross Carbon Dioxide Uptake: Global Distribution and Covariation
15 with Climate. *Science (80-.)*, **329**(5993), 834–838, doi:10.1126/science.1184984.
- 16 Beiser-McGrath, L. F., and T. Bernauer, 2021: Domestic Provision of Global Public Goods: How Other
17 Countries’ Behavior Affects Public Support for Climate Policy. *Glob. Environ. Polit.*, , 1–22,
18 doi:10.1162/glep_a_00612.
- 19 Bellamy, R., and J. Lezaun, 2017: Crafting a public for geoengineering. *Public Underst. Sci.*, ,
20 doi:10.1177/0963662515600965.
- 21 Bellamy, R., and O. Geden, 2019: Govern CO2 removal from the ground up. *Nat. Geosci.*, ,
22 doi:10.1038/s41561-019-0475-7.
- 23 Benjamin, L., 2021: *Companies and Climate Change: Theory and Law in the United Kingdom*.
24 Cambridge University Press, Cambridge, UK,.
- 25 Benoit, C., 2011: Picking Tariff Winners: Non-Product Related PPMs and DSB Interpretations of
26 Unconditionally within Article I:1. *Georg. J. Int. Law*, **42**(2), 583–604.
- 27 Benveniste, H., O. Boucher, C. Guivarch, H. Le Treut, and P. Criqui, 2018: Impacts of nationally
28 determined contributions on 2030 global greenhouse gas emissions: Uncertainty analysis and
29 distribution of emissions. *Environ. Res. Lett.*, **13**(1), doi:10.1088/1748-9326/aaa0b9.
- 30 Bergman, N., 2018: Impacts of the Fossil Fuel Divestment Movement: Effects on Finance, Policy and
31 Public Discourse. *Sustainability*, **10**(7), 2529, doi:10.3390/su10072529.
- 32 Bernasconi-Osterwalder, N., and A. Cosbey, 2021: Carbon and Controversy: Why we need global
33 cooperation on border carbon adjustment. *Int. Inst. Sustain. Dev. Blog.*,
34 <https://www.iisd.org/articles/carbon-border-adjustment-global-cooperation/>.
- 35 Berrone, P. et al., 2019: EASIER: An evaluation Model for public private partnerships contributing to
36 sustainable development. *Sustainability*, **11**(8), 2339, doi:10.3390/su11082339.
- 37 Bertoldi, P., A. Kona, S. Rivas, and J. F. Dallemand, 2018: Towards a global comprehensive and
38 transparent framework for cities and local governments enabling an effective contribution to the
39 Paris climate agreement. *Curr. Opin. Environ. Sustain.*, **30**(C), 67–74,
40 doi:10.1016/j.cosust.2018.03.009.
- 41 Besharati, N. A., C. Rawhani, and O. G. Rios, 2017: *A Monitoring And Evaluation Framework For*
42 *South-South Cooperation*. NeST Africa, Johannesburg, 1–28 pp. [https://saiaa.org.za/research/a-](https://saiaa.org.za/research/a-monitoring-and-evaluation-framework-for-south-south-cooperation/)
43 [monitoring-and-evaluation-framework-for-south-south-cooperation/](https://saiaa.org.za/research/a-monitoring-and-evaluation-framework-for-south-south-cooperation/).
- 44 Best, R., and P. J. Burke, 2018: Adoption of solar and wind energy: The roles of carbon pricing and
45 aggregate policy support. *Energy Policy*, **118**, 404–417, doi:10.1016/J.ENPOL.2018.03.050.
- 46 Betsill, M. M., and H. Bulkeley, 2004: Transnational Networks and Global Environmental Governance:

- 1 The Cities for Climate Protection Program. *Int. Stud. Q.*, **48**(2), 471–493, doi:10.1111/j.0020-
2 8833.2004.00310.x.
- 3 Biermann, F., and I. Möller, 2019: Rich man’s solution? Climate engineering discourses and the
4 marginalization of the Global South. *Int. Environ. Agreements Polit. Law Econ.*, **19**(2), 151–167,
5 doi:10.1007/s10784-019-09431-0.
- 6 Biermann, F., P. Pattberg, H. van Asselt, and F. Zelli, 2009: The fragmentation of global governance
7 architectures: A framework for analysis. *Glob. Environ. Polit.*, **9**(4),
8 doi:10.1162/glep.2009.9.4.14.
- 9 Blondeel, M., J. Colgan, and T. Van de Graaf, 2019: What drives norm success? Evidence from anti-
10 fossil fuel campaigns. *Glob. Environ. Polit.*, **19**(4), 63–84, doi:10.1162/glep_a_00528.
- 11 Blondeel, M., T. Van de Graaf, and T. Haesebrouck, 2020: Moving beyond coal: Exploring and
12 explaining the Powering Past Coal Alliance. *Energy Res. Soc. Sci.*, **59**, 101304,
13 doi:10.1016/j.erss.2019.101304.
- 14 Bodansky, D., 2013: The who, what, and wherefore of geoengineering governance. *Clim. Change*,
15 **121**(3), 539–551, doi:10.1007/s10584-013-0759-7.
- 16 Bodansky, D., 2015: Legally binding versus non-legally binding instruments Daniel. In: *Geneva*
17 *Reports on the World Economy*.
- 18 Bodansky, D., 2016: The legal character of the Paris agreement. *Rev. Eur. Comp. Int. Environ. Law*,
19 **25**(2), 142–150, doi:10.1111/reel.12154.
- 20 Bodansky, D., and L. Rajamani, 2016: The Evolution and Governance Architecture of the United
21 Nations Climate Change Regime. In: *Global Climate Policy: Actors, Concepts, and Enduring*
22 *Challenges* [Sprinz, D. and U. Luterbacher, (eds.)], Cambridge University Press, pp. 13–66.
- 23 Bodansky, D., J. Brunnée, and L. Rajamani, 2017a: Introduction to International Climate Change Law.
24 In: *International Climate Change Law*, Oxford University Press, pp. 1–34.
- 25 Bodansky, D., J. Brunnée, and L. Rajamani, 2017b: *International Climate Change Law*. First. Oxford
26 University Press, Oxford, 374 pp.
- 27 Bodansky, D. M., S. A. Hoedl, G. E. Metcalf, and R. N. Stavins, 2016: Facilitating linkage of climate
28 policies through the Paris outcome. *Clim. Policy*, , doi:10.1080/14693062.2015.1069175.
- 29 Bodle, R. et al., 2014: *Options and Proposals for the International Governance of Geoengineering*.
30 Umweltbundesamt,.
- 31 Boekholt, P., J. Edler, P. Cunningham, and K. Flanagan, 2009: *Drivers of International Collaboration*
32 *in Research. Final Report*. 47 pp.
- 33 Böhringer, C., A. Müller, and J. Schneider, 2015: Carbon tariffs revisited. *J. Assoc. Environ. Resour.*
34 *Econ.*, **2**(4), 629–672, doi:10.1086/683607.
- 35 Booth, E., 2019: Extinction Rebellion: social work, climate change and solidarity. *Crit. Radic. Soc.*
36 *Work*, **7**(2), 257–261, doi:10.1332/204986019x15623302985296.
- 37 Bos, A. B. et al., 2017: Comparing methods for assessing the effectiveness of subnational REDD+
38 initiatives. *Environ. Res. Lett.*, **12**(7), 74007, doi:10.1088/1748-9326/aa7032.
- 39 Bos, K., and J. Gupta, 2019: Stranded assets and stranded resources: Implications for climate change
40 mitigation and global sustainable development. *Energy Res. Soc. Sci.*, **56**, 101215,
41 doi:10.1016/j.erss.2019.05.025.
- 42 Bouwer, L. M., and J. C. J. H. Aerts, 2006: Financing climate change adaptation. *Disasters*, **30**(1), 49–
43 63, doi:10.1111/j.1467-9523.2006.00306.x.
- 44 Bows-Larkin, A., 2015: All adrift: aviation, shipping, and climate change policy. *Clim. Policy*, **15**(6),
45 681–702, doi:10.1080/14693062.2014.965125.

- 1 Boykoff, M., and O. Pearman, 2019: Now or Never: How Media Coverage of the IPCC Special Report
2 on 1.5°C Shaped Climate-Action Deadlines. *One Earth*, **1**(3), 285–288,
3 doi:10.1016/j.oneear.2019.10.026.
- 4 Boyle, A., 2018: Climate Change, the Paris Agreement and Human Rights. *Int. Comp. Law Q.*, ,
5 doi:10.1017/S0020589318000222.
- 6 Boyle, A., 2019: Litigating climate change under Part XII of the LOSC. *Int. J. Mar. Coast. Law*, **34**(3),
7 458–481, doi:10.1163/15718085-13431097.
- 8 Brandi, C., 2017: *Trade Elements in Countries' Climate Contributions under the Paris Agreement*. ,
9 Geneva,.
- 10 Brandi, C., D. Blümer, and J.-F. Morin, 2019: When Do International Treaties Matter for Domestic
11 Environmental Legislation? *Glob. Environ. Polit.*, **19**(4), 14–44, doi:10.1162/glep_a_00524.
- 12 Brauch, M. D. et al., 2019: Treaty on Sustainable Investment for Climate Change Mitigation and
13 Adaptation: Aligning International Investment Law with the Urgent Need for Climate Change
14 Action. *J. Int. Arbitr.*, **36**(1), 7–35.
- 15 Brechin, S. R., and M. I. Espinoza, 2017: A case for further refinement of the Green Climate Fund's
16 50:50 ratio climate change mitigation and adaptation allocation framework: toward a more
17 targeted approach. *Clim. Change*, **142**(3–4), 311–320, doi:10.1007/s10584-017-1938-8.
- 18 Brenton, A., 2013: “Great Powers” in climate politics. *Clim. policy*, **13**(5), 541–546,
19 doi:10.1080/14693062.2013.774632.
- 20 Bretschger, L., 2017: Equity and the convergence of nationally determined climate policies. *Environ.*
21 *Econ. Policy Stud.*, **19**(1), 1–14, doi:10.1007/s10018-016-0161-6.
- 22 Brewer, T. L., H. Derwent, A. Błachowicz, and M. Grubb, 2016: *Carbon Market Clubs and the New*
23 *Paris Regime*. World Bank, Washington, DC,.
- 24 Brockhaus, M. et al., 2017: REDD+, transformational change and the promise of performance-based
25 payments: a qualitative comparative analysis”. *Clim. Policy*, **17**(6), 708–730.
- 26 Bruce, S., 2017: The Project for an International Environmental Court. In: *Conciliation in International*
27 *Law* [Tomuschat, C., R.P. Mazzeschi, and D. Thürer, (eds.)], Brill Nijhoff, pp. 133–170.
- 28 Bruce, S., 2018: Global Energy Governance and International Institutions. *SSRN Electron. J.*, ,
29 doi:10.2139/ssrn.3402057.
- 30 Buck, H. J. et al., 2020: Evaluating the efficacy and equity of environmental stopgap measures. *Nat.*
31 *Sustain.*, **3**, 499–504, doi:10.1038/s41893-020-0497-6.
- 32 Budolfson, M. B. et al., 2021: Utilitarian benchmarks for emissions and pledges promote equity, climate
33 and development. *Nat. Clim. Chang.*, **11**(10), 827–833, doi:10.1038/s41558-021-01130-6.
- 34 Buis, H., 2009: The role of local government associations in increasing the effectiveness of city-to-city
35 cooperation. *Habitat Int.*, **33**(2), 190–194, doi:10.1016/j.habitatint.2008.10.017.
- 36 Bulkeley, H., 2010: Cities and the governing of climate change. *Annu. Rev. Environ. Resour.*,
37 **35**(November 2010), 229–253.
- 38 Burniaux, J.-M., J. Château, and J. Sauvage, 2011: *The Trade Effects of Phasing Out Fossil-Fuel*
39 *Consumption Subsidies*. OECD Publishing, 1–18 pp.
- 40 Burns, E. T. et al., 2016: What do people think when they think about solar geoengineering? A review
41 of empirical social science literature, and prospects for future research. *Earth's Futur.*, **4**(11), 536–
42 542, doi:10.1002/2016ef000461.
- 43 Burns, W., and C. R. Corbett, 2020: Antacids for the Sea? Artificial Ocean Alkalinization and Climate
44 Change. *One Earth*, **3**(2), 154–156, doi:10.1016/j.oneear.2020.07.016.
- 45 Burton, C., R. A. Betts, C. D. Jones, and K. Williams, 2018: Will Fire Danger Be Reduced by Using

- 1 Solar Radiation Management to Limit Global Warming to 1.5 °C Compared to 2.0 °C? *Geophys.*
2 *Res. Lett.*, **45**(8), 3644–3652, doi:10.1002/2018gl077848.
- 3 Busby, J., 2016: After Paris: good enough climate governance. *Curr. Hist.*, **115**(777), 3–9,
4 doi:10.1525/curh.2016.115.777.3.
- 5 Busby, J., and J. Urpelainen, 2020: Following the Leaders? How to Restore Progress in Global Climate
6 Governance. *Glob. Environ. Polit.*, **20**(4), 99–121, doi:10.1162/glep_a_00562.
- 7 Busch, J., F. Godoy, W. R. Turner, and C. A. Harvey, 2011: Biodiversity co-benefits of reducing
8 emissions from deforestation under alternative reference levels and levels of finance. *Conserv.*
9 *Lett.*, **4**(2), 101–116, doi:10.1111/j.1755-263x.2010.00150.x.
- 10 Caetano, T., H. Winker, and J. Depledge, 2020: Towards zero carbon and zero poverty: integrating
11 national climate change mitigation and sustainable development goals. *Clim. Policy*, **20**(7), 773–
12 778, doi:10.1080/14693062.2020.1791404.
- 13 Caldeira, K., and G. Bala, 2017: Reflecting on 50 years of geoengineering research. *Earth's Futur.*,
14 **5**(1), 10–17, doi:10.1002/2016ef000454.
- 15 Callies, D. E., 2019: The Slippery Slope Argument against Geoengineering Research. *J. Appl. Philos.*,
16 **36**(4), 675–687, doi:10.1111/japp.12345.
- 17 Calzadilla, P. V., 2018: Human Rights and the New Sustainable Mechanism of the Paris Agreement: A
18 New Opportunity to Promote Climate Justice. *Potchefstroom Electron. Law J.*, **21**(1), 1–39,
19 doi:10.17159/1727-3781/2018/v21i0a3189.
- 20 Comes, M. et al., 2016: *How additional is the Clean Development Mechanism? Analysis of the*
21 *application of current tools and proposed alternatives*. Öko-Institut/INFRAS/SEI, Berlin, 173 pp.
- 22 Campagnolo, L., and M. Davide, 2019: Can the Paris deal boost SDGs achievement? An assessment of
23 climate mitigation co-benefits or side-effects on poverty and inequality. *World Dev.*, **122**, 96–109,
24 doi:10.1016/j.worlddev.2019.05.015.
- 25 Campbell-Durufié, C., 2018a: Clouds or Sunshine in Katowice? Transparency in the Paris Agreement
26 Rulebook. *Carbon Clim. Law Rev.*, **12**(3), 209–217.
- 27 Campbell-Durufié, C., 2018b: Accountability or Accounting? Elaboration of the Paris Agreement's
28 Implementation and Compliance Committee at cop 23. *Clim. Law*, **8**, 1–38,
29 doi:10.1163/18786561-00801001.
- 30 Caney, S., 2011: Climate change, energy rights, and equality. In: *The Ethics of Global Climate Change*
31 [Arnold, D.G., (ed.)], Cambridge University Press (CUP), pp. 77–103.
- 32 Caparrós, A., 2016: The Paris Agreement as a step backward to gain momentum: Lessons from and for
33 theory. *Rev. Econ. Polit.*, **126**(3), 347, doi:10.3917/redp.263.0347.
- 34 Caparrós, A., and J. C. Péreau, 2017: Multilateral versus sequential negotiations over climate change.
35 *Oxf. Econ. Pap.*, **69**(2), 365–387, doi:10.1093/oepegp075.
- 36 Caparrós, A., R. E. Just, and D. Zilberman, 2015: Dynamic Relative Standards versus Emission Taxes
37 in a Putty-Clay Model. *J. Assoc. Environ. Resour. Econ.*, **2**(2), 277–308, doi:10.1086/681599.
- 38 Carazo, M. P., 2017: Contextual Provisions (Preamble and Article 1). In: *The Paris Agreement on*
39 *Climate Change: Analysis and Commentary* [Daniel Klein, M.P. Carazo, M. Doelle, J. Bulmer,
40 and A. Higham, (eds.)], Oxford University Press, pp. 107–121.
- 41 Carlson, C. J. et al., 2020: Solar geoengineering could redistribute malaria risk in developing countries.
42 *medRxiv*, , 1–17, doi:10.1101/2020.10.21.20217257.
- 43 Carr, W. A., and L. Yung, 2018: Perceptions of climate engineering in the South Pacific, Sub-Saharan
44 Africa, and North American Arctic. *Clim. Change*, **147**(1), 119–132, doi:10.1007/s10584-018-
45 2138-x.
- 46 Carraro, C., 2016: A Bottom-Up, Non-Cooperative Approach to Climate Change Control: Assessment

- 1 and Comparison of Nationally Determined Contributions (NDCs). *J. Sustain. Dev.*, **9**(5), 175,
2 doi:10.5539/jsd.v9n5p175.
- 3 Carty, T., J. Kowalzig, and B. Zageba, 2020: *Climate Finance Shadow Report 2020: Assessing*
4 *progress towards the \$100 billion commitment*. Oxfam International, 32 pp.
- 5 Casado-Asensio, J., and R. Steurer, 2014: Integrated strategies on sustainable development, climate
6 change mitigation and adaptation in Western Europe: communication rather than coordination. *J.*
7 *Public Policy*, **34**(3), 437–473, doi:10.1017/s0143814x13000287.
- 8 CBD, 2020: *Global Biodiversity Outlook 5*. , Montreal, 1–208 pp.
9 <https://www.cbd.int/gbo/gbo5/publication/gbo-5-en.pdf>.
- 10 CDP, 2015: CDP cities 2015.
- 11 CESCR, 1991: General comment No. 4: The right to adequate housing. *Committee on Economic, Social*
12 *and Cultural Rights Sixth session*, E/1992/23.
- 13 CESCR, 2002: General Comment No. 15: The right to water. *Substantive Issues Arising in the*
14 *Implementation of the International Covenant on Economic, Social and Cultural Rights*,
15 E/C.12/2002/11.
- 16 CESCR, 2010: Statement on the Right to Sanitation. *Committee on Economic, Social and Cultural*
17 *Rights Forty-fifth session*, E-C-12-2010-1.
- 18 Chai, Q., S. Fu, H. Xu, W. Li, and Y. Zhong, 2017: The gap report of global climate change mitigation,
19 finance, and governance after the United States declared its withdrawal from the Paris Agreement.
20 *Chinese J. Popul. Resour. Environ.*, **15**(3), 196–208, doi:10.1080/10042857.2017.1365450.
- 21 Chain Reaction Research, 2020: The Chain: Detected Deforestation Within Oil Palm Concessions Has
22 Decreased So Far in 2020. *Sustain. Risk Anal.*, [https://chainreactionresearch.com/the-chain-](https://chainreactionresearch.com/the-chain-detected-deforestation-within-oil-palm-concessions-has-decreased-so-far-in-2020/)
23 [detected-deforestation-within-oil-palm-concessions-has-decreased-so-far-in-2020/](https://chainreactionresearch.com/the-chain-detected-deforestation-within-oil-palm-concessions-has-decreased-so-far-in-2020/) (Accessed
24 August 26, 2021).
- 25 Chan, G., R. Stavins, and Z. Ji, 2018: International Climate Change Policy. *Annu. Rev. Resour. Econ.*,
26 **10**(1), 335–360, doi:10.1146/annurev-resource-100517-023321.
- 27 Chan, N., 2016a: Climate Contributions and the Paris Agreement: Fairness and Equity in a Bottom-Up
28 Architecture. *Ethics Int. Aff.*, **30**(3), 291–301, doi:10.1017/s0892679416000228.
- 29 Chan, N., 2016b: The ‘New’ Impacts of the Implementation of Climate Change Response Measures.
30 *Rev. Eur. Comp. Int. Environ. Law*, **25**(2), 228–237, doi:<https://doi.org/10.1111/reel.12161>.
- 31 Chan, S. et al., 2015: Reinvigorating International Climate Policy: A Comprehensive Framework for
32 Effective Nonstate Action. *Glob. Policy*, **6**(4), 466–473, doi:10.1111/1758-5899.12294.
- 33 Chan, S., C. Brandi, and S. Bauer, 2016: Aligning Transnational Climate Action with International
34 Climate Governance: The Road from Paris. *Rev. Eur. Comp. Int. Environ. Law*, **25**(2), 238–247,
35 doi:10.1111/reel.12168.
- 36 Chan, S. et al., 2019: Promises and risks of nonstate action in climate and sustainability governance.
37 *Wiley Interdiscip. Rev. Clim. Chang.*, **10**(3), e572, doi:10.1002/wcc.572.
- 38 Chander, P., 2017: Subgame-perfect cooperative agreements in a dynamic game of climate change. *J.*
39 *Environ. Econ. Manage.*, **84**, 173–188, doi:10.1016/j.jeem.2017.03.001.
- 40 Charlery, L., and S. L. M. Traerup, 2019: The nexus between nationally determined contributions and
41 technology needs assessments: a global analysis. *Clim. Policy*, **19**, 189–205,
42 doi:10.1080/14693062.2018.1479957.
- 43 Charnovitz, S., and C. Fischer, 2015: Canada–Renewable Energy: Implications for WTO Law on Green
44 and Not-So-Green Subsidies. *World Trade Rev.*, **14**(2), 177–210,
45 doi:10.1017/s1474745615000063.
- 46 Chasek, P. et al., 2019: Land degradation neutrality: The science-policy interface from the UNCCD to

- 1 national implementation. *Environ. Sci. Policy*, , doi:10.1016/j.envsci.2018.11.017.
- 2 Chazdon, R. L. et al., 2017: A Policy-Driven Knowledge Agenda for Global Forest and Landscape
3 Restoration: A policy-driven agenda for restoration. *Conserv. Lett.*, **10**(1), 125–132,
4 doi:10.1111/conl.12220.
- 5 Chen, K., Y. Zhang, and X. Fu, 2019: International research collaboration: An emerging domain of
6 innovation studies? *Res. Policy*, **48**(1), 149–168, doi:10.1016/j.respol.2018.08.005.
- 7 Chenoweth, E., and M. Belgioioso, 2019: The physics of dissent and the effects of movement
8 momentum. *Nat. Hum. Behav.*, **3**, 1088–1095, doi:10.1038/s41562-019-0665-8.
- 9 Chepeliev, M., and D. van der Mensbrugghe, 2020: Global fossil-fuel subsidy reform and Paris
10 Agreement. *Energy Econ.*, **85**, 104598, doi:https://doi.org/10.1016/j.eneco.2019.104598.
- 11 Christensen, J., and A. Olhoff, 2019: *Lessons from a decade of emissions gap assessments.* , Nairobi,
12 1–14 pp. <https://wedocs.unep.org/bitstream/handle/20.500.11822/30022/EGR10.pdf>.
- 13 Christodoulou, A., D. Dalaklis, A. I. Ölçer, and P. G. Masodzadeh, 2021: Inclusion of Shipping in the
14 EU-ETS: Assessing the Direct Costs for the Maritime Sector Using the MRV Data. *Energies*,
15 **14**(13), 3915, doi:10.3390/en14133915.
- 16 Christoff, P., 2016: The promissory note: COP 21 and the Paris Climate Agreement. *Env. Polit.*, **25**(5),
17 765–787, doi:10.1080/09644016.2016.1191818.
- 18 Cima, E., 2021: Retooling the Energy Charter Treaty for climate change mitigation: lessons from
19 investment law and arbitration. *J. World Energy Law Bus.*, **14**(2), 75–87,
20 doi:10.1093/jwelb/jwab007.
- 21 Ciplet, D., and J. Roberts, 2017: Splintering South: Ecologically Unequal Exchange Theory in a
22 Fragmented Global Climate. *J. World - Syst. Res.*, **23**(2), 372–398, doi:10.5195/jwsr.2017.669.
- 23 Ciplet, D., J. T. Roberts, and M. R. Khan, 2015: *Power in a warming world: The new global politics of*
24 *climate change and the remaking of environmental inequality*. MIT Press, 342 pp.
- 25 Ciplet, D., K. M. Adams, R. Weikmans, and J. T. Roberts, 2018: The Transformative Capability of
26 Transparency in Global Environmental Governance. *Glob. Environ. Polit.*, **18**(3), 130–150,
27 doi:10.1162/glep_a_00472.
- 28 Claeys, P., and D. Delgado Pugley, 2017: Peasant and indigenous transnational social movements
29 engaging with climate justice. *Can. J. Dev. Stud.*, **38**(3), 325–340,
30 doi:10.1080/02255189.2016.1235018.
- 31 Clarke, A., and A. MacDonald, 2016: Outcomes to Partners in Multi-Stakeholder Cross-Sector
32 Partnerships: A Resource-Based View. *Bus. Soc.*, **58**(2), 298–332,
33 doi:10.1177/0007650316660534.
- 34 Clarke, A., and E. Ordonez-Ponce, 2017: City scale: Cross-sector partnerships for implementing local
35 climate mitigation plans. *Climate Change and Public Administration: A Blog Commentary*
36 *Symposium*, [Dolšak, N. and A. Prakash, (eds.)], Vol. 2 of, Public Administration Review, 25–28
37 http://faculty.washington.edu/aseem/Public_Administration_Review_climate_change_symposium.pdf.
38
- 39 Cléménçon, R., 2016: The Two Sides of the Paris Climate Agreement: Dismal Failure or Historic
40 Breakthrough? *J. Environ. Dev.*, **25**(1), 3–24, doi:10.1177/1070496516661362.
- 41 Climate Action Network International, 2020: About CAN: Overview. *CAN Int.*,
42 <https://climatenetwork.org/overview/> (Accessed October 27, 2021).
- 43 Climate Action Tracker, 2020a: Global update: Paris Agreement Turning Point.
44 <https://climateactiontracker.org/publications/global-update-paris-agreement-turning-point/>
45 (Accessed August 25, 2021).
- 46 Climate Action Tracker, 2020b: International Aviation.

- 1 <https://climateactiontracker.org/sectors/aviation/> (Accessed October 27, 2021).
- 2 Climate Action Tracker, 2020c: International Shipping.
3 <https://climateactiontracker.org/sectors/shipping/> (Accessed October 27, 2021).
- 4 Climate Focus, 2016: *Progress on the New York Declaration on Forests: Eliminating Deforestation*
5 *from the Production of Agricultural Commodities – Goal 2 Assessment Report*. 1–8 pp.
6 [https://www.climatefocus.com/sites/default/files/2016-NYDF-Goal-2-Assessment-Report-](https://www.climatefocus.com/sites/default/files/2016-NYDF-Goal-2-Assessment-Report-Executive-Summary.pdf)
7 [Executive-Summary.pdf](https://www.climatefocus.com/sites/default/files/2016-NYDF-Goal-2-Assessment-Report-Executive-Summary.pdf).
- 8 Climate Focus, 2017: *Progress on the New York Declaration on Forests: Finance for Forests - Goals*
9 *8 and 9 Assessment Report*. 1–53 pp. [www.climatefocus.com/sites/default/files/NYDF](http://www.climatefocus.com/sites/default/files/NYDF_report_2017_FINAL.pdf) report
10 [2017 FINAL.pdf](http://www.climatefocus.com/sites/default/files/NYDF_report_2017_FINAL.pdf).
- 11 Cochran, I., and A. Pauthier, 2019: *A framework for Aligning with Paris Agreement. The Why, What*
12 *and how for financial institutions. Discussion Paper*. Institute for Climate Economics, 51 pp.
13 [https://www.i4ce.org/wp-core/wp-](https://www.i4ce.org/wp-core/wp-content/uploads/2019/09/I4CE-Framework_Alignment_Financial_Paris_Agreement_52p.pdf)
14 [content/uploads/2019/09/I4CE-Framework_Alignment_Financial_Paris_Agreement_52p.pdf](https://www.i4ce.org/wp-core/wp-content/uploads/2019/09/I4CE-Framework_Alignment_Financial_Paris_Agreement_52p.pdf).
- 15 Coen, D., J. Kreienkamp, and T. Pogram, 2020: *Global Climate Governance*. Cambridge University
16 Press,.
- 17 Collier, P., and A. J. Venables, 2014: Closing coal: economic and moral incentives. *Oxford Rev. Econ.*
18 *Policy*, **30**(3), 492–512, doi:10.1093/oxrep/gru024.
- 19 Colmer, J., R. Martin, M. Muûls, and U. J. Wagner, 2020: Does Pricing Carbon Mitigate Climate
20 Change? Firm-Level Evidence from the European Union Emissions Trading Scheme. *SSRN*
21 *Electron. J.*, , doi:10.2139/SSRN.3725482.
- 22 Committee on the Elimination of Discrimination against Women, 2018: *General Recommendation No.*
23 *37 on Gender-related dimensions of disaster risk reduction in the context of climate change. (7*
24 *February 2018) UN Doc. CEDAW/C/GC/37. 1–22 pp.*
25 [https://tbinternet.ohchr.org/Treaties/CEDAW/Shared](https://tbinternet.ohchr.org/Treaties/CEDAW/SharedDocuments/1_Global/CEDAW_C_GC_37_8642_E.pdf)
26 [Documents/1_Global/CEDAW_C_GC_37_8642_E.pdf](https://tbinternet.ohchr.org/Treaties/CEDAW/SharedDocuments/1_Global/CEDAW_C_GC_37_8642_E.pdf).
- 27 Coninck, H. de, and D. Puig, 2015: Assessing climate change mitigation technology interventions by
28 international institutions. *Clim. Change*, **131**(3), 417–433, doi:10.1007/s10584-015-1344-z.
- 29 Corry, O., 2017: The international politics of geoengineering: The feasibility of Plan B for tackling
30 climate change. *Secur. Dialogue*, **48**(4), 297–315, doi:10.1177/0967010617704142.
- 31 Cosbey, A., and P. C. Mavroidis, 2014: A Turquoise Mess: Green Subsidies, Blue Industrial Policy and
32 Renewable Energy: The Case for Redrafting the Subsidies Agreement of the WTO. *J. Int. Econ.*
33 *Law*, **17**(1), 11–47, doi:10.1093/jiel/jgu003.
- 34 Cosbey, A., S. Droege, C. Fischer, and C. Munnings, 2019: Developing Guidance for Implementing
35 Border Carbon Adjustments: Lessons, Cautions, and Research Needs from the Literature. *Rev.*
36 *Environ. Econ. Policy*, **13**(1), 3–22, doi:10.1093/reep/rey020.
- 37 CPI, 2021: *Preview: Global Landscape of Climate Finance 2021*. 1–56 pp.
38 [https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Global-Landscape-of-](https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Global-Landscape-of-Climate-Finance-2021.pdf)
39 [Climate-Finance-2021.pdf](https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Global-Landscape-of-Climate-Finance-2021.pdf).
- 40 Crane, A., and M. M. Seitanidi, 2014: *Social partnerships and responsible business: What, why and*
41 *how?* Routledge, 1–40 pp.
- 42 Creutzig, F. et al., 2017: The underestimated potential of solar energy to mitigate climate change. *Nat.*
43 *Energy*, **2**(9), 17140, doi:10.1038/nenergy.2017.140.
- 44 Crook, J. A., L. S. Jackson, S. M. Osprey, and P. M. Forster, 2015: A comparison of temperature and
45 precipitation responses to different Earth radiation management geoengineering schemes. *J.*
46 *Geophys. Res. Atmos.*, **120**(18), 9352–9373, doi:10.1002/2015jd023269.
- 47 Crutzen, P. J., 2006: Albedo Enhancement by Stratospheric Sulfur Injections: A Contribution to

- 1 Resolve a Policy Dilemma? *Clim. Change*, **77**(3–4), 211–220, doi:10.1007/s10584-006-9101-y.
- 2 CTCN, 2020a: About the Climate Technology Centre and Network (CTCN). *Connect. Ctries. to Clim.*
3 *Technol. Solut.*, <https://www.ctc-n.org/about-ctcn> (Accessed June 4, 2020).
- 4 CTCN, 2020b: Network. *Connect. Ctries. to Clim. Technol. Solut.*, <https://www.ctc-n.org/network>
5 (Accessed June 4, 2020).
- 6 Cullenward, D., and D. G. Victor, 2020: *Making climate policy work*. John Wiley & Sons, 1–242 pp.
- 7 Cummings, C. L., S. H. Lin, and B. D. Trump, 2017: Public perceptions of climate geoengineering: a
8 systematic review of the literature. *Clim. Res.*, **73**(3), 247–264, doi:10.3354/cr01475.
- 9 Curry, C. L. et al., 2014: A multimodel examination of climate extremes in an idealized geoengineering
10 experiment. *J. Geophys. Res. Atmos.*, **119**(7), 3900–3923, doi:10.1002/2013jd020648.
- 11 Curtis, P. G., C. M. Slay, N. L. Harris, A. Tyukavina, and M. C. Hansen, 2018: Classifying drivers of
12 global forest loss. *Science (80-.)*, **361**(6407), 1108–1111, doi:10.1126/science.aau3445.
- 13 Dagnet, Y. et al., 2016: *Staying on track from Paris: advancing the key elements of the Paris Agreement*.
14 , Washington DC, US, 1–60 pp. <https://www.wri.org/publication/staying-track-paris>.
- 15 Dagon, K., and D. P. Schrag, 2019: Quantifying the effects of solar geoengineering on vegetation. *Clim.*
16 *Change*, **153**(1), 235–251, doi:10.1007/s10584-019-02387-9.
- 17 Dai, Z., D. K. Weisenstein, F. N. Keutsch, and D. W. Keith, 2020: Experimental reaction rates constrain
18 estimates of ozone response to calcium carbonate geoengineering. *Commun. Earth Environ.*,
19 **1**(63), 1–9, doi:10.1038/s43247-020-00058-7.
- 20 Daniel, A., and D. Neubert, 2019: Civil society and social movements: conceptual insights and
21 challenges in African contexts. *Crit. African Stud.*, **11**(2), 176–192,
22 doi:10.1080/21681392.2019.1613902.
- 23 Darrin, Grimsey and Mervyn, L., 2002: Evaluating the risks of public private partnerships for
24 infrastructure project. *Internatioanal J. Public Manag.*, **20**(2), 107–118,
25 doi:10.1016/s0263/d0263-7863(00)00040-5.
- 26 Das, K., H. van Asselt, S. Droege, and M. Mehling, 2019: Making the International Trade System Work
27 for the Paris Agreement: Assessing the Options. *Environ. Law Report.*, **49**(6), 10553–10580.
- 28 Dave, R. et al., 2019: *Second Bonn Challenge progress report: application of the Barometer in 2018*.
29 IUCN, International Union for Conservation of Nature, 80 pp.
- 30 Davidson Ladly, S., 2012: Border carbon adjustments, WTO-law and the principle of common but
31 differentiated responsibilities. *Int. Environ. Agreements Polit. Law Econ.*, **12**(1), 63–84,
32 doi:10.1007/s10784-011-9153-y.
- 33 Davin, E. L., S. I. Seneviratne, P. Ciais, A. Oliosio, and T. Wang, 2014: Preferential cooling of hot
34 extremes from cropland albedo management. *Proc. Natl. Acad. Sci.*, **111**(27), 9757–9761,
35 doi:10.1073/pnas.1317323111.
- 36 Day, T. et al., 2020: *Navigating the nuances of net-zero targets*. 1–74 pp. [newclimate.org/wp-](https://www.newclimate.org/wp-content/uploads/2020/10/NewClimate_NetZeroReport_October2020.pdf)
37 [content/uploads/2020/10/NewClimate_NetZeroReport_October2020.pdf](https://www.newclimate.org/wp-content/uploads/2020/10/NewClimate_NetZeroReport_October2020.pdf) (Accessed August 25,
38 2021).
- 39 de Bakker, F. G. A., F. den Hond, B. King, and K. Weber, 2013: Social Movements, Civil Society and
40 Corporations: Taking Stock and Looking Ahead. *Organ. Stud.*, **34**(5–6), 573–593,
41 doi:10.1177/0170840613479222.
- 42 De Bièvre, D., I. Espa, and A. Poletti, 2017: No iceberg in sight: on the absence of WTO disputes
43 challenging fossil fuel subsidies. *Int. Environ. Agreements Polit. Law Econ.*, **17**(3), 411–425,
44 doi:10.1007/s10784-017-9362-0.
- 45 de Coninck, H., and A. Sagar, 2015a: Making sense of policy for climate technology development and
46 transfer. *Clim. Policy*, **15**(1), 1–11, doi:10.1080/14693062.2014.953909.

- 1 de Coninck, H., and A. Sagar, 2015b: *Technology in the 2015 Paris Climate Agreement and beyond.*,
2 Geneva, Switzerland, 1–31 pp. [https://www.ru.nl/publish/pages/749373/2015_-
_technology_in_the_2015_paris_climate_agreement_and_beyond_-
_ictsd_issue_paper_no_42.pdf](https://www.ru.nl/publish/pages/749373/2015_-
3 _technology_in_the_2015_paris_climate_agreement_and_beyond_-
4 _ictsd_issue_paper_no_42.pdf).
- 5 de Coninck, H. et al., 2018: Strengthening and implementing the global response. In: *Global Warming
6 of 1.5C: an IPCC special report on the impacts of global warming of 1.5C above pre-industrial
7 levels and related global greenhouse gas emission pathways, in the context of strengthening the
8 global response to the threat of climate change* [MassonDelmotte, V. et al., (eds.)], pp. 313–443.
- 9 de Melo, J., and J.-M. Solleder, 2020: Barriers to trade in environmental goods: How important they
10 are and what should developing countries expect from their removal. *World Dev.*, **130**, 104910,
11 doi:<https://doi.org/10.1016/j.worlddev.2020.104910>.
- 12 Dehm, J., 2020: Climate change, ‘slow violence’ and the indefinite deferral of responsibility for ‘loss
13 and damage.’ *Griffith Law Rev.*, , 1–33, doi:10.1080/10383441.2020.1790101.
- 14 Delimatsis, P., 2016: Sustainable Standard-setting, Climate Change and the TBT Agreement. In:
15 *Research Handbook on Climate Change and Trade Law* [Delimatsis, P., (ed.)], Edward Elgar
16 Publishing, Cheltenham, UK, pp. 148–180.
- 17 Delina, L., 2017: Multilateral development banking in a fragmented climate system: shifting priorities
18 in energy finance at the Asian Development Bank. *Int. Environ. Agreements Polit. Law Econ.*,
19 **17**(1), 73–88, doi:10.1007/s10784-016-9344-7.
- 20 Delina, L. L., and B. K. Sovacool, 2018: Of temporality and plurality: an epistemic and governance
21 agenda for accelerating just transitions for energy access and sustainable development. *Curr.
22 Opin. Environ. Sustain.*, **34**, 1–6, doi:10.1016/j.cosust.2018.05.016.
- 23 Dellaux, J., 2017: Le mécanisme visant la conservation des forêts tropicales de la convention-cadre sur
24 les changements climatiques (REDD+) : illustration de l’adaptativité du droit international.
25 Université Aix-Marseille, 1–737 pp.
- 26 den Elzen, M. et al., 2016: Contribution of the G20 economies to the global impact of the Paris
27 agreement climate proposals. *Clim. Change*, **137**(3), 655–665, doi:10.1007/s10584-016-1700-7.
- 28 Depledge, J., 2017: The legal and policy framework of the United Nations Climate Change Regime. In:
29 *The Paris Agreement on climate change: Analysis and commentary* [Carazo, P., Doelle, M.,
30 Bulmer, J., and Higham, A., (ed.)], Oxford University Press.
- 31 Derman, B. B., 2014: Climate governance, justice, and transnational civil society. *Clim. Policy*, **14**(1),
32 23–41, doi:10.1080/14693062.2014.849492.
- 33 Di Ciommo, M., 2017: *Approaches to measuring and monitoring South-South cooperation.*
34 Development Initiatives, 2–3 pp. [http://devinit.org/wp-content/uploads/2017/02/Approaches-to-
measuring-and-monitoring-South-South-cooperation.pdf](http://devinit.org/wp-content/uploads/2017/02/Approaches-to-
35 measuring-and-monitoring-South-South-cooperation.pdf).
- 36 Dimitrov, R., J. Hovi, D. F. Sprinz, H. Sælen, and A. Underdal, 2019: Institutional and Environmental
37 Effectiveness: Will the Paris Agreement Work? *WIREs Clim. Chang.*, **10**(4), e583,
38 doi:10.1002/wcc.583.
- 39 Djenontin, I., S. Foli, and L. Zulu, 2018: Revisiting the Factors Shaping Outcomes for Forest and
40 Landscape Restoration in Sub-Saharan Africa: A Way Forward for Policy, Practice and Research.
41 *Sustainability*, **10**(4), 906, doi:10.3390/su10040906.
- 42 Dobson, N. L., 2018: The EU’s conditioning of the ‘extraterritorial’ carbon footprint: A call for an
43 integrated approach in trade law discourse. *Rev. Eur. Comp. Int. Environ. Law*, **27**(1), 75–89,
44 doi:<https://doi.org/10.1111/reel.12226>.
- 45 Dobson, N. L., 2020: Competing Climate Change Responses: Reflections on EU Unilateral Regulation
46 of International Transport Emissions in Light of Multilateral Developments. *Netherlands Int. Law
47 Rev.*, **67**(2), 183–210, doi:10.1007/s40802-020-00167-2.

- 1 Doda, B., and L. Taschini, 2017: Carbon Dating: When Is It Beneficial to Link ETSs? *J. Assoc. Environ.*
2 *Resour. Econ.*, **4**(3), 701–730, doi:10.2139/ssrn.2610076.
- 3 Doda, B., S. Quemin, and L. Taschini, 2019: Linking Permit Markets Multilaterally. *J. Environ. Econ.*
4 *Manage.*, **98**(1), 102259, doi:10.1016/j.jeem.2019.102259.
- 5 Doelle, M., 2016: The Paris Agreement: Historic Breakthrough or High Stakes Experiment? *Clim. Law*,
6 **6**(1–2), 1–20, doi:10.1163/18786561-00601001.
- 7 Doelle, M., 2019: The Heart of the Paris Rulebook: Communicating NDCs and Accounting for Their
8 Implementation. *Clim. Law*, **9**(1–2), 3–20, doi:10.1163/18786561-00901002.
- 9 Doelle, M., and A. Chircop, 2019: Decarbonizing international shipping: An appraisal of the IMO’s
10 Initial Strategy. *Rev. Eur. Comp. Int. Environ. Law*, **28**(3), 268–277, doi:10.1111/reel.12302.
- 11 Dong, Y., and K. Holm Olsen, 2017: Stakeholder participation in CDM and new climate mitigation
12 mechanisms: China CDM case study. *Clim. Policy*, **17**(2), 171–188,
13 doi:10.1080/14693062.2015.1070257.
- 14 Donofrio, S., P. Rothrock, and J. Leonard, 2017: *Supply-change: Tracking Corporate Commitments to*
15 *Deforestation-free Supply Chain*. Forest Trends, Washington DC, 1–32 pp. [https://www.forest-](https://www.forest-trends.org/wp-content/uploads/2017/03/2017SupplyChange_FINAL.pdf)
16 [trends.org/wp-content/uploads/2017/03/2017SupplyChange_FINAL.pdf](https://www.forest-trends.org/wp-content/uploads/2017/03/2017SupplyChange_FINAL.pdf).
- 17 Dow, K. et al., 2013: Limits to adaptation. *Nat. Clim. Chang.*, **3**(4), 305–307,
18 doi:10.1038/nclimate1847.
- 19 Downs, G. W., D. M. Roche, and P. N. Barsoom, 1996: Is the Good News About Compliance Good
20 News About Cooperation? *Int. Organ.*, **50**(3), 379–406, doi:10.1017/s0020818300033427.
- 21 Draguljić, G., 2019: The Climate Change Regime Complex: Path Dependence amidst Institutional
22 Change. *Glob. Gov. A Rev. Multilater. Int. Organ.*, **25**(3), 476–498, doi:10.1163/19426720-
- 23 02503006.
- 24 Droege, S., H. van Asselt, K. Das, and M. Mehling, 2017: The Trade System and Climate Action: Ways
25 Forward under the Paris Agreement. *South Carolina J. Int. Law Bus.*, **13**(2), 195–276.
- 26 Duan, L., L. Cao, G. Bala, and K. Caldeira, 2020: A Model-Based Investigation of Terrestrial Plant
27 Carbon Uptake Response to Four Radiation Modification Approaches. *J. Geophys. Res. Atmos.*,
28 **125**(9), e2019jd031883, doi:10.1029/2019jd031883.
- 29 Dubash, N. K., 2020: Climate laws help reduce emissions. *Nat. Clim. Change* **10**(8), 709–710,
30 doi:10.1038/s41558-020-0853-6.
- 31 Duguma, L. A., P. A. Minang, and M. van Noordwijk, 2014: Climate Change Mitigation and Adaptation
32 in the Land Use Sector: From Complementarity to Synergy. *Environ. Manage.*, **54**(3), 420–432,
33 doi:10.1007/s00267-014-0331-x.
- 34 Duyck, S., 2015: The Paris Climate Agreement and the Protection of Human Rights in a Changing
35 Climate. *Yearb. Int. Environ. Law*, **26**, 3–45, doi:10.1093/yiel/yvx011.
- 36 Duyck, S., 2019: Delivering on the Paris Promises? Review of the Paris Agreement’s Implementing
37 Guidelines from a Human Rights Perspective. *Clim. Law*, **9**(3), 202–223, doi:10.1163/18786561-
- 38 00903004.
- 39 Duyck, S., E. Lennon, W. Obergassel, and A. Savaresi, 2018: Human Rights and the Paris Agreement’s
40 Implementation Guidelines: Opportunities to Develop a Rights-based Approach. *Carbon Clim.*
41 *Law Rev.*, **12**(3), 191–202, doi:10.21552/cclr/2018/3/5.
- 42 Dzebo, A., H. Janetschek, C. Brandi, and G. Iacobuta, 2019: *Connections between the Paris Agreement*
43 *and the 2030 Agenda The case for policy coherence*. Stockholm Environment Institute,
44 Stockholm, 1–38 pp. [https://www.sei.org/wp-content/uploads/2019/08/connections-between-the-](https://www.sei.org/wp-content/uploads/2019/08/connections-between-the-paris-agreement-and-the-2030-agenda.pdf)
45 [paris-agreement-and-the-2030-agenda.pdf](https://www.sei.org/wp-content/uploads/2019/08/connections-between-the-paris-agreement-and-the-2030-agenda.pdf).
- 46 Eastham, S. D., D. K. Weisenstein, D. W. Keith, and S. R. H. Barrett, 2018: Quantifying the impact of

- 1 sulfate geoengineering on mortality from air quality and UV-B exposure. *Atmos. Environ.*, **187**,
2 424–434, doi:10.1016/j.atmosenv.2018.05.047.
- 3 Edwards, G., I. Cavelier Adarve, M. C. Bustos, and J. T. Roberts, 2017: Small group, big impact: how
4 AILAC helped shape the Paris Agreement. *Clim. Policy*, **17**(1), 71–85,
5 doi:10.1080/14693062.2016.1240655.
- 6 Effiong, U., and R. L. Neitzel, 2016: Assessing the direct occupational and public health impacts of
7 solar radiation management with stratospheric aerosols. *Environ. Heal.*, **15**(1), 1–9,
8 doi:10.1186/s12940-016-0089-0.
- 9 Ehara, M., K. Hyakumura, and Y. Yokota, 2014: REDD+ initiatives for safeguarding biodiversity and
10 ecosystem services: harmonizing sets of standards for national application. *J. For. Res.*, **19**, 427–
11 436, doi:10.1007/s10310-013-0429-7.
- 12 Ehara, M. et al., 2019: REDD+ engagement types preferred by Japanese private firms: The challenges
13 and opportunities in relation to private sector participation. *For. Policy Econ.*, **106**, 101945,
14 doi:10.1016/j.forpol.2019.06.002.
- 15 Eisenack, K., and L. Kähler, 2016: Adaptation to climate change can support unilateral emission
16 reductions. *Oxf. Econ. Pap.*, **68**(1), 258–278, doi:10.1093/oepp/gpv057.
- 17 Ekawati, S., Subarudi, K. Budiningsih, G. K. Sari, and M. Z. Muttaqin, 2019: Policies affecting the
18 implementation of REDD+ in Indonesia (cases in Papua, Riau and Central Kalimantan). *For.*
19 *Policy Econ.*, **108**(C), 101939, doi:10.1016/j.forpol.2019.05.025.
- 20 El-Sayed, A., and S. J. Rubio, 2014: Sharing R and D investments in cleaner technologies to mitigate
21 climate change. *Resour. Energy Econ.*, **38**, 168–180, doi:10.1016/j.reseneeco.2014.07.003.
- 22 Emmerling, J., and M. Tavoni, 2018: Exploration of the interactions between mitigation and solar
23 radiation management in cooperative and non-cooperative international governance settings.
24 *Glob. Environ. Chang.*, **53**, 244–251, doi:10.1016/j.gloenvcha.2018.10.006.
- 25 Emmerling, J., U. Kornek, V. Bosetti, and K. Lessmann, 2020: Climate thresholds and heterogeneous
26 regions: Implications for coalition formation. *Rev. Int. Organ.*, **16**(2), 293–316,
27 doi:10.1007/s11558-019-09370-0.
- 28 Engen, L., and A. Prizzon, 2018: *A guide to multilateral development banks*. Overseas Development
29 Institute 2018, London, 1–92 pp.
- 30 Epps, T., and A. Green, 2010: *Reconciling Trade and ClimateHow the WTO Can Help Address Climate*
31 *Change*. Edward Elgar Publishing, Cheltenham, UK, 280 pp.
- 32 Erickson, L. E., 2017: Reducing greenhouse gas emissions and improving air quality: Two global
33 challenges. *Environ. Prog. Sustain. Energy*, **36**(4), 982–988, doi:10.1002/ep.12665.
- 34 Erickson, P., M. Lazarus, and R. Spalding-Fecher, 2014: Net climate change mitigation of the Clean
35 Development Mechanism. *Energy Policy*, **72**(September), 146–154,
36 doi:10.1016/j.enpol.2014.04.038.
- 37 Erickson, P. et al., 2020: Why fossil fuel producer subsidies matter. *Nature*, **578**(7793),
38 doi:10.1038/s41586-019-1920-x.
- 39 Eriksen, H. H., and F. X. Perrez, 2014: The Minamata Convention: A Comprehensive Response to a
40 Global Problem. *Rev. Eur. Comp. Int. Environ. Law*, **23**(2), 195–210, doi:10.1111/reel.12079.
- 41 Erling, U. M., 2018: How to Reconcile the European Union Emissions Trading System (EU ETS) for
42 Aviation with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSA)?
43 *Air Sp. Law*, **43**(4), 371–386.
- 44 Ernst & Young, 2017: *Report on the independent review of the effective implementation of the Climate*
45 *Technology Centre and Network presented to the Twenty-Third Conference of the Parties of the*
46 *UNFCCC*. 72 pp. <http://unfccc.int/resource/docs/2017/cop23/eng/03.pdf>.

- 1 Eskander, S. M. S. U., and S. Fankhauser, 2020: Reduction in greenhouse gas emissions from national
2 climate legislation. *Nat. Clim. Change*, **10**(8), 750–756, doi:10.1038/s41558-020-0831-z.
- 3 Espa, I., and G. Marín Durán, 2018: Renewable Energy Subsidies and WTO Law: Time to Rethink the
4 Case for Reform Beyond Canada – Renewable Energy/Fit Program. *J. Int. Econ. Law*, **21**(3), 621–
5 653, doi:10.1093/jiel/jgy031.
- 6 Estache, A., and S. Saussier, 2014: Public-Private Partnerships and Efficiency: A short assessment.
7 *CESifo DICE Rep.*, **12**(3), 8–13.
- 8 European Commission, 2019: *Communication From The Commission To The European Parliament,*
9 *The European Council, The Council, The European Economic And Social Committee And The*
10 *Committee Of The Regions: The European Green Deal.* , Brussels, 1–24 pp.
- 11 European Commission, 2021: *Proposal for a directive of the European Parliament and of the Council*
12 *amending Directive 2003/87/EC. No. COM/2021/551.* 65 pp. [https://eur-lex.europa.eu/legal-](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0551)
13 [content/EN/TXT/?uri=CELEX%3A52021PC0551.](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0551)
- 14 European Court of Human Rights, 2020: *Duarte Agostinho and Others v. Portugal and Others,*
15 *Application Number 39371/20.*
- 16 Evans, J. R. G., E. P. J. Stride, M. J. Edirisinghe, D. J. Andrews, and R. R. Simons, 2010: Can oceanic
17 foams limit global warming? *Clim. Res.*, **42**(2), 155–160, doi:10.3354/cr00885.
- 18 Extinction Rebellion, 2019: Our Demands. *Extinction Rebellion webpage.*, <https://rebellion.earth/>
19 (Accessed December 17, 2019).
- 20 Eyben, R., 2013: *Building Relationships in Development Cooperation : Traditional Donors and the*
21 *Rising Powers.* 4 pp. <https://core.ac.uk/download/pdf/19918344.pdf>.
- 22 Eyland, T., and G. Zaccour, 2012: Strategic effects of a border tax adjustment. *Int. Game Theory Rev.*,
23 **14**(3), 1250016, doi:10.1142/s0219198912500168.
- 24 Falkner, R., 2016a: A Minilateral Solution for Global Climate Change? On Bargaining Efficiency, Club
25 Benefits, and International Legitimacy. *Perspect. Polit.*, **14**(1), 87–101,
26 doi:10.1017/s1537592715003242.
- 27 Falkner, R., 2016b: The Paris agreement and the new logic of international climate politics. *Int. Aff.*,
28 **92**(5), 1107–1125, doi:10.1111/1468-2346.12708.
- 29 Falkner, R., 2019: The unavoidability of justice - and order - in international climate politics: From
30 Kyoto to Paris and beyond. *Br. J. Polit. Sci. Int. Relations*, **21**, 270–278,
31 doi:10.1177/1369148118819069.
- 32 Falkner, R., N. Nasiritousi, and G. Reischl, 2021: Climate clubs: politically feasible and desirable?
33 *Clim. Policy*, , 1–8, doi:10.1080/14693062.2021.1967717.
- 34 FAO, 2010: *Managing forests for climate change.* FAO, Rome, 19 pp.
35 <http://www.fao.org/3/i1960e/i1960e00.pdf>.
- 36 FAO, 2018: *FAO's south-south and triangular cooperation to achieve the sustainable development*
37 *goals. Fostering partnership among the global South.* FAO, Rome, Italy, 16 pp.
38 <http://www.fao.org/3/ca1379en/CA1379EN.pdf>.
- 39 FAO, 2019: *South-South and Triangular Cooperation in FAO – Strengthening partnerships to achieve*
40 *the Sustainable Development Goals.* FAO, Rome, 84 pp.
41 <http://www.fao.org/3/ca3695en/CA3695EN.pdf>.
- 42 Fattouh, B., and L. Mahadeva, 2013: OPEC: What Difference Has It Made? *Annu. Rev. Resour. Econ.*,
43 **5**(1), 427–443, doi:10.1146/annurev-resource-091912-151901.
- 44 Fay, M. et al., 2015: Getting the Finance Flowing. In: *Decarbonizing Development: Three Steps to a*
45 *Zero-Carbon Future. Climate Change and Development.*, The World Bank, Washington DC, pp.
46 119–136.

- 1 FDI Intelligence, 2020: *The fDi report 2020. Global Greenfield Investment Trends*. [McMillan, C. and
2 G. Ewing, (eds.)]. The Financial Times Limited 2020, London, 1–24 pp.
- 3 Field, L. et al., 2018: Increasing Arctic Sea Ice Albedo Using Localized Reversible Geoengineering.
4 *Earth's Futur.*, **6**(6), 882–901, doi:10.1029/2018ef000820.
- 5 Finus, M., and A. Caparrós, 2015: *Game Theory and International Environmental Cooperation:
6 Essential Readings*. Edward Elgar Publishing, Cheltenham, UK, 934 pp.
- 7 Finus, M., and M. McGinty, 2019: The anti-paradox of cooperation: Diversity may pay! *J. Econ. Behav.*
8 *Organ.*, **157**, 541–559, doi:10.1016/j.jebo.2018.10.015.
- 9 Flegal, J. A., and A. Gupta, 2018: Evoking equity as a rationale for solar geoengineering research?
10 Scrutinizing emerging expert visions of equity. *Int. Environ. Agreements Polit. Law Econ.*, **18**(1),
11 45–61, doi:10.1007/s10784-017-9377-6.
- 12 Flegal, J. A., A. M. Hubert, D. R. Morrow, and J. B. Moreno-Cruz, 2019: Solar Geoengineering: Social
13 Science, Legal, Ethical, and Economic Frameworks. *Annu. Rev. Environ. Resour.*, **44**(1), 399–
14 423, doi:10.1146/annurev-environ-102017-030032.
- 15 Forest Declaration, 2019: *Protecting and Restoring Forests: A Story of Large Commitments yet Limited
16 Progress: Five Year Assessment Report. September 2019*. [Climate Focus, (ed.)]. 1–96 pp.
- 17 Forsell, N. et al., 2016: Assessing the INDCs' land use, land use change, and forest emission projections.
18 *Carbon Balance Manag.*, **11**(1), 26, doi:10.1186/s13021-016-0068-3.
- 19 Foster, V., and A. Rana, 2020: *Rethinking Power Sector Reform in the Developing World*. World Bank,
20 Washington, D.C., 359 pp.
- 21 Freestone, D., 2010: From Copenhagen to Cancun: Train Wreck or Paradigm Shift? *Environ. Law Rev.*,
22 **12**(2), 87–93, doi:10.1350/enlr.2010.12.2.081.
- 23 Fridahl, M., 2017: Socio-political prioritization of bioenergy with carbon capture and storage. *Energy
24 Policy*, , doi:10.1016/j.enpol.2017.01.050.
- 25 Fridays for Future, 2019: About Fridays for Future. <https://www.fridaysforfuture.org/about> (Accessed
26 December 17, 2019).
- 27 Friedrich, J., 2017: Global Stocktake (Article 14). In: *The Paris Agreement on Climate Change -
28 Analysis and Commentary* [Klein, D., M.P. Carazo, M. Doelle, J. Bulmer, and A. Higham, (eds.)],
29 Oxford University Press, Croydon, pp. 319–337.
- 30 Frisari, G., and M. Stadelmann, 2015: De-risking concentrated solar power in emerging markets: The
31 role of policies and international finance institutions. *Energy Policy*, **82**, 12–22,
32 doi:https://doi.org/10.1016/j.enpol.2015.02.011.
- 33 Froyn, C. B., and J. Hovi, 2008: A climate agreement with full participation. *Econ. Lett.*, **99**(2), 317–
34 319, doi:10.1016/j.econlet.2007.07.013.
- 35 Frumhoff, P. C., and J. C. Stephens, 2018: Towards legitimacy of the solar geoengineering research
36 enterprise. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*, **376**(2119), 1–12,
37 doi:10.1098/rsta.2016.0459.
- 38 Fuglestedt, J. et al., 2018: Implications of possible interpretations of 'greenhouse gas balance' in the
39 Paris Agreement. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*, **376**(2119), 20160445,
40 doi:10.1098/rsta.2016.0445.
- 41 Fujimori, S. et al., 2016: Will international emissions trading help achieve the objectives of the Paris
42 Agreement? *Environ. Res. Lett.*, **11**(10), 104001, doi:10.1088/1748-9326/11/10/104001.
- 43 Fünfgeld, H., 2015: Facilitating local climate change adaptation through transnational municipal
44 networks. *Curr. Opin. Environ. Sustain.*, **12**, 67–73, doi:10.1016/j.cosust.2014.10.011.
- 45 Fuss, S. et al., 2014: Betting on negative emissions. *Nat. Clim. Chang.*, **4**(10), 850–853,
46 doi:10.1038/nclimate2392.

- 1 Fuss, S. et al., 2018: Negative emissions—Part 2: Costs, potentials and side effects. *Environ. Res. Lett.*,
2 **13**(6), 63002, doi:10.1088/1748-9326/aabf9f.
- 3 Fyson, C. L., and M. L. Jeffery, 2019: Ambiguity in the Land Use Component of Mitigation
4 Contributions Toward the Paris Agreement Goals. *Earth's Futur.*, **7**(8), 873–891,
5 doi:10.1029/2019ef001190.
- 6 Fyson, C. L., S. Baur, M. Gidden, and C.-F. Schleussner, 2020: Fair-share carbon dioxide removal
7 increases major emitter responsibility. *Nat. Clim. Chang.*, **10**(9), 836–841, doi:10.1038/s41558-
8 020-0857-2.
- 9 Gajevic Sayegh, A., 2017: Climate justice after Paris: a normative framework. *J. Glob. Ethics*, **13**(3),
10 344–365, doi:10.1080/17449626.2018.1425217.
- 11 Gallagher, K. P., R. Kamal, J. Jin, Y. Chen, and X. Ma, 2018: Energizing development finance? The
12 benefits and risks of China's development finance in the global energy sector. *Energy Policy*, **122**,
13 313–321, doi:10.1016/j.enpol.2018.06.009.
- 14 Gampfer, R., 2016: Minilateralism or the UNFCCC? The Political Feasibility of Climate Clubs. *Glob.*
15 *Environ. Polit.*, **16**(3), 62–88, doi:10.1162/glep_a_00366.
- 16 Gandenberger, C., M. Bodenheimer, J. Schleich, R. Orzanna, and L. Macht, 2015: Factors driving
17 international technology transfer: Empirical insights from a CDM project survey. *Clim. Policy*,
18 **16**(8), 1065–1084, doi:10.1080/14693062.2015.1069176.
- 19 Ganguly, G., J. Setzer, and V. Heyvaert, 2018: If at First You Don't Succeed: Suing Corporations for
20 Climate Change. *Oxf. J. Leg. Stud.*, **38**(4), 841–868, doi:10.1093/ojls/gqy029.
- 21 Gao, S., M. Smits, A. P. J. Mol, and C. Wang, 2016: New market mechanism and its implication for
22 carbon reduction in China. *Energy Policy*, **98**, 221–231, doi:10.1016/j.enpol.2016.08.036.
- 23 Gardiner, A., M. Bardout, F. Grossi, and S. Dixon-Declève, 2016: *Public-Private Partnerships for*
24 *Climate Finance*. TemaNord, Nordic Council of Ministers, Copenhagen, 78 pp.
- 25 Garrett, R. D. et al., 2019: Criteria for effective zero-deforestation commitments. *Glob. Environ.*
26 *Chang.*, **54**, 135–147, doi:10.1016/j.gloenvcha.2018.11.003.
- 27 Gasparini, B., Z. McGraw, T. Storelvmo, and U. Lohmann, 2020: To what extent can cirrus cloud
28 seeding counteract global warming? *Environ. Res. Lett.*, **15**(5), 54002, doi:10.1088/1748-
29 9326/ab71a3.
- 30 GCF, 2011: *Governing Instrument for the Green Climate Fund*. 17 pp.
31 <https://www.greenclimate.fund/sites/default/files/document/governing-instrument.pdf> (Accessed
32 December 11, 2020).
- 33 GCF, 2021: *Status of the GCF pipeline – Addendum IV Update on the REDD-plus Results-Based*
34 *Payments*. , Washington DC, 1–5 pp.
35 <https://www.greenclimate.fund/sites/default/files/document/gcf-b28-inf08-add04.pdf>.
- 36 GEA, 2012: *Global Energy Assessment Toward a Sustainable Future*. Cambridge University Press,
37 Cambridge and New York,.
- 38 Geden, O., 2016a: An actionable climate target. *Nat. Geosci.*, **9**(5), 340–342, doi:10.1038/ngeo2699.
- 39 Geden, O., 2016b: The Paris Agreement and the inherent inconsistency of climate policymaking. *WIREs*
40 *Clim. Chang.*, **7**(6), 790–797, doi:https://doi.org/10.1002/wcc.427.
- 41 Geels, F., B. K. Sovacool, T. Schwanen, and S. Sorrell, 2017: Sociotechnical transitions for deep
42 decarbonization. *Science (80-.)*, **357**(6357), 1242, doi:10.1126/science.aao3760.
- 43 Geels, F., S. Sharpe, and D. Victor, 2019: *Accelerating the low carbon transition: the case for stronger,*
44 *more targeted and coordinated international action.* , London, UK, 138 pp.
- 45 Gehring, M. W., and E. Morison, 2020: *Climate and Energy Provisions in Trade Agreements with*
46 *Relevance to the Commonwealth*. Commonwealth Secretariat, London, 21 pp.

- 1 Gehring, M. W. et al., 2013: *Climate Change and Sustainable Energy Measures in Regional Trade*
2 *Agreements (RTAs): An Overview. ICTSD Programme on Global Economic Policy and*
3 *Institutions. Issue Paper No. 3.* International Centre for Trade and Sustainable Development,
4 Geneva, 44 pp.
- 5 Gençsü, I., and M. Hino, 2015: *Raising Ambition to Reduce International Aviation and Maritime*
6 *Emissions. Contributing paper for Seizing the Global Opportunity: Partnerships for Better*
7 *Growth and a Better Climate.* [Davis, M. and S. Chatwin, (eds.)]. , London and Washington, DC,
8 24 pp.
- 9 Gerlagh, R., and T. O. Michielsen, 2015: Moving targets—cost-effective climate policy under scientific
10 uncertainty. *Clim. Change*, **132**(4), 519–529, doi:10.1007/s10584-015-1447-6.
- 11 Germain, M., P. Toint, H. Tulkens, and A. de Zeeuw, 2003: Transfers to sustain dynamic core-theoretic
12 cooperation in international stock pollutant control. *J. Econ. Dyn. Control*, **28**, 79–99,
13 doi:10.1016/S0165-1889(02)00107-0.
- 14 German Constitutional Court, 2021: *Neubauer et al. v. Germany. Order of the First Senate of 24 March*
15 *2021. paras. 1-270.* 1–78 pp. [http://climatecasechart.com/climate-change-litigation/wp-](http://climatecasechart.com/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2021/20210429_11817_judgment-1.pdf)
16 [content/uploads/sites/16/non-us-case-documents/2021/20210429_11817_judgment-1.pdf](http://climatecasechart.com/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2021/20210429_11817_judgment-1.pdf).
- 17 Gerres, T., M. Haussner, K. Neuhoff, and A. Pirlot, 2021: To ban or not to ban carbon-intensive
18 materials: A legal and administrative assessment of product carbon requirements. *Rev. Eur. Comp.*
19 *Int. Environ. Law*, **30**(2), 249–262, doi:10.1111/reel.12395.
- 20 GESAMP, 2019: *High level review of a wide range of proposed marine geoengineering techniques.*
21 [Boyd, P.W. and C.M.G. Vivian, (eds.)]. International Maritime Organization (IMO), London,
22 144 pp.
- 23 Gewirtzman, J. et al., 2018: Financing loss and damage: reviewing options under the Warsaw
24 International Mechanism. *Clim. Policy*, **18**(8), 1076–1086, doi:10.1080/14693062.2018.1450724.
- 25 Giang, A., L. C. Stokes, D. G. Streets, E. S. Corbitt, and N. E. Selin, 2015: Impacts of the Minamata
26 Convention on Mercury Emissions and Global Deposition from Coal-Fired Power Generation in
27 Asia. *Environ. Sci. Technol.*, **49**(9), 5326–5335, doi:10.1021/acs.est.5b00074.
- 28 Gilbert, P., and A. Bows, 2012: Exploring the scope for complementary sub-global policy to mitigate
29 CO₂ from shipping. *Energy Policy*, **50**, 613–622, doi:10.1016/j.enpol.2012.08.002.
- 30 Gilroy, J. J. et al., 2014: Cheap carbon and biodiversity co-benefits from forest regeneration in a hotspot
31 of endemism. *Nat. Clim. Chang.*, **4**, 503–507, doi:10.1038/nclimate2200.
- 32 GIZ, 2017: *Enabling subnational climate action through multi-level governance.* GIZ, Bonn, Germany,
33 13 pp. [http://e-lib.iclei.org/wp-content/uploads/2017/11/GIZ-ICLEI-](http://e-lib.iclei.org/wp-content/uploads/2017/11/GIZ-ICLEI-UNHabitat_2017_EN_Enabling-subnational-climate-action.pdf)
34 [UNHabitat_2017_EN_Enabling-subnational-climate-action.pdf](http://e-lib.iclei.org/wp-content/uploads/2017/11/GIZ-ICLEI-UNHabitat_2017_EN_Enabling-subnational-climate-action.pdf).
- 35 Gladwell, M., 2002: *The Tipping Point: How little things can make a big difference.* Back Bay Books,
36 301 pp.
- 37 Glienke, S., P. J. Irvine, and M. G. Lawrence, 2015: The impact of geoengineering on vegetation in
38 experiment G1 of the GeoMIP. *J. Geophys. Res. Atmos.*, **120**(19), 10,110-196,213,
39 doi:10.1002/2015jd024202.
- 40 Goldthau, A., and J. Witte, eds., 2010: *Global energy governance: The new rules of the game.*
41 Brookings Institution Press, Washington, D.C., 372 pp.
- 42 Gollier, C., and J. Tirole, 2015: Negotiating effective institutions against climate change. *Econ. Energy*
43 *Environ. Policy*, **4**(2), 5–28, doi:10.5547/2160-5890.4.2.cgol.
- 44 Gomez-Echeverri, L., 2018: Climate and development: enhancing impact through stronger linkages in
45 the implementation of the Paris Agreement and the Sustainable Development Goals (SDGs).
46 *Philos. Trans. R. Soc. A Math. Eng. Sci.*, **376**(2119), 20160444, doi:10.1098/rsta.2016.0444.
- 47 Goulder, L., M. A. Hafstead, G. Kim, and X. Long, 2019: Impacts of a Carbon Tax across US

- 1 Household Income Groups: What Are the Equity-Efficiency Trade-Offs? *J. Public Econ.*, **175**,
2 44–64, doi:10.1016/j.jpubeco.2019.04.002.
- 3 Government of Indonesia, 2016: *First Nationally Determined Contribution. Republic Of Indonesia*. 1–
4 18 pp. [https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Indonesia First/First NDC](https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Indonesia%20First/First%20NDC%20Indonesia_submitted%20to%20UNFCCC_Set_November_2016.pdf)
5 [Indonesia_submitted to UNFCCC Set_November 2016.pdf](https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Indonesia%20First/First%20NDC%20Indonesia_submitted%20to%20UNFCCC_Set_November_2016.pdf) (Accessed January 9, 2021).
- 6 Grassi, G. et al., 2017: The key role of forests in meeting climate targets requires science for credible
7 mitigation. *Nat. Clim. Chang.*, **7**, 220–226, doi:10.1038/nclimate3227.
- 8 Gray, K., and B. K. Gills, 2016: South–South cooperation and the rise of the Global South. *Third World*
9 *Q.*, **37**(4), 557–574, doi:10.1080/01436597.2015.1128817.
- 10 Green, A., 2005: Climate Change, Regulatory Policy and the WTO: How Constraining Are Trade
11 Rules? *J. Int. Econ. Law*, **8**(1), 143–189, doi:10.1093/jielaw/jgi008.
- 12 Green, J. F., 2017: The strength of weakness: pseudo-clubs in the climate regime. *Clim. Change*, **144**(1),
13 41–52, doi:10.1007/s10584-015-1481-4.
- 14 Green, J. F., 2021: Does carbon pricing reduce emissions? A review of ex-post analyses. *Environ. Res.*
15 *Let.*, **16**(4), 043004, doi:10.1088/1748-9326/abdae9.
- 16 Green, J. F., T. Sterner, and G. Wagner, 2014: A balance of “bottom–up” and “top–down” in linking
17 climate policies. *Nat. Clim. Chang.*, **4**(12), 1064–1067, doi:10.1038/nclimate2429.
- 18 Greiner, S. et al., 2020: *Article 6 Piloting: State of play and stakeholder experiences*. 1–135 pp.
19 [https://www.climatefinanceinnovators.com/wp-content/uploads/2020/12/Climate-Finance-](https://www.climatefinanceinnovators.com/wp-content/uploads/2020/12/Climate-Finance-Innovators_Article-6-piloting_State-of-play-and-stakeholder-experiences_December-2020.pdf)
20 [Innovators_Article-6-piloting_State-of-play-and-stakeholder-experiences_December-2020.pdf](https://www.climatefinanceinnovators.com/wp-content/uploads/2020/12/Climate-Finance-Innovators_Article-6-piloting_State-of-play-and-stakeholder-experiences_December-2020.pdf).
- 21 Griscom, B. W. et al., 2017: Natural climate solutions. *Proc. Natl. Acad. Sci. U. S. A.*, **114**(44), 11645–
22 11650, doi:10.1073/pnas.1710465114.
- 23 Grubb, M., 2011: International climate finance from border carbon cost levelling. *Clim. Policy*, **11**(3),
24 1050–1057, doi:10.1080/14693062.2011.582285.
- 25 Grubb, M., J.-C. Hourcade, and K. Neuhoff, 2014: *Planetary economics: energy, climate change and*
26 *the three domains of sustainable development*. Routledge, London,.
- 27 Grubb, M. et al., 2021: Induced innovation in energy technologies and systems: a review of evidence
28 and potential implications for CO₂ mitigation. *Environ. Res. Let.*, **16**(4), 043007,
29 doi:10.1088/1748-9326/abde07.
- 30 Grunewald, N., and I. Martínez-Zarzoso, 2012: How Well Did the Kyoto Protocol Work? A Dynamic-
31 GMM Approach with External Instruments. *SSRN Electron. J.*, (February), 37,
32 doi:10.2139/ssrn.2013086.
- 33 Grunewald, N., and I. Martínez-Zarzoso, 2016: Did the Kyoto Protocol fail? An evaluation of the effect
34 of the Kyoto Protocol on CO₂ emissions. *Environ. Dev. Econ.*, **21**(1), 1–22,
35 doi:10.1017/s1355770x15000091.
- 36 Gsottbauer, E., R. Gampfer, E. Bernold, and A. M. Delas, 2018: Broadening the scope of loss and
37 damage to legal liability: an experiment. *Clim. Policy*, **18**(5), 600–611,
38 doi:10.1080/14693062.2017.1317628.
- 39 Gulbrandsen, L. H., J. Wettestad, D. G. Victor, and A. Underdal, 2019: The Political Roots of Diverging
40 Carbon Market Design: implications for linking. *Clim. Policy*, **19**(4), 427–438,
41 doi:10.1080/14693062.2018.1551188.
- 42 Gunningham, N., 2019: Averting Climate Catastrophe: Environmental Activism, Extinction Rebellion
43 and coalitions of Influence. *King’s Law J.*, **30**(2), 194–202, doi:10.1080/09615768.2019.1645424.
- 44 Gupta, A., and H. van Asselt, 2019: Transparency in multilateral climate politics: Furthering (or
45 distracting from) accountability? *Regul. Gov.*, **13**(1), 18–34, doi:10.1111/regg.12159.
- 46 Gupta, A. et al., 2020: Anticipatory governance of solar geoengineering: conflicting visions of the future

- 1 and their links to governance proposals. *Curr. Opin. Environ. Sustain.*, **45**, 10–19,
2 doi:10.1016/j.cosust.2020.06.004.
- 3 Gupta, H., and L. C. Dube, 2018: Addressing biodiversity in climate change discourse: Paris
4 mechanisms hold more promise. *Int. For. Rev.*, **20**(1), 104–114,
5 doi:10.1505/146554818822824282.
- 6 Gupta, J. et al., 2010: Mainstreaming climate change in development cooperation policy: conditions for
7 success. In: *Making climate change work for us* [Hulme, M. and H. Neufeldt, (eds.)], Cambridge
8 University Press, Cambridge, UK, pp. 319–339.
- 9 Hadden, J., 2014: Explaining Variation in Transnational Climate Change Activism: The Role of Inter-
10 Movement Spillover. *Glob. Environ. Polit.*, **14**(2), 7–25, doi:10.1162/glep_a_00225.
- 11 Haites, E., 2016: Experience with linking greenhouse gas emissions trading systems. *Wiley Interdiscip.*
12 *Rev. Energy Environ.*, **5**(3), 246–260, doi:10.1002/wene.191.
- 13 Haites, E., 2018: Carbon taxes and greenhouse gas emissions trading systems: what have we learned?
14 *Climate Policy* **18**(8), 955–966, doi:10.1080/14693062.2018.1492897.
- 15 Hale, T., 2016: “All Hands on Deck”: The Paris Agreement and Nonstate Climate Action. *Glob.*
16 *Environ. Polit.*, **16**(3), 12–22, doi:10.1162/glep_a_00362.
- 17 Hale, T., 2020: Catalytic Cooperation. *Glob. Environ. Polit.*, **20**(4), 73–98, doi:10.1162/glep_a_00561.
- 18 Hale, T. et al., 2016: Exploring links between national climate strategies and non-state and subnational
19 climate action in nationally determined contributions (NDCs). *Clim. Policy*, **6**(4), 1–15,
20 doi:10.1080/14693062.2019.1624252.
- 21 Hales, R., and B. Mackey, 2018: Carbon budgeting post-COP21: The need for an equitable strategy for
22 meeting CO₂e targets. In: *Pathways to a Sustainable Economy: Bridging the Gap between Paris*
23 *Climate Change Commitments and Net Zero Emissions* [Hossain, M., R. Hales, and T. Sarker,
24 (eds.)], Springer, Cham, pp. 209–220.
- 25 Hanger, S. et al., 2016: Community acceptance of large-scale solar energy installations in developing
26 countries: Evidence from Morocco. *Energy Res. Soc. Sci.*, **14**, doi:10.1016/j.erss.2016.01.010.
- 27 Hanna, R., and D. G. Victor, 2021: Marking the decarbonization revolutions. *Nat. Energy*, **6**(6), 568–
28 571, doi:10.1038/s41560-021-00854-1.
- 29 Harding, A. R., K. Ricke, D. Heyen, D. G. MacMartin, and J. Moreno-Cruz, 2020: Climate econometric
30 models indicate solar geoengineering would reduce inter-country income inequality. *Nat.*
31 *Commun.*, **11**(1), 1–9, doi:10.1038/s41467-019-13957-x.
- 32 Hartl, A., 2019: The effects of the Kyoto Protocol on the carbon trade balance. *Rev. World Econ.*, **155**,
33 539–574, doi:10.1007/s10290-019-00350-5.
- 34 Hein, J., A. Guarin, E. Frommé, and P. Pauw, 2018: Deforestation and the Paris climate agreement: An
35 assessment of REDD + in the national climate action plans. *For. Policy Econ.*, **90**, 7–11,
36 doi:10.1016/j.forpol.2018.01.005.
- 37 Heinrichs, D., K. Krellenberg, and M. Fragkias, 2013: Urban Responses to Climate Change: Theories
38 and Governance Practice in Cities of the Global South. *Int. J. Urban Reg. Res.*, **37**(6), 1865–1878,
39 doi:10.1111/1468-2427.12031.
- 40 Held, D., and C. Roger, 2018: Three Models of Global Climate Governance: From Kyoto to Paris and
41 Beyond. *Glob. Policy*, **9**(4), 527–537, doi:10.1111/1758-5899.12617.
- 42 Helland, L., J. Hovi, and H. Sælen, 2017: Climate leadership by conditional commitments. *Oxf. Econ.*
43 *Pap.*, **70**(2), 417–442, doi:10.1093/oenp/gpx045.
- 44 Helm, C., and D. F. Sprinz, 2000: Measuring the Effectiveness of International Environmental Regimes.
45 *J. Conflict Resolut.*, **45**(5), 630–652.
- 46 Helwegen, K. G., C. E. Wieners, J. E. Frank, and H. A. Dijkstra, 2019: Complementing CO₂ emission

- 1 reduction by solar radiation management might strongly enhance future welfare. *Earth Syst. Dyn.*,
2 **10**(3), 453–472, doi:10.5194/esd-10-453-2019.
- 3 Henderson, I., J. Coello, R. Fischer, I. Mulder, and T. Christophersen, 2013: *The Role of the Private*
4 *Sector in REDD+: the Case for Engagement and Options for Intervention*. 12 pp.
5 [https://www.unredd.net/documents/redd-papers-and-publications-90/un-redd-publications-](https://www.unredd.net/documents/redd-papers-and-publications-90/un-redd-publications-1191/policy-brief-series-3154/10509-private-sector-engagement-policy-brief-en-final-version-low-res-10509.html)
6 [1191/policy-brief-series-3154/10509-private-sector-engagement-policy-brief-en-final-version-](https://www.unredd.net/documents/redd-papers-and-publications-90/un-redd-publications-1191/policy-brief-series-3154/10509-private-sector-engagement-policy-brief-en-final-version-low-res-10509.html)
7 [low-res-10509.html](https://www.unredd.net/documents/redd-papers-and-publications-90/un-redd-publications-1191/policy-brief-series-3154/10509-private-sector-engagement-policy-brief-en-final-version-low-res-10509.html).
- 8 Hensengerth, O., 2017: Regionalism, Identity, and Hydropower Dams: The Chinese-Built Lower
9 Sesan 2 Dam in Cambodia. *J. Curr. Chinese Aff.*, **46**(3), 85–118,
10 doi:10.1177/186810261704600304.
- 11 Hermwille, L., A. Siemons, H. Förster, and L. Jeffery, 2019: Catalyzing mitigation ambition under the
12 Paris Agreement: elements for an effective Global Stocktake. *Clim. Policy*, **19**(8), 988–1001,
13 doi:10.1080/14693062.2019.1624494.
- 14 Herrala, R., and R. K. Goel, 2016: Sharing the emission reduction burden in an uneven world. *Energy*
15 *Policy*, **94**, 29–39, doi:10.1016/j.enpol.2016.03.028.
- 16 Hertel, M., 2011: Climate-Change-Related Trade Measures and Article XX: Defining Discrimination
17 in Light of the Principle of Common but Differentiated Responsibilities. *J. World Trade*, **45**(3),
18 653–678.
- 19 Heutel, G., J. Moreno-Cruz, and S. Shayegh, 2018: Solar geoengineering, uncertainty, and the price of
20 carbon. *J. Environ. Econ. Manage.*, **87**, 24–41, doi:10.1016/j.jeem.2017.11.002.
- 21 Hillman, J., 2013: *Changing Climate for Carbon Taxes: Who's Afraid of the WTO?*. *Climate & Energy*
22 *Policy Paper Series, July 2013*. The German Marshall Fund of the United States, Washington,
23 DC, 15 pp. <https://scholarship.law.georgetown.edu/facpub/2030>.
- 24 Hoch, S., A. Michaelowa, A. Espelage, and A. K. Weber, 2019: Governing complexity: How can the
25 interplay of multilateral environmental agreements be harnessed for effective international
26 market-based climate policy instruments? *Int. Environ. Agreements Polit. Law Econ.*, **19**, 595–
27 613, doi:10.1007/s10784-019-09455-6.
- 28 Hochstetler, K., and M. Milkoreit, 2013: Emerging Powers in the Climate Negotiations: Shifting
29 Identity Conceptions. *Polit. Res. Q.*, **67**(1), 224–235, doi:10.1177/1065912913510609.
- 30 Hof, A., C. Brink, A. M. Beltran, and M. den Elzen, 2012: *Greenhouse gas emission reduction targets*
31 *for 2030 - Conditions for an EU target of 40%*. PBL Publishers, The Hague, 52 pp.
- 32 Hofman, E., and W. van der Gaast, 2019: Enhancing ambition levels in nationally determined
33 contributions—Learning from Technology Needs Assessments. *Wiley Interdiscip. Rev. - Energy*
34 *Environ.*, **8**(e311), doi:10.1002/wene.311.
- 35 Hogl, K., D. Kleinschmit, and J. Rayner, 2016: Achieving policy integration across fragmented policy
36 domains: Forests, agriculture, climate and energy. *Environ. Plan. C Gov. Policy*, **34**(3), 399–414,
37 doi:10.1177/0263774x16644815.
- 38 Höglund-Isaksson, L. et al., 2017: Cost estimates of the Kigali Amendment to phase-down
39 hydrofluorocarbons. *Environ. Sci. Policy*, **75**, 138–147, doi:10.1016/j.envsci.2017.05.006.
- 40 Höhne, N. et al., 2017: The Paris Agreement: resolving the inconsistency between global goals and
41 national contributions. *Clim. Policy*, , doi:10.1080/14693062.2016.1218320.
- 42 Höhne, N., H. Fekete, M. G. J. den Elzen, A. F. Hof, and T. Kuramochi, 2018: Assessing the ambition
43 of post-2020 climate targets: a comprehensive framework. *Clim. Policy*, **18**(4), 425–441,
44 doi:10.1080/14693062.2017.1294046.
- 45 Höhne, N. et al., 2021: Wave of net zero emission targets opens window to meeting the Paris
46 Agreement. *Nat. Clim. Chang.*, **11**(10), 820–822, doi:10.1038/s41558-021-01142-2.
- 47 Holmberg, A., and A. Alvinus, 2019: Children's protest in relation to the climate emergency: A

- 1 qualitative study on a new form of resistance promoting political and social change. *Childhood*, ,
2 0907568219879970, doi:10.1177/0907568219879970.
- 3 Holzer, K., 2014: *Carbon-related Border Adjustment and WTO Law*. Edward Elgar Publishing,
4 Cheltenham, UK, 352 pp.
- 5 Holzer, K., and T. Cottier, 2015: Addressing climate change under preferential trade agreements:
6 Towards alignment of carbon standards under the Transatlantic Trade and Investment Partnership.
7 *Glob. Environ. Chang.*, **35**, 514–522, doi:10.1016/j.gloenvcha.2015.06.006.
- 8 Holzer, K., and A. H. Lim, 2020: Trade and Carbon Standards: Why Greater Regulatory Cooperation
9 is Needed. In: *Cool Heads in a Warming World: How Trade Policy Can Help Fight Climate
10 Change* [Esty, D.C. and S. Biniiaz, (eds.)], Yale Center for Environmental Law & Policy, New
11 Haven, CT, p. pp. 27.
- 12 Honegger, M., and D. Reiner, 2018: The political economy of negative emissions technologies:
13 consequences for international policy design. *Clim. Policy*, **18**(3), 306–321,
14 doi:10.1080/14693062.2017.1413322.
- 15 Honegger, M., A. Michaelowa, and J. Pan, 2021a: Potential implications of solar radiation modification
16 for achievement of the Sustainable Development Goals. *Mitig. Adapt. Strateg. Glob. Chang.*,
17 **26**(5), 1–20, doi:10.1007/s11027-021-09958-1.
- 18 Honegger, M., M. Poralla, A. Michaelowa, and H.-M. Ahonen, 2021b: Who Is Paying for Carbon
19 Dioxide Removal? Designing Policy Instruments for Mobilizing Negative Emissions
20 Technologies. *Front. Clim.*, **3**(June), 1–15, doi:10.3389/fclim.2021.672996.
- 21 Horlick, G., and P. A. Clarke, 2017: Rethinking Subsidy Disciplines for the Future: Policy Options for
22 Reform. *J. Int. Econ. Law*, **20**(3), 673–703, doi:10.1093/jiel/jgx022.
- 23 Horton, J., and D. Keith, 2016: Solar geoengineering and obligations to the global poor. In: *Climate
24 justice and geoengineering: Ethics and policy in the atmospheric anthropocene* [Preston, C.,
25 (ed.)], Rowman Littlefield, Lanham, pp. 79–92.
- 26 Horton, J. B., and B. Koremenos, 2020: Steering and influence in transnational climate governance:
27 nonstate engagement in solar geoengineering research. *Glob. Environ. Polit.*, **20**(3), 93–111,
28 doi:10.1162/glep_a_00572.
- 29 Hourdequin, M., 2018: Climate Change, Climate Engineering, and the ‘Global Poor’: What Does
30 Justice Require? *Ethics, Policy Environ.*, **21**(3), 270–288, doi:10.1080/21550085.2018.1562525.
- 31 Hourdequin, M., 2019: Geoengineering Justice: The Role of Recognition. *Sci. Technol. Hum. Values*,
32 **44**(3), 448–477, doi:10.1177/0162243918802893.
- 33 Hovi, J., D. F. Sprinz, H. Sælen, and A. Underdal, 2016: Climate change mitigation: A role for climate
34 clubs? *Palgrave Commun.*, **2**(May), 1–9, doi:10.1057/palcomms.2016.20.
- 35 Hovi, J., D. F. Sprinz, H. Sælen, and A. Underdal, 2017: The Club Approach: A Gateway to Effective
36 Climate Co-operation? *Br. J. Polit. Sci.*, **49**(3), 1071–1096, doi:10.1017/s0007123416000788.
- 37 Howard, A., 2017: Voluntary Cooperation (Article 6). In: *The Paris Agreement on climate change:
38 Analysis and commentary* [Klein, D., M. Pía Carazo, M. Doelle, J. Bulmer, and A. Higham, (eds.)],
39 Oxford University Press, Oxford, p. pp. 178.
- 40 Hsu, A. et al., 2019a: A research roadmap for quantifying non-state and subnational climate mitigation
41 action. *Nat. Clim. Chang.*, **9**(1), doi:10.1038/s41558-018-0338-z.
- 42 Hsu, A., J. Brandt, O. Widerberg, S. Chan, and A. Weinfurter, 2019b: Exploring links between national
43 climate strategies and non-state and subnational climate action in nationally determined
44 contributions (NDCs). *Clim. Policy*, **6**(4), 1–15, doi:10.1080/14693062.2019.1624252.
- 45 Hu, X. et al., 2020: The impacts of the trade liberalization of environmental goods on power system
46 and CO2 emissions. *Energy Policy*, **140**, 111173, doi:10.1016/j.enpol.2019.111173.

- 1 Huang, J., 2018: What Can the Paris Agreement's Global Stocktake Learn from the Sustainable
2 Development Goals? *Carbon Clim. Law Rev.*, **12**(3), 218–228, doi:10.21552/cclr/2018/3/8.
- 3 Hubert, A. M., 2020: A Code of Conduct for Responsible Geoengineering Research. *Glob. Policy*,
4 **12**(S1), 82–96, doi:10.1111/1758-5899.12845.
- 5 Hufbauer, G. C., J. Kim, and S. Charnovitz, 2009: *Global Warming and the World Trading System*.
6 Peterson Institute for International Economics, Washington DC, 166 pp.
- 7 Huggins, A., and M. S. Karim, 2016: Shifting Traction: Differential Treatment and Substantive and
8 Procedural Regard in the International Climate Change Regime. *Transnatl. Environ. Law*, **5**(2),
9 427–448, doi:10.1017/s2047102516000170.
- 10 Hulme, M., 2014: *Can science fix climate change? : a case against climate engineering*. Polity Press,
11 Cambridge, UK, 144 pp.
- 12 Human Rights Committee, 2018: *General comment No. 36 (2018) on article 6 of the International*
13 *Covenant on Civil and Political Rights, on the right to life (30 October 2018)*. *UN Doc.*
14 *CCPR/C/GC/36*. 1–21 pp. [https://tbinternet.ohchr.org/Treaties/CCPR/Shared](https://tbinternet.ohchr.org/Treaties/CCPR/SharedDocuments/1_Global/CCPR_C_GC_36_8785_E.pdf)
15 [Documents/1_Global/CCPR_C_GC_36_8785_E.pdf](https://tbinternet.ohchr.org/Treaties/CCPR/SharedDocuments/1_Global/CCPR_C_GC_36_8785_E.pdf).
- 16 Hurrell, A., and S. Sengupta, 2012: Emerging powers, North–South relations and global climate
17 politics. *Int. Aff.*, **88**(3), 463–484, doi:10.1111/j.1468-2346.2012.01084.x.
- 18 Hurwitz, M. M., E. L. Fleming, P. A. Newman, F. Li, and Q. Liang, 2016: Early action on HFCs
19 mitigates future atmospheric change. *Environ. Res. Lett.*, **11**(11), 114019, doi:10.1088/1748-
20 9326/11/11/114019.
- 21 ICAO, 2016: *Resolution A39-3: Consolidated statement of continuing ICAO policies and practices*
22 *related to environmental protection – Global Market-based Measure (MBM) scheme*.
23 International Civil Aviation Organisation, 25–32 pp.
24 https://www.icao.int/Meetings/a39/Documents/Resolutions/a39_res_prov_en.pdf.
- 25 ICAO, 2019: *SARPs - Annex 16 — Environmental Protection, Volume IV — Carbon Offsetting and*
26 *Reduction Scheme for International Aviation (CORSA)*. ICAO, 120 pp.
27 [https://www.icao.int/environmental-protection/CORSA/Pages/SARPs-Annex-16-Volume-](https://www.icao.int/environmental-protection/CORSA/Pages/SARPs-Annex-16-Volume-IV.aspx)
28 [IV.aspx](https://www.icao.int/environmental-protection/CORSA/Pages/SARPs-Annex-16-Volume-IV.aspx).
- 29 ICAP, 2019: *Emissions Trading Worldwide. International Carbon Action Partnership (ICAP) – Status*
30 *Report 2019*. International Carbon Action Partnership, Berlin, 130 pp.
31 <https://icapcarbonaction.com/en/icap-status-report-2019>.
- 32 ICSU ISSC, 2015: *Review of Targets for the Sustainable Development Goals: the science perspective*.
33 International Council for Science, Paris, 88 pp. [https://council.science/wp-](https://council.science/wp-content/uploads/2017/05/SDG-Report.pdf)
34 [content/uploads/2017/05/SDG-Report.pdf](https://council.science/wp-content/uploads/2017/05/SDG-Report.pdf).
- 35 IIGCC, 2020: *Paris Aligned Investment Initiative: Net Zero Investment Framework for Consultation*.
36 The Institutional Investors Group on Climate Change, 40 pp. [https://www.iigcc.org/download/net-](https://www.iigcc.org/download/net-zero-investment-framework-consultation/?wpdmdl=3602&masterkey=5f270ef146677)
37 [zero-investment-framework-consultation/?wpdmdl=3602&masterkey=5f270ef146677](https://www.iigcc.org/download/net-zero-investment-framework-consultation/?wpdmdl=3602&masterkey=5f270ef146677) (Accessed
38 December 9, 2020).
- 39 IMO, 2018: *Resolution MEPC.304(72): Initial IMO Strategy on Reduction of GHG Emissions from*
40 *Ships. MEPC 72/17/Add.1 Annex 11*. International Maritime Organization (IMO), 1–11 pp.
41 <https://www.wcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution>
42 [MEPC.304\(72\)_E.pdf](https://www.wcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution).
- 43 IMO, 2019: UN agency pushes forward on shipping emissions reduction. *Press Briefings.*,
44 <https://www.imo.org/en/MediaCentre/PressBriefings/Pages/11-MEPC-74-GHG.aspx> (Accessed
45 October 27, 2021).
- 46 InfoFLR, 2018: The Bonn Challenge Barometer. Info Forest Landscape Restoration. *Int. Union*
47 *Conserv. Nat.*, <https://infoflr.org/bonn-challenge-barometer> (Accessed October 27, 2021).

- 1 Ingham, A., J. Ma, and A. M. Ulph, 2013: Can adaptation and mitigation be complements? *Clim.*
2 *Change*, **120**, 39–53, doi:10.1007/s10584-013-0815-3.
- 3 INPE, 2019: Monitoramento dos Focos Ativos por País - Programa Queimadas - INPE.
4 http://queimadas.dgi.inpe.br/queimadas/portal-static/estatisticas_paises/ (Accessed December 22,
5 2020).
- 6 Institute for Climate Economics, 2017: THE INITIATIVE – Climate Action in Financial Institutions.
7 <https://www.mainstreamingclimate.org/initiative/> (Accessed December 8, 2020).
- 8 IPCC, 2014: Climate-Resilient Pathways: Adaptation, Mitigation, and Sustainable Development. In:
9 *Climate Change 2014 Impacts, Adaptation, and Vulnerability* [Field, C.B., V.R. Barros, D.J.
10 Dokken, K.J. Mach, and M.D. Mastrandrea, (eds.)], Cambridge University Press, Cambridge, pp.
11 1101–1131.
- 12 IPCC, 2018a: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of*
13 *1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the*
14 *context of strengthening the global response to the threat of climate change.*, [Masson-Delmotte,
15 V. et al., (eds.)]. Intergovernmental Panel on Climate Change, 616 pp.
- 16 IPCC, 2018b: IPCC Special Report 1.5 - Summary for Policymakers. In: *Global warming of 1.5°C. An*
17 *IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and*
18 *related global greenhouse gas emission pathways, in the context of strengthening the global*
19 *response to the threat of climate change*, World Meteorological Organization, Geneva,
20 Switzerland, p. pp. 32.
- 21 IPCC, 2019: Summary for Policy Makers. In: *IPCC Special Report on the Ocean and Cryosphere in a*
22 *Changing Climate* [Pörtner, H.-O. et al., (eds.)], p. pp. 35.
- 23 IPCC, 2020: *Climate Change and Land: an IPCC special report on climate change, desertification,*
24 *land degradation, sustainable land management, food security, and greenhouse gas fluxes in*
25 *terrestrial ecosystems.* [Shukla, P.R. et al., (eds.)]. Intergovernmental Panel on Climate Change,
26 896 pp.
- 27 Irawan, S., T. Widiastomo, L. Tacconi, J. D. Watts, and B. Steni, 2019: Exploring the design of
28 jurisdictional REDD+: The case of Central Kalimantan, Indonesia. *For. Policy Econ.*, **108**,
29 101853, doi:10.1016/j.forpol.2018.12.009.
- 30 IRENA, 2021: International Renewable Energy Agency Avoided Emissions Calculator.
31 <https://www.irena.org/climatechange/Avoided-Emissions-Calculator> (Accessed 3 November
32 2021).
- 33 Irvine, P. J., and D. W. Keith, 2020: Halving warming with stratospheric aerosol geoengineering
34 moderates policy-relevant climate hazards. *Environ. Res. Lett.*, **15**(4), 44011, doi:10.1088/1748-
35 9326/ab76de.
- 36 Irvine, P. J. et al., 2017: Towards a comprehensive climate impacts assessment of solar geoengineering.
37 *Earth's Futur.*, **5**(1), 93–106, doi:10.1002/2016ef000389.
- 38 ISA, 2015: Framework Agreement on the establishment of the International Solar Alliance.
39 <https://isolaralliance.org/about/framework-agreement#book5/undefined> (Accessed October 28,
40 2021).
- 41 Ismer, R., and K. Neuhoﬀ, 2007: Border tax adjustment: a feasible way to support stringent emission
42 trading. *Eur. J. Law Econ.*, **24**(2), 137–164, doi:10.1007/s10657-007-9032-8.
- 43 Ismer, R., and M. Haussner, 2016: Inclusion of Consumption into the EU ETS: The Legal Basis under
44 European Union Law. *Rev. Eur. Comp. Int. Environ. Law*, **25**(1), 69–80,
45 doi:https://doi.org/10.1111/reel.12131.
- 46 Ismer, R., K. Neuhoﬀ, and A. Pirlot, 2020: *Border Carbon Adjustments and Alternative Measures for*
47 *the EU ETS: An Evaluation.* DIW Berlin, 2020, Berlin, 21 pp.
48 https://www.diw.de/documents/publikationen/73/diw_01.c.743698.de/dp1855.pdf.

- 1 Ismer, R. et al., 2021: *Climate Neutral Production, Free Allocation of Allowances under Emissions*
2 *Trading Systems, and the WTO: How to Secure Compatibility with the ASCM*. DIW Berlin, 2021,
3 Berlin, 18 pp. https://www.diw.de/documents/publikationen/73/diw_01.c.818655.de/dp1948.pdf.
- 4 Ivanova, A., 2017: Green financing for cities: current options and future challenges. In: *Climate*
5 *Change-Sensitive Cities: Building capacities for urban resilience, sustainability, and equity*
6 [Delgado, G.C., (ed.)], PINCC-UNAM, pp. 283–306.
- 7 Ivanova, A., and C. Lopez, 2013: The energy crisis and the policies for implementation of renewable
8 energies. In: *Strategies towards a sustainable development in front of the three crisis*, UAM-
9 Iztapalapa & Miguel Angel Porrúa, pp. 267–282.
- 10 Ivanova, A., A. Bermudez, and A. Martinez, 2015: Climate action plan for the city of La Paz, Baja
11 California Sur, Mexico: a tool for sustainability. In: *The Sustainable City X* [Brebba, C.A. and
12 W.F. Florez-Escobar, (eds.)], Vol. 194 of *WIT Transactions on Ecology and the Environment*,
13 WIT Press, pp. 439–449.
- 14 Ivanova, A., A. Zia, P. Ahmad, and M. Bastos-Lima, 2020: Climate mitigation policies and actions:
15 access and allocation issues. *Int. Environ. Agreements Polit. Law Econ.*, **20**(2), 287–301,
16 doi:10.1007/s10784-020-09483-7.
- 17 Iwata, H., and K. Okada, 2014: Greenhouse gas emissions and the role of the Kyoto Protocol. *Environ.*
18 *Econ. Policy Stud.*, **16**(4), 325–342, doi:10.1007/s10018-012-0047-1.
- 19 Iyer, G. et al., 2017: Measuring progress from nationally determined contributions to mid-century
20 strategies. *Nat. Clim. Chang.*, **7**(12), 871–874, doi:10.1038/s41558-017-0005-9.
- 21 Jachnik, R., M. Mirabile, and A. Dobrinevski, 2019: *Tracking finance flows towards assessing their*
22 *consistency with climate objectives*. OECD Publishing, Paris, 41 pp.
- 23 Jackson, L. S., J. A. Crook, and P. M. Forster, 2016: An intensified hydrological cycle in the simulation
24 of geoengineering by cirrus cloud thinning using ice crystal fall speed changes. *J. Geophys. Res.*
25 *Atmos.*, **121**(12), 6822–6840, doi:10.1002/2015jd024304.
- 26 Jacquet, J., and D. Jamieson, 2016: Soft but significant power in the Paris Agreement. *Nat. Clim.*
27 *Chang.*, **6**(7), 643–646, doi:10.1038/nclimate3006.
- 28 Jaffe, A. B., R. G. Newell, and R. N. Stavins, 2005: A tale of two market failures: Technology and
29 environmental policy. *Ecol. Econ.*, **54**(2–3), 164–174, doi:10.1016/j.ecolecon.2004.12.027.
- 30 James, R. et al., 2014: Characterizing loss and damage from climate change. *Nat. Clim. Chang.*, **4**(11),
31 938–939, doi:10.1038/nclimate2411.
- 32 Janetschek, H., C. Brandi, A. Dzebo, and B. Hackmann, 2020: The 2030 Agenda and the Paris
33 Agreement: voluntary contributions towards thematic policy coherence. *Clim. Policy*, **20**(4), 430–
34 442, doi:10.1080/14693062.2019.1677549.
- 35 Janus, H., S. Klingebiel, and T. C. Mahn, 2014: *How to Shape Development Cooperation? The Global*
36 *Partnership and the Development Cooperation Forum (March 10, 2014)*. Briefing Paper, 3/2014.
37 German Development Institute, 4 pp.
- 38 Jeffery, M. L., J. Gütschow, M. R. Rocha, and R. Gieseke, 2018: Measuring Success: Improving
39 Assessments of Aggregate Greenhouse Gas Emissions Reduction Goals. *Earth's Futur.*, **6**(9),
40 1260–1274, doi:10.1029/2018ef000865.
- 41 Jewell, J. et al., 2018: Limited emission reductions from fuel subsidy removal except in energy-
42 exporting regions. *Nature*, **554**(7691), 229–233, doi:10.1038/nature25467.
- 43 Jewell, J., V. Vinichenko, L. Nacke, and A. Cherp, 2019: Prospects for powering past coal. *Nat. Clim.*
44 *Chang.*, **9**(8), 592–597, doi:10.1038/s41558-019-0509-6.
- 45 Jinnah, S., and S. Nicholson, 2019: The hidden politics of climate engineering. *Nat. Geosci.*, **12**(11),
46 876–879, doi:10.1038/s41561-019-0483-7.

- 1 Jinnah, S., S. Nicholson, and J. Flegal, 2018: Toward Legitimate Governance of Solar Geoengineering
2 Research: A Role for Sub-State Actors. *Ethics, Policy Environ.*, **21**(3), 362–381,
3 doi:10.1080/21550085.2018.1562526.
- 4 Johnson, B. A., R. Dasgupta, A. D. Mader, and H. Scheyvens, 2019: Understanding national
5 biodiversity targets in a REDD+ context. *Environ. Sci. Policy*, **92**, 27–33,
6 doi:10.1016/j.envsci.2018.11.007.
- 7 Jones, A. et al., 2021: North Atlantic Oscillation response in GeoMIP experiments G6solar and
8 G6sulfur: Why detailed modelling is needed for understanding regional implications of solar
9 radiation management. *Atmos. Chem. Phys.*, **21**(2), 1287–1304, doi:10.5194/acp-21-1287-2021.
- 10 Jones, A. C. et al., 2018: Regional Climate Impacts of Stabilizing Global Warming at 1.5 K Using Solar
11 Geoengineering. *Earth's Futur.*, **6**(2), 230–251, doi:10.1002/2017ef000720.
- 12 Jordan, A. J. et al., 2015: Emergence of polycentric climate governance and its future prospects. *Nat.*
13 *Clim. Chang.*, **5**(11), 977–982, doi:10.1038/nclimate2725.
- 14 Joung, T.-H., S.-G. Kang, J.-K. Lee, and J. Ahn, 2020: The IMO initial strategy for reducing
15 Greenhouse Gas(GHG) emissions, and its follow-up actions towards 2050. *J. Int. Marit. Safety,*
16 *Environ. Aff. Shipp.*, **4**(1), 1–7, doi:10.1080/25725084.2019.1707938.
- 17 Jun, M., and S. Zadek, 2019: *Decarbonizing the Road and Belt. A Green Finance Roadmap.* 54 pp.
18 [https://www.vivideconomics.com/wp-content/uploads/2019/09/Decarbonizing-the-Belt-and-](https://www.vivideconomics.com/wp-content/uploads/2019/09/Decarbonizing-the-Belt-and-Road-Final-Report-English.pdf)
19 [Road—Final-Report-English.pdf.](https://www.vivideconomics.com/wp-content/uploads/2019/09/Decarbonizing-the-Belt-and-Road-Final-Report-English.pdf)
- 20 Karlas, J., 2017: States, coalitions, and the legalization of the global climate regime: negotiations on
21 the post-2020 architecture. *Env. Polit.*, **26**(5), 1–22, doi:10.1080/09644016.2017.1324754.
- 22 Karlsson-Vinkhuyzen, S. I. et al., 2018: Entry into force and then? The Paris agreement and state
23 accountability. *Clim. Policy*, **18**(5), 593–599, doi:10.1080/14693062.2017.1331904.
- 24 Karlsson, C., M. Hjerpe, C. Parker, and B.-O. Linnér, 2012: The Legitimacy of Leadership in
25 International Climate Change Negotiations. *Ambio*, **41**(1), 46–55, doi:10.1007/s13280-011-0240-
26 7.
- 27 Kartha, S. et al., 2018: Cascading biases against poorer countries. *Nat. Clim. Chang.*, **8**(5), 348–349,
28 doi:10.1038/s41558-018-0152-7.
- 29 Kasperson, R., and J. X. Kasperson, 2001: *Climate change, vulnerability, and social justice.* Stockholm
30 Environment Institute, Stockholm, 18 pp. [http://stc.umsl.edu/essj/unit4/climate change risk.pdf.](http://stc.umsl.edu/essj/unit4/climate%20change%20risk.pdf)
- 31 Kavlak, G., J. McNerney, and J. E. Trancik, 2018: Evaluating the causes of cost reduction in
32 photovoltaic modules. *Energy Policy* **123**(August), 700–710, doi:10.1016/j.enpol.2018.08.015.
- 33 Keith, D. W., and D. G. MacMartin, 2015: A temporary, moderate and responsive scenario for solar
34 geoengineering. *Nat. Clim. Chang.*, **5**, 201–206, doi:10.1038/nclimate2493.
- 35 Keller, D. P., 2018: Marine Climate Engineering. In: *Handbook on Marine Environment Protection*
36 [Salomon, M. and T. Markus, (eds.)], Springer, Cham, Switzerland, pp. 261–276.
- 37 Kemp, L., 2018: A Systems Critique of the 2015 Paris Agreement on Climate. In: *Pathways to a*
38 *Sustainable Economy*, Springer International Publishing, Cham, pp. 25–41.
- 39 Keohane, N., A. Petsonk, and A. Hanafi, 2017: Toward a club of carbon markets. *Clim. Change*, **144**(1),
40 81–95, doi:10.1007/s10584-015-1506-z.
- 41 Keohane, R. O., and M. Oppenheimer, 2016: Paris: Beyond the Climate Dead End through Pledge and
42 Review? *Polit. Gov.*, **4**(3), 142, doi:10.17645/pag.v4i3.634.
- 43 Kérébel, C., and J. Keppler, 2009: *La Gouvernance Mondiale De L'énergie. Gouvernance Européenne*
44 *Et Géopolitique De L'énergie.* IFRI, Paris, 258 pp.
- 45 Kern, F., and K. S. Rogge, 2016: The pace of governed energy transitions: Agency, international
46 dynamics and the global Paris agreement accelerating decarbonisation processes? *Energy Res.*

- 1 *Soc. Sci.*, **22**, 13–17, doi:10.1016/j.erss.2016.08.016.
- 2 Kern, K., and H. Bulkeley, 2009: Cities, Europeanization and Multi-level Governance: Governing
3 Climate Change through Transnational Municipal Networks. *JCMS J. Common Mark. Stud.*,
4 **47**(2), 309–332, doi:10.1111/j.1468-5965.2009.00806.x.
- 5 Khan, M., D. Mfitumukiza, and S. Huq, 2020: Capacity building for implementation of nationally
6 determined contributions under the Paris Agreement. *Clim. Policy*, **20**(4), 499–510,
7 doi:10.1080/14693062.2019.1675577.
- 8 Khan, M. R., and J. T. Roberts, 2013: Adaptation and international climate policy. *Wiley Interdiscip.*
9 *Rev. Clim. Chang.*, **4**(3), 171–189, doi:10.1002/wcc.212.
- 10 Khan, S. A., and K. Kulovesi, 2018: Black carbon and the Arctic: Global problem-solving through the
11 nexus of science, law and space. *Rev. Eur. Comp. Int. Environ. Law*, **27**(1), 5–14,
12 doi:10.1111/reel.12245.
- 13 Kim, Y., K. Tanaka, and S. Matsuoka, 2020: Environmental and economic effectiveness of the Kyoto
14 Protocol. *PLoS One*, **15**(7), e0236299, doi:10.1371/journal.pone.0236299.
- 15 Kinley, R., M. Z. Cutajar, Y. de Boer, and C. Figueres, 2020: Beyond good intentions, to urgent action:
16 Former UNFCCC leaders take stock of thirty years of international climate change negotiations.
17 *Clim. Policy*, **21**(5), 593–603, doi:10.1080/14693062.2020.1860567.
- 18 Kirchherr, J., and F. Urban, 2018: Technology transfer and cooperation for low carbon energy
19 technology: Analysing 30 years of scholarship and proposing a research agenda. *Energy Policy*,
20 **119**, 600–609, doi:10.1016/j.enpol.2018.05.001.
- 21 Kissinger, G., A. Gupta, I. Mulder, and N. Unterstell, 2019: Climate financing needs in the land sector
22 under the Paris Agreement: An assessment of developing country perspectives. *Land use policy*,
23 **83**, 256–269, doi:10.1016/j.landusepol.2019.02.007.
- 24 Klein, D., M. Pia Carazo, M. Doelle, J. Bulmer, and A. Higham, eds., 2017: *The Paris agreement on*
25 *climate change: analysis and commentary*. Oxford University Press, Oxford, 328 pp.
- 26 Klinsky, S. et al., 2017: Why equity is fundamental in climate change policy research. *Glob. Environ.*
27 *Chang.*, **44**, 170–173, doi:10.1016/j.gloenvcha.2016.08.002.
- 28 Kloeckner, J., 2012: The power of eco-labels: Communicating climate change using carbon footprint
29 labels consistent with international trade regimes under the WTO. *Clim. Law*, **3**(3–4), 209–230,
30 doi:10.1163/el-120064.
- 31 Knox, J. H., 2016: *Report of the Special Rapporteur on the issue of human rights obligations relating*
32 *to the enjoyment of a safe, clean, healthy and sustainable environment*. UN Human Rights
33 Council, 22 pp. <https://digitallibrary.un.org/record/861173?ln=en>.
- 34 Knox, J. H., 2019: The Paris Agreement as a Human Rights Treaty. In: *Human Rights and the 21st*
35 *Century Challenges: Poverty, Conflict and the Environment*, Oxford University Press, pp. 323–
36 347.
- 37 Kollmuss, A., L. Schneider, and V. Zhezherin, 2015: *Has Joint Implementation reduced GHG*
38 *emissions? Lessons learned for the design of carbon market mechanisms*. Stockholm Environment
39 Institute, 124 pp. [https://www.sei.org/publications/has-joint-implementation-reduced-ghg-](https://www.sei.org/publications/has-joint-implementation-reduced-ghg-emissions-lessons-learned-for-the-design-of-carbon-market-mechanisms/)
40 [emissions-lessons-learned-for-the-design-of-carbon-market-mechanisms/](https://www.sei.org/publications/has-joint-implementation-reduced-ghg-emissions-lessons-learned-for-the-design-of-carbon-market-mechanisms/).
- 41 Kona, A., P. Bertoldi, F. Monforti-Ferrario, S. Rivas, and J. F. Dallemand, 2018: Covenant of mayors
42 signatories leading the way towards 1.5 degree global warming pathway. *Sustain. Cities Soc.*, **41**,
43 568–575, doi:10.1016/j.scs.2018.05.017.
- 44 Kona, A. et al., 2021: Global Covenant of Mayors, a dataset of greenhouse gas emissions for 6200 cities
45 in Europe and the Southern Mediterranean countries. *Earth Syst. Sci. Data*, **13**(7), 3551–3564,
46 doi:10.5194/essd-13-3551-2021.
- 47 Kosugi, T., 2013: Fail-safe solar radiation management geoengineering. *Mitig. Adapt. Strateg. Glob.*

- 1 *Chang.*, **18**(8), 1141–1166, doi:10.1007/s11027-012-9414-2.
- 2 Kowarsch, M. et al., 2016: Scientific assessments to facilitate deliberative policy learning. *Palgrave*
3 *Commun.*, **2**(1), 16092, doi:10.1057/palcomms.2016.92.
- 4 Kramarz, T., and S. Park, 2016: Accountability in Global Environmental Governance: A Meaningful
5 Tool for Action? *Glob. Environ. Polit.*, **16**(2), 1–21, doi:10.1162/glep_a_00349.
- 6 Kravitz, B., and D. G. MacMartin, 2020: Uncertainty and the basis for confidence in solar
7 geoengineering research. *Nat. Rev. Earth Environ.*, **1**(1), 64–75, doi:10.1038/s43017-019-0004-7.
- 8 Kravitz, B. et al., 2015: The Geoengineering Model Intercomparison Project Phase 6 (GeoMIP6):
9 simulation design and preliminary results. *Geosci. Model Dev.*, **8**(10), 3379–3392,
10 doi:10.5194/gmd-8-3379-2015.
- 11 Kreibich, N., 2018: *Raising Ambition through Cooperation. Using Article 6 to bolster climate change*
12 *mitigation. JIKO Policy Paper. No. 02/2018.* , Wuppertal, 1–29 pp.
13 https://epub.wupperinst.org/frontdoor/deliver/index/docId/7122/file/7122_Raising_Ambition.pdf
14 .
- 15 Krishnamohan, K. P. S. P., G. Bala, L. Cao, L. Duan, and K. Caldeira, 2019: Climate system response
16 to stratospheric sulfate aerosols: Sensitivity to altitude of aerosol layer. *Earth Syst. Dyn.*, **10**(4),
17 885–900, doi:10.5194/esd-10-885-2019.
- 18 Krueger, P., Z. Sautner, and L. T. Starks, 2020: The Importance of Climate Risks for Institutional
19 Investors. *Rev. Financ. Stud.*, **33**(3), 1067–1111, doi:10.1093/rfs/hhz137.
- 20 Krugman, P., 1991: History Versus Expectations. *Q. J. Econ.*, **106**(2), 651–667, doi:10.2307/2937950.
- 21 Kruitwagen, L., K. Madani, B. Caldecott, and M. H. W. Workman, 2017: Game theory and corporate
22 governance: conditions for effective stewardship of companies exposed to climate change risks.
23 *J. Sustain. Financ. Invest.*, **7**(1), 14–36, doi:10.1080/20430795.2016.1188537.
- 24 Kulovesi, K., 2014: International Trade Disputes on Renewable Energy: Testing Ground for the Mutual
25 Supportiveness of WTO Law and Climate Change Law. *Rev. Eur. Comp. Int. Environ. Law*, **23**(3),
26 342–353, doi:10.1111/reel.12092.
- 27 Kumazawa, R., and M. S. Callaghan, 2012: The effect of the Kyoto Protocol on carbon dioxide
28 emissions. *J. Econ. Financ.*, **36**(1), 201–210, doi:10.1007/s12197-010-9164-5.
- 29 Kuramochi, T. et al., 2020: Beyond national climate action: the impact of region, city, and business
30 commitments on global greenhouse gas emissions. *Clim. Policy*, **20**(3), 275–291,
31 doi:10.1080/14693062.2020.1740150.
- 32 Kuriyama, A., and N. Abe, 2018: Ex-post assessment of the Kyoto Protocol – quantification of CO2
33 mitigation impact in both Annex B and non-Annex B countries. *Appl. Energy*, **220**, 286–295,
34 doi:10.1016/j.apenergy.2018.03.025.
- 35 Kuyper, J., H. Schroeder, and B.-O. Linnér, 2018a: The Evolution of the UNFCCC. *Annu. Rev. Environ.*
36 *Resour.*, **43**(1), 343–368, doi:10.1146/annurev-environ-102017-030119.
- 37 Kuyper, J. W., B. O. Linnér, and H. Schroeder, 2018b: Non-state actors in hybrid global climate
38 governance: justice, legitimacy, and effectiveness in a post-Paris era. *Wiley Interdiscip. Rev. Clim.*
39 *Chang.*, **9**(1), 1–18, doi:10.1002/wcc.497.
- 40 Kverndokk, S., 2018: Climate Policies, Distributional Effects and Transfers Between Rich and Poor
41 Countries. *Int. Rev. Environ. Resour. Econ.*, **12**(2–3), 129–176, doi:10.1561/101.00000100.
- 42 Kwiatkowski, L., P. Cox, P. R. Halloran, P. J. Mumby, and A. J. Wiltshire, 2015: Coral bleaching under
43 unconventional scenarios of climate warming and ocean acidification. *Nat. Clim. Chang.*, **5**(8),
44 777–781, doi:10.1038/nclimate2655.
- 45 La Hoz Theuer, S., L. Schneider, and D. Broekhoff, 2019: When less is more: limits to international
46 transfers under Article 6 of the Paris Agreement. *Clim. Policy*, **19**(4), 401–413,

- 1 doi:10.1080/14693062.2018.1540341.
- 2 Labordena, M., A. Patt, M. Bazilian, M. Howells, and J. Lilliestam, 2017: Impact of political and
3 economic barriers for concentrating solar power in Sub-Saharan Africa. *Energy Policy*, **102**, 52–
4 72, doi:10.1016/j.enpol.2016.12.008.
- 5 Lamb, W. F. et al., 2021: A review of trends and drivers of greenhouse gas emissions by sector from
6 1990 to 2018. *Environ. Res. Lett.*, **16**(7), 073005, doi:10.1088/1748-9326/ABEE4E.
- 7 Lambin, E. F. et al., 2018: The role of supply-chain initiatives in reducing deforestation. *Nat. Clim.*
8 *Change*, **8**, 109–116, doi:10.1038/s41558-017-0061-1.
- 9 Larsen, G. et al., 2018: *Towards Paris Alignment. How the Multilateral Development Banks Can Better*
10 *Support the Paris Agreement*. World Resources Institute, 118 pp.
- 11 Larsson, J., A. Elofsson, T. Sterner, and J. Åkerman, 2019: International and national climate policies
12 for aviation: a review. *Clim. Policy*, **19**(6), 787–799, doi:10.1080/14693062.2018.1562871.
- 13 Latham, J. et al., 2012: Marine cloud brightening. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*,
14 **370**(1974), 4217–4262, doi:10.1098/rsta.2012.0086.
- 15 Latham, J., J. Kleypas, R. Hauser, B. Parkes, and A. Gadian, 2013: Can marine cloud brightening reduce
16 coral bleaching? *Atmos. Sci. Lett.*, **14**(4), 214–219, doi:10.1002/asl2.442.
- 17 Laurens, N., Z. Dove, J.-F. Morin, and S. Jinnah, 2019: NAFTA 2.0: The Greenest Trade Agreement
18 Ever? *World Trade Rev.*, **18**(4), 659–677, doi:10.1017/s1474745619000351.
- 19 Lawrence, P., and D. Wong, 2017: Soft law in the paris climate agreement: Strength or weakness? *Rev.*
20 *Eur. Comp. Int. Environ. Law*, **26**(3), 276–286, doi:10.1111/reel.12210.
- 21 Lawrence, P., and M. Reder, 2019: Equity and the Paris agreement: Legal and philosophical
22 perspectives. *J. Environ. Law*, **31**(3), 511–531, doi:10.1093/jel/eqz017.
- 23 Le Blanc, D., 2015: Towards Integration at Last? The Sustainable Development Goals as a Network of
24 Targets. *Sustain. Dev.*, **23**(3), 176–187, doi:10.1002/sd.1582.
- 25 Lederer, M., and J. Kreuter, 2018: Organising the unthinkable in times of crises: Will climate
26 engineering become the weapon of last resort in the Anthropocene? *Organization*, **25**(4), 472–
27 490, doi:10.1177/1350508418759186.
- 28 Lee, D. S. et al., 2021a: The contribution of global aviation to anthropogenic climate forcing for 2000
29 to 2018. *Atmos. Environ.*, **244**, 117834, doi:10.1016/j.atmosenv.2020.117834.
- 30 Lee, K., C. Fyson, and C.-F. Schleussner, 2021b: Fair distributions of carbon dioxide removal
31 obligations and implications for effective national net-zero targets. *Environ. Res. Lett.*, **16**(9),
32 94001, doi:10.1088/1748-9326/ac1970.
- 33 Lees, E., 2017: Responsibility and liability for climate loss and damage after Paris. *Clim. Policy*, **17**(1),
34 59–70, doi:10.1080/14693062.2016.1197095.
- 35 Leffel, B., 2018: *Subnational Diplomacy, Climate Governance & Californian Global Leadership*. USC
36 Center on Public Diplomacy, 10 pp.
37 [https://www.uspublicdiplomacy.org/sites/uspublicdiplomacy.org/files/useruploads/u39301/Subnational Diplomacy%2C Climate Governance %26 Californian Global Leadership - Benjamin](https://www.uspublicdiplomacy.org/sites/uspublicdiplomacy.org/files/useruploads/u39301/Subnational%20Diplomacy%20Climate%20Governance%20Californian%20Global%20Leadership%20-%20Benjamin%20Leffel_0.pdf)
38 [Leffel_0.pdf](https://www.uspublicdiplomacy.org/sites/uspublicdiplomacy.org/files/useruploads/u39301/Subnational Diplomacy%2C Climate Governance %26 Californian Global Leadership - Benjamin Leffel_0.pdf).
39
- 40 Leonard, L., 2014: Tackling Climate Change in the Global South: An Analysis of the Global Methane
41 Initiative Multilateral Partnership. *J. Soc. Dev. Sci.*, **5**(4), 168–175, doi:10.22610/jsds.v5i4.817.
- 42 Le Quéré C, Korsbakken J I, Wilson C, Tosun J, Andrew R, Andres R J, Canadell J G, Jordan A, Peters
43 G P and van Vuuren D P, 2019: Drivers of declining CO₂ emissions in 18 developed economies
44 *Nat. Clim. Change* **9** 213–7.
- 45 Lesage, D., T. Van de Graaf, and K. Westphal, 2010: *Global Energy Governance in a Multipolar World*.

- 1 [Kirton, J.J. and M. Schreurs, (eds.)]. Ashgate Publishing Limited, Aldershot, UK, 221 pp.
- 2 Lessmann, K. et al., 2015: The Stability and Effectiveness of Climate Coalitions: A Comparative
3 Analysis of Multiple Integrated Assessment Models. *Environ. Resour. Econ.*, **62**(4), 811–836,
4 doi:10.1007/s10640-015-9886-0.
- 5 Lewis, J. I., 2014: The Rise of Renewable Energy Protectionism: Emerging Trade Conflicts and
6 Implications for Low Carbon Development. *Glob. Environ. Polit.*, **14**(4), 10–35,
7 doi:10.1162/glep_a_00255.
- 8 Liagre, L., P. L. Almuedo, C. Besacier, and M. Conigliaro, 2015: *Sustainable financing for forest and*
9 *landscape restoration: Opportunities, challenges and the way forward*. FAO/UNCCD, Rome, 131
10 pp.
- 11 Lindberg, M. B., J. Markard, and A. D. Andersen, 2018: Policies, actors and sustainability transition
12 pathways: A study of the EU’s energy policy mix. *Res. Policy*, **48**(10), 103668,
13 doi:10.1016/j.respol.2018.09.003.
- 14 Liu, J.-Y., S. Fujimori, and T. Masui, 2016: Temporal and spatial distribution of global mitigation cost:
15 INDCs and equity. *Environ. Res. Lett.*, **11**(11), 114004, doi:10.1088/1748-9326/11/11/114004.
- 16 Liu, J., 2011a: The Cancun Agreements. *Environ. Law Rev.*, **13**(1), 43–49,
17 doi:10.1350/enlr.2011.13.1.112.
- 18 Liu, J., 2011b: The Role of ICAO in Regulating the Greenhouse Gas Emissions of Aircraft. *Carbon*
19 *Clim. Law Rev.*, **5**(4), 417–431.
- 20 Liu, J. et al., 2017a: South-south cooperation for large-scale ecological restoration. *Restor. Ecol.*, **25**(1),
21 27–32, doi:10.1111/rec.12462.
- 22 Liu, J., P. E. Love, J. Smith, and M. Regan, 2017b: A new framework for evaluating public-private
23 partnerships. *Second International Conference on Public-Private Partnerships. May 26–29, 2015*,
24 [Zhang, Z., C. Queiroz, and C.M. Walton, (eds.)], Austin, Texas, American Society of Civil
25 Engineers, 290–301.
- 26 Liu, L., and M. Waibel, 2010: Managing Subnational Credit and Default Risks. In: *Sovereign Debt and*
27 *the Financial Crisis* [Primo Braga, C.A. and G.A. Vincelette, (eds.)], The World Bank,
28 Washington DC, Washington DC, pp. 273–293.
- 29 Liu, W., X. Zhang, and S. Feng, 2019: Does renewable energy policy work? Evidence from a panel
30 data analysis. *Renew. Energy*, **135**(May), 635–642, doi:10.1016/j.renene.2018.12.037.
- 31 Livingston, D., 2016: *The G7 Climate Mandate and the Tragedy of the Horizons*. Carnegie Endowment
32 for International Peace, 1–26 pp. <http://www.jstor.org/stable/resrep12840>.
- 33 Lloyd, I. D., and M. Oppenheimer, 2014: On the Design of an International Governance Framework for
34 Geoengineering. *Glob. Environ. Polit.*, **14**(2), 45–63, doi:10.1162/glep_a_00228.
- 35 Locatelli, B., V. Evans, A. Wardell, A. Andrade, and R. Vignola, 2011: Forests and Climate Change in
36 Latin America: Linking Adaptation and Mitigation. *Forests*, **2**(1), 431–450,
37 doi:10.3390/f2010431.
- 38 London Convention/Protocol, 2010: *Resolution LC-LP.2 on the assessment framework for scientific*
39 *research involving ocean fertilization (14 October 2010)*. Document LC 32/15. Annex 5. 2 pp.
40 [https://www.wcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/LCLPDo](https://www.wcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/LCLPDocuments/LC-LP.2(2010).pdf)
41 [cuments/LC-LP.2\(2010\).pdf](https://www.wcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/LCLPDocuments/LC-LP.2(2010).pdf).
- 42 Low, S., and M. Honegger, 2020: A Precautionary Assessment of Systemic Projections and Promises
43 From Sunlight Reflection and Carbon Removal Modeling. *Risk Anal.*, (Online), 1–15,
44 doi:10.1111/risa.13565.
- 45 LSE, 2020: Climate Change Laws of the World database, Grantham Research Institute on Climate
46 Change and the Environment and Sabin Center for Climate Change Law. <https://climate-laws.org/>
47 (Accessed December 14, 2020).

- 1 Lui, S. et al., 2021: Correcting course: the emission reduction potential of international cooperative
2 initiatives. *Clim. Policy*, **21**(2), 232–250, doi:10.1080/14693062.2020.1806021.
- 3 Lyle, C., 2018: Beyond the ICAO’s CORSIA: Towards a More Climatically Effective Strategy for
4 Mitigation of Civil-Aviation Emissions. *Clim. Law*, **8**(1–2), 104–127, doi:10.1163/18786561-
5 00801004.
- 6 Maamoun, N., 2019: The Kyoto protocol: Empirical evidence of a hidden success. *J. Environ. Econ.*
7 *Manage.*, **95**(May), 227–256, doi:10.1016/j.jeem.2019.04.001.
- 8 Maas, A., and J. Scheffran, 2012: Climate Conflicts 2.0? Climate Engineering as a Challenge for
9 International Peace and Security. *Sicherheit und Frieden / Secur. Peace*, **30**(4), 193–200,
10 doi:10.2307/24233201.
- 11 Macchi, C., and J. van Zeben, 2021: Business and human rights implications of climate change
12 litigation: Milieudefensie et al. v Royal Dutch Shell. *Rev. Eur. Comp. Int. Environ. Law*, (Online),
13 1–7, doi:10.1111/reel.12416.
- 14 MacDonald, A., A. Clarke, L. Huang, M. Roseland, and M. M. Seitanidi, 2017: Multi-stakeholder
15 Partnerships (SDG #17) as a Means of Achieving Sustainable Communities and Cities. In: *World*
16 *Sustainability Series* [Leal Filho, W., (ed.)], Springer, pp. 193–209.
- 17 MacDougall, A. H. et al., 2020: Is there warming in the pipeline? A multi-model analysis of the Zero
18 Emissions Commitment from CO₂. *Biogeosciences*, **17**(11), 2987–3016, doi:10.5194/bg-17-
19 2987-2020.
- 20 Mace, M. J., 2016: Mitigation Commitments under the Paris Agreement and the Way Forward. *Clim.*
21 *Law*, **6**(1–2), 21–39, doi:10.1163/18786561-00601002.
- 22 Mace, M. J., and R. Verheyen, 2016: Loss, damage and responsibility after COP21: All options open
23 for the Paris agreement. *Rev. Eur. Comp. Int. Environ. Law*, **25**(2), 197–214,
24 doi:10.1111/reel.12172.
- 25 Mace, M. J., C. Fyson, M. Schaeffer, and B. Hare, 2018: *Governing large-scale carbon dioxide*
26 *removal: are we ready?* Carnegie Climate Geoengineering Governance Initiative (C2G2), New
27 York, US, 46 pp. <https://www.c2g2.net/wp-content/uploads/C2G2-2018-CDR-Governance-1.pdf>.
- 28 Mace, M. J., C. L. Fyson, M. Schaeffer, and W. L. Hare, 2021: Large-Scale Carbon Dioxide Removal
29 to Meet the 1.5°C Limit: Key Governance Gaps, Challenges and Priority Responses. *Glob. Policy*,
30 **12**(S1), 67–81, doi:10.1111/1758-5899.12921.
- 31 MacKay, M., B. Parlee, and C. Karsgaard, 2020: Youth Engagement in Climate Change Action: Case
32 Study on Indigenous Youth at COP24. *Sustainability*, **12**(16), 6299, doi:10.3390/su12166299.
- 33 MacLeod, M., and J. Park, 2011: Financial Activism and Global Climate Change: The Rise of Investor-
34 Driven Governance Networks. *Glob. Environ. Polit.*, **11**(2), 54–74, doi:10.1162/glep_a_00055.
- 35 MacMartin, D. G., and B. Kravitz, 2019: Mission-driven research for stratospheric aerosol
36 geoengineering. *Proc. Natl. Acad. Sci.*, **116**(4), 1089–1094, doi:10.1073/pnas.1811022116.
- 37 MacMartin, D. G., K. Caldeira, and D. W. Keith, 2014: Solar geoengineering to limit the rate of
38 temperature change. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*, **372**(2031),
39 doi:10.1098/rsta.2014.0134.
- 40 MacMartin, D. G., K. L. Ricke, and D. W. Keith, 2018: Solar geoengineering as part of an overall
41 strategy for meeting the 1.5°C Paris target. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*,
42 **376**(2119), 20160454, doi:10.1098/rsta.2016.0454.
- 43 Madani, K., 2020: How International Economic Sanctions Harm the Environment. *Earth’s Futur.*,
44 **8**(12), e2020ef001829, doi:10.1029/2020ef001829.
- 45 Maguire, P. et al., 2021: *Forest Trends’ Ecosystem Marketplace - A Green Growth Spurt: State of*
46 *Forest Carbon Finance 2021*. Forests Trend Association, Washington DC, 1–67 pp.
47 www.ecosystemmarketplace.com/publications/state-of-forest-carbon-finance-2021/.

- 1 Malhotra, A., A. Mathur, S. Diddi, and A. D. Sagar, 2021: Building institutional capacity for addressing
2 climate and sustainable development goals: achieving energy efficiency in India. *Climate Policy*,
3 1-19, doi:10.1080/14693062.2021.1984195.
- 4 Maljean-Dubois, S., 2016: The Paris Agreement: A New Step in the Gradual Evolution of Differential
5 Treatment in the Climate Regime? *Rev. Eur. Community Int. Environ. Law*, **25**(2), 151–160,
6 doi:10.1111/reel.12162.
- 7 Maljean-Dubois, S., 2019: Climate change litigation. In: *Max Planck Encyclopedia of Procedural Law*,
8 Oxford University Press, pp. 1–26.
- 9 Maljean-Dubois, S., and M. Wemaëre, 2016: The Paris Agreement: A Starting Point towards Achieving
10 Climate Neutrality? *Carbon Clim. Law Rev.*, **10**(1), 1–4.
- 11 Maltais, A., and B. Nykvist, 2020: Understanding the role of green bonds in advancing sustainability.
12 *J. Sustain. Financ. Invest.*, (Online), 1–20, doi:10.1080/20430795.2020.1724864.
- 13 Mansourian, S., N. Dudley, and D. Vallauri, 2017: Forest Landscape Restoration: Progress in the Last
14 Decade and Remaining Challenges. *Ecol. Restor.*, **35**(4), 281–288, doi:10.3368/er.35.4.281.
- 15 Marcu, A., 2016: *Carbon Market Provisions in the Paris Agreement (Article 6)*. Centre for European
16 Policy Studies, Brussels, 26 pp.
17 http://aei.pitt.edu/71012/1/SR_No_128_ACM_Post_COP21_Analysis_of_Article_6.pdf.
- 18 Marjanac, S., and L. Patton, 2018: Extreme weather event attribution science and climate change
19 litigation: An essential step in the causal chain? *J. Energy Nat. Resour. Law*, **36**(3), 265–298,
20 doi:10.1080/02646811.2018.1451020.
- 21 Markard, J., 2018: The next phase of the energy transition and its implications for research and policy.
22 *Nat. Energy*, **3**(8), 628–633, doi:10.1038/s41560-018-0171-7.
- 23 Marques, A. et al., 2014: A framework to identify enabling and urgent actions for the 2020 Aichi
24 Targets. *Basic Appl. Ecol.*, **15**(8), 633–638, doi:10.1016/j.baae.2014.09.004.
- 25 Martinez Romera, B., 2016: The Paris Agreement and the Regulation of International Bunker Fuels.
26 *Rev. Eur. Comp. Int. Environ. Law*, **25**(2), 215–227, doi:10.1111/reel.12170.
- 27 Mayer, B., 2016a: The relevance of the no-harm principle to climate change law and politics. *Asia*
28 *Pacific J. Environ. Law*, **19**(1), 79–104, doi:10.4337/apjel.2016.01.04.
- 29 Mayer, B., 2016b: Human Rights in the Paris Agreement. *Clim. Law*, **6**(1–2), doi:10.1163/18786561-
30 00601007.
- 31 Mayer, B., 2018a: Obligations of conduct in the international law on climate change: A defence. *Rev.*
32 *Eur. Comp. Int. Environ. Law*, **27**(2), 130–140, doi:10.1111/reel.12237.
- 33 Mayer, B., 2018b: International Law Obligations Arising in relation to Nationally Determined
34 Contributions. *Transnatl. Environ. Law*, **7**(2), 251–275, doi:10.1017/s2047102518000110.
- 35 Mayer, B., 2019: Transparency Under the Paris Rulebook: Is the Transparency Framework Truly
36 Enhanced? *Clim. Law*, **9**(1–2), 40–64, doi:10.1163/18786561-00901004.
- 37 Mayer, B., 2021: Climate Change Mitigation as an Obligation Under Human Rights Treaties? *Am. J.*
38 *Int. Law*, **115**(3), 409–451, doi:10.1017/ajil.2021.9.
- 39 Mayer, B., and F. Crépeau, 2016: Introduction. In: *Research Handbook on Climate Change, Migration*
40 *and the Law* [Mayer, B. and F. Crépeau, (eds.)], Elgar, Cheltenham, UK, pp. 1–26.
- 41 Mayr, S., B. Hollaus, and V. Madner, 2020: Palm Oil, the RED II and WTO Law: EU Sustainable
42 Biofuel Policy Tangled up in Green? *Rev. Eur. Comp. Int. Environ. Law*, **30**(2), 233–248,
43 doi:10.1111/reel.12386.
- 44 McAdam, D., 2017: Social Movement Theory and the Prospects for Climate Change Activism in the
45 United States. *Annu. Rev. Polit. Sci.*, **20**, 189–208, doi:10.1146/annurev-polisci-052615-025801.

- 1 McAdam, J., 2016: Climate Change-related Displacement of Persons. In: *The Oxford Handbook of*
2 *International Climate Change Law* [Gray, K.R., R. Tarasofsky, and C. Carlarne, (eds.)], Oxford
3 University Press, Oxford, p. pp. 519.
- 4 McAusland, C., and N. Najjar, 2015: The WTO Consistency of Carbon Footprint Taxes. *Georg. J. Int.*
5 *Law*, **46**(3), 765–801.
- 6 McCusker, K. E., K. C. Armour, C. M. Bitz, and D. S. Battisti, 2014: Rapid and extensive warming
7 following cessation of solar radiation management. *Environ. Res. Lett.*, **9**(2), 24005,
8 doi:10.1088/1748-9326/9/2/024005.
- 9 McDonald, J., J. McGee, K. Brent, and W. Burns, 2019: Governing geoengineering research for the
10 Great Barrier Reef. *Clim. Policy*, **19**(7), 801–811, doi:10.1080/14693062.2019.1592742.
- 11 McGee, J., and R. Taplin, 2006: The Asia–Pacific partnership on clean development and climate: A
12 complement or competitor to the Kyoto protocol? *Glob. Chang. Peace Secur.*, **18**(3), 173–192,
13 doi:10.1080/14781150600960230.
- 14 McKinnon, C., 2019: Sleepwalking into lock-in? Avoiding wrongs to future people in the governance
15 of solar radiation management research. *Env. Polit.*, **28**(3), 441–459,
16 doi:10.1080/09644016.2018.1450344.
- 17 McLaren, D., 2016: Mitigation deterrence and the “moral hazard” of solar radiation management.
18 *Earth’s Futur.*, **4**(12), 596–602, doi:10.1002/2016ef000445.
- 19 McLaren, D., and O. Corry, 2021: The politics and governance of research into solar geoengineering.
20 *Wiley Interdiscip. Rev. Clim. Chang.*, **12**(3), e707, doi:10.1002/wcc.707.
- 21 McLaren, D. P., D. P. Tyfield, R. Willis, B. Szerszynski, and N. O. Markusson, 2019: Beyond “Net-
22 Zero”: A Case for Separate Targets for Emissions Reduction and Negative Emissions. *Front.*
23 *Clim.*, **1**, 1–5, doi:10.3389/fclim.2019.00004.
- 24 McNamara, K. E., and C. Farbotko, 2017: Resisting a ‘Doomed’ Fate: an analysis of the Pacific Climate
25 Warriors. *Aust. Geogr.*, **48**(1), 17–26, doi:10.1080/00049182.2016.1266631.
- 26 McNamara, K. E., and G. Jackson, 2019: Loss and damage: A review of the literature and directions
27 for future research. *Wiley Interdiscip. Rev. Clim. Chang.*, **10**(2), e564, doi:10.1002/wcc.564.
- 28 MDB, 2012: MDB Joint Statement for Rio +20. 2012. *Announcements.*,
29 [https://www.iadb.org/en/news/announcements/2012-06-19/mdb-joint-statement-for-](https://www.iadb.org/en/news/announcements/2012-06-19/mdb-joint-statement-for-rio20%2C10032.html)
30 [rio20%2C10032.html](https://www.iadb.org/en/news/announcements/2012-06-19/mdb-joint-statement-for-rio20%2C10032.html) (Accessed October 28, 2021).
- 31 Meehan, F., L. Tacconi, and K. Budiningsih, 2019: Are national commitments to reducing emissions
32 from forests effective? Lessons from Indonesia. *For. Policy Econ.*, **108**(November), 101968,
33 doi:10.1016/j.forpol.2019.101968.
- 34 Mehling, M. A., 2019: Governing Cooperative Approaches under the Paris Agreement. *Ecol. Law Q.*,
35 **46**(3), 765–827, doi:10.15779/z389g5gd97.
- 36 Mehling, M. A., G. E. Metcalf, and R. N. Stavins, 2018: Linking climate policies to advance global
37 mitigation. *Science (80-.)*, **359**(6379), 997–998, doi:10.1126/science.aar5988.
- 38 Mehling, M. A., H. Van Asselt, K. Das, S. Droege, and C. Verkuil, 2019: Designing Border Carbon
39 Adjustments for Enhanced Climate Action. *Am. J. Int. Law*, **113**(3), doi:10.1017/ajil.2019.22.
- 40 Meinshausen, M. et al., 2015: National post-2020 greenhouse gas targets and diversity-aware
41 leadership. *Nat. Clim. Chang.*, **5**(12), 1098–1106, doi:10.1038/nclimate2826.
- 42 Meltzer, J. P., 2013: The Trans-Pacific Partnership Agreement, the environment and climate change.
43 In: *Trade Liberalisation and International Co-operation. A Legal Analysis of the Trans-Pacific*
44 *Partnership Agreement* [Voon, T., (ed.)], Edward Elgar Publishing, Cheltenham, UK, pp. 207–
45 230.
- 46 Merk, C., G. Pönitzsch, C. Kniebes, K. Rehdanz, and U. Schmidt, 2015: Exploring public perceptions

- 1 of stratospheric sulfate injection. *Clim. Change*, **130**(2), 299–312, doi:10.1007/s10584-014-1317-
2 7.
- 3 Merk, C., G. Pönitzsch, and K. Rehdanz, 2016: Knowledge about aerosol injection does not reduce
4 individual mitigation efforts. *Environ. Res. Lett.*, **11**(5), 54009, doi:10.1088/1748-
5 9326/11/5/054009.
- 6 Merk, C., G. Pönitzsch, and K. Rehdanz, 2019: Do climate engineering experts display moral-hazard
7 behaviour? *Clim. Policy*, **19**(2), 231–243, doi:10.1080/14693062.2018.1494534.
- 8 Meyer, T., 2017: Explaining energy disputes at the World Trade Organization. *Int. Environ. Agreements*
9 *Polit. Law Econ.*, **17**(3), 391–410, doi:10.1007/s10784-017-9356-y.
- 10 Michaelowa, A., and K. Michaelowa, 2011a: Climate business for poverty reduction? The role of the
11 World Bank. *Rev. Int. Organ.*, **6**, 259–286, doi:10.1007/s11558-011-9103-z.
- 12 Michaelowa, A., and K. Michaelowa, 2011b: Coding Error or Statistical Embellishment? The Political
13 Economy of Reporting Climate Aid. *World Dev.*, **39**(11), 2010–2020,
14 doi:10.1016/j.worlddev.2011.07.020.
- 15 Michaelowa, A., L. Hermwille, W. Obergassel, and S. Butzengeiger, 2019a: Additionality revisited:
16 guarding the integrity of market mechanisms under the Paris Agreement. *Clim. Policy*, **19**(10),
17 1211–1224, doi:10.1080/14693062.2019.1628695.
- 18 Michaelowa, A., I. Shishlov, and D. Brescia, 2019b: Evolution of international carbon markets: lessons
19 for the Paris Agreement. *Wiley Interdiscip. Rev. Clim. Chang.*, **10**(6), doi:10.1002/wcc.613.
- 20 Michaelowa, A., A. Espelage, and B. Müller, 2020a: *2020 Update: Negotiating cooperation under*
21 *Article 6 of the Paris Agreement*. [Sharma, A., (ed.)]. European Capacity Building Initiative, 1–
22 30 pp. [https://ecbi.org/sites/default/files/Article 6 2020_0.pdf](https://ecbi.org/sites/default/files/Article%206%202020_0.pdf) (Accessed August 24, 2021).
- 23 Michaelowa, A., S. Hoch, A. K. Weber, R. Kassaye, and T. Hailu, 2020b: Mobilising private climate
24 finance for sustainable energy access and climate change mitigation in Sub-Saharan Africa. *Clim.*
25 *Policy*, **21**(1), 47–62, doi:10.1080/14693062.2020.1796568.
- 26 Michaelowa, K., and A. Michaelowa, 2017: Transnational Climate Governance Initiatives: Designed
27 for Effective Climate Change Mitigation? *Int. Interact.*, **43**, 129–155,
28 doi:10.1080/03050629.2017.1256110.
- 29 Miles, K., 2019: *Research Handbook on Environment and Investment Law*. [Miles, K., (ed.)]. Edward
30 Elgar Publishing, Cheltenham, UK, 576 pp.
- 31 Milkoreit, M., and K. Haapala, 2019: The global stocktake: design lessons for a new review and
32 ambition mechanism in the international climate regime. *Int. Environ. Agreements Polit. Law*
33 *Econ.*, **19**(1), 89–106, doi:10.1007/s10784-018-9425-x.
- 34 Milman, A., L. Bunclark, D. Conway, and W. N. Adger, 2013: Assessment of institutional capacity to
35 adapt to climate change in transboundary river basins. *Clim. Change*, **121**(4), 755–770,
36 doi:10.1007/s10584-013-0917-y.
- 37 Mitchell, I., E. Ritchie, and A. Tahmasebi, 2021: *Is Climate Finance Towards \$100 Billion 'New and*
38 *Additional'?*, Washington, DC, 1–14 pp. [https://www.cgdev.org/sites/default/files/PP205-](https://www.cgdev.org/sites/default/files/PP205-Mitchell-Ritchie-Tahmasebi-Climate-Finance.pdf)
39 [Mitchell-Ritchie-Tahmasebi-Climate-Finance.pdf](https://www.cgdev.org/sites/default/files/PP205-Mitchell-Ritchie-Tahmasebi-Climate-Finance.pdf).
- 40 Miyamoto, M., and K. Takeuchi, 2019: Climate agreement and technology diffusion: Impact of the
41 Kyoto Protocol on international patent applications for renewable energy technologies. *Energy*
42 *Policy*, **129**(June), 1331–1338, doi:10.1016/j.enpol.2019.02.053.
- 43 Moerenhout, T. S. H., and T. Irschlinger, 2020: *Exploring the Trade Impacts of Fossil Fuel Subsidies*.
44 International Institute for Sustainable Development, Geneva, 50 pp.
45 <https://www.iisd.org/system/files/publications/trade-impacts-fossil-fuel-subsidies.pdf>.
- 46 Molina, M. et al., 2009: Reducing abrupt climate change risk using the Montreal Protocol and other
47 regulatory actions to complement cuts in CO₂ emissions. *Proc. Natl. Acad. Sci.*, **106**(49), 20616–

- 1 20621, doi:10.1073/pnas.0902568106.
- 2 Morgan, J., and E. Northrop, 2017: Will the Paris Agreement accelerate the pace of change? *Wiley*
3 *Interdiscip. Rev. Clim. Chang.*, **8**(5), e471, doi:10.1002/wcc.471.
- 4 Morin, J.-F., and S. Jinnah, 2018: The untapped potential of preferential trade agreements for climate
5 governance. *Env. Polit.*, **27**(3), 541–565, doi:10.1080/09644016.2017.1421399.
- 6 Moriyama, R. et al., 2017: The cost of stratospheric climate engineering revisited. *Mitig. Adapt. Strateg.*
7 *Glob. Chang.*, **22**(8), 1207–1228, doi:10.1007/s11027-016-9723-y.
- 8 Mormann, F., 2020: Why the divestment movement is missing the mark. *Nat. Clim. Chang.*, **10**, 1067–
9 1068, doi:10.1038/s41558-020-00950-2.
- 10 Morrow, D. R., 2014: Ethical aspects of the mitigation obstruction argument against climate
11 engineering research. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*, **372**(2031), 1–14,
12 doi:10.1098/rsta.2014.0062.
- 13 Müller, B., and A. Michaelowa, 2019: How to operationalize accounting under Article 6 market
14 mechanisms of the Paris Agreement. *Clim. Policy*, **19**(7), 812–819,
15 doi:10.1080/14693062.2019.1599803.
- 16 Multilateral Investment Guarantee Agency, 2019: About MIGA. *About.*, [https://www.miga.org/about-](https://www.miga.org/about-us)
17 [us](https://www.miga.org/about-us) (Accessed October 28, 2021).
- 18 Murata, A. et al., 2016: Environmental co-benefits of the promotion of renewable power generation in
19 China and India through clean development mechanisms. *Renew. Energy*, **87**(Part 1), 120–129,
20 doi:10.1016/j.renene.2015.09.046.
- 21 Muri, H., U. Niemeier, and J. E. Kristjánsson, 2015: Tropical rainforest response to marine sky
22 brightening climate engineering. *Geophys. Res. Lett.*, **42**(8), 2951–2960,
23 doi:10.1002/2015gl063363.
- 24 Nakhooda, S. et al., 2014: *Climate Finance - Is it making a difference? A review of the effectiveness of*
25 *multilateral climate funds*. Overseas Development Institute, London, UK, 88 pp.
- 26 Nasiritousi, N., M. Hjerpe, and B.-O. Linnér, 2016: The roles of non-state actors in climate change
27 governance: understanding agency through governance profiles. *Int. Environ. Agreements Polit.*
28 *Law Econ.*, **16**(1), 109–126, doi:10.1007/s10784-014-9243-8.
- 29 National Academies of Sciences Engineering and Medicine, 2021: *Reflecting Sunlight:*
30 *Recommendations for Solar Geoengineering Research and Research Governance*. National
31 Academies Press, Washington DC, 1–328 pp.
- 32 NCE, 2016: *The Sustainable Infrastructure Imperative, Financing for better growth and development.*
33 *The 2016 New Climate Economy Report*. [Davis, M., (ed.)]. New Climate Economy, 150 pp.
34 [http://newclimateeconomy.report/2016/wp-](http://newclimateeconomy.report/2016/wp-content/uploads/sites/4/2014/08/NCE_2016Report.pdf)
35 [content/uploads/sites/4/2014/08/NCE_2016Report.pdf](http://newclimateeconomy.report/2016/wp-content/uploads/sites/4/2014/08/NCE_2016Report.pdf).
- 36 Nelson, J. P., L. Kaplan, and D. Tomblin, 2021: Assessing solar geoengineering research funders:
37 Insights from two US public deliberations: *Anthr. Rev.*, **8**(1), 37–55,
38 doi:10.1177/2053019620964845.
- 39 Nemati, M., W. Hu, and M. Reed, 2019: Are free trade agreements good for the environment? A panel
40 data analysis. *Rev. Dev. Econ.*, **23**(1), 435–453, doi:10.1111/rode.12554.
- 41 Nemet, G. F., 2019: How solar energy became cheap a model for low-carbon innovation. Routledge.,
42 260 pp.
- 43 Newell, P., and A. Simms, 2020: Towards a fossil fuel non-proliferation treaty. *Clim. Policy*, **20**(8),
44 1043–1054, doi:10.1080/14693062.2019.1636759.
- 45 Newton, P., J. A Oldekop, G. Brodnig, B. K. Karna, and A. Agrawal, 2016: Carbon, biodiversity, and
46 livelihoods in forest commons: synergies, trade-offs, and implications for REDD+. *Environ. Res.*

- 1 *Let.*, **11**(4), 44017, doi:10.1088/1748-9326/11/4/044017.
- 2 Nicholson, S., S. Jinnah, and A. Gillespie, 2018: Solar radiation management: a proposal for immediate
3 polycentric governance. *Clim. Policy*, **18**(3), 322–334, doi:10.1080/14693062.2017.1400944.
- 4 Niemeier, U., H. Schmidt, and C. Timmreck, 2011: The dependency of geoengineered sulfate aerosol
5 on the emission strategy. *Atmos. Sci. Lett.*, **12**(2), 189–194, doi:10.1002/asl.304.
- 6 Nilsson, M., D. Griggs, and M. Visbeck, 2016: Policy: map the interactions between Sustainable
7 Development Goals. *Nature*, **534**(7607), 320–322, doi:10.1038/534320a.
- 8 Nordhaus, W., 2015: Climate Clubs: Overcoming Free-riding in International Climate Policy. *Am.*
9 *Econ. Rev.*, **105**(4), 1339–1370, doi:10.1257/aer.15000001.
- 10 NYDF Assessment Partners, 2020: *Progress on the New York Declaration on Forests (NYDF):*
11 *Balancing forests and development - Addressing infrastructure and extractive industries,*
12 *promoting sustainable livelihoods. Goals 3 & 4 Progress Report.* , Washington DC, 1–109 pp.
13 www.forestdeclaration.org/images/uploads/resource/2020NYDFReport.pdf.
- 14 Obergassel, W., F. Mersmann, and H. Wang-Helmreich, 2017a: Two for One: Integrating the
15 Sustainable Development Agenda with International Climate Policy. *Gaia - Ecol. Perspect. Sci.*
16 *Soc.*, **26**, 249–253, doi:10.14512/gaia.26.3.8.
- 17 Obergassel, W. et al., 2017b: Human rights and the clean development mechanism: lessons learned
18 from three case studies. *J. Hum. Rights Environ.*, , doi:10.4337/jhre.2017.01.03.
- 19 Oberthür, S., 2016: Reflections on Global Climate Politics Post Paris: Power, Interests and
20 Polycentricity. *Int. Spect.*, **51**, 80–94, doi:10.1080/03932729.2016.1242256.
- 21 Oberthür, S., and R. Bodle, 2016: Legal Form and Nature of the Paris Outcome. *Clim. Law*, **6**(1–2), 40–
22 57, doi:10.1163/18786561-00601003.
- 23 Oberthür, S., and E. Northrop, 2018: Towards an Effective Mechanism to Facilitate Implementation
24 and Promote Compliance under the Paris Agreement. *Clim. Law*, **8**(1–2), 39–69,
25 doi:10.1163/18786561-00801002.
- 26 Oberthür, S., and L. Groen, 2020: Hardening and softening of multilateral climate governance towards
27 the Paris Agreement. *J. Environ. Policy Plan.*, **22**(6), 801–813,
28 doi:10.1080/1523908x.2020.1832882.
- 29 Oberthür, S. et al., 2017: *COP21: Results and Implications for Pathways and Policies for Low*
30 *Emissions European Societies. Ref. Ares(2017)5316295 - 31/10/2017.* European Commission,
31 129 pp. <https://cordis.europa.eu/project/id/730427/results>.
- 32 OECD, 2012: *Meeting global challenges through better governance: international co-operation in*
33 *science, technology and innovation.* OECD Publishing, Paris, France, 242 pp.
- 34 OECD, 2019a: Climate Change: OECD DAC External Development Finance Statistics.
35 [http://www.oecd.org/dac/financing-sustainable-development/development-finance-](http://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm)
36 [topics/climate-change.htm](http://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm) (Accessed December 11, 2019).
- 37 OECD, 2019b: *Annual survey of large pension funds and public pension reserve funds.* Organisation
38 for Economic Co-operation and Development, 45 pp. [www.oecd.org/finance/survey-large-](http://www.oecd.org/finance/survey-large-pension-funds.htm)
39 [pension-funds.htm](http://www.oecd.org/finance/survey-large-pension-funds.htm) (Accessed December 9, 2020).
- 40 OECD, 2021: *Climate Finance Provided and Mobilised by Developed Countries: Aggregate Trends*
41 *Updated with 2019 Data, Climate Finance and the USD 100 Billion Goal.* OECD Publishing,
42 Paris, 1–21 pp.
- 43 Office of the High Commissioner for Human Rights, 2019: Five UN human rights treaty bodies issue a
44 joint statement on human rights and climate change (16 September 2019).
45 <https://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=24998> (Accessed
46 October 25, 2021).

- 1 Oh, C., 2019: Political Economy of International Policy on the Transfer of Environmentally Sound
2 Technologies in Global Climate Change Regime. *New Polit. Econ.*, **24**(1), 22–36,
3 doi:10.1080/13563467.2017.1417361.
- 4 Oh, C., 2020a: Discursive Contestation on Technological Innovation and the Institutional Design of the
5 UNFCCC in the New Climate Change Regime. *New Polit. Econ.*, **25**(4), 660–674,
6 doi:10.1080/13563467.2019.1639147.
- 7 Oh, C., 2020b: Contestations over the financial linkages between the UNFCCC’s Technology and
8 Financial Mechanism: using the lens of institutional interaction. *Int. Environ. Agreements*, **20**,
9 559–575, doi:10.1007/s10784-020-09474-8.
- 10 Oh, C., and S. Matsuoka, 2017: The genesis and end of institutional fragmentation in global governance
11 on climate change from a constructivist perspective. *Int. Environ. Agreements Polit. Law Econ.*,
12 **17**(2), 143–159, doi:10.1007/s10784-015-9309-2.
- 13 Olmstead, S. M., and R. N. Stavins, 2012: Three Key Elements of a Post-2012 International Climate
14 Policy Architecture. *Rev. Environ. Econ. Policy*, **6**(1), 65–85, doi:10.1093/reep/rer018.
- 15 Olsen, K. H., C. Arens, and F. Mersmann, 2018: Learning from CDM SD tool experience for Article
16 6.4 of the Paris Agreement. *Clim. Policy*, **18**(4), 383–395, doi:10.1080/14693062.2016.1277686.
- 17 Orr, B. J. et al., 2017: *Scientific Conceptual Framework for Land Degradation Neutrality. A report of*
18 *the science-policy interface*. United Nations Convention to Combat Desertification (UNCCD),
19 Bonn, Germany, 136 pp.
- 20 Osofsky, H., J. Peel, B. McDonnell, and A. Foerster, 2019: Energy re-investment. *Indiana Law J.*, **94**(2),
21 595–652.
- 22 Osofsky, H. M., 2010: The continuing importance of climate change litigation. *Clim. Law*, **1**(1), 3–29,
23 doi:10.1163/cl-2010-002.
- 24 Ostrom, E., 2010: Polycentric systems for coping with collective action and global environmental
25 change. *Glob. Environ. Chang.*, **20**(4), 550–557, doi:10.1016/j.gloenvcha.2010.07.004.
- 26 Otto, F. E. L., R. B. Skeie, J. S. Fuglestedt, T. Berntsen, and M. R. Allen, 2017: Assigning historic
27 responsibility for extreme weather events. *Nat. Clim. Chang.*, **7**(11), 757–759,
28 doi:10.1038/nclimate3419.
- 29 Ourbak, T., and A. K. Magnan, 2018: The Paris Agreement and climate change negotiations: Small
30 Islands, big players. *Reg. Environ. Chang.*, **18**(8), 2201–2207, doi:10.1007/s10113-017-1247-9.
- 31 PAGE, 2018: *International Investment Agreements and Sustainable Development: Safeguarding Policy*
32 *Space and Mobilising Investment for a Green Economy*. United Nations Environment Programme,
33 1–35 pp. [https://www.un-](https://www.un-page.org/files/public/international_investment_agreements_sustainable_development_1.pdf)
34 [page.org/files/public/international_investment_agreements_sustainable_development_1.pdf](https://www.un-page.org/files/public/international_investment_agreements_sustainable_development_1.pdf).
- 35 Panfil, S. N., and C. A. Harvey, 2016: REDD+ and Biodiversity Conservation: A Review of the
36 Biodiversity Goals, Monitoring Methods, and Impacts of 80 REDD+ Projects. *Conserv. Lett.*, **9**(2),
37 143–150, doi:10.1111/conl.12188.
- 38 Parker, A., 2014: Governing solar geoengineering research as it leaves the laboratory. *Philos. Trans. R.*
39 *Soc. A Math. Phys. Eng. Sci.*, **372**(2031), 1–17, doi:10.1098/rsta.2014.0173.
- 40 Parker, A., and P. J. Irvine, 2018: The Risk of Termination Shock From Solar Geoengineering. *Earth’s*
41 *Futur.*, **6**(3), 456–467, doi:10.1002/2017ef000735.
- 42 Parker, A., J. B. Horton, and D. W. Keith, 2018: Stopping Solar Geoengineering Through Technical
43 Means: A Preliminary Assessment of Counter-Geoengineering. *Earth’s Futur.*, **6**(8), 1058–1065,
44 doi:10.1029/2018ef000864.
- 45 Parker, C. F., C. Karlsson, and M. Hjerpe, 2014: Climate change leaders and followers: Leadership
46 recognition and selection in the UNFCCC negotiations. *Int. Relations*, **29**(4), 434–454,
47 doi:10.1177/0047117814552143.

- 1 Parker, C. F., C. Karlsson, and M. Hjerpe, 2015: Climate change leaders and followers: Leadership
2 recognition and selection in the UNFCCC negotiations. *Int. Relations*, **29**(4), 434–454,
3 doi:10.1177/0047117814552143.
- 4 Parkes, B., A. Challinor, and K. Nicklin, 2015: Crop failure rates in a geoengineered climate: impact of
5 climate change and marine cloud brightening. *Environ. Res. Lett.*, **10**(8), 84003,
6 doi:10.1088/1748-9326/10/8/084003.
- 7 Paroussos, L. et al., 2019: Climate clubs and the macro-economic benefits of international cooperation
8 on climate policy. *Nat. Clim. Chang.*, **9**(7), 542–546, doi:10.1038/s41558-019-0501-1.
- 9 Parson, E. A., 2014: Climate Engineering in Global Climate Governance: Implications for Participation
10 and Linkage. *Transnatl. Environ. Law*, **3**(1), 89–110, doi:10.1017/s2047102513000496.
- 11 Parson, E. A., and L. N. Ernst, 2013: International Governance of Climate Engineering. *Theor. Inq.*
12 *Law*, **14**(1), 307–338, doi:10.1515/til-2013-015.
- 13 Partanen, A.-I., D. P. Keller, H. Korhonen, and H. D. Matthews, 2016: Impacts of sea spray
14 geoengineering on ocean biogeochemistry. *Geophys. Res. Lett.*, **43**(14), 7600–7608,
15 doi:10.1002/2016gl070111.
- 16 Patt, A., 2015: *Transforming energy: solving climate change with technology policy*. Cambridge
17 University Press, New York.
- 18 Patt, A., 2017: Beyond the tragedy of the commons: Reframing effective climate change governance.
19 *Energy Res. Soc. Sci.*, **34**, 1–3, doi:10.1016/j.erss.2017.05.023.
- 20 Patton, L. E., 2021: Litigation needs the latest science. *Nat. Clim. Chang.*, **11**(8), 644–645,
21 doi:10.1038/s41558-021-01113-7.
- 22 Pauw, W. P. et al., 2018: Beyond headline mitigation numbers: we need more transparent and
23 comparable NDCs to achieve the Paris Agreement on climate change. *Clim. Change*, **147**(1–2),
24 23–29, doi:10.1007/s10584-017-2122-x.
- 25 Pauw, W. P., P. Castro, J. Pickering, and S. Bhasin, 2020: Conditional nationally determined
26 contributions in the Paris Agreement: foothold for equity or Achilles heel? *Clim. Policy*, **20**(4),
27 468–484, doi:10.1080/14693062.2019.1635874.
- 28 Pauwelyn, J., 2013: Carbon leakage measures and border tax adjustments under WTO law. In: *Research*
29 *handbook on Environment, Health and the WTO* [Van Calster, G. and D. Prévost, (eds.)], Edward
30 Elgar Publishing, Cheltenham, UK, pp. 448–506.
- 31 Pavlova, Y., and A. De Zeeuw, 2013: Asymmetries in international environmental agreements. *Environ.*
32 *Dev. Econ.*, **18**(1), 51–68, doi:10.1017/s1355770x12000289.
- 33 Peake, S., and P. Ekins, 2017: Exploring the financial and investment implications of the Paris
34 Agreement. *Clim. Policy*, **17**(7), 832–852, doi:10.1080/14693062.2016.1258633.
- 35 Pearse, R., 2017: Gender and climate change. *Wiley Interdiscip. Rev. Clim. Chang.*, **8**(2), e451,
36 doi:10.1002/wcc.451.
- 37 Peel, J., and H. M. Osofsky, 2018: A Rights Turn in Climate Change Litigation? *Transnatl. Environ.*
38 *Law*, **7**(1), 37–67, doi:10.1017/S2047102517000292.
- 39 Peel, J., and J. Lin, 2019: Transnational Climate Litigation: The Contribution of the Global South. *Am.*
40 *J. Int. Law*, **113**(04), 679–726, doi:10.1017/ajil.2019.48.
- 41 Peel, J., and H. M. Osofsky, 2020: Climate Change Litigation. *Annu. Rev. Law Soc. Sci.*, **16**(1), 21–38,
42 doi:10.1146/annurev-lawsocsci-022420-122936.
- 43 Pekkarinen, V., 2020: Going beyond CO2: Strengthening action on global methane emissions under the
44 UN climate regime. *Rev. Eur. Comp. Int. Environ. Law*, **29**(3), 464–478, doi:10.1111/reel.12329.
- 45 Pereira, L. et al., 2021: From Fairplay to Climate Wars: Making climate change scenarios more
46 dynamic, creative and integrative. *Ecol. Soc.*, (accepted).

- 1 Peters, G. P. et al., 2017: Key indicators to track current progress and future ambition of the Paris
2 Agreement. *Nat. Clim. Chang.*, **7**(2), 118–122, doi:10.1038/nclimate3202.
- 3 Peterson, L., and J. Skovgaard, 2019: Bureaucratic politics and the allocation of climate finance. *World*
4 *Dev.*, **117**, 72–97, doi:10.1016/j.worlddev.2018.12.011.
- 5 Phelps, J., E. L. Webb, and W. M. Adams, 2012: Biodiversity co-benefits of policies to reduce forest-
6 carbon emissions. *Nat. Clim. Chang.*, **2**, 497–503, doi:10.1038/nclimate1462.
- 7 Phillips, J., and P. Newell, 2013: The governance of clean energy in India: The clean development
8 mechanism (CDM) and domestic politics. *Energy Policy*, **59**, 654–662,
9 doi:10.1016/j.enpol.2013.04.019.
- 10 Pickering, J., F. Jotzo, and P. J. Wood, 2015: Sharing the Global Climate Finance Effort Fairly with
11 Limited Coordination. *Glob. Environ. Polit.*, **15**(4), 39–62, doi:10.1162/GLEP_a_00325.
- 12 Pickering, J., C. Betzold, and J. Skovgaard, 2017: Special issue: managing fragmentation and
13 complexity in the emerging system of international climate finance. *Int. Environ. Agreements*
14 *Polit. Law Econ.*, **17**, 1–16, doi:10.1007/s10784-016-9349-2.
- 15 Pickering, J., J. S. McGee, S. I. Karlsson-Vinkhuyzen, and J. Wenta, 2019: Global climate governance
16 between hard and soft law: Can the Paris agreement’s “Crème Brûlée” approach enhance
17 ecological reflexivity? *J. Environ. Law*, **31**(1), 1–28, doi:10.1093/jel/eqy018.
- 18 Pidgeon, N. et al., 2012: Exploring early public responses to geoengineering. *Philos. Trans. R. Soc. A*
19 *Math. Phys. Eng. Sci.*, **370**(1974), 4176–4196, doi:10.1098/rsta.2012.0099.
- 20 Piggot, G., P. Erickson, H. van Asselt, and M. Lazarus, 2018: Swimming upstream: addressing fossil
21 fuel supply under the UNFCCC. *Clim. Policy*, **18**(9), 1189–1202,
22 doi:10.1080/14693062.2018.1494535.
- 23 Pinke, Z., S. Pow, and Z. Kern, 2019: Volcanic mega-eruptions may trigger major cholera outbreaks.
24 *Clim. Res.*, **79**(2), 151–162, doi:10.3354/cr01587.
- 25 Pinz, A., N. Roudyani, and J. Thaler, 2018: Public–private partnerships as instruments to achieve
26 sustainability-related objectives: the state of the art and a research agenda. *Public Manag. Rev.*,
27 **20**(1), 1–22, doi:10.1080/14719037.2017.1293143.
- 28 Pirard, R. et al., 2019: *Effectiveness of forest conservation interventions: An evidence gap map*. Green
29 Climate Fund, Songdo, 57 pp. [https://www.cbd.int/doc/presentations/tc-imrr/Learning-Paper-
30 2.pdf](https://www.cbd.int/doc/presentations/tc-imrr/Learning-Paper-2.pdf).
- 31 Pistorius, T., and L. Kiff, 2015: The Politics of German Finance for REDD+. In: *CGD Working Paper*
32 *390, CGD Climate and Forest Paper Series #16*, Center for Global Development, Washington
33 DC, pp. 1–49.
- 34 Pitari, G. et al., 2014: Stratospheric ozone response to sulfate geoengineering: Results from the
35 Geoengineering Model Intercomparison Project (GeoMIP). *J. Geophys. Res. Atmos.*, **119**(5),
36 2629–2653, doi:10.1002/2013jd020566.
- 37 Pitt, D., 2010: The impact of internal and external characteristics on the adoption of climate mitigation
38 policies by US municipalities. *Environ. Plan. C Polit. Sp.*, **28**(5), 851–871, doi:10.1068/c09175.
- 39 Pollitt, H., K. Neuhoff, and X. Lin, 2020: The impact of implementing a consumption charge on carbon-
40 intensive materials in Europe. *Clim. Policy*, **20**(sup1), s74–s89,
41 doi:10.1080/14693062.2019.1605969.
- 42 Pongratz, J., D. B. Lobell, L. Cao, and K. Caldeira, 2012: Crop yields in a geoengineered climate. *Nat.*
43 *Clim. Chang.*, **2**(2), 101–105, doi:10.1038/nclimate1373.
- 44 Popp, D., 2019: Environmental Policy and Innovation: A Decade of Research. *Int. Rev. Environ.*
45 *Resour. Econ.*, **13**(3–4), 265–337, doi:10.1561/101.00000111.
- 46 Porterfield, M., 2019: Border Adjustments for Carbon Taxes, PPMs, and the WTO. *Univ. Pennsylvania*

- 1 *J. Int. Law*, **41**(1), 1–42.
- 2 Porterfield, M., K. P. Gallagher, and J. C. Schachter, 2017: Assessing the Climate Impacts of U.S. Trade
3 Agreements. *Michigan J. Environ. Adm. Law*, **7**(1), 51–81.
- 4 Potoski, M., 2017: Green clubs in building block climate change regimes. *Clim. Change*, **144**(1), 53–
5 63, doi:10.1007/s10584-015-1517-9.
- 6 Potoski, M., and A. Prakash, 2013: Green Clubs: Collective Action and Voluntary Environmental
7 Programs. *Annu. Rev. Polit. Sci.*, **16**(1), 399–419, doi:10.1146/annurev-polisci-032211-211224.
- 8 Pozo, C., Á. Galán-Martín, D. M. Reiner, N. Mac Dowell, and G. Guillén-Gosálbez, 2020: Equity in
9 allocating carbon dioxide removal quotas. *Nat. Clim. Chang.*, **10**, 640–646, doi:10.1038/s41583-
10 020-0802-4.
- 11 Preston, B. J., 2020: The Influence of the Paris Agreement on Climate Litigation: Legal Obligations
12 and Norms (Part I). *J. Environ. Law*, **33**(1), 1–32, doi:10.1093/jel/eqaa020.
- 13 Preston, C., and W. Carr, 2018: Recognition Justice, Climate Engineering, and the Care Approach.
14 *Ethics, Policy Environ.*, **21**(3), 308–323, doi:10.1080/21550085.2018.1562527.
- 15 Proctor, J., S. Hsiang, J. Burney, M. Burke, and W. Schlenker, 2018: Estimating global agricultural
16 effects of geoengineering using volcanic eruptions. *Nature*, **560**(7719), 480–483,
17 doi:10.1038/s41586-018-0417-3.
- 18 Quélin, B. V., I. Kivleniece, and S. Lazzarini, 2017: Public-private collaboration, hybridity and social
19 value: Towards new theoretical perspectives. *J. Manag. Stud.*, **54**(6), 763–792,
20 doi:10.1111/joms.12274.
- 21 Rabitz, F., 2019: Governing the termination problem in solar radiation management. *Env. Polit.*, **28**(3),
22 502–522, doi:10.1080/09644016.2018.1519879.
- 23 Rahman, A. A., P. Artaxo, A. Asrat, and A. Parker, 2018: Developing countries must lead on solar
24 geoengineering research. *Nature*, **556**(7699), 22–24, doi:10.1038/d41586-018-03917-8.
- 25 Raiser, K., U. Kornek, C. Flachsland, and W. F. Lamb, 2020: Is the Paris Agreement effective? A
26 systematic map of the evidence. *Environ. Res. Lett.*, **15**(8), 83006, doi:10.1088/1748-
27 9326/ab865c.
- 28 Rajamani, L., 2010: The making and unmaking of the Copenhagen accord. *Int. Comp. Law Q.*, **59**(3),
29 824–843, doi:10.1017/s0020589310000400.
- 30 Rajamani, L., 2015: The Devilish Details: Key Legal Issues in the 2015 Climate Negotiations. *Mod.*
31 *Law Rev.*, **78**(5), 826–853, doi:10.1111/1468-2230.12145.
- 32 Rajamani, L., 2016a: Ambition and Differentiation in the Paris Agreement: Interpretative Possibilities
33 and Underlying Politics. *Int. Comp. Law Q.*, **65**(2), 493–514, doi:10.1017/s0020589316000130.
- 34 Rajamani, L., 2016b: The 2015 Paris Agreement: Interplay between hard, soft and non-obligations. *J.*
35 *Environ. Law*, **28**(2), 337–358, doi:10.1093/jel/eqw015.
- 36 Rajamani, L., 2017: India’s approach to international law in the climate change regime. *Indian J. Int.*
37 *Law*, **57**(1), 1–23, doi:10.1007/s40901-018-0072-0.
- 38 Rajamani, L., 2018: Human Rights in the Climate Change Regime: From Rio to Paris and Beyond. In:
39 *The Human Right to a Healthy Environment* [Knox, J.H. and R. Pejan, (eds.)], Cambridge
40 University Press, 2018, pp. 236–251.
- 41 Rajamani, L., 2019: Integrating Human Rights in the Paris Climate Architecture: Contest, Context, and
42 Consequence. *Clim. Law*, **9**(3), 180–201, doi:10.1163/18786561-00903003.
- 43 Rajamani, L., and J. Werksman, 2018: The legal character and operational relevance of the Paris
44 Agreement’s temperature goal. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*, **376**(2119),
45 20160458, doi:10.1098/rsta.2016.0458.

- 1 Rajamani, L., and D. Bodansky, 2019: The Paris Rulebook: Balancing Prescriptiveness with National
2 Discretion. *Int. Comp. Law Q.*, **68**(4), 1023–1040, doi:10.1017/s0020589319000320.
- 3 Rajamani, L. et al., 2021: National ‘fair shares’ in reducing greenhouse gas emissions within the
4 principled framework of international environmental law. *Clim. Policy*, **21**(8), 983–1004,
5 doi:10.1080/14693062.2021.1970504.
- 6 Rampa, F., S. Bilal, and E. Sidiropoulos, 2012: Leveraging South–South cooperation for Africa’s
7 development. *South African J. Int. Aff.*, **19**(2), 247–269, doi:10.1080/10220461.2012.709400.
- 8 Rashidi, K., and A. Patt, 2018: Subsistence over symbolism: the role of transnational municipal
9 networks on cities’ climate policy innovation and adoption. *Mitig. Adapt. Strateg. Glob. Chang.*,
10 **23**(4), 507–523, doi:10.1007/s11027-017-9747-y.
- 11 Rashidi, K., M. Stadelmann, and A. Patt, 2017: Valuing co-benefits to make low-carbon investments in
12 cities bankable: The case of waste and transportation projects. *Sustain. Cities Soc.*, **34**, 69–78,
13 doi:10.1016/j.scs.2017.06.003.
- 14 Rashidi, K., M. Stadelmann, and A. Patt, 2019: Creditworthiness and climate: Identifying a hidden
15 financial co-benefit of municipal climate adaptation and mitigation policies. *Energy Res. Soc. Sci.*,
16 **48**, 131–138, doi:10.1016/j.erss.2018.09.021.
- 17 Ravikumar, A., 2020: Opinion: Carbon border taxes are unjust. *MIT Technol. Rev.*,
18 [https://www.technologyreview.com/2020/07/27/1005641/carbon-border-taxes-eu-climate-](https://www.technologyreview.com/2020/07/27/1005641/carbon-border-taxes-eu-climate-change-opinion/)
19 [change-opinion/](https://www.technologyreview.com/2020/07/27/1005641/carbon-border-taxes-eu-climate-change-opinion/) (Accessed October 29, 2021).
- 20 Rayner, S. et al., 2013: The Oxford Principles. *Clim. Change*, **121**(3), 499–512, doi:10.1007/s10584-
21 012-0675-2.
- 22 RE100, 2019: RE100 Overview. <http://there100.org/re100> (Accessed December 18, 2019).
- 23 REN21, 2019: REN21: Renewables Now! *ren21.net.*, <https://www.ren21.net/about-us/who-we-are/>
24 (Accessed December 18, 2019).
- 25 Reynolds, J. L., 2019a: *The governance of solar geoengineering: managing climate change in the*
26 *Anthropocene*. Cambridge University Press, 268 pp.
- 27 Reynolds, J. L., 2019b: Solar geoengineering to reduce climate change: a review of governance
28 proposals. *Proc. R. Soc. A*, **475**(2229), 1–33, doi:10.1098/rspa.2019.0255.
- 29 RGI, 2011: *European Grid Declaration On Electricity Network Development and Nature Conservation*
30 *in Europe (10 November 2011)*. Renewables Grid Initiative, 11 pp.
- 31 Richards, M. B., E. Wollenberg, and D. van Vuuren, 2018: National contributions to climate change
32 mitigation from agriculture: allocating a global target. *Clim. Policy*, **18**(10), 1271–1285,
33 doi:10.1080/14693062.2018.1430018.
- 34 Ricke, K. L., J. B. Moreno-Cruz, and K. Caldeira, 2013: Strategic incentives for climate geoengineering
35 coalitions to exclude broad participation. *Environ. Res. Lett.*, **8**, 014021, doi:10.1088/1748-
36 9326/8/1/014021.
- 37 Rickels, W. et al., 2020: Who turns the global thermostat and by how much? *Energy Econ.*, **91**, 104852,
38 doi:10.1016/j.eneco.2020.104852.
- 39 Ripley, K., and C. Verkuijl, 2016: “Ozone Family” Delivers Landmark Deal for the Climate. *Environ.*
40 *Policy Law*, **46**(6), 371–375.
- 41 Ritchie, H., and D. S. Reay, 2017: Delivering the two degree global climate change target using a
42 flexible ratchet framework. *Clim. Policy*, **17**(8), 1031–1045,
43 doi:10.1080/14693062.2016.1222260.
- 44 Ritchie, J., 2021: Movement from the margins to global recognition: climate change activism by young
45 people and in particular indigenous youth. *Int. Stud. Sociol. Educ.*, **30**(1–2), 53–72,
46 doi:10.1080/09620214.2020.1854830.

- 1 Roberts, C. et al., 2018: The politics of accelerating low-carbon transitions: Towards a new research
2 agenda. *Energy Res. Soc. Sci.*, **44**, 304–311, doi:10.1016/j.erss.2018.06.001.
- 3 Roberts, E., K. van der Geest, K. Warner, and S. Andrei, 2014: Loss and Damage: When adaptation is
4 not enough. *Environ. Dev.*, **11**, 219–227, doi:10.1016/j.envdev.2014.05.001.
- 5 Roberts, J. T., and R. Weikmans, 2017: Postface: fragmentation, failing trust and enduring tensions
6 over what counts as climate finance. *Int. Environ. Agreements Polit. Law Econ.*, **17**(1), 129–137,
7 doi:10.1007/s10784-016-9347-4.
- 8 Roberts, J. T. et al., 2017: How Will We Pay for Loss and Damage? *Ethics Policy Environ.*, **20**(2), 208–
9 226, doi:10.1080/21550085.2017.1342963.
- 10 Roberts, J. T. et al., 2021: Rebooting a failed promise of climate finance. *Nat. Clim. Chang.*, **11**(3),
11 180–182, doi:10.1038/s41558-021-00990-2.
- 12 Roberts, M. W., 2017: Finishing the job: The Montreal Protocol moves to phase down
13 hydrofluorocarbons. *Rev. Eur. Comp. Int. Environ. Law*, **26**(3), 220–230, doi:10.1111/reel.12225.
- 14 Robinson, S.-A., 2018: Capacity building and transparency under Paris. In: *The Paris Framework for*
15 *Climate Change Capacity Building* [Khan, M.R., J.T. Roberts, S. Huq, and V. Hoffmeister, (eds.)],
16 Routledge, London, pp. 203–222.
- 17 Robiou du Pont, Y., and M. Meinshausen, 2018: Warming assessment of the bottom-up Paris
18 Agreement emissions pledges. *Nat. Commun.*, **9**(1), 4810, doi:10.1038/s41467-018-07223-9.
- 19 Robiou du Pont, Y. et al., 2017: Equitable mitigation to achieve the Paris Agreement goals. *Nat. Clim.*
20 *Chang.*, **7**(1), 38–43, doi:10.1038/nclimate3186.
- 21 Roelfsema, M. et al., 2020: Taking stock of national climate policies to evaluate implementation of the
22 Paris Agreement. *Nat. Commun.*, **11**(1), 2096, doi:10.1038/s41467-020-15414-6.
- 23 Rogelj, J. et al., 2010: Analysis of the Copenhagen Accord pledges and its global climatic impacts—a
24 snapshot of dissonant ambitions. *Environ. Res. Lett.*, **5**(3), 034013, doi:10.1088/1748-
25 9326/5/3/034013.
- 26 Rogelj, J. et al., 2015: Energy system transformations for limiting end-of-century warming to below 1.5
27 °C. *Nat. Clim. Chang.*, **5**(6), 519–527, doi:10.1038/nclimate2572.
- 28 Rogelj, J. et al., 2016: Paris Agreement climate proposals need a boost to keep warming well below 2
29 °c. *Nature*, **534**(7609), 631–639, doi:10.1038/nature18307.
- 30 Rogelj, J. et al., 2017: Understanding the origin of Paris Agreement emission uncertainties. *Nat.*
31 *Commun.*, **8**(15748), doi:10.1038/ncomms15748.
- 32 Rogelj, J. et al., 2018: Mitigation pathways compatible with 1.5°C in the context of sustainable
33 development. In: *Global Warming of 1.5 °C an IPCC special report on the impacts of global*
34 *warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission*
35 *pathways, in the context of strengthening the global response to the threat of climate change*
36 [Masson-Delmotte, V. et al., (eds.)], In Press, pp. 93–174.
- 37 Rogelj, J., O. Geden, A. Cowie, and A. Reisinger, 2021: Net-zero emissions targets are vague: three
38 ways to fix. *Nature*, **591**(7850), 365–368, doi:10.1038/d41586-021-00662-3.
- 39 Rosen, A. M., 2015: The Wrong Solution at the Right Time: The Failure of the Kyoto Protocol on
40 Climate Change. *Polit. Policy*, **43**(1), 30–58, doi:10.1111/polp.12105.
- 41 Rosenow, J., F. Kern, and K. Rogge, 2017: The need for comprehensive and well targeted instrument
42 mixes to stimulate energy transitions: The case of energy efficiency policy. *Energy Res. Soc. Sci.*,
43 **33**, 95–104, doi:10.1016/J.ERSS.2017.09.013.
- 44 Rubini, L., and I. Jegou, 2012: Who'll Stop the Rain? Allocating Emissions Allowances for Free:
45 Environmental Policy, Economics, and WTO Subsidy Law. *Transnatl. Environ. Law*, **1**(2), 325–
46 354, doi:10.1017/s2047102512000143.

- 1 Rubio, S. J., 2017: Sharing R & D investments in breakthrough technologies to control climate change.
2 *Oxf. Econ. Pap.*, **69**(2), 496–521, doi:10.1093/oenp/gpw067.
- 3 Rumpel, C. et al., 2020: The 4p1000 initiative: Opportunities, limitations and challenges for
4 implementing soil organic carbon sequestration as a sustainable development strategy. *Ambio*, ,
5 doi:10.1007/s13280-019-01165-2.
- 6 Sabel, C. F., and D. G. Victor, 2017: Governing global problems under uncertainty: making bottom-up
7 climate policy work. *Clim. Change*, **144**(1), 15–27, doi:10.1007/s10584-015-1507-y.
- 8 Sælen, H., 2020: Under What Conditions Will the Paris Process Produce a Cycle of Increasing Ambition
9 Sufficient to Reach the 2°C Goal? *Glob. Environ. Polit.*, **20**(2), 83–104,
10 doi:10.1162/glep_a_00548.
- 11 Sælen, H., J. Hovi, D. F. Sprinz, and A. Underdal, 2020: How US Withdrawal Might Influence
12 Cooperation Under the Paris Climate Agreement. *Environ. Sci. Policy*, **108**, 121–132,
13 doi:10.1016/j.envsci.2020.03.011.
- 14 Sands, P. Q. C., 2016: Climate change and the rule of law: Adjudicating the future in international law.
15 *J. Environ. Law*, **28**(1), 19–35, doi:10.1093/jel/eqw005.
- 16 Sands, P. Q. C., and J. Peel, 2018: *Principles of International Environmental Law*. 4th ed. Cambridge
17 University Press, Cambridge, 1032 pp.
- 18 Savaresi, A., 2016: The Paris agreement: A new beginning? *J. Energy Nat. Resour. Law*, **34**(1), 16–26,
19 doi:10.1080/02646811.2016.1133983.
- 20 Savaresi, A., 2018: Climate change and human rights: Fragmentation, interplay, and institutional
21 linkages. In: *Routledge Handbook of Human Rights and Climate Governance* [Duyck, S., S.
22 Jodoin, and A. Johl, (eds.)], Routledge, London, pp. 31–42.
- 23 Savaresi, A., and J. Auz, 2019: Climate change litigation and human rights: Pushing the boundaries.
24 *Clim. Law*, **9**(3), 244–262, doi:10.1163/18786561-00903006.
- 25 Schade, J., and W. Obergassel, 2014: Human rights and the Clean Development Mechanism.
26 *Cambridge Rev. Int. Aff.*, **27**(4), 717–735, doi:10.1080/09557571.2014.961407.
- 27 Schäfer, S., 2019: Decoupling the EU ETS from subsidized renewables and other demand side effects:
28 lessons from the impact of the EU ETS on CO₂ emissions in the German electricity sector. *Energy*
29 *Policy*, **133**, 110858, doi:10.1016/J.ENPOL.2019.06.066.
- 30 Scheidel, A. et al., 2020: Environmental conflicts and defenders: A global overview. *Glob. Environ.*
31 *Chang.*, **63**, 102104, doi:10.1016/j.gloenvcha.2020.102104.
- 32 Scheinman, L., 1987: *The International Atomic Energy Agency and World Nuclear Order*. Resources
33 for the Future, Washington DC, 320 pp.
- 34 Schleussner, C. F. et al., 2016: Science and policy characteristics of the Paris Agreement temperature
35 goal. *Nat. Clim. Chang.*, **6**(9), 827–835, doi:10.1038/nclimate3096.
- 36 Schlosberg, D., and L. B. Collins, 2014: From environmental to climate justice: Climate change and the
37 discourse of environmental justice. *Wiley Interdiscip. Rev. Clim. Chang.*, **5**(3), 359–374,
38 doi:10.1002/wcc.275.
- 39 Schmale, J., D. Shindell, E. Von Schneidmesser, I. Chabay, and M. Lawrence, 2014: Air pollution:
40 Clean up our skies. *Nature*, **515**, 335–337, doi:10.1038/515335a.
- 41 Schmiege, G. et al., 2017: Modeling normativity in sustainability: a comparison of the sustainable
42 development goals, the Paris agreement, and the papal encyclical. *Sustain. Sci.*, **13**, 785–796,
43 doi:10.1007/s11625-017-0504-7.
- 44 Schneider, L., and S. La Hoz Theuer, 2019: Environmental integrity of international carbon market
45 mechanisms under the Paris Agreement. *Clim. Policy*, **19**(3), 386–400,
46 doi:10.1080/14693062.2018.1521332.

- 1 Schneider, L., A. Kollmuss, and M. Lazarus, 2014: *Addressing the risk of double counting emission*
2 *reductions under the UNFCCC*. Stockholm Environment Institute, Stockholm, 1–56 pp.
3 [https://mediamanager.sei.org/documents/Publications/Climate/SEI-WP-2014-02-Double-](https://mediamanager.sei.org/documents/Publications/Climate/SEI-WP-2014-02-Double-counting-risks-UNFCCC.pdf)
4 [counting-risks-UNFCCC.pdf](https://mediamanager.sei.org/documents/Publications/Climate/SEI-WP-2014-02-Double-counting-risks-UNFCCC.pdf).
- 5 Schneider, L., M. Lazarus, C. Lee, and H. Van Asselt, 2017: Restricted linking of emissions trading
6 systems: options, benefits and challenges. *Int. Environ. Agreements Polit. Law Econ.*, **17**(6), 883–
7 898, doi:10.1007/s10784-017-9370-0.
- 8 Schneider, L. et al., 2019: Double counting and the Paris Agreement rulebook. *Science (80-.)*,
9 **366**(6462), 180–183, doi:10.1126/science.aay8750.
- 10 Schroeder, H., and C. McDermott, 2014: Beyond carbon: Enabling justice and equity in REDD+ across
11 levels of governance. *Ecol. Soc.*, **19**(1), 2–4, doi:10.5751/es-06537-190131.
- 12 Schroeder, H., M. Di Gregorio, M. Brockhaus, and T. T. Pham, 2020: Policy Learning in REDD+ Donor
13 Countries: Norway, Germany, and the UK. *Glob. Environ. Chang.*, **63**, 102106,
14 doi:10.1016/j.gloenvcha.2020.102106.
- 15 Schulte, I. et al., 2020: *Supporting Smallholder Farmers for a Sustainable Cocoa Sector: Exploring the*
16 *Motivations and Role of Farmers in the Effective Implementation of Supply Chain Sustainability*
17 *in Ghana and Cote d’Ivoire*. Meridian Institute, Washington DC, 1–59 pp.
18 [https://www.climatefocus.com/sites/default/files/Supporting_Smallholder_Farmers_for_a](https://www.climatefocus.com/sites/default/files/Supporting_Smallholder_Farmers_for_a_Sustainable_Cocoa_Sector_June_2020.pdf)
19 [Sustainable Cocoa Sector June 2020.pdf](https://www.climatefocus.com/sites/default/files/Supporting_Smallholder_Farmers_for_a_Sustainable_Cocoa_Sector_June_2020.pdf).
- 20 Selin, H., 2014: Global Environmental Law and Treaty-Making on Hazardous Substances: The
21 Minamata Convention and Mercury Abatement. *Glob. Environ. Polit.*, **14**(1), 1–19,
22 doi:10.1162/glep_a_00208.
- 23 Seneviratne, S. I. et al., 2018: Land radiative management as contributor to regional-scale climate
24 adaptation and mitigation. *Nat. Geosci.*, **11**(2), 88–96, doi:10.1038/s41561-017-0057-5.
- 25 Serdeczny, O., 2019: Non-economic Loss and Damage and the Warsaw International Mechanism. In:
26 *Loss and Damage from Climate Change. Concepts, Methods and Policy Options. Climate Risk*
27 *Management, Policy and Governance*. [Mechler, R., L. Bouwer, T. Schinko, S. Surminski, and J.
28 Linnerooth-Bayer, (eds.)], Springer, Cham, pp. 205–220.
- 29 Sethi, M., W. Lamb, J. Minx, and F. Creutzig, 2020: Climate change mitigation in cities: a systematic
30 scoping of case studies. *Environ. Res. Lett.*, **15**(9), 093008, doi:10.1088/1748-9326/AB99FF.
- 31 Setzer, J., and R. Byrnes, 2019: *Global trends in climate change litigation: 2019 snapshot*. London
32 School of Economics and Political Science, London, UK, 14 pp.
33 [https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2019/07/GRI_Global-trends-in-](https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2019/07/GRI_Global-trends-in-climate-change-litigation-2019-snapshot-2.pdf)
34 [climate-change-litigation-2019-snapshot-2.pdf](https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2019/07/GRI_Global-trends-in-climate-change-litigation-2019-snapshot-2.pdf).
- 35 Setzer, J., and L. C. Vanhala, 2019: Climate change litigation: A review of research on courts and
36 litigants in climate governance. *Wiley Interdiscip. Rev. Clim. Chang.*, **10**(3), e580,
37 doi:10.1002/wcc.580.
- 38 Setzer, J., and L. Benjamin, 2020: Climate litigation in the Global South: constraints and innovations.
39 *Transnatl. Environ. Law*, **9**(1), 77–101, doi:10.1017/s2047102519000268.
- 40 Seymour, F., and J. Busch, 2016: *Why forests? Why now?: The science, economics, and politics of*
41 *tropical forests and climate change*. Brookings Institution Press, Washington, D.C., 429 pp.
- 42 Shadikhodjaev, S., 2015: Renewable Energy and Government Support: Time to ‘Green’ the SCM
43 Agreement? *World Trade Rev.*, **14**(3), 479–506, doi:10.1017/s1474745614000317.
- 44 Shepherd, J. G., 2009: *Geoengineering the climate: science, governance and uncertainty (RS Policy*
45 *Document 10/09)*. The Royal Society 2009, London, 84 pp.
- 46 Sheriff, G., 2019: Burden Sharing under the Paris Climate Agreement. *J. Assoc. Environ. Resour. Econ.*,
47 **6**(2), 275–318, doi:10.1086/701469.

- 1 Shi, X., Y. Chen, and H. Liu, 2017: The Negative Impact of Climate Change Mitigation Measures on
2 Human Rights and the Countermeasures. *J. Hunan Police Acad.*, **1**, 7.
- 3 Shi, Y., and W. Gullett, 2018: International Regulation on Low-Carbon Shipping for Climate Change
4 Mitigation: Development, Challenges, and Prospects. *Ocean Dev. Int. Law*, **49**(2), 134–156,
5 doi:10.1080/00908320.2018.1442178.
- 6 Shimoda, Y., and S. Nakazawa, 2012: Flexible Cooperation for Indonesia’s Multi-dimensional
7 Challenges for South-South Cooperation Under A Shared Vision. In: *Scaling Up South-South and*
8 *Triangular Cooperation* [Kato, H., (ed.)], Japan International Cooperation Agency Research
9 Institute, Tokyo, pp. 149–172.
- 10 Shishlov, I., R. Morel, and V. Bellassen, 2016: Compliance of the Parties to the Kyoto Protocol in the
11 first commitment period. *Clim. Policy*, **16**(6), 768–782, doi:10.1080/14693062.2016.1164658.
- 12 Simpson, I. R. et al., 2019: The Regional Hydroclimate Response to Stratospheric Sulfate
13 Geoengineering and the Role of Stratospheric Heating. *J. Geophys. Res. Atmos.*, **124**(23), 12587–
14 12616, doi:10.1029/2019jd031093.
- 15 Sindico, F., 2016: Paris, Climate Change, and Sustainable Development. *Clim. Law*, **6**(1–2), 130–141,
16 doi:10.1163/18786561-00601009.
- 17 Skeie, R. B. et al., 2017: Perspective has a strong effect on the calculation of historical contributions to
18 global warming. *Environ. Res. Lett.*, **12**(2), 024022, doi:10.1088/1748-9326/aa5b0a.
- 19 Skjærseth, J. B., O. S. Stokke, and J. Wettestad, 2006: Soft law, hard law, and effective implementation
20 of international environmental norms. *Glob. Environ. Polit.*, **6**(3), 104–120,
21 doi:10.1162/glep.2006.6.3.104.
- 22 Smit, B., and J. Wandel, 2006: Adaptation, adaptive capacity and vulnerability. *Glob. Environ. Chang.*,
23 **16**(3), 282–292, doi:10.1016/j.gloenvcha.2006.03.008.
- 24 Smith, J. J., and M. T. Ahmad, 2018: Globalization’s Vehicle: The Evolution and Future of Emission
25 Regulation in the icao and imo in Comparative Assessment. *Clim. Law*, **8**(1–2), 70–103,
26 doi:10.1163/18786561-00801003.
- 27 Smith, W., and G. Wagner, 2018: Stratospheric aerosol injection tactics and costs in the first 15 years
28 of deployment. *Environ. Res. Lett.*, **13**(124001), doi:10.1088/1748-9326/aae98d.
- 29 Solomon, S., G.-K. Plattner, R. Knutti, and P. Friedlingstein, 2009: Irreversible climate change due to
30 carbon dioxide emissions. *Proc. Natl. Acad. Sci.*, **106**(6), 1704–1709,
31 doi:10.1073/pnas.0812721106.
- 32 Sorgho, Z., and J. Tharakan, 2020: *Do PTAs with Environmental Provisions Reduce Emissions?*
33 *Assessing the Effectiveness of Climate-related Provisions?* Fondation pour les études et recherches
34 sur le développement internationa, Clermont-Ferrand, 47 pp. [https://ferdi.fr/dl/df-](https://ferdi.fr/dl/df-nJ7WgYnTDp6qA2SGjnT25Y9F/ferdi-p274-do-ptas-with-environmental-provisions-reduce-emissions-assessing.pdf)
35 [nJ7WgYnTDp6qA2SGjnT25Y9F/ferdi-p274-do-ptas-with-environmental-provisions-reduce-](https://ferdi.fr/dl/df-nJ7WgYnTDp6qA2SGjnT25Y9F/ferdi-p274-do-ptas-with-environmental-provisions-reduce-emissions-assessing.pdf)
36 [emissions-assessing.pdf](https://ferdi.fr/dl/df-nJ7WgYnTDp6qA2SGjnT25Y9F/ferdi-p274-do-ptas-with-environmental-provisions-reduce-emissions-assessing.pdf).
- 37 Sovacool, B. K., and A. Florini, 2012: Examining the Complications of Global Energy Governance. *J.*
38 *Energy Nat. Resour. Law*, **30**(3), 235–263, doi:10.1080/02646811.2012.11435295.
- 39 Sovacool, B. K., and B.-O. Linnér, 2016: The Perils of Climate Diplomacy: The Political Economy of
40 the UNFCCC. In: *The Political Economy of Climate Change Adaptation*, Palgrave Macmillan UK,
41 London, pp. 110–135.
- 42 Spalding-Fecher, R. et al., 2012: *Assessing The Impact Of The Clean Development Mechanism. Final*
43 *Report. Report Commissioned By The High-Level Panel On The CDM Policy Dialogue.*
44 UNFCCC, Bonn, 172 pp.
- 45 Spash, C. L., 2016: This Changes Nothing: The Paris Agreement to Ignore Reality. *Globalizations*,
46 **13**(6), 928–933, doi:10.1080/14747731.2016.1161119.
- 47 Springmann, M., 2013: Carbon tariffs for financing clean development. *Clim. Policy*, **13**(1), 20–42,

- 1 doi:10.1080/14693062.2012.691223.
- 2 Sprinz, D. F., H. Sælen, A. Underdal, and J. Hovi, 2018: The Effectiveness of Climate Clubs under
3 Donald Trump. *Clim. Policy*, **18**(7), 828–838, doi:10.1080/14693062.2017.1410090.
- 4 Staver, A. C., S. Archibald, and S. A. Levin, 2011: The Global Extent and Determinants of Savanna
5 and Forest as Alternative Biome States. *Science* (80-.), **334**(6053), 230–232,
6 doi:10.1126/science.1210465.
- 7 Stavins, R. et al., 2014: International Cooperation: Agreements and Instruments. In: *Climate Change*
8 *2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment*
9 *of the Intergovernmental Panel on Climate Change* [Edenhofer, O.R. et al., (eds.)], Cambridge
10 University Press, Cambridge, pp. 1001–1082.
- 11 Steele, P., 2015: *Development finance and climate finance: Achieving zero poverty and zero emissions*.
12 IIED, London, 1–31 pp.
- 13 Steenblik, R., and S. Droegge, 2019: Time to ACCTS? Five countries announce new initiative on trade
14 and climate change. *Int. Inst. Sustain. Dev. Blog.*, [https://www.iisd.org/articles/time-accts-five-](https://www.iisd.org/articles/time-accts-five-countries-announce-new-initiative-trade-and-climate-change)
15 countries-announce-new-initiative-trade-and-climate-change (Accessed October 29, 2021).
- 16 Steenblik, R., J. Sauvage, and C. Timiliotis, 2018: Fossil Fuel Subsidies and the Global Trade Regime.
17 In: *The Politics of Fossil Fuel Subsidies and their Reform* [Van Asselt, H. and J. Skovgaard,
18 (eds.)], Cambridge University Press, Cambridge, pp. 121–139.
- 19 Stephens, J. C., and K. Surprise, 2020: The hidden injustices of advancing solar geoengineering
20 research. *Glob. Sustain.*, **3**(e2), 1–6, doi:10.1017/sus.2019.28.
- 21 Stephenson, S. R. et al., 2018: Climatic Responses to Future Trans-Arctic Shipping. *Geophys. Res. Lett.*,
22 **45**(18), 9898–9908, doi:10.1029/2018gl078969.
- 23 Stephenson, S. R., N. Oculi, A. Bauer, and S. Carhuayano, 2019: Convergence and Divergence of
24 UNFCCC Nationally Determined Contributions. *Ann. Am. Assoc. Geogr.*, **109**(4), 1240–1261,
25 doi:10.1080/24694452.2018.1536533.
- 26 Stewart, R. B., M. Oppenheimer, and B. Rudyk, 2013a: A new strategy for global climate protection.
27 *Clim. Change*, **120**(1), 1–12, doi:10.1007/s10584-013-0790-8.
- 28 Stewart, R. B., M. Oppenheimer, and B. Rudyk, 2013b: Building Blocks for Global Climate Protection.
29 *Stanford Environ. Law J.*, **32**(2), 341–392, doi:10.2139/ssrn.2186541.
- 30 Stewart, R. B., M. Oppenheimer, and B. Rudyk, 2017: Building blocks: a strategy for near-term action
31 within the new global climate framework. *Clim. Change*, **144**(1), 1–13, doi:10.1007/s10584-017-
32 1932-1.
- 33 Stilgoe, J., 2015: *Experiment earth : responsible innovation in geoengineering*. Taylor and Francis Ltd.,
34 London, UK, 222 pp.
- 35 Stjern, C. W. et al., 2018: Response to marine cloud brightening in a multi-model ensemble. *Atmos.*
36 *Chem. Phys.*, **18**(2), 621–634, doi:10.5194/acp-18-621-2018.
- 37 Storelvmo, T., and N. Herger, 2014: Cirrus cloud susceptibility to the injection of ice nuclei in the upper
38 troposphere. *J. Geophys. Res. Atmos.*, **119**(5), 2375–2389, doi:10.1002/2013jd020816.
- 39 Streck, C., and C. Parker, 2012: Financing REDD+. In: *Analysing REDD+: Challenges and choices*
40 [Angelsen, A., M. Brockhaus, W.D. Sunderlin, and L.. Verchot, (eds.)], CIFOR, Bogor, Indonesia,
41 pp. 111–127.
- 42 Streck, C., and M. Terhalle, 2013: The changing geopolitics of climate change. *Clim. Policy*, **13**(5),
43 533–537, doi:10.1080/14693062.2013.823809.
- 44 Stua, M., 2017a: A single mechanism for the certification of mitigation outcomes. In: *From the Paris*
45 *Agreement to a Low-Carbon Bretton Woods: Rationale for the Establishment of a Mitigation*
46 *Alliance*, Springer International Publishing, Cham, Switzerland, pp. 85–107.

- 1 Stua, M., 2017b: *From the Paris agreement to a low-carbon brettton woods: Rationale for the*
2 *establishment of a mitigation alliance*. Springer International Publishing, 239 pp.
- 3 Stuart-Smith, R. F. et al., 2021: Filling the evidentiary gap in climate litigation. *Nat. Clim. Chang.*,
4 **11**(8), 651–655, doi:10.1038/s41558-021-01086-7.
- 5 Suckall, N., L. C. Stringer, and E. L. Tompkins, 2015: Presenting Triple-Wins? Assessing Projects That
6 Deliver Adaptation, Mitigation and Development Co-benefits in Rural Sub-Saharan Africa.
7 *Ambio*, **44**(1), 34–41, doi:10.1007/s13280-014-0520-0.
- 8 Sugiyama, M., Y. Arino, T. Kosugi, A. Kurosawa, and S. Watanabe, 2018a: Next steps in
9 geoengineering scenario research: limited deployment scenarios and beyond. *Clim. Policy*, **18**(6),
10 681–689, doi:10.1080/14693062.2017.1323721.
- 11 Sugiyama, M., A. Ishii, S. Asayama, and T. Kosugi, 2018b: Solar Geoengineering Governance. *Oxford*
12 *Res. Encycl. Clim. Sci.*, , 26, doi:10.1093/acrefore/9780190228620.013.647.
- 13 Sugiyama, M., S. Asayama, and T. Kosugi, 2020: The North–South Divide on Public Perceptions of
14 Stratospheric Aerosol Geoengineering?: A Survey in Six Asia-Pacific Countries. *Environ.*
15 *Commun.*, **14**(5), 641–656, doi:10.1080/17524032.2019.1699137.
- 16 Svoboda, T., 2017: *The ethics of climate engineering: solar radiation management and non-ideal*
17 *justice*. 1st ed. Routledge, New York, 1–186 pp.
- 18 Svoboda, T., and P. Irvine, 2014: Ethical and Technical Challenges in Compensating for Harm Due to
19 Solar Radiation Management Geoengineering. *Ethics, Policy Environ.*, **17**(2), 157–174,
20 doi:10.1080/21550085.2014.927962.
- 21 Tacconi, L., 2017: Strengthening policy research and development through foreign aid_ the case of
22 reducing deforestation and forest degradation in Indonesia. *Aust. For.*, **80**(3), 188–194,
23 doi:10.1080/00049158.2017.1335579.
- 24 Tacconi, L., R. J. Rodrigues, and A. Maryudi, 2019: Law enforcement and deforestation: Lessons for
25 Indonesia from Brazil. *For. Policy Econ.*, **108**, 101943, doi:10.1016/j.forpol.2019.05.029.
- 26 Táíwò, O. O., and S. Talati, 2021: Who Are the Engineers? Solar Geoengineering Research and Justice.
27 *Glob. Environ. Polit.*, , 1–7, doi:10.1162/glep_a_00620.
- 28 Talberg, A., S. Thomas, P. Christoff, and D. Karoly, 2018: How geoengineering scenarios frame
29 assumptions and create expectations. *Sustain. Sci.*, **13**(4), 1093–1104, doi:10.1007/s11625-018-
30 0527-8.
- 31 Tamiotti, L., 2011: The legal interface between carbon border measures and trade rules. *Clim. Policy*,
32 **11**(5), 1202–1211, doi:10.1080/14693062.2011.592672.
- 33 Tamiotti, L. et al., 2009: *Trade and Climate Change, A report by the United Nations Environment*
34 *Programme and the World Trade Organization*. 166 pp.
35 https://www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf.
- 36 TCFD, 2017: *Final Report: Recommendations of the Task Force on Climate-related Financial*
37 *Disclosures*. 66 pp. [https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-](https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf)
38 [Report-11052018.pdf](https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf).
- 39 TDA, 2019: *Join us in raising ambition, action and advocacy towards the decarbonisation of the*
40 *transport sector before 2050*. Transportation Decarbonisation Alliance, 4 pp. [http://tda-](http://tda-mobility.org/wp-content/uploads/2018/08/TDA-Flyer.pdf)
41 [mobility.org/wp-content/uploads/2018/08/TDA-Flyer.pdf](http://tda-mobility.org/wp-content/uploads/2018/08/TDA-Flyer.pdf).
- 42 TEC, and CTCN, 2019: *Joint annual report of the Technology Executive Committee and the Climate*
43 *Technology Centre and Network for 2019*. 1–26 pp.
44 https://unfccc.int/sites/default/files/resource/sb2019_04E.pdf.
- 45 Tedsen, E., and G. Homann, 2013: Implementing the Precautionary Principle for Climate Engineering.
46 *Carbon Clim. Law Rev.*, **7**(2), 90–100, doi:10.21552/cclr/2013/2/250.

- 1 Terhalle, M., and J. Depledge, 2013: Great-power politics, order transition, and climate governance:
2 insights from international relations theory. *Clim. policy*, **13**(5), 572–588,
3 doi:10.1080/14693062.2013.818849.
- 4 Terrenoire, E., D. A. Hauglustaine, T. Gasser, and O. Penanhoat, 2019: The contribution of carbon
5 dioxide emissions from the aviation sector to future climate change. *Environ. Res. Lett.*, **14**,
6 084019, doi:10.1088/1748-9326/ab3086.
- 7 The Supreme Court of Nepal, 2018: *Advocate Padam Bahadur Shrestha Vs The office of the Prime*
8 *Minister and Council of Ministers, Singhadurbar, Kathmandu and others. Decision No. 10210,*
9 *NKP, Part 61, Vol. 3 (25 December 2018).* 1–15 pp. [http://climatecasechart.com/climate-change-](http://climatecasechart.com/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2018/20181225_074-WO-0283_judgment-1.pdf)
10 [litigation/wp-content/uploads/sites/16/non-us-case-documents/2018/20181225_074-WO-](http://climatecasechart.com/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2018/20181225_074-WO-0283_judgment-1.pdf)
11 [0283_judgment-1.pdf](http://climatecasechart.com/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2018/20181225_074-WO-0283_judgment-1.pdf).
- 12 The Supreme Court of the Netherlands, 2019: *The State of the Netherlands v. Stichting Urgenda*
13 *Foundation. Case 19/00135 (English translation).*
- 14 Thompson, R., 2017: Whither climate change post-Paris? *Anthr. Rev.*, **4**(1), 62–69,
15 doi:10.1177/2053019616676607.
- 16 Thorgeirsson, H., 2017: Objective (Article 2.1). In: *The Paris Agreement on Climate Change: Analysis*
17 *and commentary* [Klein, D., M. Pía Carazo, M. Doelle, J. Bulmer, and A. Higham, (eds.)], Oxford
18 University Press, pp. 123–130.
- 19 Thwaites, J., 2020: *The Good, the bad and the urgent in MDB Climate Finance 2019.*
20 <https://www.wri.org/insights/good-bad-and-urgent-mdb-climate-finance-2019> (Accessed
21 October 25, 2021).
- 22 Tienhaara, K., 2018: Regulatory Chill in a Warming World: The Threat to Climate Policy Posed by
23 Investor-State Dispute Settlement. *Transnatl. Environ. Law*, **7**(2), 229–250,
24 doi:10.1017/s2047102517000309.
- 25 Tienhaara, K., and L. Cotula, 2020: *Raising the Cost of Climate Action? Investor-State Dispute*
26 *Settlement and Compensation for Stranded Fossil Fuel Assets. IIED Land, Investment and Rights*
27 *series.* International Institute for Environment and Development, London, 49 pp.
28 <https://pubs.iied.org/pdfs/17660IIED.pdf>.
- 29 Tilmes, S., B. M. Sanderson, and B. C. O'Neill, 2016: Climate impacts of geoengineering in a delayed
30 mitigation scenario. *Geophys. Res. Lett.*, **43**(15), 8222–8229, doi:10.1002/2016gl070122.
- 31 Tilmes, S. et al., 2018: CESM1(WACCM) Stratospheric Aerosol Geoengineering Large Ensemble
32 Project. *Bull. Am. Meteorol. Soc.*, **99**(11), 2361–2371, doi:10.1175/bams-d-17-0267.1.
- 33 Tilmes, S. et al., 2020: Reaching 1.5 and 2.0 °C global surface temperature targets using stratospheric
34 aerosol geoengineering. *Earth Syst. Dyn.*, **11**(3), 579–601, doi:10.5194/esd-11-579-2020.
- 35 Tingley, D., and G. Wagner, 2017: Solar geoengineering and the chemtrails conspiracy on social media.
36 *Palgrave Commun.*, **3**(1), 1–7, doi:10.1057/s41599-017-0014-3.
- 37 Tormos-Aponte, F., and G. A. García-López, 2018: Polycentric struggles: The experience of the global
38 climate justice movement. *Environ. Policy Gov.*, **28**(4), 284–294, doi:10.1002/eet.1815.
- 39 Tørstad, V. H., 2020: Participation, ambition and compliance: can the Paris Agreement solve the
40 effectiveness trilemma? *Env. Polit.*, **29**(5), 761–780, doi:10.1080/09644016.2019.1710322.
- 41 Trachtman, J. P., 2017: WTO Law Constraints on Border Tax Adjustment and Tax Credit Mechanisms
42 to Reduce the Competitive Effects of Carbon Taxes. *Natl. Tax J.*, **70**(2), 469–493,
43 doi:10.17310/ntj.2017.2.09.
- 44 Tramel, S., 2016: The Road Through Paris: Climate Change, Carbon, and the Political Dynamics of
45 Convergence. *Globalizations*, **13**(6), 960–969, doi:10.1080/14747731.2016.1173376.
- 46 Traut, M. et al., 2018: CO2 abatement goals for international shipping. *Clim. Policy*, **18**(8), 1066–1075,
47 doi:10.1080/14693062.2018.1461059.

- 1 Trisos, C. H. et al., 2018: Potentially dangerous consequences for biodiversity of solar geoengineering
2 implementation and termination. *Nat. Ecol. Evol.*, **2**(3), 475–482, doi:10.1038/s41559-017-0431-
3 0.
- 4 Trouwborst, A., Trouwborst, and Arie, 2012: Transboundary Wildlife Conservation in A Changing
5 Climate: Adaptation of the Bonn Convention on Migratory Species and Its Daughter Instruments
6 to Climate Change. *Diversity*, **4**(3), 258–300, doi:10.3390/d4030258.
- 7 Tulkens, H., 2016: COP 21 and Economic Theory: Taking Stock. *Rev. Econ. Polit.*, **126**(4), 471–486,
8 doi:10.3917/redp.264.0471.
- 9 Tulkens, H., 2019: *Economics, Game Theory and International Environmental Agreements. The Ca’*
10 *Foscari Lectures*. World Scientific Publishing Co. Pte. Ltd., Singapore, 1–460 pp.
- 11 Turnhout, E. et al., 2017: Envisioning REDD+ in a post-Paris era: between evolving expectations and
12 current practice. *Wiley Interdiscip. Rev. Clim. Chang.*, **8**(1), e425, doi:10.1002/wcc.425.
- 13 TWI2050, 2018: *Transformations to achieve the Sustainable Development Goals. Report prepared by*
14 *the World in 2050 initiative*. International Institute for Applied Systems Analysis (IIASA),
15 Laxenburg, Austria, Austria, 154 pp.
- 16 Umemiya, C., M. Ikeda, and M. K. White, 2020: Lessons learned for future transparency capacity
17 building under the Paris Agreement: A review of greenhouse gas inventory capacity building
18 projects in Viet Nam and Cambodia. *J. Clean. Prod.*, **245**, 118881,
19 doi:10.1016/j.jclepro.2019.118881.
- 20 UN, 2016: *Montreal Protocol, Kigali Amendment*. , Kigali, 15 October 2016, 63 pp.
21 https://treaties.un.org/doc/Treaties/2016/10/20161015_03-23_PM/Ch_XXVII-2.f.pdf.
- 22 UN, 2017a: *UN System Strategic Approach on Climate Change Action. Report of the High Level*
23 *Committee on Programmes, Chief Executives Board for Coordination. CEB/2017/4/Add.1*. 15 pp.
24 https://unsceb.org/sites/default/files/2021-01/CEB_2017_4_Add1.pdf.
- 25 UN, 2017b: *Catalyzing the Implementation of Nationally Determined Contributions in the Context of*
26 *the 2030 Agenda through South-South Cooperation*. 68 pp.
27 https://unfccc.int/files/resource_materials/application/pdf/ssc_ndc_report.pdf.
- 28 UN, 2018: *South-South and Triangular Cooperation on Climate Technologies*. 76 pp.
29 http://www.iaii.int/admin/site/sites/default/files/2018_SouthSouth_and_Triangular_Climate_Tech.pdf.
- 30
- 31 UN, 2019: *Buenos Aires outcome document of the second High-level United Nations Conference on*
32 *South-South Cooperation (A/RES/73/291)*. 1–11 pp.
33 digitallibrary.un.org/record/3801900/files/A_RES_73_291-EN.pdf.
- 34 UN Human Rights Council, 2021: *Promotion and protection of all human rights, civil, political,*
35 *economic, social and cultural rights, including the right to development (5 October 2021)*. *UN*
36 *Doc. A/HRC/48/L.23/Rev.1*. 1–3 pp. <https://undocs.org/a/hrc/48/l.23/rev.1>.
- 37 UNCBD, 2010: *Decision X/2. The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity*
38 *Targets. UNEP/CBD/COP/DEC/X/2 (29 October 2010)*. , Nagoya, 1–13 pp.
39 <https://www.cbd.int/doc/decisions/cop-10/cop-10-dec-02-en.pdf>.
- 40 UNCCD, 2015: Land Degradation Neutrality: The Target Setting Programme. *Glob. Mech. UNCCD.*,
41 <https://www.unccd.int/actions/ldn-target-setting-programme> (Accessed December 19, 2020).
- 42 UNCTAD, 2012: *State of South-South and Triangular Cooperation in the Production, Use and Trade*
43 *of Sustainable Biofuels*. United Nations, New York and Geneva, 26 pp.
44 https://unctad.org/en/PublicationsLibrary/ditcted2011d10_en.pdf.
- 45 UNCTAD, 2019: *Taking Stock of IIA Reform: Recent Developments. IIA Issue Note. Issue 3. June 2019*.
46 UNCTAD, Geneva, 12 pp. [https://unctad.org/system/files/official-](https://unctad.org/system/files/official-document/diaepcbinf2019d5_en.pdf)
47 [document/diaepcbinf2019d5_en.pdf](https://unctad.org/system/files/official-document/diaepcbinf2019d5_en.pdf).

- 1 UNEP, 2013: *Global Mercury Assessment*. UNEP Chemicals Branch, Geneva, Switzerland, 32 pp.
2 <https://wedocs.unep.org/handle/20.500.11822/7984>.
- 3 UNEP, 2018a: *Emissions Gap Report 2018*. United Nations Environment Programme, Nairobi, 1–85
4 pp. <https://www.unenvironment.org/resources/emissions-gap-report-2018>.
- 5 UNEP, 2018b: *Report by the Secretariat on UN Environment Programme’s Private Sector Engagement*.
6 *142nd meeting of the Committee of Permanent Representatives to the United Nations Environment*
7 *Programme*. 14 pp.
- 8 UNEP, 2019: *Emissions Gap Report 2019*. United Nations Environment Programme, Nairobi, 1–81 pp.
9 <https://www.unep.org/resources/emissions-gap-report-2019>.
- 10 UNEP, 2020: *Emissions Gap Report 2020*. United Nations Environment Programme, Nairobi, 101 pp.
11 <https://www.unenvironment.org/emissions-gap-report-2020>.
- 12 UNFCCC, 1992: *United Nations Framework Convention on Climate Change*. 1–24 pp.
13 <https://unfccc.int/resource/docs/convkp/conveng.pdf> (Accessed December 10, 2020).
- 14 UNFCCC, 1997: *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. 20
15 pp. <https://unfccc.int/resource/docs/convkp/kpeng.pdf>.
- 16 UNFCCC, 2010a: *Decision 2/ CP. 15. Copenhagen Accord*. 1–9 pp.
17 <https://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf#page=4>.
- 18 UNFCCC, 2010b: Decision 1/CP.16 The Cancun Agreements: Outcome of the work of the Ad Hoc
19 Working Group on Long-term Cooperative Action under the Convention. *Report of the*
20 *Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10*
21 *December 2010*, 31.
- 22 UNFCCC, 2012: *Report of the Conference of the Parties on its seventeenth session, held in Durban*
23 *from 28 November to 11 December 2011. Addendum. Part Two: Action taken by the Conference*
24 *of the Parties at its seventeenth session*. UNFCCC, Durban, 86 pp.
25 <https://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf>.
- 26 UNFCCC, 2015a: *Paris Agreement*. 25 pp.
27 https://unfccc.int/sites/default/files/english_paris_agreement.pdf.
- 28 UNFCCC, 2015b: *Technology Mechanism: Enhancing climate technology development and transfer*.
29 United Nations Framework Convention on Climate Change, 8 pp.
- 30 UNFCCC, 2016a: *Decision 1/CP.21 Adoption of the Paris Agreement. Report of the Conference of the*
31 *Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015.*
32 *FCCC/CP/2015/10/Add.1*. 36 pp.
33 <https://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf#page=2>.
- 34 UNFCCC, 2016b: *Aggregate effect of the intended nationally determined contributions: an update.*
35 *Synthesis report by the secretariat. FCCC/CP/2016/2*. 75 pp.
36 <https://unfccc.int/resource/docs/2016/cop22/eng/02.pdf>.
- 37 UNFCCC, 2018: *UNFCCC Standing Committee on Finance: 2018 Biennial Assessment and Overview*
38 *of Climate Finance Flows. Technical Report*. 170 pp.
39 [https://unfccc.int/sites/default/files/resource/2018 BA Technical Report Final.pdf](https://unfccc.int/sites/default/files/resource/2018%20BA%20Technical%20Report%20Final.pdf).
- 40 UNFCCC, 2019a: *Decision 1/CP.25. Report of the Conference of the Parties on its twenty-fifth session,*
41 *Addendum, Part two*. 1–59 pp. https://unfccc.int/sites/default/files/resource/cp2019_13a01E.pdf.
- 42 UNFCCC, 2019b: Dec. 4/CMA.1 Further guidance in relation to the mitigation section of decision
43 1/CP.21. *Report of the Conference of the Parties serving as the meeting of the Parties to the Paris*
44 *Agreement on the third part of its first session, held in Katowice from 2 to 15 December 2018.*
45 *Addendum 1. Part two: Action taken by the Conference of the Parties s*, 4–13
46 https://unfccc.int/sites/default/files/resource/cma2018_03a01E.pdf.
- 47 UNFCCC, 2019c: Decision 4/CP.24 Report of the Standing Committee on Finance.

- 1 FCCC/CP/2018/10/Add.1. *Report of the Conference of the Parties on its twenty-fourth session,*
2 *held in Katowice from 2 to 15 December 2018. Addendum. Part two: Action taken by the*
3 *Conference of the Parties at its twenty-fourth session,* UNFCCC 2019, 14–28
4 <https://unfccc.int/sites/default/files/resource/10a1.pdf>.
- 5 UNFCCC, 2019d: Decision 18/CMA.1 Modalities, procedures and guidelines for the transparency
6 framework for action and support referred to in Article 13 of the Paris Agreement. *Report of the*
7 *Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on the third*
8 *part of its first session, held in Katowice from 2 to 15 December 2018,* 18–52
9 https://unfccc.int/sites/default/files/resource/cma2018_3_add2_new_advance.pdf.
- 10 UNFCCC, 2019e: Dec. 19/CMA.1 Matters relating to Article 14 of the Paris Agreement and paragraphs
11 99–101 of decision 1/CP.21. *Report of the Conference of the Parties serving as the meeting of the*
12 *Parties to the Paris Agreement on the third part of its first session, held in Katowice from 2 to 15*
13 *December 2018,* 53–58
14 https://unfccc.int/sites/default/files/resource/cma2018_3_add2_new_advance.pdf.
- 15 UNFCCC, 2019f: Decision 15/CMA.1 Technology framework under Article 10, paragraph 4, of the
16 Paris Agreement. FCCC/PA/CMA/2018/3 Add.2. *Report of the Conference of the Parties serving*
17 *as the meeting of the Parties to the Paris Agreement on the third part of its first session, held in*
18 *Katowice from 2 to 15 December 2018 Addendum Part two: Action taken by the Conference of*
19 *the Parties servi,* 4–10
20 https://unfccc.int/sites/default/files/resource/cma2018_3_add2_new_advance.pdf.
- 21 UNFCCC, 2019g: Dec. 14/CMA.1 Setting a new collective quantified goal on finance in accordance
22 with decision 1/CP.21, paragraph 53. *Report of the Conference of the Parties serving as the*
23 *meeting of the Parties to the Paris Agreement on the third part of its first session, held in Katowice*
24 *from 2 to 15 December 2018,* 3
25 https://unfccc.int/sites/default/files/resource/cma2018_3_add2_new_advance.pdf.
- 26 UNFCCC, 2019h: *Implementation of the framework for capacity-building in developing countries.*
27 *Synthesis report by the secretariat.* 22 pp. <https://unfccc.int/sites/default/files/resource/03.pdf>.
- 28 UNFCCC, 2019i: Decision 17/CMA.1 Ways of enhancing the implementation of education, training,
29 public awareness, public participation and public access to information so as to enhance actions
30 under the Paris Agreement. *Report of the Conference of the Parties serving as the meeting of the*
31 *Parties to the Paris Agreement on the third part of its first session, held in Katowice from 2 to 15*
32 *December 2018,* 15–17
33 https://unfccc.int/sites/default/files/resource/cma2018_3_add2_new_advance.pdf.
- 34 UNFCCC, 2019j: Decision 20/CMA.1. Modalities and procedures for the effective operation of the
35 committee to facilitate implementation and promote compliance referred to in Article 15,
36 paragraph 2, of the Paris Agreement. *Report of the Conference of the Parties serving as the*
37 *meeting of the Parties to the Paris Agreement on the third part of its first session, held in Katowice*
38 *from 2 to 15 December 2018 Addendum Part two: Action taken by the Conference of the Parties*
39 *servi,* 59–64 https://unfccc.int/sites/default/files/resource/cma2018_3_add2_new_advance.pdf.
- 40 UNFCCC, 2019k: *Common tabular formats for the electronic reporting of the information on financial,*
41 *technology development and transfer and capacity-building support provided and mobilized, as*
42 *well as support needed and received, under Articles 9–11 of the Paris Agreeeme.* 19 pp.
43 https://unfccc.int/sites/default/files/resource/SBSTA51.IN_i11c.pdf.
- 44 UNFCCC, 2019l: Decision 14/CP.24 Linkages between the Technology Mechanism and the Financial
45 Mechanism of the Convention. FCCC/CP/2018/10/Add.2. *Report of the Conference of the Parties*
46 *on its twenty-fourth session, held in Katowice from 2 to 15 December 2018. Addendum. Part two:*
47 *Action taken by the Conference of the Parties at its twenty-fourth session,* pg 5
48 https://unfccc.int/sites/default/files/resource/cp2018_10_add2_advance.pdf.
- 49 UNFCCC, 2020a: Bilateral and Multilateral Funding. *UNFCCC Top. Clim. Financ. Resour.,*
50 <https://unfccc.int/topics/climate-finance/resources/multilateral-and-bilateral-funding-sources>

- 1 (Accessed December 8, 2020).
- 2 UNFCCC, 2020b: Technology Executive Committee: Strengthening climate technology policies. *TT*
3 *Clear*,. <https://unfccc.int/ttclear/tec> (Accessed June 4, 2020).
- 4 UNFCCC, 2020c: Developing the Santiago Network for Loss and Damage. *Event*,.
5 <https://unfccc.int/event/developing-the-santiago-network-for-loss-and-damage> (Accessed
6 October 30, 2021).
- 7 UNFCCC, 2020d: Subsidiary Body for Implementation, Compilation and synthesis of fourth biennial
8 reports of Parties included in Annex I to the Convention.
9 https://unfccc.int/sites/default/files/resource/sbi2020_inf10.pdf (Accessed 2 November 2021).
- 10 UNFCCC, 2021a: *Nationally determined contributions under the Paris Agreement - Synthesis report*
11 *by the secretariat (FCCC/PA/CMA/2021/8)*. 1–42 pp.
12 https://unfccc.int/sites/default/files/resource/cma2021_08_adv_1.pdf.
- 13 UNFCCC, 2021b: Building capacity in the UNFCCC process. *Big Pict*,.
14 <https://unfccc.int/topics/capacity-building/the-big-picture/capacity-in-the-unfccc-process>
15 (Accessed October 30, 2021).
- 16 UNFCCC, 2021c: CDM Insights. <https://cdm.unfccc.int/Statistics/Public/CDMinsights/index.html>
17 (Accessed 2 November 2021).
- 18 UNFCCC, and UNOSSC, 2018: *Potential of South South Cooperation and Triangular Cooperation on*
19 *climate technologies for advancing the implementation of nationally determined contributions and*
20 *national adaptation plans*. 34 pp.
- 21 UNFCCC Subsidiary Body for Implementation, 2020: *Annual technical progress report of the Paris*
22 *Committee on Capacity-building*. FCCC/SBI/2020/13. 34 pp.
- 23 UNGA, 1948: *The Universal Declaration of Human Rights*. A/RES/217.
- 24 UNGA, 1966a: *International Covenant on Civil and Political Rights*. *General Assembly Resolution*
25 *2200A (XXI) of 16 December 1966*.
- 26 UNGA, 1966b: *International Covenant on Economic, Social and Cultural Rights*. *General Assembly*
27 *Resolution 2200A (XXI) of 16 December 1966*.
- 28 UNGA, 2019: *Report of the Special Rapporteur on the issue of human rights obligations relating to the*
29 *enjoyment of a safe, clean, healthy and sustainable environment (15 July 2019)*. *UN Doc.*
30 *A/76/161*. 1–25 pp.
- 31 UNOSC, 2017: *United Nations Action Plan on South-South Climate Cooperation (2017-2021)*.
32 [https://www.unsouthsouth.org/south-south-cooperation-action-plan-for-climate-change-](https://www.unsouthsouth.org/south-south-cooperation-action-plan-for-climate-change-engagement-strategy-2017-2021/)
33 [engagement-strategy-2017-2021/](https://www.unsouthsouth.org/south-south-cooperation-action-plan-for-climate-change-engagement-strategy-2017-2021/) (Accessed October 30, 2021).
- 34 Urban, F., 2018: China's rise: Challenging the North-South technology transfer paradigm for climate
35 change mitigation and low carbon energy. *Energy Policy*, **113**, 320–330,
36 doi:10.1016/j.enpol.2017.11.007.
- 37 Urpelainen, J., 2011: Can Unilateral Leadership Promote International Environmental Cooperation? *Int.*
38 *Interact.*, **37**(3), 320–339, doi:10.1080/03050629.2011.596018.
- 39 Urpelainen, J., and T. Van de Graaf, 2015: The International Renewable Energy Agency: a success
40 story in institutional innovation? *Int. Environ. Agreements Polit. Law Econ.*, **15**(2), 159–177,
41 doi:10.1007/s10784-013-9226-1.
- 42 Urpelainen, J., and T. Van de Graaf, 2018: United States non-cooperation and the Paris agreement.
43 *Clim. Policy*, **18**(7), 839–851, doi:10.1080/14693062.2017.1406843.
- 44 van Asselt, H., 2007: From UN-ity to Diversity? The UNFCCC, the Asia-Pacific Partnership and the
45 Future of International Law on Climate Change. *Carbon Clim. Law Rev.*, **1**(1), 12,
46 doi:10.21552/cclr/2007/1/9.

- 1 van Asselt, H., 2016: The Role of Non-State Actors in Reviewing Ambition, Implementation, and
2 Compliance under the Paris Agreement. *Clim. Law*, **6**(1–2), 91–108, doi:10.1163/18786561-
3 00601006.
- 4 van Asselt, H., 2017: *Climate Change and Trade Policy Interaction: Implications of Regionalism*.
5 *OECD Trade and Environment Working Papers. 2017/03*. OECD Publishing, 54 pp.
- 6 van Asselt, H., and F. Zelli, 2014: Connect the dots: managing the fragmentation of global climate
7 governance. *Environ. Econ. Policy Stud.*, **16**(2), 137–155, doi:10.1007/s10018-013-0060-z.
- 8 van de Graaf, T., 2013: Fragmentation in Global Energy Governance: Explaining the Creation of
9 IRENA. *Glob. Environ. Polit.*, **13**(3), 14–33, doi:10.1162/glep_a_00181.
- 10 van de Graaf, T., and D. Lesage, 2009: The International Energy Agency after 35 years: Reform needs
11 and institutional adaptability. *Rev. Int. Organ.*, **4**(3), 293–317, doi:10.1007/s11558-009-9063-8.
- 12 van de Graaf, T., and J. Colgan, 2016: Global energy governance: a review and research agenda.
13 *Palgrave Commun.*, **2**, 15047, doi:10.1057/palcomms.2015.47.
- 14 van der Voorn, T., C. Pahl-Wostl, and J. Quist, 2012: Combining backcasting and adaptive management
15 for climate adaptation in coastal regions: A methodology and a South African case study. *Futures*,
16 **44**(4), 346–364, doi:10.1016/j.futures.2011.11.003.
- 17 van der Voorn, T., J. Quist, C. Pahl-Wostl, and M. Haasnoot, 2017: Envisioning robust climate change
18 adaptation futures for coastal regions: a comparative evaluation of cases in three continents. *Mitig.*
19 *Adapt. Strateg. Glob. Chang.*, **22**(3), 519–546, doi:10.1007/s11027-015-9686-4.
- 20 van der Voorn, T., Å. Svenfelt, K. E. Björnberg, E. Fauré, and R. Milestad, 2020: Envisioning carbon-
21 free land use futures for Sweden: a scenario study on conflicts and synergies between
22 environmental policy goals. *Reg. Environ. Chang.*, **20**(2), 35, doi:10.1007/s10113-020-01618-5.
- 23 van Soest, H. L., M. G. J. den Elzen, and D. P. van Vuuren, 2021: Net-zero emission targets for major
24 emitting countries consistent with the Paris Agreement. *Nat. Commun.*, **12**(1), 2140,
25 doi:10.1038/s41467-021-22294-x.
- 26 van Tulder, R., S. B. Rodrigues, H. Mirza, and K. Sexsmith, 2021: The UN’s Sustainable Development
27 Goals: Can multinational enterprises lead the Decade of Action? *J. Int. Bus. Policy*, **4**(1), 1–21,
28 doi:10.1057/s42214-020-00095-1.
- 29 Vandyck, T. et al., 2018: Air quality co-benefits for human health and agriculture counterbalance costs
30 to meet Paris Agreement pledges. *Nat. Commun.*, **9**(1), 4939, doi:10.1038/s41467-018-06885-9.
- 31 Vanhala, L., and C. Hestbaek, 2016: Framing Climate Change Loss and Damage in UNFCCC
32 Negotiations. *Glob. Environ. Polit.*, **16**(4), 111, doi:10.1162/glep_a_00379.
- 33 Velders, G. J. M., S. O. Andersen, J. S. Daniel, D. W. Fahey, and M. McFarland, 2007: The importance
34 of the Montreal Protocol in protecting climate. *Proc. Natl. Acad. Sci. U. S. A.*, **104**(12), 4814–
35 4819, doi:10.1073/pnas.0610328104.
- 36 Velders, G. J. M., D. W. Fahey, J. S. Daniel, S. O. Andersen, and M. McFarland, 2015: Future
37 atmospheric abundances and climate forcings from scenarios of global and regional
38 hydrofluorocarbon (HFC) emissions. *Atmos. Environ.*, **123**, 200–209,
39 doi:10.1016/j.atmosenv.2015.10.071.
- 40 Verkuijl, C., H. van Asselt, T. Moerenhout, L. Casier, and P. Wooders, 2019: Tackling Fossil Fuel
41 Subsidies Through International Trade Agreements: Taking Stock, Looking Forward. *VA. J. Int.*
42 *Law*, **58**(2), 309–368.
- 43 Victor, D. G., 2011: *Global Warming Gridlock: Creating More Effective Strategies for Protecting the*
44 *Planet*. Cambridge University Press, Cambridge, UK, 392 pp.
- 45 Victor, D. G., 2016: What the Framework Convention on Climate Change Teaches Us About
46 Cooperation on Climate Change. *Polit. Gov.*, **4**(3), 133, doi:10.17645/pag.v4i3.657.

- 1 Victor, D. G., K. Raustiala, and E. B. Skolnikoff, 1998: *The Implementation and Effectiveness of*
2 *International Environmental Commitments: Theory and Practice*. [Victor, D.G., K. Raustiala, and
3 E.B. Skolnikoff, (eds.)]. MIT Press, Cambridge, MA, 1–737 pp.
- 4 Vihma, A., Y. Mulugetta, and S. Karlsson-Vinkhuyzen, 2011: Negotiating solidarity? The G77 through
5 the prism of climate change negotiations. *Glob. Chang. Peace Secur.*, **23**(3), 315–334,
6 doi:10.1080/14781158.2011.601853.
- 7 Visioni, D., G. Pitari, and V. Aquila, 2017: Sulfate geoengineering: a review of the factors controlling
8 the needed injection of sulfur dioxide. *Atmos. Chem. Phys.*, **17**(6), 3879–3889, doi:10.5194/acp-
9 17-3879-2017.
- 10 Visioni, D. et al., 2020: What goes up must come down: impacts of deposition in a sulfate
11 geoengineering scenario. *Environ. Res. Lett.*, **15**(9), 94063, doi:10.1088/1748-9326/ab94eb.
- 12 Visschers, V. H. M., J. Shi, M. Siegrist, and J. Arvai, 2017: Beliefs and values explain international
13 differences in perception of solar radiation management: insights from a cross-country survey.
14 *Clim. Change*, **142**(3), 531–544, doi:10.1007/s10584-017-1970-8.
- 15 Voigt, C., 2016: The compliance and implementation mechanism of the Paris agreement. *Rev. Eur.*
16 *Comp. Int. Environ. Law*, **25**(2), doi:10.1111/reel.12155.
- 17 Voigt, C., and F. Ferreira, 2015: The Warsaw Framework for REDD+: Implications for National
18 Implementation and Access to Results-Based Finance. *Carbon Clim. Law Rev.*, **2**, 113.
- 19 Voigt, C., and F. Ferreira, 2016a: ‘Dynamic Differentiation’: The Principles of CBDR-RC, Progression
20 and Highest Possible Ambition in the Paris Agreement. *Transnatl. Environ. Law*, **5**(2), 285–303,
21 doi:10.1017/s2047102516000212.
- 22 Voigt, C., and F. Ferreira, 2016b: Differentiation in the Paris Agreement. *Clim. Law*, **6**(1–2), 58–74,
23 doi:10.1163/18786561-00601004.
- 24 Waage, J. et al., 2015: Governing Sustainable Development Goals: interactions, infrastructures, and
25 institutions. In: *Thinking Beyond Sectors for Sustainable Development*, Ubiquity Press, pp. 79–
26 88.
- 27 Wagner, C. S., T. A. Whetsell, and L. Leydesdorff, 2017: Growth of international collaboration in
28 science: revisiting six specialties. *Scientometrics*, **110**(3), 1633–1652, doi:10.1007/s11192-016-
29 2230-9.
- 30 Watkiss, P., M. Benzie, and R. J. T. Klein, 2015: The complementarity and comparability of climate
31 change adaptation and mitigation. *Wiley Interdiscip. Rev. Clim. Chang.*, **6**(6), 541–557,
32 doi:10.1002/wcc.368.
- 33 Watts, J., and J. Depledge, 2018: Latin America in the climate change negotiations: Exploring the
34 AILAC and ALBA coalitions. *Wiley Interdiscip. Rev. Clim. Chang.*, **9**(6), e533,
35 doi:10.1002/wcc.533.
- 36 WBCSD, 2019: About us. <https://www.wbcd.org/Overview/About-us> (Accessed December 12, 2019).
- 37 Weart, S. R., 2012: The evolution of international cooperation in climate science. *J. Int. Organ. Stud.*,
38 **3**(1), 41–59.
- 39 Weikmans, R., and J. T. Roberts, 2019: The international climate finance accounting muddle: is there
40 hope on the horizon? *Clim. Dev.*, **11**(2), 97–111, doi:10.1080/17565529.2017.1410087.
- 41 Weikmans, R., H. van Asselt, and J. T. Roberts, 2020: Transparency requirements under the Paris
42 Agreement and their (un)likely impact on strengthening the ambition of nationally determined
43 contributions (NDCs). *Clim. Policy*, **20**(4), 511–526, doi:10.1080/14693062.2019.1695571.
- 44 Weischer, L., J. Morgan, and M. Patel, 2012: Climate Clubs: Can Small Groups of Countries make a
45 Big Difference in Addressing Climate Change? *Rev. Eur. Community Int. Environ. Law*, **21**(3),
46 177–192, doi:10.1111/reel.12007.

- 1 Weiss, E. B., and H. K. Jacobson, 1998: *Engaging Countries: Strengthening Compliance with*
2 *International Environmental Accords*. [Weiss, E.B. and H.K. Jacobson, (eds.)]. MIT Press,
3 Cambridge, MA, 640 pp.
- 4 Weitz, N., H. Carlsen, M. Nilsson, and K. Skånberg, 2018: Towards systemic and contextual priority
5 setting for implementing the 2030 Agenda. *Sustain. Sci.*, **13**(2), 531–548, doi:10.1007/s11625-
6 017-0470-0.
- 7 Weitzman, M. L., 2015: A Voting Architecture for the Governance of Free-Driver Externalities, with
8 Application to Geoengineering. *Scand. J. Econ.*, **117**(4), 1049–1068, doi:10.1111/sjoe.12120.
- 9 Werksman, J., 2010: Legal symmetry and legal differentiation under a future deal on climate. *Clim.*
10 *Policy*, **10**(6), 672–677, doi:10.3763/cpol.2010.0150.
- 11 Wettestad, J., and L. H. Gulbrandsen, 2018: *The Evolution of Carbon Markets: Design and Diffusion*.
12 Routledge, London and New York, 1–264 pp.
- 13 Wettestad, J., L. H. Gulbrandsen, and S. Andresen, 2021: Calling in the heavyweights: Why the World
14 Bank established the Carbon Pricing Leadership Coalition, and what it might achieve. *Int. Stud.*
15 *Perspect.*, **22**(2), 201–217, doi:10.1093/isp/ekaa013.
- 16 Wewerinke-Singh, M., 2018: *State Responsibility, Climate Change and Human Rights Under*
17 *International Law*. Hart Publishing, Oxford, 216 pp.
- 18 Wewerinke-Singh, M., and D. H. Salili, 2020: Between negotiations and litigation: Vanuatu’s
19 perspective on loss and damage from climate change. *Clim. Policy*, **20**(6), 681–692,
20 doi:10.1080/14693062.2019.1623166.
- 21 Whitehouse, 2014: US-China Joint Announcements on Climate Change. *Whitehouse Press Briefings*,
22 [https://obamawhitehouse.archives.gov/the-press-office/2014/11/11/us-china-joint-](https://obamawhitehouse.archives.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change)
23 [announcement-climate-change](https://obamawhitehouse.archives.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change) (Accessed January 11, 2021).
- 24 Whyte, K. P., 2018: Indigeneity in Geoengineering Discourses: Some Considerations. *Ethics, Policy*
25 *Environ.*, **21**(3), 289–307, doi:10.1080/21550085.2018.1562529.
- 26 Wieding, J., J. Stubenrauch, and F. Ekardt, 2020: Human Rights and Precautionary Principle: Limits to
27 Geoengineering, SRM, and IPCC Scenarios. *Sustainability*, **12**(21), 8858,
28 doi:10.3390/su12218858.
- 29 Wijaya, A., T. N. Samadhi, and R. Juliane, 2019: Indonesia Is Reducing Deforestation, but Problem
30 Areas Remain. *World Resour. Inst. - Insights*, [https://www.wri.org/insights/indonesia-reducing-](https://www.wri.org/insights/indonesia-reducing-deforestation-problem-areas-remain)
31 [deforestation-problem-areas-remain](https://www.wri.org/insights/indonesia-reducing-deforestation-problem-areas-remain) (Accessed August 26, 2021).
- 32 Wilder, M. et al., 2010: Adapting Across Boundaries: Climate Change, Social Learning, and Resilience
33 in the U.S.–Mexico Border Region. *Ann. Assoc. Am. Geogr.*, **100**(4), 917–928,
34 doi:10.1080/00045608.2010.500235.
- 35 Winickoff, D. E., J. A. Flegal, and A. Asrat, 2015: Engaging the Global South on climate engineering
36 research. *Nat. Clim. Chang.*, **5**(7), 627–634, doi:10.1038/nclimate2632.
- 37 Winkler, H., 2020: Putting equity into practice in the global stocktake under the Paris Agreement. *Clim.*
38 *Policy*, **1**, 124–132, doi:10.1080/14693062.2019.1680337.
- 39 Winkler, H., and N. K. Dubash, 2016: Who determines transformational change in development and
40 climate finance? *Clim. Policy*, **16**(6), 783–791, doi:10.1080/14693062.2015.1033674.
- 41 Winkler, H., B. Mantlana, and T. Letete, 2017: Transparency of action and support in the Paris
42 Agreement. *Clim. Policy*, **17**(7), 853–872, doi:10.1080/14693062.2017.1302918.
- 43 Winkler, H. et al., 2018: Countries start to explain how their climate contributions are fair: More rigour
44 needed. *Int. Environ. Agreements Polit. Law Econ.*, **18**, 99–115, doi:10.1007/s10784-017-9381-x.
- 45 Winterbottom, R., 1990: *Taking Stock - The Tropical Forestry Action Plan After Five Years*. World
46 Resources Institute, New York and Washington DC, 1–59 pp.

- 1 WMO, 2018: *Scientific Assessment of Ozone Depletion: 2018*. , Geneva, Switzerland, 588 pp.
2 <http://www.wmo.int/pages/prog/arep/gaw/ozone/>.
- 3 Wolf, S., C. Jaeger, J. Mielke, F. Schuetze, and R. Rosen, 2019: Framing 1.5°C - Turning an Investment
4 Challenge into a Green Growth Opportunity. *SSRN Electron. J.*, , 1–16,
5 doi:10.2139/ssrn.3324509.
- 6 Wollenberg, E. et al., 2016: Reducing emissions from agriculture to meet the 2 °C target. *Glob. Chang.*
7 *Biol.*, **22**(12), 3859–3864, doi:10.1111/gcb.13340.
- 8 World Bank, 2010: *Cities and Climate Change: An Urgent Agenda. Urban development series.*
9 *Knowledge Papers no. 10.* World Bank, Washington DC, 81 pp.
10 <https://openknowledge.worldbank.org/handle/10986/17381> (Accessed October 31, 2021).
- 11 World Bank, 2015a: *Joint Statement by the Multilateral Development Banks at Paris, COP21*
12 *Delivering Climate Change Action at Scale: Our Commitment to Implementation.* 1–3 pp.
13 [https://www.worldbank.org/content/dam/Worldbank/document/Climate/Joint MDB Statement](https://www.worldbank.org/content/dam/Worldbank/document/Climate/Joint MDB Statement Climate_NOV 28_final.pdf)
14 [Climate_NOV 28_final.pdf](https://www.worldbank.org/content/dam/Worldbank/document/Climate/Joint MDB Statement Climate_NOV 28_final.pdf) (Accessed December 8, 2020).
- 15 World Bank, 2015b: *From Billions to Trillions: Transforming Development Finance Post-2015*
16 *Financing for Development: Multilateral Development Finance. Development Committee*
17 *Discussion Note.* 23 pp. [http://pubdocs.worldbank.org/en/622841485963735448/DC2015-0002-](http://pubdocs.worldbank.org/en/622841485963735448/DC2015-0002-E-FinancingforDevelopment.pdf)
18 [E-FinancingforDevelopment.pdf](http://pubdocs.worldbank.org/en/622841485963735448/DC2015-0002-E-FinancingforDevelopment.pdf) (Accessed December 9, 2020).
- 19 World Bank, 2018: *Carbon Markets for Greenhouse Gas Emission Reduction in a Warming World.*
20 World Bank, Washington DC, 191 pp.
- 21 World Bank, 2019: *State and Trends of Carbon Pricing.* World Bank Group, Washington DC, 94 pp.
22 [http://documents.worldbank.org/curated/en/191801559846379845/State-and-Trends-of-Carbon-](http://documents.worldbank.org/curated/en/191801559846379845/State-and-Trends-of-Carbon-Pricing-2019)
23 [Pricing-2019.](http://documents.worldbank.org/curated/en/191801559846379845/State-and-Trends-of-Carbon-Pricing-2019)
- 24 World Bank, 2021: World Bank Country and Lending Groups. *Data Blog.*,
25 [https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-](https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups)
26 [lending-groups](https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups) (Accessed October 31, 2021).
- 27 Wu, M., and J. Salzman, 2014: The Next Generation of Trade and Environment Conflicts: The Rise of
28 Green Industrial Policy. *Northwest. Univ. Law Rev.*, **108**(2), 401–474.
- 29 Wurzel, R. K. W., D. Liefferink, and D. Torney, 2019: Pioneers, leaders and followers in multilevel
30 and polycentric climate governance. *Env. Polit.*, **28**(1), 1–21,
31 doi:10.1080/09644016.2019.1522033.
- 32 Xia, L. et al., 2014: Solar radiation management impacts on agriculture in China: A case study in the
33 Geoengineering Model Intercomparison Project (GeoMIP). *J. Geophys. Res. Atmos.*, **119**(14),
34 8695–8711, doi:10.1002/2013jd020630.
- 35 Xia, L., J. P. Nowack, S. Tilmes, and A. Robock, 2017: Impacts of stratospheric sulfate geoengineering
36 on tropospheric ozone. *Atmos. Chem. Phys.*, **17**(19), 11913–11928, doi:10.5194/acp-17-11913-
37 2017.
- 38 Xu, Y., Z. Dong, and Y. Wang, 2016: Establishing a measurement, reporting, and verification system
39 for climate finance in post-Paris agreement period. *Chinese J. Popul. Resour. Environ.*, **14**(4),
40 235–244, doi:10.1080/10042857.2016.1258802.
- 41 Xuemei, B., 2007: Integrating Global Environmental Concerns into Urban Management: The Scale and
42 Readiness Arguments. *J. Ind. Ecol.*, **11**(2), 15–29, doi:10.1162/jie.2007.1202.
- 43 Yamaguchi, S., 2020: *Greening Regional Trade Agreements: Subsidies Related to Energy and*
44 *Environmental Goods.* OECD Publishing, Paris, 1–81 pp.
- 45 Yamineva, Y., 2016: Climate Finance in the Paris Outcome: Why Do Today What You Can Put Off
46 Till Tomorrow? *Rev. Eur. Comp. Int. Environ. Law*, **25**(2), 174–185, doi:10.1111/reel.12160.
- 47 Yamineva, Y., and K. Kulovesi, 2018: Keeping the Arctic White: The Legal and Governance Landscape

- 1 for Reducing Short-Lived Climate Pollutants in the Arctic Region. *Transnatl. Environ. Law*, **7**(2),
2 201–227, doi:10.1017/s2047102517000401.
- 3 Yang, H. et al., 2016: Potential negative consequences of geoengineering on crop production: A study
4 of Indian groundnut. *Geophys. Res. Lett.*, **43**(22), 11786–11795, doi:10.1002/2016gl071209.
- 5 Young, O. R., 2016: The Paris Agreement: Destined to Succeed or Doomed to Fail? *Polit. Gov.*, **4**(3),
6 124–132, doi:10.17645/pag.v4i3.635.
- 7 Young, P. J. et al., 2021: The Montreal Protocol protects the terrestrial carbon sink. *Nature*, **596**(7872),
8 384–388, doi:10.1038/s41586-021-03737-3.
- 9 Zahar, A., 2019: Collective Progress in the Light of Equity Under the Global Stocktake. *Clim. Law*,
10 **9**(1–2), 101–121, doi:10.1163/18786561-00901006.
- 11 Zarin, D. J. et al., 2016: Can carbon emissions from tropical deforestation drop by 50% in 5 years?
12 *Glob. Chang. Biol.*, **22**(4), 1336–1347, doi:10.1111/gcb.13153.
- 13 Zarnetske, P. L. et al., 2021: Potential ecological impacts of climate intervention by reflecting sunlight
14 to cool Earth. *Proc. Natl. Acad. Sci.*, **118**(15), 1921854118, doi:10.1073/pnas.1921854118.
- 15 Zhan, P., W. Zhu, T. Zhang, X. Cui, and N. Li, 2019: Impacts of Sulfate Geoengineering on Rice Yield
16 in China: Results From a Multimodel Ensemble. *Earth's Futur.*, **7**(4), 395–410,
17 doi:10.1029/2018ef001094.
- 18 Zhang, H., 2016: Towards global green shipping: the development of international regulations on
19 reduction of GHG emissions from ships. *Int. Environ. Agreements Polit. Law Econ.*, **16**(4), 561–
20 577, doi:10.1007/s10784-014-9270-5.
- 21 Zhang, H., 2019: Implementing Provisions on Climate Finance Under the Paris Agreement. *Clim. Law*,
22 **9**(1–2), 21–39, doi:10.1163/18786561-00901003.
- 23 Zhang, J., K. Zhang, J. Liu, and G. Ban-Weiss, 2016: Revisiting the climate impacts of cool roofs
24 around the globe using an Earth system model. *Environ. Res. Lett.*, **11**(8), 84014,
25 doi:10.1088/1748-9326/11/8/084014.
- 26 Zhang, W., and X. Pan, 2016: Study on the demand of climate finance for developing countries based
27 on submitted INDC. *Adv. Clim. Chang. Res.*, **7**(1–2), 99–104, doi:10.1016/j.accre.2016.05.002.
- 28 Zia, A., and S. Kauffman, 2018: The Limits of Predictability in Predefining Phase Spaces of Dynamic
29 Social–Ecological Systems: “Command and Control” Versus “Complex Systems”-Based Policy
30 Design Approaches to Conserve Tropical Forests. *J. Policy Complex Syst.*, **4**(2),
31 doi:10.18278/jpcs.4.2.9.
- 32 Zihua, G., C. Voigt, and J. Werksman, 2019: Facilitating Implementation and Promoting Compliance
33 With the Paris Agreement Under Article 15: Conceptual Challenges and Pragmatic Choices. *Clim.*
34 *Law*, **9**(1–2), 65–100, doi:10.1163/18786561-00901005.
- 35 Zimm, C., and N. Nakicenovic, 2020: What are the implications of the Paris Agreement for inequality?
36 *Clim. Policy*, **20**(4), 458–467, doi:10.1080/14693062.2019.1581048.
- 37 Zürn, M., and S. Schäfer, 2013: The Paradox of Climate Engineering. *Glob. Policy*, **4**(3), 266–277,
38 doi:10.1111/gpol.12004.
- 39 IRENA, 2021: International Renewable Energy Agency Avoided Emissions Calculator.
40 <https://www.irena.org/climatechange/Avoided-Emissions-Calculator> (Accessed 3 November
41 2021)
- 42 UNFCCC, 2020d: Subsidiary Body for Implementation, Compilation and synthesis of fourth biennial
43 reports of Parties included in Annex I to the Convention.
44 https://unfccc.int/sites/default/files/resource/sbi2020_inf10.pdf (Accessed 2 November 2021).
- 45