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1. Changes with respect to the DoA

N/A.

2. Dissemination and uptake

Internally to the project, the deliverable provides useful background for the work under Work Packages (WPs) 2 and 3. Outside the project, the deliverable is appropriate for use by the broad community of experts and policymakers interested in the international governance of climate change. It provides a basis for identifying the challenges, barriers and opportunities that international climate governance faces from a sectoral system perspective, and thereby enables a more targeted approach to addressing the international decarbonisation challenge.

3. Short Summary of results (<250 words)

Much mitigation-related governance activity is evident in a range of sectoral systems, and regarding particular governance functions. However, there is a tendency for this activity to relate to the easiest functions to address, such as 'learning and knowledge building', or to take place in somewhat limited 'niches'. Across all sectoral systems examined, the gap between identified governance needs and what is currently supplied is most serious in terms of the critical function of setting rules to facilitate collective action. A lack of 'guidance and signal' is also evident, particularly in the finance, extractive industries, energy-intensive industries, and buildings sectoral systems.

Of the sectoral systems examined, the power sector appears the most advanced in covering the main international governance functions required of it. Nevertheless, it still falls short in achieving critical governance functions necessary for sufficient decarbonisation. Significantly, while the signal is strong and clear for the phase-*in* of renewable energy, it is either vague or absent when it comes to the phase-*out* of fossil fuel-generated electricity. The same lack of signal that certain high-carbon activities need actively to be phased out is also evident in financial, fossil-fuel extractive industry and transport-related sectors.

More effective mitigation action will need greater co-ordination or orchestration effort, sometimes led by the UNFCCC, but also from the bodies such as the G20, as well as existing (or potentially new) sector-level institutions. The EU needs to re-consider what it means to provide climate leadership in an increasingly 'polycentric' governance landscape.

4. Evidence of accomplishment

Several chapters are due to be presented at the forthcoming Earth System Governance (ESG) conference, Utrecht (5th - 8th November 2018), where the authors successfully proposed a dedicated panel session on *Assessing the Adequacy of the Global Climate Governance Complex après Paris*. Otherwise, the results of the work are evident from the report enclosed.

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Accronyms and Abbreviations

APEC	Asia Pacific Economic Cooperation
ATAG	Air Transport Action Group
BECCS	Bio-Energy Carbon Capture and Storage
CAPEX	Capital Expenditure
CBDR	Common but Differentiated Responsibility
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CEM	Clean Energy Ministerial
CFCs	Chlorofluorocarbons
CH₄	Methane
CIF	Climate Investment Fund
CNG	Climate-Neutral Growth
CO₂	Carbon Dioxide
COP	Conference of the Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CSI	Cement Sustainability Initiative
CTCN	Climate Technology Centre and Network
EIB	European Investment Bank
EU	European Union
EU ETS	European Union Emissions Trading Scheme
F-gases	Fluorinated Greenhouse Gases
FAO	Food and Agriculture Organization
FFFSR	Friends of Fossil Fuel Subsidy Reform
FFS	Fossil Fuel Subsidies
FSB	Financial Stability Board
G7	Group of Seven
G20	Group of Twenty
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIC	Global Investor Coalition (on Climate Change)
GST	Global Stocktake
GtCO₂eq	Gigatonnes of CO ₂ equivalent
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HFOs	Hydrofluoroolefins
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ICCA	International Council of Chemicals Associations

ICLEI	Local Governments for Sustainability
ICT	Information and Communication Technology
IDFC	Infrastructure Development Finance Company
IEA	International Energy Agency
IMF	International Monetary Fund
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
LDC	Least Developed Country
LED	Light Emitting Diode
LNG	Liquefied Natural Gas
LTS	Long-Term Strategy
LULUCF	Land Use, Land-Use Change and Forestry
MBM	Market-Based Mechanism
MDBs	Multilateral Development Banks
MENA	Middle East and North Africa
MEPC	Marine Environment Protection Committee
MEPS	Minimum Energy Performance Standards
MRV	Measuring, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Action
NDC	Nationally Determined Contribution
N₂O	Nitrous Oxide
NMFT	No More Favourable Treatment
NZEBs	Net-Zero Energy Buildings
OECD	Organization for Economic Cooperation and Development
OGCI	Oil and Gas Climate Initiative
OPEC	Organization of Petroleum Exporting Countries
PA	Paris Agreement
PPCA	Powering Past Coal Alliance
PV	Photovoltaics
R&D	Research and Development
REN21	Renewable Energy Policy Network for the 21st century
SBSTA	Subsidiary Body for Scientific and Technical Advice
SDGs	Sustainable Development Goals
SE4All	Sustainable Energy for All
SDSN	Sustainable Development Solutions Network
SIDS	Small Island Developing States
SO₂	Sulphur Dioxide
TCFD	Task Force on Climate-related Financial Disclosures
TEC	Technology Executive Committee (TEC)
TEM	Technical Expert Meetings
TWh	Terawatt Hours



UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
WBG	World Bank Group
WEF	World Economic Forum
WTO	World Trade Organization

1. Introduction

1.1. The Task in Context

Task 4.2 was designed to ‘address a series of related questions: What is the structure and composition of the existing international climate regime complex? How do its elements inter-relate? To what extent does the regime complex fulfil the governance functions identified in task 4.1 and how can existing gaps and overlaps be managed and addressed and overall effectiveness be improved? What is the current and future role of UNFCCC/Paris Agreement in the regime complex and important subsections of it?’ (COP21 RPPLES, Description of Work, p17).

As well as the role of the UNFCCC and the adequacy of the Paris Agreement (1), special attention was due to be paid to ‘(2) identifying implications and options for the EU to advance international climate governance arrangements under the UNFCCC’s Paris Agreement (and elsewhere, as appropriate), in particular with regard to core issues for the EU, such as transparency and accountability and the creation of an upward dynamic in ambition ...’ and ‘(3) issue-specific sub-sets of the regime complex of particularly high relevance such as carbon pricing, subsidy reform, or urban development (Description of Work, p40).

Deliverable 4.1 (Oberthür *et al.* 2017) laid much of the groundwork. Specifically, its sectoral differentiation provided a structure and guide for the process of mapping international and transnational institutions, and the assessment of their adequacy, in a novel way. It offered a guide to which governance functions are most important for individual sectoral systems. Deliverable 4.1’s analysis of the promise of international cooperation along sectoral system lines also provided ‘the point of reference for the assessment of related international cooperation, including the identification of scope for its further development’ (Oberthür *et al.* 2017). Task 4.2 sets out to ‘analyse international governance as being advanced through various institutional arrangements, including international organisations, international regimes and transnational institutions and arrangements that interact with each other in specific ways. It follows that we ... have to look at all institutions/ institutional arrangements that are relevant for a specific challenge/function in order to assess achievements and shortcomings (and to identify possible venues for enhancing governance)’ (Oberthür *et al.* 2017: 14).

Deliverable 4.1 also confirmed the importance of private and ‘hybrid’ transnational initiatives, alongside more conventional inter-governmental institutions. In an increasingly ‘polycentric era’, any analysis of the governance landscape would otherwise be incomplete (Betsill *et al.* 2015, Jordan *et al.* 2018). Indeed, the Paris outcome itself offers strong indications that action outside the UNFCCC’s remit will play a key role, acknowledging and encouraging action by voluntary efforts, initiatives, and coalitions.¹ In this project, the terms “institutional complexes” and “governance landscapes” are

¹ Decision 1/CP.21 (paragraphs 133-136), together with the Marrakech Partnership, take important first steps towards institutionalising the engagement with non-state and subnational actors and initiatives.

used interchangeably to denote this phenomenon (Oberthür *et al.* 2017). Research in other COP21 RPPLES tasks and work packages will focus on particular national-level governance arrangements, with potential to further enrich the project's understanding of polycentricity in the future work. Deliverable 4.1 also offered a preliminary benchmark to define 'adequacy', to apply to the current governance landscape. This consists of two interlinked criteria:

- i) 'international governance of the climate transition can be considered adequate if it maximises the contribution of this governance level to climate mitigation, in line with literature on the "problem-solving effectiveness" of international institutions ... It is worth noting, that in the context of the objectives of the Paris Agreement, problem-solving effectiveness should not only cover the mitigation perspective (1.5/2°C goal), ... but also adaptation (Art. 2.1(b)) and financial flows consistent with low-GHG and climate-resilient development (Art. 2.1(c))'.
- ii) 'Article 2.1 of the Paris Agreement posits that the global response to climate change has to be strengthened "in the context of sustainable development and efforts to eradicate poverty". It thereby highlights the second aspect of the adequacy of international governance, namely that it be considered fair and socially acceptable. This requirement can partially be justified on normative grounds, based on criteria of good governance. It can also be derived from the effectiveness objective since governance arrangements that are not considered fair and acceptable may not be stable and effective. [...] (Oberthür *et al.* 2017: 12).

Despite acknowledging the importance of adaptation in the governance landscape, due to resource constraints it was have agreed to restrict analysis exclusively to mitigation-related aspects.

1.2. Pointers from Existing Literature

To date, the tendency has been for scholars to focus on *either* the multilateral (governmental) regime complex or more non-governmental, transnational spheres, without considering their interconnections. Most research has focused on multilateral institutions, for instance the linkages between the UN climate regime and the World Trade Organization (e.g. Bacchus 2017, Brewer 2003, van Asselt 2014). Michonski and Levi (2010: 1) identified over 16 international organisations in the UN system that are part of the 'broader complex of multilateral institutions whose rules, decisions, and activities can be expected to have important consequences for international efforts to confront climate change'. Although such 'regime complexity' literature is useful, it has been liable to play down the role of non-state actors. Moreover, much of it emphasises the negative effects that actors can use to pick and choose according to their perceived interests: forum shopping, shifting, competition, and exploitation of legal ambiguities. Fewer works discuss the positive effects of complexity, such as innovation, experimentation, and the ability to avoid deadlock (Green 2013).

This dichotomy between two supposed spheres is increasingly being abandoned in favour of recognition of a governance landscape that has characteristics of a complex system. Betsill *et al.* (2015: 2) note the possibility of the UNFCCC playing a coordinating role in the broader landscape,

based on the empirical observation that several initiatives (but not all) voluntarily define themselves in relation to the UNFCCC. This sense is captured in Figure 1.1 below.

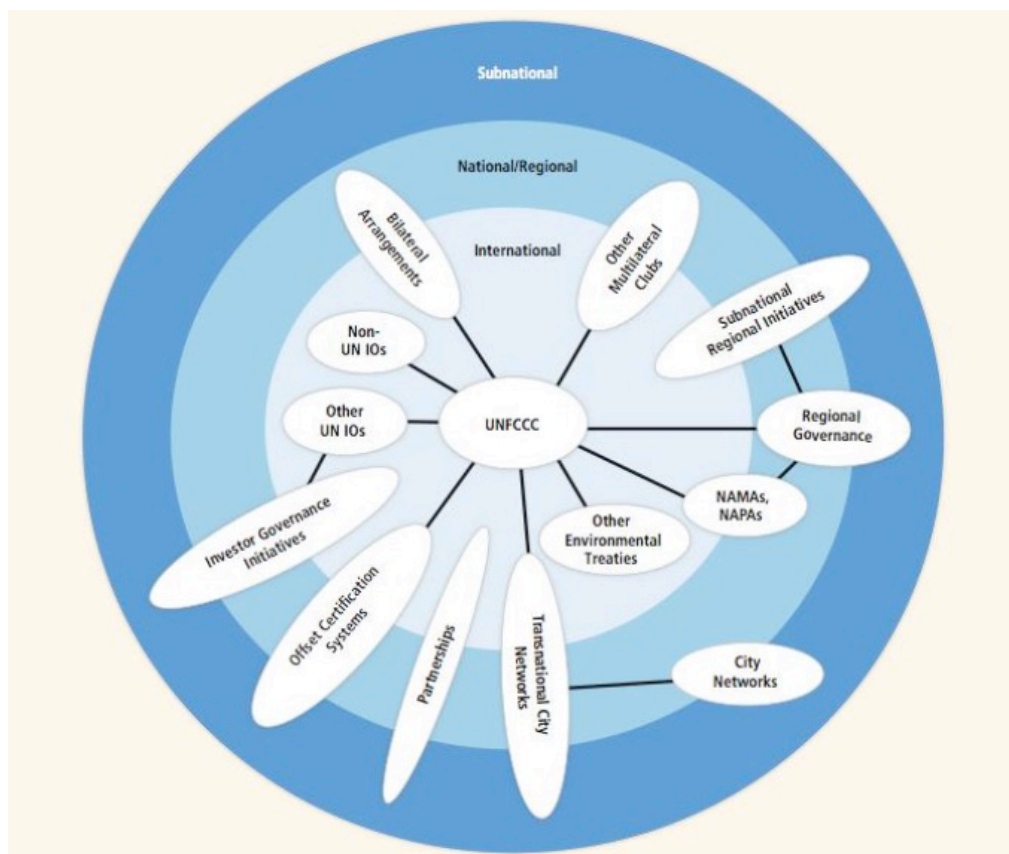


Figure 1.1: The landscape of agreements and institutions on climate change

Lines connecting different types of agreements and institutions indicate different types of links. In some cases, lines represent a formal agreement of a division of labour (e. g. between the UNFCCC and ICAO concerning aviation emissions). In other cases, lines represent a simpler mutual recognition (e. g. the accreditation of C40 cities by the UNFCCC). In others still, lines represent a functional linkage without any formal relationship (e.g. the relationship between the CDM and the NGO certification of carbon offsets). This is a rapidly-changing landscape and not all links may be captured (Source: IPCC 2014, p.1013).

Others are more sceptical of the UNFCCC's potential as a co-ordinator of international cooperative initiatives, regarding it as potentially too restrictive, and preferring a lead role for UNEP (Bakhtiari 2017).

Interesting overlaps may be noted between our agenda – to identify governance functions, and then assess how well they are fulfilled - and the kind of research proposed by Betsill *et al* (2015: 3):

‘Notions of complex systems are useful for understanding the global climate governance landscape, and for enabling us to reconceptualize the UNFCCC less as an authority that attempts to govern climate change in its entirety and more as a coordinating node in a diverse landscape of initiatives. ... Rather than expecting the UNFCCC to do all of the hard work, however, we might consider how it could facilitate governance innovations and activities beyond the treaty regime’.

‘To ensure a more effective response to the climate problem, we argue that there is a need to think more critically about how different parts of the climate governance landscape are or could be connected. We contend it is useful to (1) consider the governance functions that need to be performed; (2) look across the governance landscape to think about where and how those functions can be performed; (3) and analyze how more effective divisions of labor [sic] could be facilitated by creating linkages between the UNFCCC and other types of governance arrangements. It is also important to consider types of linkage that may undermine the activities of individual governance initiatives, as well as the question of the power and authority relationships working across the landscape’.

To a large extent our work picks up this agenda, but views it through a particular, sectoral system-specific lens and with particular governance functions in mind.

1.3. Methodology

The task began with the construction of an extensive Excel database recording governance activity by relevant international institutions or transnational initiatives, reflecting the conceptual framework developed under Task 4.1.² As initially constructed, it contained over 150 entries, compiled in large measure by drawing on the following online databases:

- i) UNEP’s Climate Initiatives Platform, which tracks ‘international cooperative climate initiatives’³;
- ii) The International Environmental Agreements (IEA) Database Project⁴;
- iii) The UNFCCC’s International Cooperative Initiatives Database⁵;
- iv) The UNFCCC’s ‘non-state actor zone for climate action’ (NAZCA) database.⁶

Following Widerberg *et al.* (2016), four criteria had to be met by an institution/initiative for it to be included in the database:

² Particular credit is due to Zoha Shawoo for setting up the database while at the University of East Anglia.

³ <http://climateinitiativesplatform.org>

⁴ <https://iea.uoregon.edu/>

⁵ <https://unfccc.int/topics/mitigation/resources/portal-on-cooperative-initiatives>

⁶ See <http://climateaction.unfccc.int/>. NAZCA captures the commitments to climate action by companies, cities, subnational, regions, investors, and civil society organisations.

- i) it is international or transnational;
- ii) it displays intentionality to steer the behaviour of its members;
- iii) it explicitly mentions a common governance goal related to climate change mitigation;
- iv) it has identifiable governance functions.

Criterion (iii) was interpreted flexibly in building the database, to allow inclusion of certain initiatives with significance for mitigation effort whose official documentation (as recorded on their websites) does not explicitly state a GHG reduction goal. This allowed the inclusion of several potentially important initiatives related to renewable energy, and to significant developments in the ozone regime (namely the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, by which hydrofluorocarbons, which have high global warming potentials, are included in the Protocol, and their use as substitutes for chlorofluorocarbons is therefore phased out). Similarly, 'climate-relevant overarching institutions' such as the G20 and World Trade Organisation were also included, although many initiatives focusing on sustainable development in general were considered 'out of scope'.

The database classifies the actors involved in terms of:

- Public/ formal inter-governmental
- Private/firm
- State/non-state hybrid forms
- Civil society

The relationship to the UNFCCC is recorded. So too is the role of the EU in relation to each initiative, with a view to potential recommendations for how the EU could address gaps identified in the post-Paris governance landscape. EU relevance has been recorded primarily in terms of the participants, funding and scope of each initiative. An effort was made to classify the entries in the database in terms of their potential contribution to fulfilling the governance functions outlined in Deliverable 4.1.

The first 'cut' produced the picture illustrated in Figure 1.2. The intention is that this will be updated in future publications.

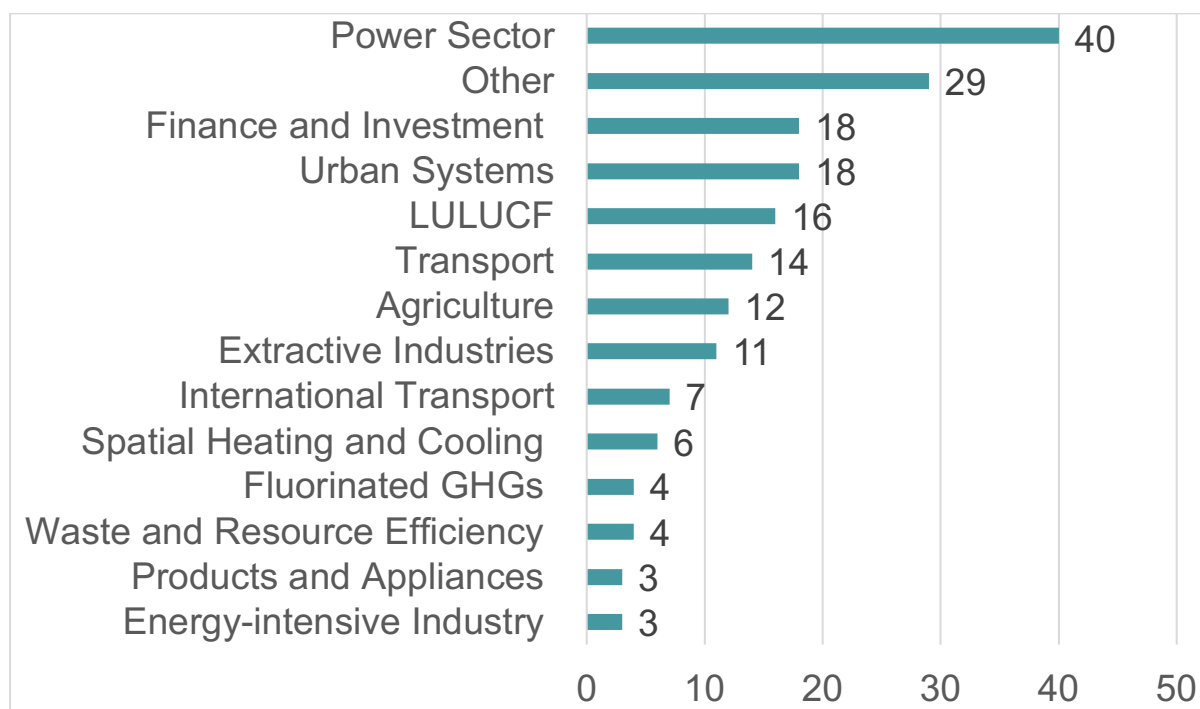


Figure 1.2: Number of institutions/ initiatives per sectoral system: initial count. (NB. Some of the 152 initially collected span multiple sectors. Efforts to update/ specify this picture further are ongoing).

Given limited resources, in conducting deeper analysis it was decided to concentrate on seven sectoral systems: power, energy intensives, extractive industries, finance, international transport, land-based transport and buildings. These were chosen in view of their:

- High contribution to global emissions;
- Potential to be governed at inter-/transnational level;
- Prominent finance and technical issues;
- Potential relevance for EU, and to the ‘issue-specific sub-sets of the regime complex of particularly high relevance’ highlighted by the Description of Work (carbon pricing, subsidy reform and urban development).

Consideration was also given to avoiding overlap between systems, though this is inevitable to some extent.

Following a common template, a more detailed set of assessments was then conducted for each sectoral system. These were designed to confirm the importance of individual governance functions for decarbonisation in each case (based on analysis conducted for Deliverable 4.1 (Oberthür *et al.* 2017), identify the role of different institutions and initiatives in addressing them, highlight gaps in terms of fulfilment of the most critical functions, and thereby assess the adequacy of the overall picture. Scores of ‘high’, ‘medium’ or ‘low’ were used to record judgments over the extent to which the governance demands identified are being fulfilled in each sectoral system. The assessment took into account any institutions that might impede the fulfilment of the most important governance

functions in the sectoral system. As a final step, scope for further development of identified potential for international cooperation was considered, including the possibility of establishing new institutions or initiatives, better co-ordinating or ‘orchestrating’ those that currently exist, and opportunities for the EU to offer leadership.⁷

Following the framework for ‘adequacy’ set out in Oberthür *et al.* (2017), each sectoral analysis also considered fairness and social acceptability aspects. Concerning fairness, the question of whether all relevant actors are contributing to emission reduction effort, in particular those who have most responsibility for present and past emissions, and/or most capacity to act, was considered. Social acceptability was deemed to relate to the perceived legitimacy of relevant institutions and processes (including issues of balance of representation within them between developed and developing countries), and how far they meet with criticism and opposition. These aspects were considered in so far as they were judged likely to affect ultimate effectiveness of mitigation action.

For each sectoral analysis, individuals with detailed sector knowledge were approached and either interviewed or asked to comment on draft assessments (or both). Where they have given their permission, these individuals are acknowledged in the relevant chapters.

1.4. Future Plans

This deliverable should be regarded as a staging post on the way to a (more readily digestible!) planned journal special issue or book project by the authors. Its findings will continue to be updated in the light of both emerging developments (such as in the international aviation sector, where decisions are imminent at the time of writing) and reviewer comments that time constraints have prevented from being acted upon fully. Several chapters are due to be presented at the forthcoming Earth System Governance (ESG) conference, Utrecht (5th - 8th November 2018), where the authors successfully proposed a dedicated panel session on *Assessing the Adequacy of the Global Climate Governance Complex après Paris*.⁸

1.5. Structure of the Report

Before the seven sectoral system assessments are set out, chapter 2 examines the UNFCCC and Paris Agreement, and the extent to which they fulfil the governance functions that have provided the common reference point for our analysis. The deliverable then presents the series of sectoral assessments (chapters 3-9). In the interests of comprehensiveness and coherence, we have included significant extracts from the respective sectoral analyses presented in Deliverable 4.1. In doing so, we have also taken the opportunity to update our analysis in some respects. Combining the analyses in this way allows us to present the important characteristics of each sector, decarbonisation

⁷ ‘Orchestration’ refers to activity whereby states or international organisations multiply their influence by initiating, guiding, broadening, and strengthening transnational governance by non-state and/or sub-state actors (Abbott 2018).

⁸ <http://www.earthsystemgovernance.net/utrecht2018/a-homepage-section/>

pathways and options, barriers to change and potential for international cooperation to fulfil the most critical governance functions in each case, before mapping the current institutional landscape against these needs, identifying gaps, and then suggesting potential means to address them at sectoral level.

In the concluding chapter, key findings from the assessments are reviewed and synthesised. The importance of the equity and social acceptability aspects of adequacy are also drawn together and highlighted. Conclusions related to the (potential) role of the EU in the different sectoral systems, and in terms of promoting progress within the framework of the UNFCCC - particularly regarding upward 'ratcheting' of ambition in the post-Paris climate regime – are also offered.

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2. The UNFCCC, the Paris Agreement and Functions of International Governance

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2.1. Introduction

In recent years international climate governance has become increasingly fragmented (van Asselt 2014), or polycentric (Jordan *et al.*, 2018). Since 2010, a wide range of governance initiatives have been mushrooming (Bulkeley *et al.*, 2014; e.g. Widerberg and Strippel, 2016; Roger, Hale and Andonova, 2017) that are broadly intended to complement the UNFCCC and the Paris Agreement (PA). The result is an increasingly complicated network of institutions and international organisations which have been described as a “regime complex” (Keohane and Victor, 2011; Abbott, 2012; Orsini, Morin and Young, 2013).

The climate regime may be complex in the sense of being an arrangement of a wide range of fragmented institutions and organisations, but also in a further, systems-theoretical sense (Pattberg, 2017). A feature of complex systems is that the interactions between their various elements produce emergent properties that cannot be explained by an analysis of the individual elements alone. This may also be true for the climate change regime complex. In other words: the climate change regime complex may be more than just the sum of its elements.

When addressing the question of the adequacy of the climate change regime complex, this project adopts a sectoral systems perspective that helps to break down overall transformation challenges implied by the 1.5°C goal of the PA into more specific governance challenges which, in turn, can be addressed to varying degrees by international (rather than national or sub-national) governance. Despite growing ‘polycentricity’, the UNFCCC, and in particular the Paris Agreement, still assume a central role within the wider regime complex (see figure 1.1 in chapter 1). Arguably, three factors in particular lie behind this special role:

- (1) The PA defines and institutionalises the collective vision for global climate action in terms of the 1.5/2°C long-term temperature limitation goal. When assessing the adequacy of the wider regime complex, this long-term goal of the PA is the ultimate benchmark.
- (2) Besides defining the goal of international climate policy, the UNFCCC and the PA are key institutions that help achieve this goal. In particular, the UNFCCC and PA provide the fundamental transparency/ accounting system for tracking individual and collective progress; eventually, the results of all climate change mitigation actions will materialise in the national GHG inventories that are mandated by the UNFCCC/PA. The UNFCCC and the PA thus do not only provide the benchmark for global climate action but also the ultimate measure for effectiveness in making progress against their goals.
- (3) The PA’s 5-yearly ambition cycle and periodic global stocktakes of climate action create political moments that can mobilise climate action across the entire regime complex and all

governance levels. While the failed negotiations for a new global climate agreement in Copenhagen were a “diplomatic disaster” (Grubb, 2010), that summit was still a success in that the extraordinary public attention it created served as a catalyst for climate action in civil society and in many cases also at subnational and transnational levels. Paris and the preparatory process beforehand functioned similarly. The PA now makes sure that there will be similar moments of high political and public attention every five years (cf. Schüssler, Rüling and Wittneben, 2014).

We therefore focus on the UNFCCC and PA as the central hub of the climate change regime complex. The PA will be assessed with respect to the five governance functions outlined in WP4.1: (1) guidance and signal function; (2) setting rules to facilitate collective action; (3) transparency and accountability (including compliance); (4) means of implementation (capacity building, technology and finance); and (5) knowledge diffusion and learning.

2.2. Guidance and Signal Function

Long before the adoption of the PA, the UNFCCC and the associated negotiation processes were instrumental in framing the climate change problem. Initially, climate change was framed in terms of a classical environmental problem (Vogler, 2016). The core components of the problem were the pollutants, and the proposed remedies focussed on the end-of-pipe curtailment of them. This paradigm was ultimately institutionalised in the Kyoto Protocol that not only defined emission caps (so-called Quantified Emission Limitation and Reduction Obligations – QELROs) for developed countries but also promoted the ‘basket’ approach in which all major greenhouse gases were included under a common metric.⁹ The global warming potential of CO₂ (over a period of 100 years) has been used as a point of reference to calculate conversion factors for all other greenhouse gases (GHGs). In so doing, it was possible to come up with a common currency for all GHGs expressed in CO₂ equivalents (CO₂e).

The concept of the 2°C goal, i.e. to prevent global mean temperature rise from exceeding 2°C above pre-industrial levels, was first introduced in the political discourse by Angela Merkel, then Environmental Minister of Germany and President of COP1 in Berlin in 1995 (Randalls, 2010). It follows from this logic of climate change as an environmental problem. A common approach for a wide range of environmental problems is to define environmental thresholds or safe limits. The below 2°C goal in its original form, although inadequate from today’s scientific point of view, can be read as such a threshold (Jaeger and Jaeger, 2011).¹⁰

⁹ GHGs in addition to CO₂ are methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆).

¹⁰ Note that recent research shows that 2°C should not be considered safe. As the final report of the Structured Expert Dialogue of the 2013-2015 review highlighted: “The ‘guardrail’ concept, in which up to 2 °C of warming is considered safe, is inadequate and would therefore be better seen as an upper limit, a defence line that needs to be stringently defended, while less warming would be preferable” (UNFCCC, 2015, p. 18).

With the failure of the US to ratify the Kyoto Protocol, geopolitical shifts and the growing share of developing countries in total GHG emissions and a new dimension was added to the framing of the problem. Climate change was increasingly seen as being linked to the issue of a development issue. China and in particular India rejected attempts to impose on them any formal mitigation obligations as a curtailment of their right to develop. The paradigm of climate change as a development issue, however, was never fully embraced by the UNFCCC negotiations. In fact, it has been argued that COP15 in Copenhagen ended in a diplomatic disaster precisely because of this lack of appreciation of the developmental implications of climate change (Moomaw and Papa, 2012; Hermwille *et al.*, 2017). In recent years, the framing of climate change has seen yet another paradigm shift – or rather, another issue expansion. It is now increasingly seen as a transformation challenge (WBGU, 2011; Hermwille, 2016), requiring a fundamental transformation of global societies and economies. The question is whether this transformation can be governed towards sustainable, climate resilient and decarbonised economies in a timely enough fashion to avoid the kind of transformation that would occur through catastrophic impacts of unabated climate change.

The PA can be read as an institutionalisation of this new paradigm. With its structuring element of 5-yearly ambition cycles (see below) and the newly formulated strengthened long-term temperature goal expressed in Article 2 (and further operationalised in Article 4.1), it creates the framework and ambition signals required for achieving the former kind of transformation. At the same time, by elevating adaptation and in particular by establishing a separate article on “loss and damage” (Article 8), it provides a foundation to adapt to and deal with unavoidable effects of the latter kind of transformation. In reality, of course, both transformations will happen simultaneously. Adaptation and loss and damage should not be considered as only a backstop for insufficient mitigation. Mitigation, adaptation, loss and damage actions all have to happen in parallel.

On the very aggregate level, the PA provides a collectively agreed vision for the global transformation. Not only is the temperature limit enshrined for the first time in an international treaty law, but it is also strengthened compared to the previous “below 2°C” formulation¹¹: “Holding the increase in the global average temperature to *well below* 2°C above pre-industrial levels”, the agreement contains and “to *pursuing* efforts to limit the temperature increase to 1.5 °C above pre-industrial levels”. This outcome reflected that recent climate science has more and more underlined that the below 2 °C limit cannot be taken to be a secure ‘guardrail’, but would in all likelihood mean severe damages from climate change (UNFCCC, 2015). Reflecting this new understanding, the PA

¹¹ Earlier language in the Cancun Agreements (1/CP.16 para 4) recognized the scientific consensus that “deep cuts in global greenhouse gas emissions are required (...) with a view to reducing global greenhouse gas emissions so as to hold the increase in global average temperature below 2 °C above pre-industrial levels, and that Parties should take urgent action to meet this long-term goal, consistent with science and on the basis of equity” (UNFCCC, 2011, para. 4).

reflects this new understanding in its 1.5°C goal. It changed the notion of the 2°C “goal” expressed already in Copenhagen and adopted in Cancún one year later into a hard well below 2°C “limit”; the new “goal” is 1.5°C.

In terms of the signalling function of the PA, the most important achievement is arguably something else. Article 4.1 provides a new translation of the ultimate objective of the Convention: to prevent dangerous anthropogenic interference with the climate system. While the Copenhagen and consequently Cancún COPs operationalised this in terms of a temperature goal, Paris now provides the next step and translates its strengthened long-term temperature goal into a global call for decarbonisation. Parties agreed that, firstly, global greenhouse gas emissions need to peak “as soon as possible”, secondly, that rapid reductions thereafter are needed and, thirdly, that “a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases” is needed “in the second half of this century” (Art. 4.1). Given that it will probably not be possible to reduce emissions from agriculture and some industrial processes to zero, the available sink capacity will be needed to compensate for emissions from these sources, which means that all emissions that can be reduced to zero need to be reduced to zero. In fact, the majority of scenarios that are commensurate with the long-term goal of limiting global warming to 1.5/well below 2°C even foresee significant negative emissions, i.e. through increased sink capacities or technologies such as bioenergy in combination with carbon capture and storage (BECCS) or direct air capture of CO₂ (van Vuuren *et al.*, 2018). The long-term goal as formulated in the PA is thus synonymous with a call to global decarbonisation by the second half of the century, and much earlier even in developed countries. This is the main message from Paris: the age of fossil fuels is coming to an end.

This signal provided by the PA can in turn offer strong legitimization for the growing civil society movements against coal power plants, mines, pipelines and other carbon-intensive infrastructure. Comparable to the Final Act of Helsinki that provided dissidents in the former Soviet Bloc with a crucial reference for their work, opponents of fossil infrastructures can now point to the goals of the PA to justify their activities.

Nevertheless, the 1.5°C goal may also be a double edged sword. While the goal provides a strong mandate for climate change mitigation, the implications for adaptation may be challenging, because all optimism notwithstanding, the collective climate action seen to date and reflected in current nationally determined contributions (NDCs) is far from sufficient to deliver an emissions trajectory consistent with achieving the 1.5°C goal. Implementing the initial commitments contained in intended nationally determined contributions (INDCs) has been projected to put the world on course for a 2.7°C increase *at best*, with 3-4°C increasingly likely (UNFCCC, 2016a; UNEP, 2017). The promise of the 1.5/2°C target may, hence, send an insufficient signal for adaptation (Jordan *et al.*, 2013; Sharma, 2017). Specifically, Article 7.1 of the PA states that Parties agree to “strengthening resilience and reducing vulnerability to climate change, with a view to [...] ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2” (UNFCCC, 2016b,

Art. 7.1).¹² The inconsistency between the aggregate likely effect of current NDCs with the overall temperature goal has been highlighted explicitly in the decision adopting the Agreement, which “notes with concern” that the contributions “do not fall within least-cost 2°C scenarios but rather lead to a projected level of 55 gigatonnes in 2030” (UNFCCC, 2016c, para. 17).

The UNFCCC for a long time has promoted a paradigm with accounting for emissions at its core. Owing to its history, in particular under the Kyoto Protocol, there is still a widespread sentiment that emission caps are the most adequate approach to address climate change (Sterk and Hermwille, 2013; Hermwille *et al.*, 2017). Limiting emissions in such a way creates a scarce resource around which a distributional conflict emerges (Moomaw and Papa, 2012; Hourcade and Shukla, 2013). Stiglitz opines that, “if emissions were appropriately restricted, the value of emission rights would be a couple trillion dollars a year – no wonder that there is a squabble over who should get them” (Stiglitz, 2010; see also Stiglitz 2006).

The PA and in particular the bottom-up NDC cycle overcome this paradigm of a “zero-sum game”. Countries are required to develop their climate change policies in line with other national interests. While synergies between climate policy and for example development or industrial policies have been dubbed “co-benefits” in the UNFCCC negotiations in the past, in many countries these co-benefits now take a much more prominent role in domestic climate policy debates. The NDCs have the potential to become a tool of collectively developing and institutionalising expectations and interests. This, in turn, is intended to reduce uncertainty and stimulate targeted innovation and investment across all sectoral systems.

2.3. Setting Rules to Facilitate Collective Action

One way to overcome collective action problems¹³ may lie in strong legal contracts and rigid non-compliance provisions that can effectively halt free riders (Fearon and Wendt, 2002; see also Oberthür *et al.*, 2017). This section discusses the legal form of the PA and the extent to which it addresses climate change as a collective action problem.

The PA has been criticised for the lack of legal ‘bindingness’ of its provisions, and in fact its legal character was a major bone of contention in the negotiations (Obergassel *et al.*, 2015, 2016; Bodansky, 2016; Oberthür and Bodle, 2016). To a great extent, the legal form was designed to accommodate the political constraints of the US constitutional system (Oberthür and Bodle, 2016), where international treaties need to be ratified by the Senate by a two-thirds majority. Because in all

¹² Only in Art. 7.4 do Parties recognise “that the current need for adaptation is significant and that greater levels of mitigation can reduce the need for additional adaptation efforts, and that greater adaptation needs can involve greater adaptation costs”.

¹³ We define collective action problems here in economic terms: While it is collectively rational to act on climate change, but from an individual country perspective it is more economically attractive to “free ride” on the efforts of others.

likelihood this was almost impossible to achieve, given the increasing tribalism in domestic politics, the US delegation made sure that the PA did not contain any substantial legal obligations that would have triggered the need for it to be ratified by the US Senate (e.g. new obligations with respect to finance). Furthermore, the Agreement was adopted as a separate international treaty rather than as a formal protocol according to Article 17 of the Framework Convention. Instead Parties opted for a new form of international accord dependent on a larger convention treaty, creating a legal construct that is at the same time an international treaty and not: under the Vienna Convention, and therefore under international law, the PA clearly qualifies as an international treaty; and yet to accommodate US political circumstances and domestic ratification processes, under US law, the Agreement falls under a category of “international agreements other than treaties” and thus it could be ratified by executive order without a Senate vote (for a detailed discussion see Obergassel *et al.*, 2015, p. 247f).

Consequently, the PA contains relatively few mandatory legal requirements on Parties in terms of “obligations of results”. There are, however, a range of “obligations of conduct” (Oberthür and Bodle, 2016): for example, procedural obligations, particularly with respect to the preparation, and communication and maintenance of successive Nationally Determined Contributions (NDCs) every 5-years – Articles 4.2, 4.3, and 4.8, 4.9 – and accounting for NDCs as well as GHG inventory reporting and reporting information necessary to track progress in implementing and achieving NDCs – Articles 4.13 and 13.7 (Bodansky, 2016). Yet, the realisation by a Party of its NDC is not mandatory in itself, leading to the conclusion that “[d]eveloped country targets have been watered down from the legally binding, comparable commitments they had under the Kyoto Protocol, to softer, weaker, disparate pledges under the Paris Agreement” (Depledge, 2016, p. 10). On the other hand, the PA includes a legally binding obligation on Parties to implement policies and measures towards achieving NDCs. As per Article 4.2 “Parties *shall* pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions” (UNFCCC, 2016b, Art. 4.2 – emphasis added).

Under the Trump administration in the US, the question has arisen as to whether a Party can re-draft its NDC in order to lower its ambition. While the EU appears willing to countenance such a development, as the price of keeping the US within the Agreement (Neslen 2017), others fear the example it would set to other states and consider that for this and other reasons, less harm would be done if the US withdraws completely (Kemp 2017; Ott et al. 2017).

These problems notwithstanding, the UNFCCC and the PA have set rules to facilitate international collaboration in a number of different ways that can overcome collective action problems. For example, a precondition for international collaboration is a forum in which Parties can discuss in a spirit of mutual trust and cooperation. Arguably, the adoption of the PA saved the process of environmental multilateralism from falling into irrelevance (Obergassel *et al.*, 2015, 2016). As the COP President Laurent Fabius declared in Paris: “if, today, we were so unfortunate as to fail, how could we rebuild hope? Confidence in the very ability of the concert of nations to make progress on climate issues would be forever shaken” (Fabius, 2015).

While the PA did not create many substantive targets or commitments, it created a set of procedural rules that help to provide a collective picture of the increase in ambition required to be consistent

with the 1.5°C goal and to stimulate and synchronise climate policy processes on the national and international level that respond to this need. The 5-yearly cycle of communicating new and updated NDCs that present a progression beyond the status quo (the so-called ‘ratchet mechanism’), and taking stock of implementation of the Agreement to assess collective progress under periodic global stocktakes creates a “pacemaker” that establishes periodic moments of high-level political and public attention, and mandates periodic review of policy processes and ambition of climate action.

With regard to the facilitation of collective action and avoidance of free riding, the lack of a common standard and/or information requirements for the NDCs must be considered a weak spot of the PA. In the run-up to COP21, Parties were unable to agree to a common set of information requirements for the NDCs (Ott *et al.*, 2014). Consequently, NDCs are extremely diverse: some including Kyoto-style economy-wide absolute emission reduction targets, others formulating commitments in terms of reductions of emission intensity or from a BAU scenario. Some countries even formulate non-GHG targets and instead focus for example on the restoration of forests or increased deployment of renewable energies. Last but not least, some countries did not make any result-based commitments but committed to specific behaviour by outlining specific policies and measures. Discussions on a more rigid framework of information requirements for the next round (updated) NDCs is still being negotiated as part of the “rulebook” for the PA that Parties have agreed to prepare for adoption at COP24 in 2018 (see section 2.3 below).

Two other aspects in which the UNFCCC and the PA have contributed to a facilitation of collective action have already been mentioned above. The first refers to standardisation: the UNFCCC and in particular the Kyoto Protocol established a standard of accounting for GHGs in an aggregated way expressed in CO₂ equivalents. On the one hand, this may have helped making commitments and achievements more comparable. It has also provided the basis for emission trading, a tool for countries and private actors to cooperate in mitigation activities.¹⁴ Fungibility of mitigation outcomes is a key prerequisite for the establishment of carbon markets.

The second aspect regards to the resolution of distributional conflicts. As discussed above, climate change for a long time was framed around “burden sharing” and the division of the remaining “environmental space”. A wide range of different approaches to operationalising equity principles have been proposed (see for example Vieweg *et al.*, 2014). While the distributional conflict has not been resolved, by focusing on NDCs developed with national interests at their core, the PA has found a way to circumvent it such that it no longer stands in the way of a comprehensive agreement. Voigt and Ferreira argue that the PA addresses the issue of equity “in three complementary ways: firstly, on a principled basis, reflecting common but differentiated responsibilities and respective capabilities (CBDR-RC), in the light of different national circumstances; secondly, in the content of its

¹⁴ With its project-based mechanisms under the Kyoto Protocol, the UNFCCC has also catalysed the development of a large set of standardised methodologies and tools for measuring, reporting and verifying emission reductions at the project level in a wide range of different sectors (CDM Policy Dialogue, 2012).

articles, in particular on mitigation, finance and transparency; and thirdly, on the basis of the principles of progression and highest possible ambition, which represent new and dynamic aspects of differentiation.” (Voigt and Ferreira, 2016, p. 285).

2.4. Transparency and Accountability

In this section we address the transparency and accountability function as a means to support collective action in line with the definition of the function in Oberthür et al (2017). The provisions of the PA’s enhanced transparency framework (Art. 13) are pertinent but not entirely congruent with this governance function.

Article 13 among other things requires parties to account for their NDCs, report at least biennially their GHG inventories and include information necessary to track progress towards the respective country’s NDC. Moreover, this information is supposed to be subjected to international expert review and multilateral consideration of its progress (Mace, 2016). The purpose of the information generated from the enhanced transparency framework is to inform the global stocktakes (according to Art. 14) which in turn is supposed to assess the collective progress towards achieving the long-term goals of the PA.

Given the non-binding nature of NDCs (at least in terms of their realisation), the element of transparency is all the more important in the context of the PA. Essentially, the weak legal mandate is supposed to be offset by a mechanism of political accountability: a high degree of transparency paired with the 5-yearly cycle of global stocktakes that creates periodic moments of concentrated political and public attention. Although the key purpose of the Global Stocktake is to assess collective progress and to inform the next round of NDCs to be developed by Parties, the high profile of the event still places a political onus on policy makers to implement the NDCs and not to be identified as laggards. It thereby helps discipline national governments so as to avoid public shaming if they fail to deliver on their commitments (cf. Obergassel *et al.*, 2015, 2016). The formula of the PA is therefore to complement accountability through a weak legal mandate with accountability through public scrutiny.

By making visible who is doing what, transparency is widely assumed to be vital to holding countries to account and building trust. Whether or not this formula will actually work crucially depends on the detailed modalities, procedures and guidelines (MPGs) provisions under the transparency framework, which are being developed and negotiated as part of the “Paris rulebook”.

At COP22 in Marrakech, Parties agreed to complete the PA Work Programme in time for it to be considered and adopted at COP24 in 2018 (Obergassel *et al.*, 2017). In Paris, consensus on the transparency provisions under Article 13 issue was achieved only by finding a balance between developed and developing countries’ positions. Developed countries demanded more transparency and detailed information with respect to GHG emissions, mitigation activities and their effects from developing countries. Developing countries pushed developed counterparts to be more transparent

with respect to the means of implementation, in particular climate finance (Oberghassel *et al.*, 2015, 2016).

President Trump's announced intention to withdraw the US from the PA could throw the negotiations on this issue out of balance.¹⁵ As stated above, the provisions for the transparency mechanism are still embryonic, yet parties have agreed that they become legally binding once agreed by the meeting of the PA's parties (CMA). Whether or not the transparency mechanism framework works in the intended way will depend on parties agreeing to binding provisions *inter alia* on information requirements and procedures for subsequent NDCs (Art. 4.8 & 4.9), information on financial and technical support (Art. 9.7), and crucially information on GHG inventories and progress with implementation of NDCs (Art. 13.7). Whether the decisions that the CMA adopts pursuant to these articles are legally binding will depend on their phrasing in mandatory terms (Bodansky, 2016, p. 148).

2.5. Means of Implementation: Capacity Building, Technology and Finance

For developing countries to implement their NDCs effectively, industrialised countries will have to cooperate with developing countries in various forms. Some NDCs, such as India's are explicit on this point. The basis for this obligation reaches back as far as the original text of the Convention (UNFCCC Art. 4). Support to developing countries in general should come in the form of finance, technology development and transfer, and capacity building.

A large portion of the PA contains provisions for support to developing countries, albeit of varying strength: Article 9 deals with finance, Article 10 with technology development and transfer, Articles 11 and 12 with capacity building and education (the "means of implementation" or MOI). The draft decision on the adoption of the PA contains a number of specifications to the articles mentioned above.

Bearing in mind that especially finance and technology are "hard currency" not only in the climate realm, but have notable implications for country budgets, the history of climate diplomacy has seen fights over MOI at almost every COP. Perhaps more than anything else within these negotiations, MOI brings out the divisions and distributional conflicts between industrialised and developing countries.

Climate change being one of the most malign governance problems of our time (Miles *et al.*, 2002), distributional conflicts are not only common, but also highly asymmetrical. Developed countries have the most responsibility to act on climate change and provide support, but do not face immediately life-threatening consequences from a changing climate, whereas, many "receivers" do, but traditionally do not have the same bargaining weight. In cooperative terms, this creates an

¹⁵ At the first negotiation rounds after President Trump's announcement, the US delegation somewhat unexpectedly continued to play a constructive role in the transparency negotiations.

"upstream-downstream" problem (Mitchell, 2009) that is very hard to solve. However, many developing countries become considerable economic and political powerhouses in their own right. This also gives them a stronger bargaining position in climate negotiations, so there is a good chance that the cards for MOI are going to be reshuffled to have a more level playing field in coming negotiations.

2.5.1. Finance

In order to channel climate finance through UNFCCC channels, the Convention features a financial mechanism that serves both the Kyoto Protocol and the PA. It is operated by the Global Environment Facility (GEF), and, since COP17, also the Green Climate fund (GCF). The financial mechanism and its operating entities are accountable to the COP, which decides on its policies, prioritisations and eligibility criteria for funding, assisted by the Standing Committee on Finance.

The GCF is by far the largest funding mechanism under the UNFCCC. Countries, regional governments and the city of Paris have collectively pledged more than 10 billion USD so far (though cuts announced by the Trump administration will likely reduce that number by 2 billion) (Washington Post, 2017).

Besides the GCF, two smaller funds exist under the convention, governed by the GEF:

- the Special Climate Change Fund, designed to finance activities in developing countries in relation to adaptation, technology transfer and capacity building, energy, transport, industry, agriculture, forestry and waste management, and economic diversification;
- the Least Developed Countries Fund, which is mainly concerned with assisting LDCs in formulating national adaptation programmes of action (NAPAs).¹⁶

In addition, the Adaptation Fund (AF) was created under the Kyoto Protocol. Following a decision at COP22, it will also serve the PA. The AF is governed by its own board, and financed in part through a share of proceeds from the Clean Development Mechanism (CDM). While the amount of funding generated to date is not much, it is interesting for constituting an international levy that is independent of national states. In actual terms, the largest part of the AF's funding comes out of voluntary contributions by states. In recent years, it has been increasingly difficult for the AF to raise even its minimum amount of funding.

Conflicts over provisions on finance within the international climate regime have always threatened to "break" the outcome of the negotiations as a whole, and Paris has been no different in this regard. Finance was among the last issues to be resolved before hammer-fall, and lost all qualifiers to the provision of climate finance in its first paragraph. It now only stipulates that "Developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention"

¹⁶ The GCF and GEF are analysed further in chapter 3.

(UNFCCC, 2016b, Art. 9.1). The PA also encourages other Parties to "provide or continue to provide such support voluntarily" (UNFCCC, 2016b, Art. 9.2). This poses no additional binding obligation on developing countries, but recognises the growing level of South-South financial support.

Some clearer language is retained in the decision text, where Parties have decided that "developed countries intend to continue their existing collective mobilisation goal through 2025 [...]; prior to 2025 the [CMA] shall set a new collective quantified goal from a floor of USD 100 billion per year..." (UNFCCC, 2016c, para. 54). With this, developed countries have committed themselves again to a (non-binding) finance goal. Moreover, with the second half of the paragraph, it is now clear that the promised 100 billion USD per year cannot be the ceiling of finance commitment, but rather a floor to scale up from before 2025. However, the paragraph may prove to be a double-edged sword for future negotiations, as the formulation of a "collective quantified goal" will once more open up fights over financing commitments by at least the economically stronger developing countries.

The Agreement text itself does not contain any reference to the \$100 billion mobilisation goal, or, in fact, any language that would imply an obligation to scale up climate finance from current levels. Financial obligations had been a clear red line for the US, as they would have required Congressional approval, in effect meaning that the US would have been unable to join the Agreement. With the US continuing to cut funding to already agreed funding mechanisms, it is still getting harder to ramp up much needed financial assistance for implementation.

2.5.2. Technology Transfer

A further crucial aspect to effective implementation of developing countries' NDCs is access to technologies that make a shift away from fossil fuel-based infrastructures possible. While always recognised, the issue of technology development and transfer had been out of the limelight of negotiations for some time, relegated to the work of the Convention's Subsidiary Bodies.¹⁷ Thus, the further development of the Convention's Technology Mechanism, including the work of Technology Executive Committee (TEC), and the development and operationalisation of the Climate Technology Centre and Network (CTCN) had been of rather low profile. With the PA in place, there is now a renewed interest in strengthening this issue under the UNFCCC.

Both the Technology Mechanism and the TEC/CTCN will serve the Agreement. As a result of developing country pressure, the PA establishes a technology framework (tabled initially by the African Group) in order to provide guidance to the Technology Mechanism. The technology framework also serves to pursue the long-term vision of all Parties set out in paragraph one of Art.

¹⁷ The Article 9 and 10 of the UNFCCC respectively establish the Subsidiary Body for Scientific and Technical Advice (SBSTA) and the Subsidiary Body for Implementation (SBI). Both are permanent fora regularly meeting two times a year. The bodies are open to all Parties and are task to provide information and advice on scientific and technological matters (SBSTA), and assessment and review of the effective implementation of the Convention (SBI).

10, citing “the importance of fully realising technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions” (UNFCCC, 2016b, Art. 10.1).

Another key feature of the PA is the establishment of a clear link between technology and finance. As set out in paragraph five of Article 10, the acceleration, encouragement, and enablement of innovation is not only to be supported through the Technology Mechanism, but also through the Financial Mechanism of the Convention. (UNFCCC, 2016b, Art. 10.5).

Predictably, Intellectual Property Rights (IPRs) do not appear in the Agreement text. The mention of IPRs has always been a red line issue for many developed countries, and it cannot be expected that this will change in the foreseeable future. However, the link between technology and finance at least acknowledges that finance could be needed for the acquisition of copyrighted technologies. Whether this will be sufficient to close the chapter on IPRs again remains to be seen.

2.5.3. Capacity Building

Capacity building had in the past been another low-profile element of the UN climate regime's support structure. While industrialised countries had always recognised it as an essential element, especially for least-developed countries, developing countries had never managed to bring the issue to the top of the agenda. However, consistent progress in developing the architecture has been made over recent years, with the Durban Forum on Capacity-Building, a multi-stakeholder forum for sharing ideas and lessons learned, the most visible outcome in 2011.

The PA recognises the importance of the issue, but the text is relatively weak and non-binding. However, the accompanying decision text contains a negotiation success for developing countries: the creation of the Paris Committee on Capacity-building, with an aim to “address gaps and needs, both current and emerging, in implementing capacity-building in developing country Parties and further enhancing capacity-building efforts, including with regard to coherence and coordination in capacity-building activities under the Convention” (UNFCCC, 2016c, para. 72). The Committee's 2016-2020 work plan contains a number of different issues related to the existing capacity-building framework under the Convention, as well as capacity gaps that should be addressed by Parties. Each year, the Committee focuses on a special topic, and holds annual in-session meetings where these areas can be addressed.

Apart from these relatively limited contributions in supplying capacity building resources, the UNFCCC and in particular the development of (I)NDCs has created strong demand for capacities, a demand that was met in many developing countries by creating new national institutions and/or by mainstreaming climate policy into line ministries (Day *et al.*, 2015). Whether this effect is best thought of as a contribution for capacity building or as an instance of institutional learning is an open question.

2.5.4. Knowledge and Learning

The UNFCCC has fostered knowledge creation and learning in a number of ways, directly and indirectly. One central direct mechanism under the UNFCCC is the obligation on Parties to regularly submit GHG inventories, National Communications and biennial reports (developed countries) or biennial update reports. As noted above, the GHG metrics form the core of the UNFCCC's common language and are the key benchmark for its effectiveness. National Communications provide a wealth of information about national circumstances and actions being taken. Information about national emission profiles is a key prerequisite for developing suitable mitigation strategies.

However, while the process of developing national communications may have served as a motor of knowledge aggregation at the national level, the information contained in them has generally not been used to promote mutual learning at the international level. Country reporting on policies and measures, in particular, could have been a key basis for organising exchanges on lessons learned, but has so far remained largely untapped (Hilden et al 2014, Schoenefeld et al 2016).

The situation has changed somewhat in recent years through the work under Workstream 2 of the Ad-hoc Working Group on the Durban Platform (ADP) and other subsequent initiatives. Workstream 2 was tasked with elaborating ways to increase ambition before 2020. While the original idea was to get countries to increase their mitigation pledges, work has increasingly re-focused on identifying mitigation potential and best practices. Following the initiative of the AOSIS group of countries, a series of technical expert meetings (TEMs) have been convened, in order to create a space for non-political and facilitative discussions. The first of these meetings was held at COP19 in Warsaw 2013 as an in-session workshop on urbanisation and the role of sub-national governments in facilitating climate action in cities (Sterk *et al.*, 2013). Building on this positive experience, parties agreed to continue this format also during the intersessional meetings in 2014 and at COP20 in Lima.

However, in practice the results in terms of facilitating diffusion of knowledge were rather limited, in particular because a constructive discussion between delegates – usually senior staff of ministries of the environment or foreign affairs – and highly specialised issue experts was difficult to maintain. While the TEMs worked well in identifying best practice solutions they had very limited success in getting governments to actually adopt them (Hermwille, forthcoming). Consequently, the series of TEMs was complemented by high-level events of the so-called Lima-Paris Action Agenda (LPAA), which provided a stage to showcase particularly successful initiatives and announce new ones.

Although the mandate of the ADP ended at COP21, Parties agreed to continue the series of TEMs, now dubbed “technical examination processes” (TEPs), under the joint auspices of the Subsidiary Body for Implementation (SBI) and the Subsidiary Body for Scientific and Technological Advice (SBSTA). Parties also encouraged the Green Climate Fund (GCF) to engage in the process, and to provide information with respect to its contribution to the implementation of policies and measures identified in the TEP. Building on the Lima-Paris Action Agenda, Parties have also agreed to convene high-level events in conjunction with each COP between 2016–2020, and to appoint two high-level champions to facilitate high-level engagement.

COP22 in Marrakech was accompanied for the first time by a parallel large-scale technological solutions conference hosted by the Government of Morocco and co-organized by the World Business Council for Sustainable Development (WBCSD), the UN Sustainable Development Solutions Network (SDSN) and the ICLEI-Local Governments for Sustainability (ICLEI).

The UNFCCC has indirectly promoted learning through its function as ‘pacemaker’ for national discussions. In particular the landmark summits in Copenhagen and Paris confronted all countries with the question of what their contributions could be to the new agreements under negotiation. The UNFCCC thus galvanised national assessments and policy development, promoting better understanding of available options and mainstreaming of climate policy in governments (cf. Day *et al.*, 2015).

The UNFCCC has also promoted learning by requesting work from others such as the IPCC, e.g. the 2018 report on the 1.5°C limit. Generally, the UNFCCC has repeatedly raised new research questions (such as the implications of the 1.5°C goal) and has created ample demand for all kinds of climate services from natural science of the climate system, to socio-economic implications of decarbonisation pathways up to research on specific climate policies.

Last but not least, the UNFCCC has also indirectly promoted learning through its Kyoto Protocol instruments such as the Clean Development Mechanism (CDM) and Joint Implementation (JI). By incentivising private actors to identify and mobilise mitigation potential, these instruments have contributed to putting climate mitigation on the agenda of many private companies and getting a better picture of mitigation options and costs. These instruments have also contributed to building capacity on how to quantify GHG emissions and reductions. In China and possibly also in other countries, the capacity built by the CDM arguably contributed to the establishment of national emissions trading (Ba, Thiers and Liu, 2018).

2.6. Discussion and Conclusions

With its new 1.5°C goal and operationalisation in Art. 4.1, the PA provides a strong overarching signal towards for the decarbonisation of all sectors. Yet, the signal still entails various ambiguities and, more importantly, needs to be broken down and translated into sectoral targets and trajectories. For example, one such ambiguity relates to the role of natural gas in the power sector. On the one hand, gas can contribute to short-term emission reductions by substituting coal and also help to provide flexibility to accommodate increasing shares of intermittent renewable energy; on the other, in the long-run natural gas, like all other fossil fuels, needs to be phased out. For other sectors such as energy-intensive industries, the ambiguity of the signal is even greater, given that the (technological) pathways towards decarbonisation to date remain much less visible.

The PA’s focus on procedural rules and obligations of conduct does not sufficiently address direct and indirect competitiveness concerns of many sectors (as explored in various chapters of this report). Transparency is closely related to rule setting. UNFCCC provides transparency at the

aggregate level, but does not provide sufficient granularity to meaningfully inform sectoral transformations. Of course, the UNFCCC is no longer the “only game in town”. Other inter- and transnational institutions may already fill this gap to some extent (as explored in the chapters to follow).

While the amount of finance and the lack of ‘bindingness’ of the financial commitment constitute a major weak spot of the PA, the UNFCCC’s financial mechanism with the Green Climate Fund (see chapter 3) still constitute a potentially powerful lever. To fully employ it, the UNFCCC must collaborate with other international institutions. Coordinating with multilateral development banks (MDBs) is already happening to the extent that the World Bank and other MDBs are accredited entities to the Green Climate Fund and help to disburse the available funding. Another candidate for closer coordination would be the Mission Innovation initiative, a global initiative of 22 countries committing to increase funding on research and innovation for clean energy.

While the UNFCCC has historically contributed to knowledge creation and diffusion, it has done so mostly in an indirect or inadvertent way. The kind of knowledge and learning we have identified as required to facilitate sectoral transformations in the various sectors analysed below are not within the purview of the UNFCCC. Importantly, though, the UNFCCC has served as a centre of demand for related research.

As stated above, the UNFCCC is no longer the only game in town. Instead, it is only one - albeit important - element within a wider international climate governance landscape (Pattberg and Widerberg, 2017). Given the deficiencies that we have identified above, this must be considered a good thing. The PA alone cannot meet the sector-specific governance needs. The question is, whether and to what extent other inter- and transnational institutions can fill in the gaps. The subsequent analyses of seven key sectoral systems will address this question in more detail.

2.7. References

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3. Financial Sector

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3.1. Transformation Challenges and Governance Demands

3.1.1. Current Status and Prospect

In this analysis, we treat the financial sector as a complex sectoral system with challenges that are inherent to finance and its own structures, and other challenges that are directly linked to other sectors, such as energy, transport, analysed at length elsewhere in this report. The overarching challenge posed is how to finance the low-carbon transition while at the same time steering finance and investments away from current carbon-intensive trends, thus avoiding the lock-in of unsustainable development pathways. This has led to the new paradigm of what civil society organisations have termed “shifting the trillions” (of dollars) in the world’s economy.

Technologies and new business practices that objectively boost the low-carbon transition need massive amounts of investments to survive the so-called “valley of death” and to diffuse, mainstream and supplant old carbon-intensive alternatives (Grubb, Hourcade and Neuhoﬀ, 2014). In its last assessment report in 2014, the IPCC finds with high certainty that substantial emission reductions would require large changes in investment patterns by both the public and the private sector. For mitigation scenarios which stabilise concentrations in the range of 430 to 530 ppm CO₂-eq by 2100, annual investments in low carbon electricity supply and energy efficiency in key sectors (transport, industry and buildings) are projected to rise by several hundred billion dollars per year before 2030 (Intergovernmental Panel on Climate Change, 2014).

The Paris Agreement (PA)’s strengthened 1.5°C warming limit implies that an even greater scale and speed is necessary in shifting investments. Estimates of investment needs have been made available based on different methodologies, relative to different timeframes and sectors, making comparability difficult. Nevertheless, as a common trend, these estimates identify the order of magnitude for annual investments needs in climate action by 2020 to be well beyond USD 1 trillion (Mission 2020, 2017). The OECD, building on IEA and IRENA’s joint analysis of additional investment required in low-carbon technologies to achieve the 66% probability of 2°C scenario, estimated that the investment required to remain below 2°C will be USD 6.9 trillion per year over the next 15 years for new infrastructure, which represents merely a 10 per cent increase relative to the USD 6.3 trillion of annual infrastructure investment needs before taking into account climate issues (OECD, 2017). This number is to be compared with current infrastructure spending of around USD 3.4 to USD 4.4 trillion.

The long lifespan of infrastructure in sectors such as energy and transport means that investments must start to shift now towards an increased alignment with the goals of the PA, if we are avoid the risk of locking in future GHG emissions and fostering financial instability from large-scale ‘stranding’ of assets (OECD, 2017). While global investment in clean energy has been rising, volumes of finance for high carbon energy in all countries remain considerably higher (UNFCCC, 2016). Global climate finance flows have been growing from 97 billion USD in 2009/10 (Climate Policy Initiative, 2011) to

an annual average of 367 billion USD in 2013/2014, with the majority (93 per cent) of these funds going to efforts to reduce GHG emissions in three main areas: renewable energy generation, energy efficiency, and sustainable transport (Climate Policy Initiative, 2016). Similarly, public and private mobilised climate finance for developing countries has been growing over the past decade reaching an average of USD 57 billion per year for 2013/2014 (OECD/ CPI, 2015). This remains a small portion of government subsidies for *fossil fuel consumption* which reached around USD 513 billion a year globally in the same period (International Energy Agency, 2014). Public support by G20 governments in subsidies to *fossil fuel production* has been estimated at USD 444 billion a year (Bast *et al.*, 2015). A global removal of fossil fuel production subsidies would result in estimated GHG emissions reductions of up to 37 GtCO₂eq over the period 2017–2050 (Gerasimchuk *et al.*, 2017). To put this in context, total global GHG emissions in 2014 were 51 GtCO₂eq (Gütschow *et al.* 2017).¹⁸

Including the private finance side, capital expenditure on fossil fuel supply has been increasing steadily between 2000 and 2014, tripling in real terms. The trend was only interrupted in 2009 by the financial crisis and more recently by the steep drop in global energy prices. More recent estimates of “brown” finance (i.e. high-carbon financing and investments) put global investments in oil, gas and coal supply in 2015 at USD 900 billion, representing a decline of 18% from the USD 1.1 trillion in the peak year 2014 (OECD/IEA, 2016). It remains to be seen whether this is a lasting change in the investment flows.

Hence, it is clear that global investments still fall significantly short of what is needed to achieve national climate targets and global goals and are not yet consistent with the necessary transition away from fossil fuel financing. The financial transformation challenge is best illustrated by putting climate finance numbers and annual infrastructure needs in the context of total assets under management (see Figure 3.1 below).

These trillions of global assets are controlled by private entities, including the global banking sector, worth USD 140 trillion; institutional investors, such as pension funds and insurance companies, managing over USD 100 trillion; and capital markets including bonds and equities of over USD 100 trillion and USD 73 trillion respectively (Climate Policy Initiative, 2016). On the other hand, public financing aimed at mitigating climate change remains key in its role of directly mobilising and leveraging private sector investment and indirectly creating scaled up and commercially sustainable markets for low-carbon technologies (Maclean *et al.*, 2008).

The PA recognises the financial challenge as one of its overarching goals: The Agreement “*aims to strengthen the global response to the threat of climate change, in the context of sustainable development [...], including by [...] making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development*” (Article 2.1(c)). In doing so, the Agreement’s text highlights the role and potential of international cooperation in aligning the global financial system with the Sustainable Development Goals and this goal of the PA.

¹⁸ More detail on the issue of fossil fuel production subsidies can be found in chapter 6 on extractive industries.

The financial system is key for permitting and boosting the low-carbon transition on several fronts. Firstly, it does so by supporting concrete climate mitigation actions and the appropriate enabling environments. It also ensures that financial assets and portfolios become climate-aligned by internalising the costs of emissions to assets and mainstreaming climate risks into financial decision-making. Finally, decarbonisation efforts have to move from specific responsible investing niches towards reforming the financial system as a whole, so it can serve as a lever for a wide transformation permeating all other sectors of the real economy.

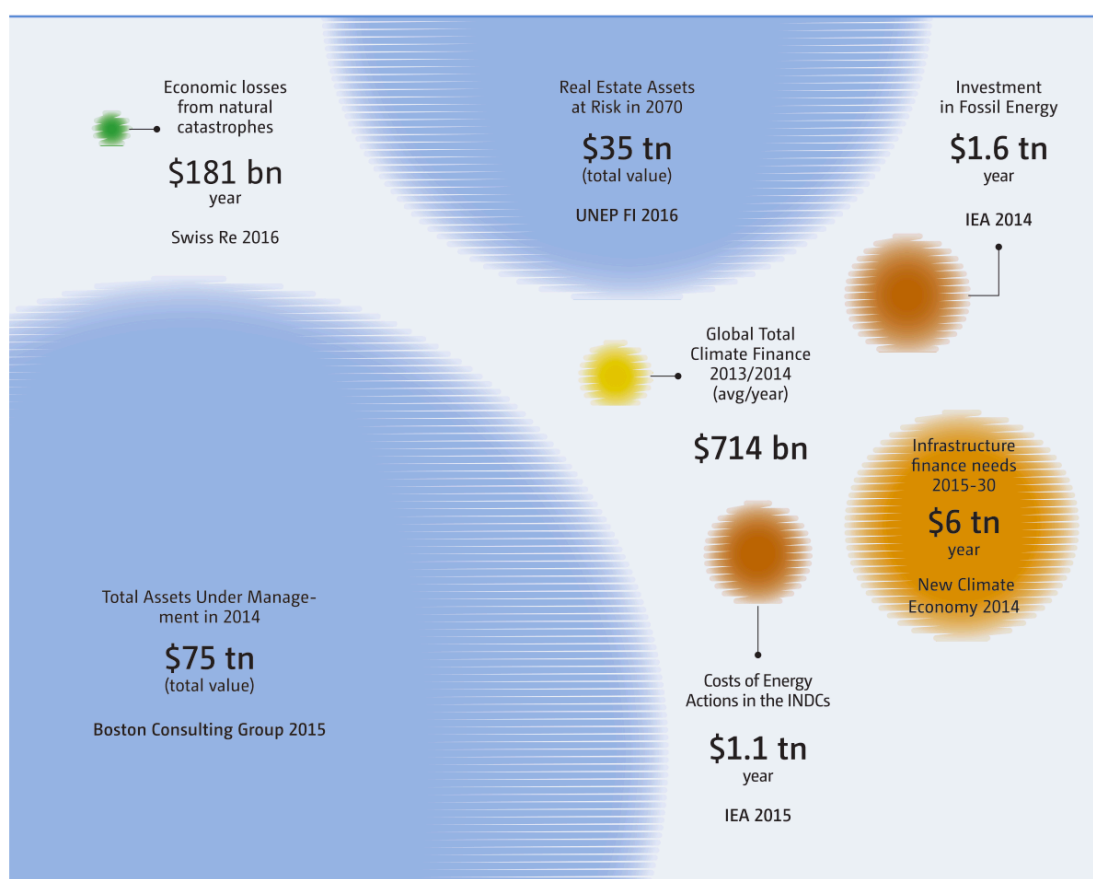


Figure 3.1: Global climate finance in context (UNFCCC, 2016)

3.1.2. Main Challenges and Barriers toward Decarbonisation

As in other sectors, the financial low-carbon transition is already underway but **needs to be accelerated from incrementalism towards transformation**. While much focus has been put on curbing emissions from specific sectors and pushing actions to regulate carbon intensity on the firm level, the financial sector holds the power to allocate capital to (i) “brown” and “climate-misaligned” activities, hence slowing down the implementation of the PA goals, or to (ii) “climate-aligned” activities, which can be considered as the entirety of investments flowing within the financial sector that do not pose objective obstacles to the PA, such as investments towards all goals of the

Sustainable Development Goals. Finally, as a sub-section of climate-aligned activities, we can define the (iii) “green” or “climate-focused” activities that are not only climate-aligned, but also essential for decarbonisation goals, such as investments into technologies and business models that can effect a transformational transition, including in renewables, energy efficiency, electric vehicles etc.

Decisions to invest in brown, climate-aligned or green activities are often carried out according to very short-term calculations of expected returns, creating a failure in financial markets to internalise medium to long-term risks and costs of climate change, potentially slowing down the transition if not properly addressed. Here, even when specific mechanisms are created to boost additional capital to green sectors, it’s still important to understand and trigger a broader transformation of the financial system (United Nations, 2018) to a direction that is consistent with decarbonisation pathways, in an effort to make all investments climate-aligned.

The “corporate veil” that separates firms from shareholders means that investors are protected to the limit of their investments from corporate actions and any liability arising from them. This effectively shields the financial sector from the objective responsibility for actions on the ground, allowing for a quicker and freer movement of capital, at the same time reducing the incentives for effectively including climate risks more comprehensively in the sector’s decision-making (Richardson, 2008). This might indicate one of the reasons why the internalisation of mitigation costs and climate risks is still under-represented on the portfolio level, with institutional and private investors still largely failing to acknowledge any positive correlation between socio-environmental criteria and financial performance (Friede, Busch and Bassen, 2015). Simply put, the sector works under the underlying assumption that a climate-aligned portfolio will not necessarily outperform a mixed or a brown one, even if the latter creates additional and externalised costs to society.

In order to correct this market failure, a growing number of initiatives have been put forward, such as those informing investors about the climate-alignment of assets through carbon content and climate-risk disclosure, policies to incentivise long-term investments over short-termism, capacity building to improve literacy regarding climate risks across investor classes. They seek to enable a holistic transition by internalising costs and risks into the financial decision-making. As an example, policy frameworks influencing investments in the energy sector may need to be reformed so that fossil fuel externalities are internalised into production and consumption practices. By setting strong carbon prices and eliminating distorting fossil fuel subsidies and other support to fossil fuels, governments can send a clear signal to the market about the increasing costs for running climate-misaligned activities. Such clearer policy direction, when coupled with new climate-related information from carbon disclosure requirements, allows investors to assess better climate risks. The result is likely to be a mix of both climate-misaligned investments becoming increasingly more expensive, for example in the form of higher interest rates or shortened repayment horizons, and investors moving away altogether from these risky investments with time.

This “moving away” can be translated into decreasing return expectations for the fossil fuel sector, stranding their assets over time. The reassessment of assets’ value as costs and opportunities forms a part of the *transition risks* of climate change (Carney, 2015), **making it imperative that a transition**

begins early and follows a predictable path in order to avoid a domino effect followed by a financial crisis from bursting the carbon (-intensive) bubble. However, it's important to underline that even with fears about the speed of this re-pricing process, or the “bursting of the carbon bubble”, climate risks from inaction and slow decarbonisation continue to mount at a fast pace, posing even greater risks for financial stability and future taxpayers (Kraemer, 2017), who are left with the burden and liabilities of today's flawed regulations and irresponsible investment decisions into carbon-intensive sectors.

In order to achieve a climate-aligned financial sector, as well as to develop climate-focused financial instruments and investment criteria to enable the decarbonisation, **there are economic, political, institutional and knowledge challenges and barriers** that need to be addressed:

A. Inconsistent Policy Signals by Governments

Inconsistent policy signals by governments are significant barriers for a decisive and orderly low-carbon transition. The PA has given a clear signal that strengthening the global response to the threat of climate change needs to make financial flows consistent with a pathway towards low GHG emissions and climate-resilient development. Given the all-encompassing characteristic of the decarbonisation goal, it is essential that policies are created and managed with a bigger picture perspective in mind, seeking to correct inconsistencies across all sectors that might erode the pursuit of the ultimate target of net-zero carbon emissions in the second half of the century.

According to OECD's Secretary General Angel Gurría, “the sum effect of policy misalignments in an economy can significantly undermine the effectiveness of climate policy efforts” (OECD *et al.*, 2015), making it of tantamount importance to identify and correct misalignments in policy domains such as investment, taxation, innovation and skills, trade, adaptation, and areas such as electricity, urban mobility and rural land use.

As an example, governments' ongoing backing and support to fossil fuel production creates **market distortions** by sending contrary signals to investors, which continue to make bad investment decisions and profit in the short-term from fossil fuels (Gerasimchuk *et al.*, 2017) while externalising risks and leaving cost burdens for future generations. Clear long-term policies and sufficient regulatory frameworks are needed to send appropriate signals to markets and investors, and to incentivise the engagement of the private sector (OECD/IEA and IRENA, 2017). While various efforts and initiatives such as carbon trading and fossil fuel subsidies reform have started to shift investments, these are generally at insufficient scale and still in early phases. G20 countries have not lived up to their commitment to phasing out inefficient fossil fuel subsidies, even though they account for 75% of global GHG emissions and about 82% of global energy-related CO₂ emissions (see chapter 6). While these countries have decreased the energy and carbon intensity of their economies, they are still at the early stages of decarbonisation and their collective efforts are not yet sufficient to lead to an overall reduction in GHG emissions. While renewable energy in these countries is on the rise, fossil fuels still dominate the energy market with coal being the primary energy supply for most G20 countries (Climate Transparency, 2017).

Subsidies to fossil fuel production further distort energy markets by lowering costs of oil, coal and gas production, thereby signalling to the market about potentially higher economic rent and increased revenue per invested unit from these activities. This is the case, including in comparison to other climate-aligned investments. This is one of the main reasons why energy efficiency and clean energy investments still remain less competitive in some markets (Gerasimchuk *et al.*, 2017). Some studies have found that a barrier for removing **fossil fuel consumer subsidies**, particularly in developing countries, is the rising cost of energy which is usually transferred to household consumers, which are most sensitive to price rises (Roberts, 2016). However, there are other studies that indicate eliminating fossil fuel subsidies does not affect all households equally, with higher income groups usually benefitting most from these subsidies (Coady *et al.*, 2015).

Beyond eliminating subsidies for fossil fuel production and consumption and other market distortions that block the internalisation of the full economic, social and environmental costs of GHG emissions, other market-based mechanisms intended to price carbon such as emission trading schemes or carbon taxes can provide further incentives to shift investments away from fossil fuels. However, remaining barriers to the market penetration of such mechanisms include **low prices of carbon and their insufficient coverage** relative to global GHG emissions, and non-equilibrium markets where price signals might not be directly taken up by players, such as energy sectors predominantly controlled by State-owned enterprises.

Carbon pricing, if well designed, could be a tool to lower GHG emissions and shift investments to low-carbon sources of energy. Various studies indicate that even where carbon-pricing schemes are in place, such as in G20 countries, prices remain too low to encourage a substantial shift to low carbon economies (Climate Transparency, 2017). According to Carbon Pricing Watch (2017), the number of carbon pricing initiatives implemented or scheduled has almost doubled over the past five years, including 40 national and 25 subnational jurisdictions, responsible for about a quarter of global GHG emissions. However, only about half of the total emissions from these jurisdictions are covered by the carbon-pricing initiatives, leading to a total coverage of only about 15 percent of global GHG emissions or about 8 GtCO₂eq (World Bank & Ecofys, 2017). Currently 60% of CO₂ emissions are priced at zero and less than 10% of the emissions are priced at EUR 30 or more (OECD, 2017). The High-Level Commission on Carbon Prices has stated that a carbon price level that is consistent with holding global temperature increase below 2°C is at least USD 40-80 per tonne of CO₂ by 2020 and USD 50–100 per tonne of CO₂ by 2030, with a supportive policy environment in place (Carbon Pricing Leadership Coalition, 2017). Since the study used scenarios to limit warming below 2°C with a greater than 66% probability, holding global temperature increase to well below 2°C and limiting this to 1.5°C would imply carbon prices at the high range or above these estimates.

B. Lack of Information and Knowledge

Lack of information and knowledge is another barrier that institutional investors and central banks face. Though the awareness and responsiveness to climate related risks of asset owners and investors has increased, most of them still lack in-house capacity and experience to develop an informed view about climate change scenarios and strategise accordingly. Moreover, many of these investors find it difficult to incorporate climate risks into their investment strategies (EY Financials Climate Change & Sustainability, 2016). A study even found that central banks do not consider as their responsibility to mainstream climate change into their operational decisions (Matikainen et al. 2017), which might be explained within the aforementioned context of “corporate veil” and the limited responsibility over public costs of climate change to financial markets.

C. Short-Termism

Another major barrier is the fact that investors tend to **prioritise financing to short-term liabilities**, impacting negatively on green investments which often require high upfront investment costs (Bank of England, 2017). High perceived risks, limited financial viability and limited long-term capital were identified as barrier for the private sector to invest in capital intense renewable energy projects (Frankfurt School of Finance & Management, 2016). Green investments typically suffer higher risk perceptions due to the relative lack of maturity of technologies, markets, and industries, especially in developing countries, and to the need of clear and long-term public policies signalling a path of change (Climate Policy Initiative, 2013). Moreover, investors often fail to recognise that delayed action should have a significant impact on stranded assets (IRENA, 2017). An overarching challenge is therefore how to channel the financial capability to support the low-carbon transition in the real economy. While governments remain important investors in sectors such as energy, with 42% share of investments in 2016 against 47% from the private sector (IEA, 2017), public money is starting also to be leveraged strategically to attract increased private capital to critical sectors and technologies. This can be done through the different types of “blended finance”, in which public money is used in mechanisms such as risk mitigation instruments including risk pooling and transfer, public concessional financing and guarantees (Frankfurt School of Finance & Management, 2016).

D. Transparency and Accountability

While there is growing momentum for financial institutions to **disclose climate risks** in their investment portfolios to investors, the **lack of coherent, comparable and standardised approach to assess and disclose risks** remains the biggest barrier. In order to address this concern, the G20 in 2015 requested the Financial Stability Board (FSB) to review how the financial sector can take account of climate related issues (TCFD, 2016). The Task Force on Climate-related Financial Disclosures (TCFD), established by the FSB, designed a coherent but voluntary framework for disclosing clear, comparable and consistent information about the risks and opportunities of climate change. The Task Force recommended that climate-related financial disclosures should be mainstreamed into financial institutions’ public annual financial filings to inform investors and others on climate-related risks and opportunities (TCFD, 2017). The fact that it is voluntary continues to create challenges - with the exception of France, that became the first country to introduce mandatory climate change-related reporting for institutional investors in 2016 (Rust, 2016).

Disclosure and more transparent frameworks should produce **better data**, also important to advance **climate-related criteria** for financial markets, informing for example positive lists with investment priorities, qualitative conditions to determine projects that might receive funding, quantitative conditions with indicators and minimum thresholds for funding projects and negative lists with technologies, industries and sectors that might be excluded from financing (Höhne *et al.*, 2017). This is relevant for increasing consistent **transparency and accountability**.

3.1.3. The Promise and Potential of International Cooperation (i.e. Governance Demand)

Given the complexity of the financial sector, the overall demand for international governance for decarbonisation is very high, especially for the governance functions related to guidance and signal, setting rules to facilitate collective action, transparency and accountability, as well as knowledge and learning. The primary demands (summarised in Table 3.1) are as follows.

The demand for **guidance and signal** in the form of consistent, credible and long-term climate policies is particularly high in order for investors and financial actors to align their decision-making with international climate objectives. A strong signalling effect is necessary to address the “tragedy of the horizons” (Carney 2015) and to bring long-term climate impacts and “social cost of carbon” (Carbon Pricing Leadership Coalition, 2017) into short-term financial decision-making. For example, investors and companies regularly call for a price signal that would correct policy and market failures, but this should be substituted with other regulatory measures whenever pricing is not effective (OECD *et al.*, 2015). A cross-cutting signalling that goes beyond the energy sector must be carried out, such as in taxation, in innovation and skills and in international trade barriers.

Fulfilling the **setting rules** function is crucial for developing and agreeing on international standards, benchmarks and metrics for 1.5 degree-compatible investments and carbon prices. This would provide clarity and consistency to public and private financial actors for how to align their portfolios and business models with the long-term temperature target. Ideally, international cooperation would facilitate collective mobilisation targets for climate-specific investments as well as targets for phasing out fossil fuel subsidies and high-carbon investments with clear timeframes and fair burden-sharing approaches. Further, to track progress in redirecting global financial flows, common accounting and reporting rules are required that capture both high-carbon and low-carbon investments.

Enhanced **transparency and accountability** regimes are essential for the decarbonisation targets set by the financial sector’s international governance. Within the financial sector, reforming investor duties and disclosure rules for investors and companies are a precondition to effect change in investment practices, as well as to hold financial institutions accountable to international finance’s targets. The need to fulfil this function is high, in order to address issues of free-riding, double-counting, additionality of flows, as well as “green-washing” of continued high-carbon investment practices.

International governance is required to facilitate the mobilisation of the **means of implementation** so developing countries can translate low-carbon and climate-resilient development strategies into climate investment plans ready for implementation. Further data on private financial flows and



carbon risks, which becomes possible with the increased transparency and accountability regimes, as well as institutional capacity-building, are necessary in both governments and financial institutions in order to build and implement international mainstreaming standards, performance metrics and disclosure rules. More advanced international financial institutions might acquire the role to provide capacity-building and to encourage other financial institutions such as national development banks in pursuing mainstreaming efforts.

Exchange of **knowledge and learning** is critical to know which policies work best to mobilise climate finance and to shift financial flows away from climate-misaligned assets. International cooperation among financial institutions and investors is required to facilitate sharing of knowledge related to climate risk analysis and management in the financial sector.



Table 3.1: Synthesis of finance-related governance demands

	Guidance and Signal	Collective Action	Transparency and Accountability	Means of implementation	Knowledge and Learning
Financial Sector	High	High	High	Medium	High
	<ul style="list-style-type: none"> • Consistent and coherent long-term climate policy actions • Environmental and economic policy signals and regulatory frameworks for investors • Pricing of carbon and removal of fossil fuel subsidies 	<ul style="list-style-type: none"> • International standards, benchmarks and metrics for 1.5 degree-compatible investments • Developing fair burden sharing approaches • Agree on concepts, definitions and methodologies for accounting and reporting rules that capture both high- and low-carbon investments. Set a minimum carbon price and target for phasing out fossil fuel subsidies 	<ul style="list-style-type: none"> • Reforming investor duties and disclosure rules for investors and companies • Enhanced transparency framework 	<ul style="list-style-type: none"> • Mobilisation of climate finance for developing countries to translate and implement their low-carbon and climate-resilient development strategies • Building capacity in governments and financial institutions to implement international mainstreaming standards, performance metrics and disclosure rules • Capacity building to financial institutions for mainstreaming efforts 	<ul style="list-style-type: none"> • Exchange of knowledge on policies that work best to mobilise climate finance and shift financial flows from climate mis-aligned assets • International cooperation among financial institutions to exchange knowledge in developing scenarios and methodologies related to climate risks analysis and management

3.2. Governance Supply

There are a high number of existing intergovernmental and transnational initiatives and institutions relevant for international governance of climate finance specifically and the financial sector more broadly. While the UNFCCC and the PA in particular play an important role for setting targets for climate finance mobilisation, establishing specialised climate funds and sending policy signals to the private sector, several relevant investor- and industry-led initiatives have also emerged. Beyond the UNFCCC, a number of climate-relevant overarching institutions are also relevant for the finance sector, such as international development finance institutions.

3.2.1. Finance in the UNFCCC

As noted in chapter 2, under the UNFCCC, industrialised countries have an obligation to provide financial resources for the implementation of developing countries' emission reduction and adaptation measures and have set collective mobilisation goals. Most notably, the 2009 Copenhagen conference of the parties produced the commitment by developed countries to jointly mobilise USD 100 billion annually in public and private financing by 2020, with a portion of that flowing through the UNFCCC's Financial Mechanism comprised of the **Global Environment Facility (GEF)** and the **Green Climate Fund (GCF)**. The GEF Trust Fund, established in 1992, is replenished with financial contributions every four years and administered by the World Bank. Besides the UNFCCC, it serves a number of other multilateral environmental agreements. Other trust funds under the GEF are the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund (LDCF). The Green Climate Fund was established in 2010 and capitalised with USD 10 billion as the largest dedicated climate fund with a clear mandate to contribute to the shift towards low-emission and climate-resilient development pathways. Since 2010, the UNFCCC's **Standing Committee on Finance (SCF)** has been mandated to assist with technical aspect of climate finance, with particular relevance for consistency in climate finance delivery and tracking of global climate finance flows to developing countries. Its authoritative reports (Biennial Assessment and Overview of Climate Finance Flows) have pointed to methodological issues in accounting and reporting of climate finance and provided recommendations for improving consistency and comparability.

The **PA's** strongest signal for the decarbonisation of the financial sector lies in the first ever recognition of the role of financial flows for the achievement of the long-term temperature goal in international law. The aim to make all finance flows consistent with low-carbon development pathways is stipulated as one of the three overarching goals of the Agreement itself (Article 2.1(c) Paris Agreement). This includes both the alignment of overall flows away from carbon-intensive and misaligned activities and the scaling-up of available green finance for efforts and technologies enabling low-carbon transition. The Agreement also stipulates the need for scaled-up financial resources for mitigation and adaptation in developing countries, with the accompanying decision establishing the existing target of USD 100 billion annually as a minimum level for the period of 2020 to 2025, while postponing the formulation of a strengthened target to 2025 (UNFCCC, Decision 1/CP.21, paragraphs 53 and 114). Finance is also part of the Agreement's enhanced transparency framework and so-called 5-yearly periodic global stocktake (GST) ambition mechanism. The PA thus

constitutes the guiding framework for global climate finance governance through three main elements:

- i. **Goal-setting:** More broadly, the setting of the overarching vision that all public and private global financial flows should be aligned with the long-term temperature goal; and specifically the setting of collective public finance mobilisation targets to support the transition in developing countries;
- ii. **Enhancing transparency and accountability:** Developing internationally agreed rules and methodologies for counting and reporting climate finance flows to developing countries;
- iii. **Facilitating tracking of collective progress:** Every five years, as part of the Agreement's Global Stocktake, assessing progress towards achieving the finance goals of mobilising at least 100 billion USD a year to developing countries and shifting financing away from fossil fuels to low-carbon development.

Overall, the PA's three overarching goals expressed in Article 2, in particular the strengthened long-term temperature goal and the finance-related goal to make all finance flows consistent with low-carbon development seem to *partially satisfy* the identified demand for **guidance and signal**. While it sends a strong signal to the private sector and financial actors, the PA lacks concrete provisions on how to achieve the finance goal. Nevertheless the formal recognition of the role of global finance beyond North-South transfers for global decarbonisation signals that finance considerations need to form part of Parties' mitigation contributions, reporting obligations and long-term low emissions development strategies.

In the absence of an international price on carbon or an explicit commitment to phase out fossil fuel subsidies in the PA, Article 2.1(c) has a crucial role as a guiding framework and catalyst for related efforts outside of the UNFCCC, e.g. other fora such as G20 and financial institutions including MDBs. Hence its successful implementation will depend on other institutions of the climate regime complex. However, there is a high potential for the UNFCCC to play an important orchestration role in the assessment of collective progress towards achieving the PA's goals through the 5-yearly periodic GST. If well-designed and coupled with the Agreement's mandate to develop common financial accounting and reporting rules, the UNFCCC could serve as a framework for **collective action** and **transparency/accountability** for "shifting the trillions" by regularly assessing the alignment of global finance with the 1.5°C temperature limit.

The three Biennial Assessment and Overview of Climate Finance Flows reports from the SCF have started to develop metrics for putting climate finance figures in relation to global financial assets in the realm of trillions. In light of climate finance mobilisation targets that are well beyond identified investment needs under 1.5°C/ well below 2°C compatible scenarios and a lack of burden-sharing arrangements, the **setting rules** function is only *partially satisfied*. The potential for financial mobilisation is also somewhat limited under the UNFCCC as a bulk of necessary investment will have to come from the private sector.

3.2.2. Specialised Climate Funds Inside and Outside the UNFCCC

As specialised funds, it is the mandate of climate funds to mobilise climate-specific financing. Mobilised public capital has been either invested directly in projects that fulfil the funds' mandates, or increasingly seek means to attract additional commercial public and private capital through leveraging and "blended finance" in order to scale-up available financing. Climate funds are on their own a type of structure that can be used to mitigate financial risks and "crowd-in" additional private capital, channelling the mobilisation through instruments such as debt, equity and mezzanine instruments, guarantees and insurance, hedging, grants and technical assistance (OECD, 2018).

- i. The **GCF**, that initially mobilised US\$ 10.3 billion in 2014, had at the time of writing a portfolio of 76 approved projects with a committed fund of US\$ 3.7 billion. Due to its transformational mandate and business model of working with partner institutions including national and international development finance institutions, civil society organisations and those from the private sector, the GCF can encourage change within the partner institutions towards low-carbon portfolios. This means that entities that are accredited under the GCF must demonstrate a process towards aligning their investments with the goals set in the PA.
- ii. The **GEF**, as the financial mechanism for numerous multilateral environmental agreements, has adopted a strategy of supporting integrated solutions to environmental challenges such as sustainable city development and deforestation, which have also great relevance for lowering GHG emissions. The total climate funding available across the current GEF-6 and previous GEF-5 replenishment periods amount to \$3.03 billion (WRI 2017).
- iii. G8 leaders recognised increased costs of climate change and set up the **Climate Investment Funds (CIFs)** in 2008. Besides the UNFCCC climate funds, the USD 8.3 billion under the CIFs have played a significant role in supporting 72 developing countries in their (adaptation and) mitigation actions and mobilising financial resources through four funds: Clean Technology Fund (CTF), Forest Investment Programme (FIP), Scaling Up Renewable Energy Programme (SREP) and Pilot Programme for Climate Resilience (PPCR).

In the last decade, the three biggest climate funds (GEF, GCF and CIFs) have mobilised around \$20 billion in climate finance. However, the adequacy of the scale and delivery of resources can be questioned. In the context of the magnitude of the climate challenge and the goal to scale-up towards \$100 billion annually by 2020 (including not only climate funds), \$20 billion remains insufficient, and future pledges are uncertain. What is more, the World Bank-administered GEF and CIFs that channel resources largely through MDBs are not fully accepted by developing countries and civil society and have been criticised for a lack of country-ownership.

This is one of the reasons why the GCF was set up and includes country ownership and direct access modalities in the core of its mandate. The direct access modality and readiness support programme indicate a stronger focus on capacity-building in developing countries. In addition to **means of implementation**, the GCF's mandate to promote the paradigm shift and to jointly mobilise funding

at scale from public and private sectors satisfies well the demand for **guidance and signal** and **setting rules to facilitate collective action**.

The GCF's requirement for partner organisations to report on their progress towards decarbonising their overall financial portfolios also contributes to the **signal and guidance**, and **transparency and accountability** functions. Developing an international methodology to establish portfolio baselines for assessing progress also contributes to **setting rules to facilitate collective action**.

The GCF is criticised by some civil society organisations and also faces issues with social acceptability and fairness due to accrediting international financial institutions and commercial banks with a track record in fossil fuel financing, which is seen as incompatible with the Fund's mandate. Some civil society organisations have further criticised the GCF for not agreeing on an exclusion list of fossil fuel projects. Even though it has no explicit exclusion list of fossil fuel projects, the GCF's objectives and Investment Criteria indirectly imply that only those projects that are aligned with the 1.5°C goal will be funded. The question is to what extent this tension is irreconcilable or can be used to effect change within the banks' strategies and portfolios. Commercial banks' continued lending to top companies responsible for the extraction, processing, and burning of fossil fuels impede efforts to make global finance flows consistent with low-carbon development pathways. Between 2014 and 2017, the global banking sector provided and mobilised financing over USD 600 billion for the top 120 coal plan developers – a clear contradiction to international governance efforts to provide guidance and signal, facilitation of collective action, and transparency and accountability for the low-carbon transition (Bank Track, 2017).

3.2.3. International, Bilateral and Regional Development Finance Institutions

The World Bank Group (WBG) and other Multilateral Development Banks (MDBs), as international financial institutions providing financial assistance globally to support sustainable development and relief programmes, play a significant role in providing financing to the public and private sector for investments that promote the transition to a low-carbon economy.

- National and sub-regional development banks also play an increasing role in supporting global sustainable development and enabling countries to align with the PA. The **International Development Finance Club (IDFC)** brings together like-minded international, national and regional development banks with total assets of more than \$2 trillion and focuses on financing green infrastructure, improving its joint green finance tracking methodology and developing international best practice standards.
- Through the **Climate Action in Financial Institutions Initiative**, members of the IDFC and MDBs have committed to align their financial flows with the PA. The initiative has also been joined by several commercial banks.

Development finance institutions as providers of public finance for mitigation projects in developing countries at a higher scale than multilateral climate funds satisfy well the **means of implementation** function. For example, the world's six largest MDBs have reported jointly on climate finance to

developing countries and emerging economies since 2011 and have collectively committed over \$158 billion from 2011 to 2016 (AfDB *et al.*, 2015). Between 2011 and 2016, the WBG alone committed on average more than \$10 billion a year to more than 1000 climate-related projects, hence satisfying the **means of implementation and knowledge and learning** functions. MDBs have also committed to align their financial flows with the PA, for which they will have to develop transition strategies and self-assess their progress towards aligning their portfolio spending with the PA. For example, the European Investment Bank (EIB) has put a plan in place to assess its alignment with the PA as part of its mid-term review of its Climate Strategy 5 year Implementation (Wright *et al.*, 2018). In addition, the WBG's 2013 announcement to stop financing coal-fired generation projects, and its 2017 announcement to stop financing upstream oil and gas after 2019, partially satisfy the demand for **guidance and signal**, including to other MDBs and financial institutions. The WBG has also pledged to report annually its greenhouse gas emissions from the investment projects it finances particularly in the energy sector, starting from end of 2018.

However, while in 2016 alone six major MDBs provided \$27,441 million in mitigation finance (AfDB *et al.*, 2015), some of the banks invested almost as much in fossil fuels as they do in energy-related climate finance. According to Oil Change International, the same MDBs continued to finance substantial amounts of new fossil fuel infrastructure through 2015 (\$83 billion from 2008 to 2015) and by all indications into 2016 and 2017 (Doukas and Bast, 2017). An analysis by E3G shows a ratio by the World Bank of 1.2 units invested in energy-related climate finance for each 1 unit invested in fossil finance; 1.2 : 1 for the European Bank for Reconstruction & Development; 1 : 1 for the European Investment Bank; and 0.9 : 1 for the Asian Development Bank (Wright *et al.*, 2018). The World Bank's 2016 mitigation finance of \$8 billion is only 13 per cent of its total portfolio worth \$61 billion (World Bank, 2016). The fossil fuel divestment campaign challenges the social acceptability and fairness of the WBG by criticising its continued support for fossil fuel projects, as well as adverse social and environmental impacts of their activities for affected populations. The WBG has been accused of indirectly continuing its coal support through the IFC, its private sector lending arm. According to an NGO report, "IFC-supported financial institutions have funded at least 41 new coal projects [...] since the World Bank announced its coal ban in 2013" (Inclusive Development International, 2016). While the WBG's announcement (World Bank, 2017) to stop financing upstream oil and gas investment starting from 2019 is significant, it means that midstream and downstream gas and oil investments will not be affected.

The **Climate Action in Financial Institutions Initiative**, due to its support from several major development finance institutions and commercial banks, their commitment to mainstreaming of climate action throughout the financial community and their adoption of five voluntary mainstreaming principles satisfy the functions of **guidance and signal**, **setting rules** (partially), as well as **knowledge and learning**. The **transparency and accountability** function is partially fulfilled, as one of the principles concerns transparency and disclosure of climate information. IDFC members in 2016 jointly committed \$153 billion in mitigation finance. Through their technical assistance and policy support to developing countries, they also score high on the **knowledge and learning** function.

3.2.4. Institutional Investor Initiatives

Institutional investors are the largest group of private sector financiers and comprise a multitude of actors ranging from insurance companies, pension funds and sovereign wealth funds. Institutional investors are estimated to manage large portfolios of assets reaching around \$93 trillion – hence a large portion of global finance flows that have to be redirected to be made compatible with 1.5°C compatible decarbonisation pathways. Climate-relevant institutions and initiatives that are led by or mobilise those investors to align their investment practices and reduce their portfolio carbon footprints therefore have a high potential for contributing to a low-carbon financial sector. Such initiatives include:

- The **Global Investor Coalition on Climate Change (GIC)**, a joint initiative of four regional climate change investor groups, namely Institutional Investors Group on Climate Change (IIGCC) for Europe, Investor Network on Climate Risk (INCR) for North America, Investor Group on Climate Change (IGCC) for Australia and New Zealand, and Asia Investor Group on Climate Change (AIGCC) for Asia. The GIC regional investor networks collaborate on joint international projects focused on climate policy, corporate engagement and investment practices, including investor statements on climate change.
- **Portfolio Decarbonisation Coalition (PDC) and Montreal Carbon Pledge**, a multi-stakeholder initiative aiming at mobilising a critical mass of institutional investors committed to gradually decarbonising their portfolios through disclosing information on the carbon intensity of their capital and annually reporting their decarbonisation progress. The 2017 annual report includes 32 investors representing over \$800 billion in decarbonisation commitments. Signing the so-called Montréal Carbon Pledge allows investors (asset owners and investment managers) to formalise their commitment to the goals of the PDC. The Pledge is overseen by the **Principles for Responsible Investment (PRI)**, an investor initiative in partnership with UNEP Finance Initiative (FI) supporting its international network of investors to integrate environmental, social and governance (ESG) factors in their investment decisions.
- The **UNEP Finance Initiative (UNEP FI)**, a global partnership between UNEP and the financial sector, acts as a sort of interface between world governments including financial regulators and over 200 banks, insurers, and investors to bring about systemic change in the financial sector.
- The **Climate Wise**, which is the global insurance industry's leadership group driving action on climate change risk.

The above identified initiatives that involve institutional investors largely fulfil the **guidance and signal** function as well as **knowledge and learning**. Especially the GIC, as a global investor network connecting regional networks, fulfils the need for knowledge and **learning**, including through exchanging on best practices and standards. In addition, the PDC and Montreal Carbon Pledge at least partially satisfy the demand for **collective action**, as well as **transparency and accountability**,

as they focus on commitments to measure, disclose and reduce their portfolio carbon footprint. The UNEP FI also has an element of **knowledge and learning** through its capacity-building activities. It is relevant to note, however, that the decentralised character of these initiatives often create overlapping of efforts and results. In the case of guidance and signal, as well as for transparency and accountability, the consequence is that implementation loses legitimacy, with possibility of greenwashing claims when the process of creation is deemed as not participative enough or the criteria's effectiveness is perceived as insufficient for its purpose. Also, the freedom by firms and investors to choose from a multitude of competing standard-setting sources can generate a "race-to-the-bottom" process, in which less ambitious criteria might be more commonly adopted in detriment of more climate-aligned and stringent ones.

3.2.5. Central Banks and Supervisors

The role of central banks and financial supervisors in the transition to a low carbon economy, through monetary policy instruments and financial regulation (e.g. capital requirements, disclosure rules) influencing capital flows into different sectors, has been largely under-explored. Aligning the credit and monetary system with the low-carbon transition would provide strong **guidance and signal** as well as **setting rules** functions for greening the financial system. The enormous risk of climate change for financial stability and the need for "breaking the tragedy of the horizon" has been famously highlighted by the governor of the Bank of England, Mark Carney. It led to the founding of the **Network of Central Banks and Supervisors for Greening the Financial System**, which united central banks and supervisors of eight countries. Starting work in 2018, the network is aiming to speed up climate mainstreaming in financial supervision and refinancing of secondary markets (commercial banks) in order to promote orderly development of green finance. This Network *partially satisfies* the demands for **guidance and signal** and **collective action** functions and satisfies well the **knowledge and learning** function.

3.2.6. Standards, Benchmarks and Metrics

Especially important for the functions **knowledge and learning** and **transparency and accountability**, **private sector and civil society initiatives that develop metrics and standards to prioritise climate compatible financial products and investments** can provide international metrics to guide the low-carbon transition. These climate-related criteria can be targeted at specific institutions, sectors or technologies, creating positive lists, qualitative and quantitative conditions, and negative lists (Höhne *et al.*, 2017) and have been developed by initiatives such as:

- The Gold Standard;
- Climate Bond Initiative;
- 2 Degrees Investing Initiative; and
- Climate Change Reporting and Fiduciary Duty.

The absence of a more concerted setting of rules by a single institution or a group of institutions together means that different standards, benchmarks and metrics can end up competing among themselves. This creates uncertainty and increases risks for the market regarding what should be an aligned, a brown or a green investment, and what might constitute greenwashing, with the

respective reputational and financial risks. In the meantime, initiatives such as The Gold Standard, Climate Bond Initiative, 2 Degrees Investing Initiative, Climate Change Reporting and Fiduciary Duty satisfy the demand for **knowledge and learning** by feeding the system with 1.5 °C compatible standards, benchmarks and metrics. While they cannot set rules themselves, they contribute to satisfying the demand for international **rules-setting to facilitate collective action**.

3.2.7. Global Divestment Movements

Especially important for the **guidance and signal** function, growing global civil society movements such as the **Fossil Free campaign** are highlighting the moral imperative of moving investments away from the fossil fuel industry. By 2018, 785 governments, pension funds, private companies, foundations, NGOs, educational and faith-based organisations have joined the **Divest-Invest global network** and pledged to shift their capital. The **Big Shift Global campaign** aims to mobilise public opinion for urging MDBs to shift their portfolios away from fossil fuels.

These global divestment movements satisfy two governance functions, namely **guidance and signal** and by mobilising public awareness and changing social values also **knowledge and learning**.

3.2.8. G20 Initiatives

As a joint forum of industrialised nations and major emerging economies, collectively G20 countries account for about 80 per cent of global economic output. Traditionally a forum for economic and financial issues, since 2009 climate change has moved more and more on its agenda. Within the so-called **“finance track”**, in which finance ministers and central bank governors meet, the G20 established a **study group on climate finance** in 2012 and the **Green Finance Study Group** in 2016.

While G20 decisions may not be legally binding, they have a strong political signalling effect for reforms on national and multinational levels. The most significant development for mainstreaming climate in the financial sector has been the G20 request to its Financial Stability Board to consider climate risk, which led to the establishment of an industry-led **task force on developing climate-related financial disclosures (TCFD)** as a prerequisite for financial firms appropriately manage and price climate risks. Three countries (France, Sweden and the UK) and more than 200 businesses have pledged to support the implementation of the recommendations by the FSB.

The G20's reiterated yet unimplemented commitment to phasing out inefficient fossil fuel subsidies (see chapter 6) and its establishment of the Green Finance Study Group are significant political signals, at least in light of the group's major share in global financial assets and GHG emissions. However, the initiatives only fulfil little of the needed **guidance and signal** function due to the unimplemented and/or voluntary nature of its outputs. The work of the Green Finance Study Group partially satisfies the **knowledge and learning** function.

G20 governments' continued public support to high-carbon infrastructure directly impedes fulfilling the necessary governance functions of **guidance and signal**, **setting rules**, and **transparency and accountability**. G20 countries' public finance institutions, such as national and international

development banks, majority state-owned banks and export credit agencies, spent over US\$ 88 billion on average annually on coal, oil and gas projects between 2013 and 2014 (Bast et al., 2015). Further, G20's continued fossil fuel subsidies are in acute conflict with the PA's low-carbon guidance and signal and rules for collective actions. In fact, as a negative carbon price, it has a negative signalling effect. Despite their repeated commitment since 2009 to phase out inefficient fossil fuel subsidies, G20 countries provided over USD 230 billion subsidies to coal, oil and gas in 2014 (Climate Transparency, 2017).

The TCFD *satisfies* several functions, albeit partially since its recommendations remain voluntary to encourage broad participation: by recommending standardised and universally-applicable climate-related financial disclosure, it scores on **guidance and signal, rule-setting, transparency and accountability**, and **knowledge and learning**. Especially the recommendation to provide climate-related disclosure as part of mainstream public financial filings is relevant for **transparency** and could be a step to hold companies and financial institutions accountable.

3.2.9. Carbon Pricing and Fossil Fuel Subsidy Reform Initiatives

An internationally agreed and adequate carbon price would in a way be the strongest and most credible policy signal to the financial sector and would facilitate transnational collective action. International cooperation on carbon pricing is required to ensure consistency across countries and to avoid possible carbon leakage and trade distortions. While the PA did not set an explicit price on carbon through a carbon tax or a cap and trade system, there is continued momentum for carbon pricing through existing and emerging carbon initiatives beyond the UNFCCC.

- **China's national cap and trade carbon market** is set to replace the **EU Emission Trading Scheme (EUETS)** as the largest carbon market in the world, and the platform for cooperation on "Carbon Pricing in the Americas (CPA) was created in 2017. However, coverage of GHG emissions under these schemes remains limited.
- The so-called **Carbon Pricing Leadership Coalition (CPLC)**, a voluntary partnership of national and sub-national governments, businesses, and civil society organisations that was launched in Paris, has adopted and is working towards the long-term objective of a carbon price applied throughout the global economy that is in line with the PA objectives. CPLC is complemented by a high-level political **Carbon Pricing Panel** that calls for the expansion of carbon pricing coverage to 25 percent of global emissions by 2020 and 50 percent by 2030, as well as a **High Level Economic Commission** that aims to identify Paris-compatible corridors of carbon prices. Its influential 2017 high-level report on carbon prices (the so-called Stern-Stieglitz report) (High-level Commission on Carbon Pricing 2017) finds that explicit carbon-price levels consistent with achieving the Paris temperature limit would have to significantly increase from current levels to at least US\$40 – 80/tCO₂ by 2020 and US\$50 – 100/ tCO₂ by 2030. It is significant that this high-level economic report also highlights the currently underestimated "social cost of carbon".

- The Stern-Stiglitz report also mentions the reduction of fossil fuel subsidies as an essential part of carbon pricing, as subsidies in effect constitute a negative price on carbon and hinder the achievement of climate targets. Hence subsidies provide a negative guidance and signal that are inconsistent with climate policy signals. Every year since 2009, the G20 has pledged to phase out fossil fuel subsidies, however this pledge lacks a plan for implementation. In 2010, a group of non-G20 members formed the **Friends of Fossil Fuel Subsidy Reform** (FFFSR) initiative to encourage the G20 to implement their commitment.

The Carbon Pricing Leadership Coalition and the FFFSR initiative fulfil several functions: **guidance and signal**, support for **setting rules** and **knowledge and learning** by developing pathways for different carbon pricing policies and timelines, encouraging other countries to join the initiative and implement their commitments, and creating platforms for sharing experiences.

3.2.10. Research Initiatives on Green Finance and Financial Sector Reform

Various research initiatives on climate finance, renewable energy finance and green finance have emerged that are relevant in the context of international governance demands of **knowledge and learning** and **transparency and accountability**. They serve as international research collaboratives, networks and platforms that produce technical and policy knowledge on mobilising and tracking climate finance and standards for greening the financial sector, as well as best practice learning, often through a hybrid structure including governments, the finance sector and civil society. These include:

- UNEP FI & UNEP Inquiry Research on Sustainable Financial System
- OECD Centre on Green Finance and Investment & OECD Tracking Private Climate Finance initiative
- Global Commission on the Economy and Climate
- Global Innovation Lab for Climate Finance, and
- IRENA and IEA produce knowledge on international renewable energy finance.

These international research initiatives satisfy mainly the **knowledge and learning** function. In addition, the OECD's initiatives of Tracking Private Climate Finance further contribute to the **transparency and accountability** function by working to promote a more transparent and comprehensive international measurement and reporting system for climate finance.

3.3. Assessing the Governance Complex

Due to the complexity of the financial sector and the impact of financial sector governance for different sectors in the real economy, the overall need for international governance has been identified as very high, especially for the governance functions related to guidance and signal, rule-setting to facilitate collective action, transparency and accountability, and knowledge and learning. These are discussed in turn below.

However it has not been not feasible to include an overall ranking (low, medium, high) on the supply-side for each of the five governance functions considered, given the number of institutions and initiatives, and the broad diversity of their contributions towards governance supply functions, within the financial sector. A more detailed methodological approach for how rankings could be calculated and applied would need to be developed before overall rankings could be applied in an objective, non-arbitrary way. In view of this, the following analysis instead provides a brief overview of how institutions and initiatives deliver on the different governance functions.

3.3.1. Guidance and Signal

The PA's article 2.1(c) and its Financial Mechanism comprised of the GCF and GEF, as well as other specialised climate funds such as the NAMA facility and CIFs, fulfil their role of **guidance and signal function** with their direct mandate to support the transformation towards low-carbon economies.

There is **some guidance and signal provided**, at least indirectly, by many initiatives involving financial institutions including MDBs and institutional investors, who have started to adopt joint objectives for mainstreaming climate across portfolios. The World Bank's recent announcement to no longer finance upstream oil and gas sends a strong signal in that regard. The role of MDBs in demonstrating how different innovative financing mechanisms work, as is the case with green bonds and de-risking activities, has provided the guidance for other actors to replicate leveraging strategies and attract private financing for climate-aligned and climate-focused projects on the local, national and regional levels.

Other international fora such as the G20 Finance track, Green Finance Study Group, and in particular the TCFD overall respond to the **guidance and signal function** with increasing adoption of objectives related to managing the risk that climate poses to the global economy.

3.3.2. Setting Rules to Facilitate Collective Action

The UNFCCC could serve as a framework to facilitate collective action in setting common accounting and reporting rules for 1.5 °C-compatible investments. Specialised climate funds could also fulfil the function of facilitating collective action by jointly mobilising climate finance.

Initiatives such as the Gold Standard, Climate Bond Initiative, 2 Degrees Investing Initiative, Climate Change Reporting and Fiduciary Duty contribute to satisfying the demand for international **rules-setting and collective action**. Other initiatives by institutional investors such as the PDC and Montreal Carbon Pledge with their commitments to measure and disclose their portfolio carbon footprint partially satisfy the **collective action** governance function.

3.3.3. Transparency and Accountability

The enhanced transparency framework established by the PA, and its rules being developed under the UNFCCC process, has the potential to agree on methodologies and rules that would allow assessing alignment of global finance with the 1.5°C goal set in the PA.

The finance sector has been pushed by the international community to advance on its **transparency and accountability**, in the form of financial climate costs and risk disclosure and accounting rules for assessing flows. With TCFD recommendations to provide climate-related disclosure as part of mainstream public financial filings being voluntary and the pledge by the G20 countries to phase out fossil fuel subsidies remaining unimplemented, the main gap relates to **transparency and accountability** with regards to successful shifts away from fossil fuel financing and not just increasing green financing.

Investor initiatives such as the PDC and Montreal Carbon Pledge whose members are committed to measure and disclose their portfolio carbon footprint partially fulfil the **transparency and accountability** function.

3.3.4. Means of Implementation

Specialised funds such as the GCF, GEF and CIFs have a direct mandate to provide the **means of implementation**, which together with MDBs and sector-specific initiatives such as the ones conducted by institutional investors can turn finance into the means of implementation for all other sectors. Initiatives such as the IDFC and UNEP's FI build the capacity of their members to track and report on their green finance flows and better understand the impacts of environmental and social considerations on financial performance.

3.3.5. Knowledge and Learning

The financial sector has been kick-starting many initiatives on its own, seeking to produce **knowledge and learning**. Going forward, international governance will need to help develop more knowledge and learning on common standards, metrics and benchmarks for the different types of flows counting or not as Paris compatible. In this regard, initiatives such as sustainable finance research, carbon pricing and global divestment movements play significant roles in raising public awareness, expanding knowledge and lessons learned.

A synthesis of how the main institutions and initiatives in the financial sector contribute to the five governance functions is provided in Table 3.2 below.

3.4. Conclusions and Recommendations

There is a need for a new governance regime for finance to transition to a world where all finance is aligned with climate goals.

Given the financial sector's global reach, going beyond the limitations of national borders, there is a very high demand for international governance. Existing inter- and transnational institutions offer a growing, yet mostly partial or indirect guidance and signal. Emerging voluntary collective action has sought to make climate-related financial costs and risks more transparent and committed to mainstreaming climate considerations into financial decision-making. The provision of public finance as means of implementation has been increasing, although amounts remain insufficient compared

to global investment needs. As public finance seeks to tap into the commercial markets' potential through leveraging and de-risking activities, it must ensure that financial biases towards big infrastructure projects will not be detrimental to smaller and more localised types of decarbonisation interventions. A high number of institutions provide knowledge and learning on sustainable and green finance, but this remains a niche within the larger financial sector.

There is untapped governance potential to send the sector-wide signals necessary to shift away from high carbon investment patterns. This should include the redefinition of climate-focused standards and rules for the financial sector itself, including more apt structures that enable feedbacks from decarbonisation efforts in specific sectors to be taken on board by financial metrics and integrated into broader investors' decision-making. A more dynamic structure is required for a smooth transition, both to diminish risks of financial instability, and also in order to allow the inclusion of evolving standards relating to carbon-intensity and carbon risk of sectors over time, cost-optimisation alternatives linked to improved decarbonisation pathways, introduction of new climate-focused technologies and business practices, etc.

In conclusion, there is a great potential for decarbonisation within the financial sector emerging from existing initiatives, which can be scaled up. However for this potential to be fulfilled and for financial flows to contribute effectively to decarbonisation efforts within other sectors in the real economy, the broader climate regime complex must overcome three main challenges:

i. The role of finance in enhancing ambition

- *Guidance and signal and rule-setting* - How to effectively operationalise Article 2.1(c) of the PA: consistency of global financial flows with the Agreement should become a key consideration of the Paris architecture designed to enhance mitigation ambition over time, covering public and private, development and commercial flows.

ii. Mainstreaming

- *Guidance and signal and rule-setting* - How to continue to mainstream climate considerations into sectoral financial governance, where finance is not part of its original mandate. "Green", "sustainable" and climate-aligned finance have to advance from a niche topic to the new norm with wide-spread participation from financial actors, while avoiding "greenwashing" practices.
- *Knowledge and learning* – Co-developing, improving and sharing metrics and benchmarks for operationalising mainstreaming goals in practice.

iii. Additionality

- *Transparency and accountability* - How to ensure that through transparency and accountability under i) and ii) above, governance will achieve additionality in the mobilisation of all types of finance for climate mitigation measures. This should be maintained through ongoing measuring and verification of additional emissions impacts in changing the climate and their links to investments.

Based on the above three challenges, we identify potential engagement that should take place through the UNFCCC, other international institutions, and internally within the EU and its member states:

3.4.1. Recommendations for Engagement with the UNFCCC

The UNFCCC provides the framework for setting overarching goals and raising ambition on how to reduce emissions and make financial flows consistent with the PA. As such, it should send a clearer and stronger signal about divesting from carbon intensive investments and aligning all financial flows with climate goals, as set out in Article 2.1(c).

- Potential opportunities to integrate the alignment of financial flows in the design of PA's rule book include:
 - Guidance for Nationally Determined Contributions (NDCs) – NDCs could include finance-related commitments and policies to help reach mitigation targets such as reducing fossil fuel subsidies, carbon pricing instruments, national legislation for mandatory climate-related financial disclosure.
 - Enhanced transparency framework – Relevant reporting rules under the PA should include space to report on the implementation of actions not just to mobilise climate-specific financing, but also in efforts to ensure broader finance flows consistent with low-emissions and climate-resilient development pathways.
 - Sources of inputs and modalities for the Global Stocktake – One of the main focuses of the Global Stocktake should be assessing progress towards achieving the long-term goal set out in Article 2.1(c). Information on financial flows that are relevant for this goal should be identified as inputs to the GST, and recommendations and guidance to both Parties and non-Party actors in relation to achieving the goal should be one of its main outputs.
 - The cooperative approaches and new market mechanism identified in Article 6 of the PA should be designed to help shift financial flows to support increased mitigation action.
 - The UNFCCC Standing Committee on Finance's Biennial Assessment and Overview of Climate Finance Flows should include relevant data on both climate-specific flows and flows that are inconsistent with low-carbon development pathways in order to determine the benchmark for assessing progress on Article 2.1(c). This could constitute a relevant source of information for the Global Stocktake.
 - The Financial Mechanism of the Convention and the PA should take stronger measures to translate the UNFCCC's guidance into concrete targets, policies and benchmarks to encourage partner institutions to commit to reducing their overall portfolio's carbon footprints. The Green Climate Fund in particular has potential for establishing a first international methodology to establish baselines to measure decarbonisation of financial portfolios.
 - The international climate finance landscape is currently fragmented and complex with partly overlapping mandates. The UNFCCC could provide direction and coordination to improve the division of labour between different multilateral climate funds.

- The UN and UNFCCC should work to build political momentum to mobilise greater finance and capacity-building that can unlock increased mitigation ambition and measures to implement and enhance NDCs. Specific moments include the 2018 Talanoa Dialogue, the 2019 Climate Summit by the UN Secretary General (SG Summit), and the first Global Stocktake in 2023. The SG Summit will focus on six key issues that will include investment in clean technology, carbon pricing, and mobilising finance.

3.4.2. Recommendations for Engagement with Other International Institutions

International institutions such as the G7¹⁹, G20²⁰ and OECD have a significant convening power for engaging financial actors and the private sector, for example in relevant initiatives, task forces, expert groups, and research collaboratives whose outputs are targeted at advancing decarbonisation efforts in the financial sector. G20 and G7 summits also have the potential to help coordinate governance functions, with OECD, IMF, WEF and other forums working towards functions of signal and guidance, setting the rules, transparency and accountability and knowledge and learning.

- The G20, whose member countries represent 85% of global economic output, should play a role in bolder goal-setting, along with implementation of previous commitments such as phasing out of inefficient fossil fuel subsidies. Their actions have impact beyond their membership, since other countries look to them for guidance, and are likely to follow with similar commitments.
- Multilateral development banks can play a significant role in mainstreaming decarbonisation efforts, including by ceasing finance for fossil fuel production and ramping up investments in low-carbon infrastructure.
- Multilateral funds with specific climate mandates, such as the GCF and the CIFs (in case the CIFs will continue to operate despite their sunset clause), can act as multipliers by establishing new norms for working with their accredited MDB partner institutions, and by using their limited financing to catalyse transformational action by other actors.
- Transnational institutional investor initiatives have potential to encourage more investors to align their capital with climate goals.
- More advanced international financial institutions might acquire the role to provide capacity-building to national and local financial institutions and to governments.
- The TCFD's voluntary recommendations on climate-related financial disclosure have potential to become the new international standard for financial institutions and private businesses to disclose the climate risk their portfolios are exposed to, as well as their transition strategies.

¹⁹ The seven major advanced economies as reported by the International Monetary Fund - including the EU.

²⁰ Founded in 1999, the G20 aims to discuss policy pertaining to the promotion of international financial stability. It seeks to address issues that go beyond the responsibilities of any one organisation. G20 consumes 95% of the world's coal, more than 70% of its oil and gas, and is responsible for 85% of global investment in. It includes a mixture of wealthy and emerging economies (Goldthau 2017).



- The One Planet Summit in 2017 helped build political momentum for mobilising the financial sector to implement the PA, by providing a platform for capturing existing and emerging decarbonisation coalitions, including on carbon pricing and decarbonisation in financial institutions. A One Planet Platform with annual Summits is under discussion, and could provide a regular venue for making pledges, setting targets, and tracking progress. In particular, there is a need for transparency and accountability of these announcements and initiatives that involve financial actors. The One Planet Platform could be a mechanism for monitoring and assessing progress.

Table 3.2: Synthesis of finance-related governance supply

	Governance Functions				
Institutions/ Initiatives	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
	<i>Consistent, credible and long-term climate policies for investors and financial actors to align their decision making with international climate objectives</i>	<i>Developing and agreeing on international standards, benchmarks and metrics for 1.5 degree-compatible investments and carbon prices</i>	<i>Required to address issues of free-riding, double-counting, additionality of flows, as well as green-washing of continued high-carbon investment practices</i>	<i>Required to translate low-carbon and climate-resilient development strategies into climate investment plans ready for implementation</i>	<i>To know which policies work best to mobilize climate finance and divest assets from fossil fuels.</i>
UNFCCC/Paris Agreement	Article 2.1 (c) of the PA	Could serve as a framework for Collective Action	Enhanced transparency framework		
	Orchestration role through the GST		Assessing alignment of global finance with 1.5 °C		
Specialised CC Funds (GCF, GEF, CIFs)	Support the transformation towards low-carbon economies. For example the GCF promotes paradigm shift.	Facilitate collective action by jointly mobilising climate finance		Provide finance, capacity building and technology development	

MDBs	Commitment to align their financial flows with the Paris Agreement	Adoption of five voluntary mainstreaming principles	Transparent tracking and reporting of climate finance flows and impacts	Provide public finance and mobilise investments for climate actions	Technical assistance and policy support
	IDFC-Development finance institutions' commitment to mainstream climate action in their investments			Build the capacity of IDFC members to track and report on their green finance flows	
	WB's 2017 announcement to stop financing upstream oil and gas after 2019				
Investor Initiatives (GIC, PDC, Montreal Carbon Pledge, UNEP-FI)	Mobilising institutional investors to gradually decarbonise their portfolios	PDC and Montreal Carbon Pledge- commitments to measure and disclose their portfolio carbon footprint.	PDC and Montreal Carbon Pledge- commitments to measure and disclose their portfolio carbon footprint.	UNEP- FI- partnership to understand the impacts of environmental and social considerations on financial performance.	GIC- connecting regional networks and exchanging on best practices and standards
Global Divestment Movements	Mobilising public awareness by calling on investors to build an equitable and clean future and freeze any new investment in fossil fuel companies		Calling for transparency about impacts of investments in energy and the lives of people		Mobilising public awareness and changing social values

G20 Initiatives	Commitment to phasing out inefficient fossil fuel subsidies	TCFD recommending standardised and universally-applicable climate-related financial disclosure,	TCFD- provide climate-related disclosure as part of mainstream public financial filings		Expand learning networks for capacity building and encourage and facilitate knowledge sharing on environmental and financial risk
	Establishment of the Green Finance Study Group				
Carbon Pricing initiatives (CPLC & FFFS reform)	Developing pathways for different carbon pricing policies and timelines, encouraging other countries to join the initiative and implement their commitments				Enhancing cooperation and creating platforms for sharing experiences and lessons learned on developing and implementing carbon pricing
Sustainable Finance Research Initiatives			Initiatives of Tracking Private Climate Finance (OECD) works to promote a more transparent and comprehensive international measurement and reporting system for climate finance		Publishing annual global reports

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4. Power Sector

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4.1. Transformation Challenges and Governance Demands

4.1.1. Current Status and respect

The CO₂ emissions from the energy sector contribute some 61 per cent of global GHG emissions. Within that sector, electricity generation is the single largest subsector accounting for some 38.2 per cent of CO₂ emissions from fuel combustion (IEA, 2016a).²¹ With respect to the global transformation challenge, global power supply is a key sector for two reasons: (1) with maturing renewable energy (RE) technologies, solutions for zero-emissions electricity are already technically available and cost competitive, and (2) for many other sectors electrification of processes is the most promising mitigation strategy. This holds for example for transport and emission intensive basic materials such as steel and cement (Ahman *et al.*, 2016).

Despite the availability of low-carbon alternatives, global CO₂ emissions from electricity generation have been rising at an average rate of around three per cent annually between 2000 and 2015. Only after 2011 has this trend started to level off somewhat. While growth in electricity demand (and hence electric output) remained largely stable, the emission intensity of global electricity has started to slightly decrease after 2011 (IEA, 2017a). Since the latest data is available only for 2015, it is at this point difficult to assess whether this trend is robust. However, the recent development of for all energy related emissions (more recent data is available for the aggregate energy related emissions) suggests that they have not yet peaked. Having remained constant for three years over 2014-2016, energy-related emissions reached a historic high of 32.5 GtCO₂-e/yr in 2017 – 1.4% higher than in 2016. According to the IEA, this was due to higher energy demand, and a slowing in energy efficiency improvements (IEA, 2018a).

Historically, electricity has been supplied by five energy sources: **coal** (hard coal and lignite), **natural gas**, **oil**, **(large) hydro**, and **nuclear**. Only recently have other renewable energy sources (wind, solar, geothermal, tidal, and bioenergy) started to assume a more significant share of the global electricity mix. The technologies and measures needed for decarbonisation are already available, and the long-term benefits of decarbonisation will vastly outweigh the near-term costs (IRENA, 2018). The ongoing renewables revolution has fundamentally reshaped the global energy landscape – much more can be done much faster than was thought was possible just a few years ago. And a lot more has to be done to meet the objectives of the Paris Agreement (PA) and to limit global warming to well below 2°C.

²¹ Differentiating CO₂ emissions from heat and electricity generation is challenging, since data is not reported separately in the IEA's CO₂ emissions from fuel combustion data set. We have calculated CO₂ emissions of electricity generation by multiplying the reported CO₂ emission factors per electricity output [tonnes CO₂ /kWh electricity generated] with reported global electricity output [TWh]. For 2014 this calculation yields a total of 12360 Mt CO₂, i.e. some 9.3 per cent less than the 13,625 Mt reported jointly for electricity and heat.

To date, the stock of global electricity generation capacity is still heavily dominated by fossil fuel, nuclear and large hydro power plants. However, the lion's share of new investments has shifted towards renewable energies in recent years, both in terms of dollars spent and capacities added (Frankfurt School/UNEP/Bloomberg, 2016). The following paragraphs synthesise key developments with respect to all of the above-mentioned technologies.

Coal used to be the backbone of the majority of the world's power systems. And coal still is both abundant as well as relatively cheap. For many developing countries therefore, investing in coal capacities was considered a viable way of fuelling their rapid economic growth. And to some extent this is still the case. In 2017 Global coal demand rose about 1%, reversing the declining trend seen over the last years. This growth was mainly driven by an increase in coal-fired electricity generation in Asia (IEA, 2018a). If existing capacities and only a fraction of generation capacities currently in the planning are utilised to their full technical life-time, the remaining global carbon budget will already be consumed entirely (Edenhofer, 2015; Pfeiffer *et al.*, 2018). However, there are some signs that the coal boom may come to an end. In the US, coal consumption and production has plummeted in recent years, partly due to regulation under the Obama administration and partly by stiff competition from shale gas and renewable energies. In the wake of this downturn, Peabody Energy, the largest private coal mining enterprise, filed for bankruptcy in its domestic US market (Reuters, 2016). The most dramatic turn has arguably been seen in the United Kingdom (UK), with 2017 witnessing the first working day without coal power since the industrial revolution (Brown, 2017). Also China and India drastically cut their respective coal project pipelines and China even halted ongoing constructions on new coal power plants (Shearer *et al.*, 2018). It is still important however to note that in 2017, coal power plants were the biggest contributor to global energy related CO₂ emissions. After a two year decline in 2015-2016, coal emissions rose by 1.4% over 2017 (IEA, 2018a).

Ever since the IPCC's Special Report on **carbon capture and storage (CCS)** in 2005, there has been hope that CCS would make a substantial contribution to reducing CO₂ emissions from the power sector (IPCC, 2005). There was particular hope that CCS would help to bring about "clean coal".²² CCS is a combination of mostly proven technologies. However, to date there are only two large-scale projects operational in the power sector that prove that the concept works not only as a technical theory but in terms of being technically, economically, and socially viable to be deployed at commercial scale (Global CCS Institute, 2018). To change this, the IEA had set a goal to establish 100 CCS demonstration projects across the globe by 2009. However, in 2013 the IEA had to change this goal to only 30 projects in 2020. And given the current pipeline of CCS projects it may be even

²² The issue of CCS is not restricted to emissions from fuel combustion but may also cover industrial emissions (see section 4.6). Furthermore, many scenario modelling exercises come to the conclusion that negative emissions will be necessary to attain the well below 2/1.5°C target. These negative emissions could be achieved by combining the combustion of bio-energy with CCS (BECCS). However, we do not consider BECCS as an integral part of the power sector's transformation challenge and therefore do not cover this important issue here.

difficult to meet this much more humble target. Apart from the two projects mentioned above there are no other large-scale demonstration projects in construction or advanced stages of development (Global CCS Institute, 2018; also see James Gaede and Meadowcroft, 2016).

Among fossil fuels, **natural gas** has the lowest specific emission factor at combustion. However, gas extraction and in particular hydraulic fracturing (fracking) can lead to inadvertent diffuse CH₄ emissions that necessitate a significant increase of the emission factor. The recent boom in natural gas production was driven primarily by this technology. Annual production rose from 21.23 million terajoules (TJ) in 2010 to 29.43 million TJ in 2015 in the US alone (IEA, 2016c). While increased consumption of natural gas may yield short-term emission reductions by replacing coal, it may also 'lock-in' carbon emissions in the long run (Climate Action Tracker, 2017). With respect to global trade, another trend was observed in the recent decade: increasing investments in liquefied natural gas (LNG) technology and infrastructure. LNG terminals and supertankers unshackled natural gas from pipeline infrastructure and made natural gas a globalised commodity (IEA, 2016d; Elkind, 2017).

The global share of **nuclear power** has been in decline over the last decade (EIA, 2017). While 60 reactors are currently being built, mostly in developing countries and emerging economies, numerous reactors are rapidly approaching the end of their technological lifetime (IAEA, 2017). What is more, a number of countries have reversed their nuclear energy policy after the Fukushima catastrophe and committed to phase out (e.g. Germany) or reduce the reliance on (e.g. France) nuclear energy. A common thread among all nuclear reactors currently under construction, at least in industrialised countries, is heavy cost overruns. This holds for example for constructions in Finland, the US, and France (Gilbert, Sovacool, Johnstone, & Stirling, 2017). In the UK, the planned nuclear station in Britain, Hinkley Point C, could only attract investors after the government had guaranteed a hefty feed-in tariff. The rate is already now much higher than what is usually paid for wind power and will not decrease over time but automatically increase with inflation (UK Department of Energy and Climate Change, 2013). All things considered, the "nuclear renaissance" that was proclaimed repeatedly in the past is far from materialising.²³

Renewables represents the most dynamic part of the global power sector. Technology costs for solar and wind power have been falling sharply, with renewable energy and storage systems now the cheapest source of new supply in many parts of the world (IRENA, 2018; Tanti, 2018). For example, global average utility-scale levelised cost of electricity of solar photovoltaics (PV) fell by around 58 per cent between 2010 and 2015 and the cost are projected to continue to fall (IRENA, 2016). When levelised costs of electricity are considered, renewable energies are already competitive in many markets. In particularly well-suited locations, renewable energies are providing some of the cheapest electricity ever produced. Examples include solar PV in United Arab Emirates that was recently contracted at 2.4 ct/kWh (USD) and wind power in Morocco at ~3 ct/kWh (USD) (Dipaola, 2016;

²³ Because of these developments we did not consider in detail institutions that primarily promote nuclear energy in our below analysis. Also, when speaking of a transformation of the power sector we are typically implying a transformation based on renewable energy.

Parkinson, 2016). In the wake of this development, there has been a strong uptake in investments in renewable energy, particularly in emerging economies. India and China are not only among the leading markets, but have considered the renewable energy industry a priority for industrial policy and hence have become leading suppliers for renewable energy technologies (REN21, 2016). Apart from hydro, wind and solar power, bioenergy plays an important role in the global power mix. This, however, brings a risk of severe side effects (e.g. for food supply and biodiversity), particularly if biomass is not sustainably sourced.

Decarbonisation of power sector by focusing on the supply side transformation is one side of the coin. The remaining emissions budget under the 1.5°C limit, however, appears prohibitively small. Decarbonisation of power supply needs to be supplemented by efficiency improvements of the demand side as well as moving towards more integrated energy systems and electrification of heat, transport, and industry sectors. The most recent literature exploring 1.5°C-compatible pathways, while limiting/minimising the need for negative emission technologies, project steep reductions in energy demand to achieve the required deep emission reductions (Kriegler *et al.*, 2018; Rogelj *et al.*, 2018; Strefler *et al.*, 2018; van Vuuren *et al.*, 2018).

Beyond these technical challenges, there are a number of other developments with relevance to the power sector. One issue is the central **role that electric power plays in human development**. Basic access to electricity can be considered a necessary condition for the eradication of poverty (IPCC, 2012). Still more than 1.2 billion people, predominantly in rural areas in Africa and Asia still do not have access to electrical energy (IEA, 2015). The Agenda 2030 for Sustainable Development reflects the priority of providing electricity to these people with a separate Sustainable Development Goal (SDG 7). Also, many NDCs submitted under the PA make reference to the challenges of providing access to sustainable energy.

Another issue of importance to the power sector is the **global fossil-fuel divestment campaign** that has scored some big successes and continues to build momentum in convincing (institutional) investors to remove shares in companies that generate a large part of their revenue from the fossil energy industry from their portfolios (see chapter 3 for more on the divestment campaign).

Additional to these general trends, the sectoral transformation challenges are very diverse in different countries. Key characteristics that determine these differences include the following:

- renewable energy potentials;
- existence of domestic fossil fuel reserves;
- structure and ownership of the power market;
- state of the power system (grid infrastructure, current power mix).

4.1.2. Main Challenges and Barriers toward Decarbonisation

The transformation of the global power sector is already well under way. Sustainable technologies are technologically and economically mature and competitive. Still, in order to achieve a complete decarbonisation of the power sector several challenges and barriers remain.

The physical pre-conditions for renewable energy deployment differ greatly across countries. Correspondingly, the **transformation challenges and barriers for renewable energy deployment differ across countries**. Countries with a high share of hydro power, for example, have the advantage that hydro power can typically be dispatched flexibly and hence is particularly suitable for integration with variable power supply from intermittent renewable energy sources like wind and solar power. For countries without access to significant hydro resources other technical solutions will need to be developed. Another key difference with deep implications for the transformation of the power system is the type of power system that different countries have chosen – from completely liberalised power markets to integrated state-owned monopolies.

With respect to technological aspects, the need for **storage capacities** is one of the key challenges. Two different types of storage will be necessary to ensure the stability of power systems with high shares of intermittent renewable energy, particularly wind and solar power:

1. Short-term storage that can help with buffering variability in frequency and voltage in a matter of split seconds up to a couple of minutes (ancillary services). In the shorter term, the need for storage can be reduced by making electricity demand more responsive (Palensky & Dietrich, 2011). Currently, power demand is largely inelastic and is not significantly impacted by short-term price hikes. Smart grids (and smart appliances) are showing significant potential in helping to manage demand in order to shift some of it from peak load hours to hours with lower demand and/or more abundant renewable energy supply.
2. Long-term storage will be required to balance out seasonal variability in the availability of RE. Energy storage is still dominated globally by pumped hydropower. Still, both research spending as well as investments in battery storage have been skyrocketing in recent years. As a matter of consequence, battery costs have plummeted at rates similar to those seen in the cost reductions of Solar PV (IEA, 2016b).

Another key technical challenge that needs to be addressed is the **update and re-build of existing grid infrastructures**. In countries that historically relied on fossil fuelled power generation, power plants typically were built at locations that are close to the centres of electricity demand (i.e. major industrial centres). Contrastingly, renewable energy generation units ideally should be located wherever the potential of renewable resources are highest. This is often in rather rural areas without large amounts of demand. While in prototypical fossil fuelled power systems the role of distribution networks was mainly one of interconnecting industrial hubs and thus hedging against the risk of black outs, the task in a prototypical RE-based power system is one of connecting centres of supply

to the centres of demand. This may require fundamentally different grid layouts and enormous investments over the coming decades (IEA, 2016b).

This leads us to **economic barriers**. In the economic realm, two broad challenges are standing in the way of a global transformation of the power sector: **an investment challenge as well as a market-design and dispatch challenge**. The investment challenge directly relates to Art. 2.1(c) of the PA, “[m]aking finance flows consistent with a pathway towards low GHG emissions and climate-resilient development.” Current investments in renewable energy in 2015 amounted to nearly USD 286 billion (REN21, 2016). Yet, in order to have a chance of limiting global warming well below 2°C additional investments in the trillions will be required to build up sustainable energy infrastructure (Ceres, 2014; IRENA, 2018). At the same time, investments in fossil fuel infrastructure need to be phased down and out.

The often cited issue of high costs for renewable energy technologies is no longer a central barrier to decarbonisation as technology costs have plummeted in recent years. In particular cost for solar PV and wind have come down and this cost decrease is likely to continue (IRENA, 2016). This is not to say, that costs have become a non-issue. Despite low cost for the hardware, renewable energy can become excessively expensive if an unfavourable general investment climate (high prime lending rates) drives up capital costs and if a lack of local expertise and skilled workers drives up the soft costs of installing and maintaining renewable energy systems. Also, cost distribution may be an issue, including regarding equity and fairness.

The second challenge is one of **market design**. Since the early 1980s numerous countries have started to liberalise (and privatise) their respective power markets. Typically, these markets are organised with power spot markets at their core. Prices at the spot market are based primarily on marginal generation costs. Most forms of RE, however, do not feature marginal generation costs. Wind and solar energy is generated when the wind blows or the sun shines, irrespective of the wholesale price for electricity. In markets with particularly high shares of electricity with zero marginal costs, the market design approaches its limits. Prices are generally low and can even become negative. In consequence, the spot market loses to essential functions. Firstly, the spot market cannot ensure that investments – irrespective of whether in renewable energy or fossil fuel capacities – can be recouped over the project lifetime without other revenues streams. Secondly, the spot market loses its ability to organise the dispatch of power plants, i.e. signalling which plant should be generating power to satisfy the exact current level of demand and which plant should not be running. While renewable energy has become competitive in current market environments, a proved market design for systems with very high shares of intermittent renewable energy that ensures that (1) long-term investments can be recouped and that (2) efficiently organises dispatch is still not on the horizon.

The **challenges and barriers differ among countries also in the way the power sector is structured**. While in some countries, the power sector is dominated by privately owned utilities, in many countries utilities are state-owned. In some countries, institutional linkages between government and utilities is particularly close and amount to what Unruh has called a “techno-industrial complex”

from which strong systemic change resistance must be expected (Unruh, 2000; Harich, 2010; Heyen, Hermwille and Wehnert, 2017). Increasing deployment of renewable energy can contribute to a diversification of the ownership structure in the power sector. For example, in Germany investments in renewable energy have been largely driven by municipal utilities, small energy cooperatives and even individuals (Schmid, Knopf, & Pechan, 2016).

Lastly, **human capital and social barriers** are important to highlight. Implementing global energy transformation towards renewable energy requires a skilled workforce. In many developing countries technical capabilities and skilled workers are still a bottleneck for the scaled-up renewable energy deployment (Hirsch, 2015). Social barriers include issues such as energy poverty. Changes in the provision of electricity may result in shifting costs and payments. In the course of the transformation of global power sectors, particular attention needs to be paid to avoiding potential effects that policies may have on marginalised communities so as to avoid increased incidence of energy poverty (Cherian, 2015).

4.1.3. The Promise and Potential of International Cooperation

4.1.1.1 Guidance and Signal Function

The signalling function of international governance is of particular relevance for the power sector. Investments in the sector are extremely long-lived. On the one hand, this means that investments in fossil fuel infrastructure today may literally cement a carbon-intensive pathway for the next decades. On the other hand, this long-term perspective requires investors to make investment decisions to a large extent on the basis of long-term expectations of the sector and the economy in general as opposed to the market conditions of the day. When countries credibly agree on long-term visions and goals for the sector, this may alter the investors' expectations about the viability of their projected investments and hence their investment decisions of today. The more specific the vision is, the more impact it is likely to have on the investment decisions.

One particular example relates to investments in CCS. One of the key barriers is that potential investors face split incentives. Investing in CCS may help to "future-proof" the sector, yet this may come at significant short-term financial risks (J. Gaede and Meadowcroft, 2016; see also Kern *et al.*, 2016). Also, the countries that have the strongest interest in developing CCS are those that have vested interests and/or large fossil fuel reserves. Yet, this interest in CCS is contingent on ambitious climate policy. The private sector will only invest in CCS in the presence of strict and credible long-term climate policies. In the past, many of those countries have rather focused on delaying aggressive climate action (de Coninck and Bäckstrand, 2011). A strong international signal could help shift the political economy so that interest and consequently investment in developing CCS increases.

4.1.1.2 Setting Rules to Facilitate Collective Action

There are various ways in which the power sector transformation in one country interrelates with the sector transformation in other countries. The most direct interdependence relates to global trade and competition. Power systems are connected through markets for fossil fuels, as well as globalised technology markets for all types of energy technologies, including renewable energy technologies

and battery storage. Since electricity is an essential input to almost all industries, there may be indirect competition among countries: if in the course of a sector transformation a country experiences (temporary) electricity price increases, energy intensive industries may migrate to another country with lower electricity prices (De Cian *et al.*, 2017). A power sector transformation can thus become an issue of industrial competitiveness for the country. Moreover, direct international interdependencies may exist in the form of multinational corporations that are active in more than one country and often have significant economic power. However, in the power sector this may be less of an issue than for example in the extractive industries sector. While some multinational utilities exist, the majority of national power sectors are dominated by nationally operating utilities. Last but not least, regional spill-overs exist where power systems are physically interconnected. As a decarbonisation of the power sector will also reshape the grid infrastructure (see above), the transformation in country A will have ripple effects on the power system in country B with which country A is interconnected.

Corresponding to the analysis of international interdependencies between power sectors of different countries, there are two types of rules could facilitate the decarbonisation of the sector. The first regards concerns of industrial competitiveness. Coordinated target setting could address such concerns at least partially. This could take the form of harmonised RE targets and/or quotas or even collective cap and trade systems for carbon emissions. Moreover, possible approaches for international cooperation include joint research programmes, patent pooling and removing trade barriers.

The second type of rules are pertinent where power grids are regionally interconnected. In these cases regional governance approaches may be conducive to the transformation. Inter alia, coordinated investments in the grid infrastructure could minimise the need for storage capacities as variability in renewable energy supply to some extent balances itself out over large geographic distances.

4.1.1.3 Transparency and Accountability

Transparent reporting and monitoring can support and help reinforce rules, targets and/or standards collectively agreed as outlined above. The specific needs what to monitor and by whom, of course, depend on the specific rules, targets or standards agreed.

4.1.1.4 Means of Implementation

Another leverage point for international governance is mobilising the means of implementation for the sector transformation (for a discussion of the different means of implementation see Oberthür *et al.*, 2017). In particular, international cooperation relating to means of implementation could help address the investment challenges described above. For example, typically, renewable energy investments incur the lion's share of their lifetime cost in the form of upfront investment costs while featuring low or even close to zero operating costs later on. For countries in which difficult investment conditions prevail, this becomes a critical barrier for renewable energy investment. Due to high prime lending rates and currency related risks, capital cost can render renewable energy

technologies, which would otherwise outcompete the alternatives, uneconomical. This argument also holds for any highly capital intensive component of the energy system including storage and grid infrastructure. At the same time, there is no lack of investors looking for opportunities to invest. If ways were found to enhance the attractiveness of investments in sustainable power systems, this could strongly expedite the transformation of power sectors across the globe. International governance may especially contribute through arrangements for sharing the increased financial risks for investments in developing countries. More specifically, by providing some form of guarantee or security, developed countries could help bring down lending rates in developing countries in order to make private investments in renewable energy more attractive.

Means of implementation, in terms of international transfer of renewable energy and energy storage technologies as well as capacity building (administrative and technological), are both highly beneficial for a successful transformation of power systems.

4.1.1.5 Knowledge and Learning

Learning and knowledge diffusion can also make a significant positive contribution to expediting global power sector transformations. For example, a successful sector transformation in one country may demonstrate the feasibility of transformation. Ideally, more success would demonstrate that there are numerous configurations that work, encouraging other countries to pursue the transformation of their sectors and at the same time providing orientation. This includes for example governance learning: which policies work and which political processes are promising in order to forge alliances and align interests. It also pertains to learning of management and organisational practices including for example effective market designs for high RE-share power markets. Furthermore, if successful transformations take place in large enough markets, this can lead to de-facto standard setting of technological parameters.

These kinds of spill-overs could be supported inter alia by creating (international) fora in which experimentation and good practice sharing with respect to policies and political processes can be facilitated, e.g. with respect to market designs and long-term planning procedures.

The key governance functions necessary for decarbonisation of the power sector are summarised in Table 4.1 below.

Table 4.1: Overview of key governance needs in the power sector

Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
<ul style="list-style-type: none"> • Signal for low-carbon investments in energy infrastructure. 	<ul style="list-style-type: none"> • Coordinated target setting (decreasing importance due to increasingly competitive renewable energy technologies) • Coordination at the regional level (especially grid development) 	<ul style="list-style-type: none"> • Required to support collective action function 	<ul style="list-style-type: none"> • Risk sharing for capital intensive investments in sustainable power systems, especially in developing countries • International transfer of renewable energy and energy storage technologies • Administrative and technological capacity building 	<ul style="list-style-type: none"> • Sharing of good practice policies e.g. on market designs and long-term planning

4.2. Governance Supply

Global energy governance is a relatively new but increasingly popular field of academic inquiry. However, the existing literature has focused almost exclusively on perspectives aligned with different sources of energy (Florini and Sovacool, 2009; Lesage, Van de Graaf and Westphal, 2010; Cherp, Jewell and Goldthau, 2011; Dubash and Florini, 2011; Sovacool and Florini, 2012; Van de Graaf, 2013, 2017; Müller, 2015; Roehrkasten, 2015; Westphal, 2015; Van de Graaf and Colgan, 2016; Van de Graaf and Zelli, 2016). To some extent this can be explained by the historical focus of the existing international organisations that are the study object of global energy governance; whether they are OPEC and IEA that are tied to oil, the Gas Exporting Countries Forum (GECF) focussing on natural gas, or IRENA with a specific focus on renewable energy.

It is, however, striking that to date, no one seems to have approached the question of global energy governance from the point of view of the **systemic transformation challenges of the power sector**. The subsequent section targets this research gap.

We have identified several **thematic clusters** to spasswordstructure the various institutions²⁴ that are relevant for the power sector. We start with two elements of the UN system, the United Nations Framework Convention on Climate Change (UNFCCC) and the Sustainable Development Goals (SDG), that provide goals and address thematic issues directly relevant to the power sector. We then proceed to key initiatives focusing explicitly on the power sector. Subsequently we highlight three rather narrow yet very ambitious institutions that play pioneering roles for the power sector. After that we discuss Multilateral Development Banks (MDBs). The last three sections consist of initiatives that could be divided into those with a regional focus, those with a technological focus and private sector institutions.

Note that the list of institutions referred to below is neither exhaustive nor exclusive but focuses on the most salient ones. Particularly in the transnational realm there is a plethora of institutions, a comprehensive account of which would exceed the scope of this chapter. We therefore provide example accounts of a subset of institutions that are illustrative of a wider range of similar institutions and initiatives.

4.2.1. Overarching Institutions within the UN System and Beyond

Various institutions provide overarching governance pertinent to the power sector. These include the **UNFCCC** and the **Paris Agreement (PA)**, the **SDGs** as well as the UN Secretary General's **Sustainable Energy for All (SE4All)** initiative as a key enabler of SDG7 on energy.

The **PA** with its long-term temperature goal of holding global temperature increase to well below 2°C and pursuing efforts to limit warming to 1.5°C (Art. 2.1(a)) and the accompanying goals of peaking of greenhouse gas emissions as soon as possible, rapid reductions thereafter and achieving net zero emissions in the second half of the century (Art. 4.1) have been interpreted as a clear signal to phase out fossil fuel production and consumption (Hermwille, 2016) and the implications of this signal are relatively clear for the power sector. Kuramochi et al. (2018) conclude that current growth rates for renewable energy of 25-30% per annum need to be maintained at least until 2025 in order to limit global warming to 1.5°C. For coal they deem it necessary to issue an immediate worldwide moratorium on new coal power plants and emission reductions of the existing fleet of coal power plants by 30% by 2025. Making these implications explicit in terms of specific sectoral goals could further strengthen the signal.

The PA does not only express collective long-term temperature and other goals. The Agreement also places obligations on its Parties to develop and communicate successive, progressively more ambitious nationally determined contributions (NDCs) every five years. While the actual attainment of the mitigation contributions in NDCs are not legally binding in terms of obligations of result,

²⁴ We define international institutions as negotiated, dynamic, sectoral normative systems consisting of rules and practices, including decision-making procedures, that prescribe behavioural roles, constrain activity and shape actor expectations (cf. Oberthür *et al.*, 2017, p. 12).

Parties have agreed on a legally binding obligation of conduct to implement domestic mitigation measures with the aim of achieving the objectives of their NDCs (Oberthür and Bodle 2016).

The first round of NDCs has demonstrated the important role of the power sector in reducing emissions.²⁵ The vast majority of NDCs mention renewable energy as a key mitigation option: 108 countries declare their intention to expand renewable energy further as part of their reduction strategies, and 75 of them have also quantified this intended expansion. Eight countries – the Cape Verde Islands, Cook Island, Costa Rica, Fiji, Papua New Guinea, Samoa, Tuvalu, and Vanuatu – even intend to decarbonise their power systems completely by 2030 (see Stephan, Schurig, and Leidreiter 2016). Countries are however much less explicit with respect to phasing out reliance on fossil fuels.

Moreover, all Parties have obligations to report biennially (except for SIDS and LDCs, which have discretion) on their inventories of greenhouse gas emissions and progress made in implementing and achieving their NDCs. Under the PA, a new and enhanced transparency framework for action and support is established and its modalities, procedures and guidelines (MPGs) to be applicable to all Parties are currently being negotiated as part of the “Paris Agreement Work Programme”, which will provide the detailed modalities and guidance that underpin implementation of the Agreement.

The periodic elements of the PA – the NDCs, regular reporting and review, as well as the five-yearly Global Stocktake that will assess collective progress towards the goals of the PA (see chapter 2) – create a ‘pacemaker’ that provides not only a one-off signal, but a periodic signal that is renewed refined every five years.

With its financial mechanism and corresponding operating entities, the Global Environmental Facility (GEF) and the Green Climate Fund (GCF) (for a more detailed discussion see chapter 3), the UNFCCC and PA serve as key enablers of financial support to developing countries.²⁶ In total, developed countries have pledged to mobilise US-Dollar 100 billion per annum from 2020 through to 2025 and agreed to negotiate an increase of that number for the period after 2025. However, individual contributions are not legally binding (see Obergassel *et al.*, 2015, 2016). Looking at the project portfolio of the GCF – by far the largest funding mechanism under the UN climate regime – reveals that renewable energy projects are one of the priority areas of the fund (Green Climate Fund, 2018).

Technology transfer and capacity building are also within the purview of the UNFCCC and the PA. With respect to the former, the Convention’s Technology Mechanism will now be further developed and refined to serve the PA. Moreover, the PA establishes a Technology Framework in order to

²⁶ Long-term low greenhouse gas emission development strategies that parties are invited to prepare in accordance with Art. 4.19 of the Paris Agreement could potentially also play an important role in facilitating the decarbonization of the power sector. To date, however, only a hand full of countries have presented such strategies.

provide guidance to the Technology Mechanism. In practice, however, the provision of technological support and technology transfer has been limited. For example, the Technology Executive Committee of the UNFCCC has contributed via papers, thematic reports and dialogues (UNFCCC Technology Executive Committee, 2016, 2017). Another example includes the national Technology Needs Assessments that many developing countries have conducted. Still, what has been delivered is mostly paper based and does not meet the needs we have identified in our above analysis.

Capacity building has been on the agenda for many years, but has not been a priority in recent years. While industrialised countries had always recognised it as an essential element, especially for least-developed countries and small island development states, developing countries had never managed to bring the issue to the top of the agenda. The PA recognises the importance of capacity building, but the actual text of Article 11 that specifies the capacity building provisions of the PA is relatively weak and non-binding. Moreover, the capacity building provisions are rather generic in nature. As one should expect of an overarching institutions such as the UNFCCC, the provisions are not specific enough to address the needs of the power sector we have identified above.

The UNFCCC has fostered knowledge creation and learning in a number of ways, directly and indirectly. One central direct mechanism is the obligation on Parties to regularly submit GHG inventories and National Communications. Its GHG metrics form the core of the UNFCCC's common language and are the key benchmark for its effectiveness. National Communications provide a wealth of information about national circumstances and actions being taken. Information about national emission profiles is a key prerequisite for developing suitable mitigation strategies. However, while the process of developing national communications may have served as a motor of knowledge aggregation at the national level, the information contained in them has not been used to promote mutual learning at the international level. Especially country's reporting on policies and measures could have been a key basis for organising exchanges on lessons learned, which has so far remained largely untapped (Hildén, Jordan and Rayner, 2014; Schoenefeld, Hildén and Jordan, 2018).

The situation has changed somewhat in recent years. As described in chapter 2, a series of technical expert meetings (TEMs) have been convened, in order to create a space for non-political and facilitative discussions (Sterk *et al.*, 2013; Hermwille, 2018). The promotion of renewable energy was repeatedly a thematic focus of the TEMs. The UNFCCC has also promoted learning through its function as 'pacemaker' for national discussions. It has also served to raise new research questions (such as the impacts of global warming of 1.5°C) and created demand for new research on climate policies and transformation pathways. A key contribution also is the official request to the IPCC for the upcoming Intergovernmental Panel on Climate Change (IPCC) special report on the impacts of global warming of 1.5°C which will directly inform the negotiations.

Last but not least, the UNFCCC has also indirectly contributed to the creation of methodologies and administrative knowledge with respect to determining emission reductions through its market-based

instruments such as the Clean Development Mechanism (CDM) and Joint Implementation (JI).²⁷ By incentivising private actors to identify and mobilise mitigation potential, these instruments have contributed to putting climate mitigation on the agenda of many private companies and getting a better picture of mitigation options and costs.

Alongside the UNFCCC, the **Sustainable Development Goals (SDGs)** is the second large overarching international institution that aims at governing the sectoral transformation of the power sector and addresses the same sectoral transformation challenges identified in our assessment of the governance demands (see also Hermwille, 2017; Obergassel, Mersmann and Wang-Helmreich, 2017). For power supply, especially relevant are targets 7.2 (by 2030, to substantially increase the share of renewable energy in the global energy mix) and the two implementation-oriented targets 7.a (to enhance international cooperation and promote investment in energy infrastructure and clean energy technology) and 7.b (to expand and upgrade infrastructure in developing countries to enable supply of sustainable energy services).

The SDGs provide an overarching framework which will be implemented with the help of a variety of international organisations/initiatives. Yet the primary responsibility for implementation rests with national governments which are free to prioritise according to their respective national circumstances. Moreover, the targets are not very precise. Specifically, it remains unclear what constitutes a “substantial increase” in the share of renewable energy.

For SDG7, the Sustainable Energy 4 All Initiative (SE4All) is particularly important. SE4All is a non-profit organisation co-chaired by the UN Secretary-General and the President of the World Bank. Although SE4All predates the SDGs, it has now become a key initiative to facilitate the implementation of SDG7. To do so, it works with government leaders, the private sector, and civil society. With its general objectives “(...)ensuring universal access to modern energy services”, “(...)doubling the share of renewable energy in the global energy mix” and “(...)doubling the global rate of improvement in energy efficiency” (SE4All website, no date). Inter alia SE4All maintains a Global Tracking Framework to monitor progress and trends in relation to energy access, renewable energy and energy efficiency. It furthermore produces a series of reports inter alia on financial flows towards energy access and clean cooking (SE4All, 2017). It also functions as a coordinator and distributor of knowledge through various regional and thematic hubs.

Finally, the **G7** and **G20** as well as the **World Trade Organisation (WTO)** merit brief mention. All three have to a limited extent sought to govern on global energy matters, but mostly on an *ad hoc* basis. Examples are the G7’s call for decarbonisation of global economies expressed in the 2015 Leaders’ Declaration (G7, 2015) and the G20’s call for the phase-out of inefficient fossil fuel subsidies dating back to the 2009 summit in Pittsburgh (Dubash and Florini, 2011). Various scholars have in the past called for a much stronger role of the G20 in global energy governance (Roehrkasten, Thielges and

²⁷ The CDM and JI are mechanisms under the Kyoto Protocol. Their continuation under the Paris Agreement is uncertain (CDM) or excluded (JI).

Quitow, 2016; Goldthau, 2017). The WTO is particularly relevant with respect to the trade of renewable energy and other low carbon technologies. Preferential trade agreements could play a strong facilitative role in promoting the deployment of renewable energy and their potential is currently not being exploited according to some analysts (Lewis, 2014; Morin and Jinnah, 2018). In 2014 a group of 14 countries including the United States, EU, China and Japan started to negotiate a so-called “Environmental Goods Agreement” to reduce tariffs and trade barriers on low-carbon technologies (Van de Graaf and Colgan, 2016). In the meantime, the number of countries has increased to 18 members representing a total of 46 countries, yet the negotiations are slow and seem to have lost some of the initial momentum (Meyer, 2016; WTO, 2017).

4.2.2. Energy Specific IGOs

Institutions that are highly relevant for the power sector include the International Energy Agency, the International Renewable Energy Agency, as well as the Renewable Energy Policy Network for the 21st century.

The **International Energy Agency (IEA)** is an autonomous intergovernmental organisation under the OECD (on the origins of the IEA see Van de Graaf, 2017). Its members are 30 of the 35 OECD countries (plus Chile which is in status of accession to full membership), as well as currently seven association countries which are not part of the OECD. The OECD also has working relationships with a number of other non-OECD countries. Despite its limited membership, “the IEA is the closest we currently have to a World Energy Organization” (Van de Graaf, 2013, p. 107). Also, the IEA has in recent years made strategic efforts to increase its reach by opening its doors to associated countries (without a full OECD membership). This was successful to the extent that Brazil, China, India, Indonesia, Morocco, Singapore, and Thailand are now association countries (see also Heubaum and Biermann, 2015).

The overall objective of the IEA is to provide reliable, affordable and clean energy to its members and also beyond the member countries. Originally, the IEA was founded as a ‘buyers club’ to counter the Organisation of Petroleum Exporting Countries (OPEC) and to ensure securing of oil supplies (Dubash and Florini, 2011). But the IEA has widened its portfolio to include all energy sources (Heubaum and Biermann, 2015). Most recently, the IEA has launched an extensive “Clean Energy Transition Programme” that focuses on leveraging a global energy transition beyond the IEA member countries, particularly in major emerging economies (IEA, 2017b). Specifically relevant to the power sector is the fact that the IEA has announced 2018 as the Year of Electricity. Activities include a special focus on electricity in the annual World Energy Outlook and a “Status Report on Power System Transformation” to be published in the course of the year (IEA, 2018b). The agency’s main purview has hence become to make available information on all types of energy markets and technologies. “This information function has become the hallmark of the IEA’s day-to-day functioning” (Van de Graaf, 2017, p. 595).

Especially noteworthy in this context are the above mentioned World Energy Outlook (WEO), and the Energy Technology Perspectives reports, which provide energy-market analysis and projections that

are so influential that they effectively function as a key benchmark for decision making in all sorts of organisations from public administrations to private enterprises. Yet the IEA's scenarios have been criticised for repeated skewed predictions and dramatically underestimating the uptake of renewable energy, in particular solar PV (Creutzig *et al.*, 2017). Muttitt (2018) even accuses the IEA of distorting its projections in ways that systematically support investments in fossil fuels and high carbon infrastructures. But as highlighted by Heubaum and Biermann, *"the IEA was hardly the only organization that got it wrong"* (Heubaum and Biermann, 2015, p. 232).

Complementary to its informational resources, the IEA maintains various Technology Collaboration Programmes (TCPs) which facilitate collaboration between experts in order to support governments and industries in the field of, among others, renewable energy and hydrogen.

Unlike the IEA, the **International Renewable Energy Agency (IRENA)** exclusively focuses on renewable energy governance. It is an intergovernmental organisation with 154 members. IRENA was founded in 2009 and is a rare example for a newly established international organisation that partly overlaps with an existing international organisation, namely the IEA. In fact, Van de Graaf posits that "IRENA was part of an institutional hedging strategy (...) to counter the IEA's allegedly supportive stance toward the fossil and nuclear energy industries" (Van de Graaf, 2013, p. 108).

According to Müller, IRENA has attained a "leading role as a political entrepreneur in the field of renewable energy" (Müller, 2015, p. 252). It has achieved this by building a global knowledge base on renewable energy that it consequently employs as a means "to exert power over knowledge" (Müller, 2015, p. 252). Key contributions in this regard are the 'Global Atlas for Solar And Wind' as well as IRENA's regular and comprehensive renewable energy statistics and regional and/or technology specific roadmaps. Another key means of governance are the so-called "renewable readiness assessments" in which IRENA orchestrates national entities (related ministries, regional entities, specialised agencies financial institutions as well as corporate and civil society stakeholders) and brings in transnational knowledge brokers to identify gaps in the existing technological and administrative environment and developing concrete action plans to overcome these gaps (Müller, 2015). IRENA also plays a key role in several relevant regional initiatives: the Clean Energy Corridor for Central America (CECCA), the Africa Clean Energy Corridor (ACEC), the West Africa Clean Energy Corridor (WACEC) and the Small Island Developing States (SIDS) Lighthouse Initiative.

Although not strictly an intergovernmental organisation, the **Renewable Energy Policy Network for the 21st century (REN21)** is also worth highlighting here. Again, REN21 is an institution that does not cover the full range of energy sources. REN21 is a transnational institution with a diverse membership. Members include national governments, industry organisations, research organisations, civil society organisations as well as numerous intergovernmental organisations. Its key governance instrument is the annual Renewables Global Status Report, which has become a key resource that includes not only statistical data on renewable energy capacities, generation, and investments but also reviews the state of the industry as well as national RE policy frameworks (REN21, 2017).

Numerous other intergovernmental organisations may be mentioned in terms of wider energy governance. These include the Organisation of the Petroleum Exporting Countries (OPEC), the Gas Exporting Countries Forum (GECF), International Atomic Energy Agency (IAEA), the Nuclear Energy Agency, and the International Energy Charter, all of which are important but mostly focus on commodity trade. Moreover, they hardly contribute specifically to climate governance by means of the specific governance functions assessed here (Lesage et al., 2010; see Dubash and Florini, 2011).

4.2.3. Multilateral Development Banks

Basically, all relevant Multilateral Development Banks (MDBs) focus on *means of implementation* due to their general function of providing financial assistance in the context of development projects (Lesage, Van de Graaf and Westphal, 2010) (for a more elaborate discussion see chapter 3). Especially noteworthy is the **World Bank** as the largest and most influential development bank, which funds energy projects focusing on “affordable, reliable, and sustainable energy supply needed to end extreme poverty and promote shared prosperity” (World Bank, 2018). This is clearly aligned with the Bank’s engagement in the SE4ALL initiative (see above) and SDG 7. The Bank also mobilises private sector participation and investment for funding clean energy and supports various strategic global partnerships and programs. Particularly noteworthy is the Bank’s announcement to stop financing upstream oil and gas investments as of 2019 (World Bank, 2017b). It is noteworthy, because the Bank was the first international ‘heavyweight’ that not only focused on the phase-out of coal – which is becoming more and more commonplace – but also included oil and gas related investments. Due to its significant clout, the World Bank indirectly has helped to reinforce and amplify the signal to initiate decarbonisation.

Additionally, the World Bank maintains an extensive statistical database which constitutes an important information hub for all types of stakeholders. Important elements in this regard are the Global Tracking Framework for the SE4ALL initiative and other regular reports such as the Regulatory Indicators in Sustainable Energy Report (RISE) and the State of Energy Access Report (SEAR).

Another relevant development bank for the power sector is the **African Development Bank (AfDB)**. The AfDB’s engagement in the power sector is guided by two goals: “Support Regional Member Countries (RMCs) in their efforts to provide all of their populations and productive sectors with access to modern, affordable and reliable energy services [and] help RMCs develop their energy sector in a socially, economically and environmentally sustainable manner” (AfDB, 2012).

Like the World Bank and the AfDB, all other MDBs are also relevant to the power sector transformation. These include the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and the Inter-American Development Bank (IDB), the Asian Development Bank (ADB), the Asian Infrastructure Investment Bank (AIIB), and the New Development Bank co-founded by Brazil, Russia, India, China and South Africa.

Finally, the **Climate Investment Funds (CIF)** is worth mentioning. Funded and supported by national governments and MDBs (African Development Bank, Asian Development Bank, European Bank for

Reconstruction and Development, Inter-American Development Bank and the World Bank Group), CIF provides financial means of implementation to low and middle income countries with a specific view to build up and help establish emerging and unproven markets. The total budget of the CIF accounts for 8.3 billion US-Dollars. Particularly relevant for the power sector are the CIF's 5.6 billion US-Dollar Clean Technology Fund and the 780 US-Dollar million 'Scaling Up Renewable Energy in Low Income Countries Program'.

4.2.4. Informal Energy Alliances

We would like to highlight three institutions with a more narrow scope and/or membership yet with rather high ambitions: the International Solar Alliance, the Powering Past Coal Alliance, the Clean Energy Ministerial, Renewable Energy and Energy Efficiency Partnership, as well as Mission Innovation and the Breakthrough Energy Coalition.

The **International Solar Alliance (ISA)** was launched at COP 21 in Paris in 2015. It is an intergovernmental organisation and consists of 121 countries with high solar energy potential. Its core objective is to implement solar energy in a streamlined fashion. To this end the ISA concentrates on establishing expert groups and partnerships; training programmes; sharing of experiences and analysis. Each member has to establish a National Focal Point to create a stable network within the member states. Beyond capacity building, the ISA is also cooperating with various MDBs including the European Investment Bank and the Asian Development Bank on risk sharing arrangements and implementing financial mechanisms to support solar energy in developing countries (International Solar Alliance, 2016, 2017).

The **Powering Past Coal Alliance (PPCA)** was recently launched at COP23 (2017). It is an international alliance of governments, businesses and organisations that collaborate to reach the complete phase-out of coal. In general, all members are committed to introduce policies and investments that are supportive of clean power. At the same time they commit to decrease investments in traditional coal power without carbon capture and storage. Member states should phase out existing traditional coal in their jurisdiction and new traditional coal power stations should only be established if operational CCS is available within their jurisdiction. Though promising, it can be observed that all of the founding member countries already have very limited coal consumption and consequently have little "skin in the game" (Oberghassel *et al.*, 2018). The PPCA also invites non-governmental members which commit to abandon coal for their special energy needs.

The **Clean Energy Ministerial (CEM)** is an association of 24 countries and the EU that works towards a global clean energy economy. It organises regular meetings of energy ministers to discuss clean energy, delivers necessary information and tools to decision makers and collaborates with other line ministries, institutions and private-sector partners. In addition, it finances public research and development in the context of clean energy technologies and implements initiatives relating to energy supply, capacity building and policy expertise.

The **Renewable Energy and Energy Efficiency Partnership (REEEP)** is a multi-stakeholder partnership that was founded in the aftermath of the 2002 Johannesburg Earth Summit (Roehrkasten, 2015; Van de Graaf and Zelli, 2016). REEEP is primarily a platform that serves to connect and to some extent orchestrate a wide range of actors. Its prime focus is to facilitate and foster investment in renewables and energy efficiency technologies in developing countries, whether that is through funding actual projects that are pioneering yet replicable at the large scale, or whether that is through supporting governments in developing favourable regulatory frameworks (see also Parthan *et al.*, 2010). REEEP maintains an online knowledge hub (reegle.info) that collates all kinds of information including country profiles and statistics for potential investors (REEEP, 2018).

Finally, there are international institutions with a technology neutral innovation-oriented purview. Salient examples are **Mission Innovation** and the **Breakthrough Energy Coalition**. Mission Innovation is a high-level political initiative that regularly unites energy and other related ministers from 22 mostly industrialised countries and the EU. Member countries have committed to double public spending for energy R&D with a view to cumulatively reaching over 32 billion US-Dollars by 2020 (Sanchez and Sivaram, 2017). The initiative is particularly important because the membership covers nearly all public R&D funding. Beyond the financial commitment, Mission Innovation has become a hub for information sharing (on energy R&D), identification of innovation gaps, coordination of R&D funding plans as well as attraction of private-public partnership engagement. The latter was in fact a key prerogative of Mission Innovation from the outset. Its official announcement at COP21 was accompanied by representatives of the Breakthrough Energy Coalition, which unites private investors, global corporations and financial institutions who have collectively pledged to invest 1 billion US-Dollar in early-stage technology companies through the Coalition's Breakthrough Energy Ventures Fund (Sanchez and Sivaram, 2017; Breakthrough Energy Coalition, 2018).

4.2.5. Institutions with Regional and Local Focus

As sketched out above, IRENA includes a number of regional initiatives reflecting the organisation's global commitment on a regional level. In addition to IRENA's regional initiatives, a range of other international institutions have a focus on specific regions. As an example, we focus on Africa as a regional cluster, but similar institutions exist for other world regions.²⁸

With respect to Africa, the most salient institutions are the Africa Renewable Energy Initiative (AREI) and the regional interconnected power grids, the Eastern Africa Power Pool (EAPP), the Western African Power Pool (WAPP) and Southern African Power Pool (SAPP).

The AREI is led and owned by African institutions and was launched at COP 21 in Paris. The initiative's goal is to ramp up renewable energy generation capacity to at least 10 GW by 2020 and 300 GW by

²⁸ Examples include the Caribbean Centre for Renewable Energy and Energy Efficiency, Latin America Energy Organization (OLADE), the Association of Southeast Asian Nation Centre for Energy, and Baltic Sea Region Energy Cooperation.

2030 in order to support African countries to transform their energy systems, ensure energy access and increase economic and energy security. In order to provide the required financial support, several industrialised donor countries, including Canada, France, Germany, the USA, together with the EU for example had pledged an initial 10 billion US-Dollar. Additionally, AREI provides capacity building on strengthening regulatory frameworks, mobilisation of capacities for all stakeholders as well as support for project development.

EAPP, WAPP and SAPP are grid networks that all seek improvements in the field of energy supply and efficiency for their respective area by interconnecting power grids of different African countries. This requires technical rules to adjust different power systems.

A particularly peculiar regional initiative is the **Western Climate Initiative (WCI)**. It is the only transnational emission trading scheme.²⁹ The WCI established a regional greenhouse gas emissions trading scheme in the western United States and Canada which is mandatory within the member's respective jurisdictions. To support this, the WCI has a compliance tracking system in place that enables tracking of allowances and offsets certificates. It manages allowance auctions and performs market monitoring of certificate trading. This initiative is, of course, not exclusively geared towards the power sector, but does directly affect power generation.

Alongside these institutions with regional focus, there are **numerous institutions that focus on the local level**. One of the largest regional initiatives, the **Covenant of Mayors for Climate & Energy**, should be highlighted here. It unites over 7000 local and regional authorities from 57 countries who have pledged to decarbonise their territories, adapt to climate change impacts, and provide "secure, sustainable and affordable energy" by 2050 (Energy Cities, 2018). Inter alia, the Covenant of Mayors has established a standardised format for so-called Sustainable Energy and Climate Plans (SECAP) that include baseline emission inventories as well as climate risks and vulnerability assessments. Member cities are obligated to regularly report their progress every two years on the implementation of their commitments.

The **100% Renewable Energy Cities & Regions Network convened by Local Governments for Sustainability (ICLEI)** comprises leading cities, towns and regions envisioning the transition towards a exclusively renewable energy supply. It is also part of the to the Global 100% Renewable Energy Campaign (Global 100% RE, see below). Members must pledge 100% renewable energy target in at least one sector. Additionally, the network facilitates capacity building inter alia through peer-learning arrangements and guidance provided by the ICLEI Secretariat.

Another example of an institution focussing on the local level is the **Carbon Neutral Cities Alliance**. Participating cities make commitments concerning energy supply and renewable energy, ranging

²⁹ Of course, the EU Emissions Trading Scheme also extends across borders, but given the supranational nature of the EU, it is still not comparable with the WCI which unites subnational entities of to different countries.

from voluntary actions and financial incentives to obligations, in order to contribute to reaching the Alliance's general target of reducing greenhouse gas emissions by at least 80% by 2050.

There is also a wide range of governance institutions such as "under2 coalition" and "C40 Cities" that have a general climate policy focus and hence cover power sector issues on the general level. However, they do not have an explicit power sector focus and were hence not included in the assessment in further detail.

4.2.6. Institutions Geared toward the Private Sector

A number of institutions provide power sector-related governance directly towards the private sector. **RE100** is a project by the Climate Group. It provides a platform for its 116 member companies to pledge and register their commitment to exclusively use renewable electricity for their global activities. Members also subscribe to RE100's credibility and transparency requirements. This includes, for example, annual reporting of the amount of renewable electricity procured and consumed. **Global 100% RE** is an initiative with partners from civil society, industry, science and policy. It envisions the introduction of 100% renewable energy and solely renewable energy-investments in the context of energy financing. It strives for uniting and organising motivated actors worldwide to define a roadmap towards the common objective.

4.3. Assessing the Governance Complex

4.3.1. Guidance and Signal

As identified above, strong signals for the power sector are especially important to influence investment decisions towards decarbonisation. The guidance and signal from existing inter- and transnational governance institutions is already relatively elaborated. **Overarching institutions like the UNFCCC and the SDGs**, particularly SDG7, collectively provide relatively clear 'terms of reference' for the global energy transformation regarding their respective goals and targets (Hermwille, 2017). The periodic elements of the PA – NDCs, transparency reporting and the Global Stocktake – ensure that the signal is not intermittent or time-limited, but continuous guidance is provided through periodically renewed and revised signals.

While the 1.5°C warming limit, peaking of emissions as soon as possible and net zero emissions goals of the PA still fall short of an explicit call for the phase-out of fossil fuel extraction and consumption, its implications are relatively straightforward for the power sector. As noted above, Kuramochi et al. (2018) conclude that current growth rates for renewable energy of 25-30% per annum need to be maintained at least until 2025 in order to limit global warming to 1.5°C. For coal they deem it necessary to issue an immediate worldwide moratorium on new coal power plants and emission reductions of the existing fleet of coal power plants by 30% by 2025. Still, it needs to be noted that the signal could be strengthened if these implications were made explicit as specific goals, for example in terms of a global decarbonisation roadmap for the sector.

Moreover, it bears noting that the signal is less clear when it comes to oil- and particularly gas-fuelled power. On the one hand gas can contribute to short-term emission reductions by substituting coal and also help to provide flexibility to accommodate increasing shares of intermittent renewable energy. Indeed, a significant share of the recent emission reductions in the United States can be attributed to gas replacing coal as a fuel for electricity generation (Mohlin *et al.*, 2018). Yet in the long-run, gas like any other fossil fuel is clearly incompatible with decarbonisation. The only institution which has sent a strong signal to this effect is the World Bank (see section 4.2.3).

The overarching signal of the PA and the SDGs is being echoed and amplified by a range of other institutions. For example, SE4All sends clear signals towards the required shift, aiding actual implementation. The role of local authorities and municipal utilities is often overlooked in stimulating the transformation of power systems on the ground. The Covenant of Mayors for Climate & Energy and the Carbon Neutral Cities Alliance are actively developing the signal from the UNFCCC and SDG7 and translating it into action at the local level. And in the realm of private sector institutions Global 100% RE, for example, explicitly demands from its members to invest accordingly.

However, the signal to phase in renewable energy resonates much more strongly within the wider governance complex than the signal to phase out energy-related fossil fuel production (see chapter 6) and consumption. The Powering Past Coal Alliance is the only institution providing a corresponding signal directly and explicitly. However, as noted above its membership is still rather limited and includes only countries that have limited coal generation capacity. Overall, the signal is being heard, at least in some parts of the world: Europe's energy utilities through their trade association EURELECTRIC have collectively committed not to build any new coal power plants after 2020. The only EU countries that have not committed are Poland and Greece (EurActiv, 2017).

On the other hand, global coal demand has started to decrease in recent years (IEA, 2017c), but the pipeline of coal power plants in the planning or already under construction is still extensive. If all these plants were built, the well below 2°C and limiting warming to 1.5 °C goal would be doomed (Edenhofer, 2015; Oil Change International, 2016; Pfeiffer *et al.*, 2018). Therefore, what would be needed is a truly global Powering Past Coal Alliance.

To conclude, an overarching signal is provided by the PA and the SDGs, supported by a wide range of international institutions. The signal to the power sector to ramp up renewable energy is loud and clear from the existing global governance landscape: low-carbon energy sources, first and foremost renewable energy, and the corresponding infrastructure needs to be expanded post-haste. What is lacking, though, is an explicit roadmap/target for decarbonisation of the power sector. Also, the signal is somewhat ambiguous when it comes to the role of natural gas. Finally, what is missing is a more explicit focus on the flipside of the renewable energy revolution, namely on the phase out of fossil fuel production and consumption. We therefore assess the guidance and signal function to be fulfilled to a **medium** level.

4.3.2. Setting Rules

Ideally, rule setting within the power sector should be realised in form of coordinated target setting, for example by harmonised RE targets/quotas or cap and trade systems that cover emissions from the power sector, and coordinated investments in grid and generation infrastructure particularly where power systems are physically interconnected. The former has not been achieved at a larger scale. A first attempt to introduce top-down coordinated target setting with legally binding commitments infamously failed at the 2009 Copenhagen COP.³⁰ As chapter 2 has elaborated, the PA instead has focused much more on procedural obligations (Oberthür and Bodle, 2016), but has consequently been criticised for its lack of legal ‘bindingness’ (Obergassel et al., 2015, 2016; Bodansky, 2016; Oberthür and Bodle, 2016).

Although the PA makes no explicit reference to the power sector in general or renewable energy in particular, the first round of NDCs has demonstrated the important role of the sector. Still, due to the lack of a common standardised format of NDCs their comparability is low. In their current form they hence are more of a tool for target setting that is coincidental rather than effectively coordinated.

Apart from the UNFCCC, no other international institution has the authority or mandate to serve as a forum for the kind of coordinated target setting at the global level that would resolve the competitiveness concerns outlined above. But even despite this, the world is seeing ever more carbon pricing initiatives (World Bank, 2017a; Métivier, Bulteel and Postic, 2018), though hardly any schemes covering the international realm.³¹ The one exception is the Western Climate Initiative which unites subnational entities of two countries, the United States and Canada. This proliferation of carbon pricing approaches already to some degrees addresses competitiveness concerns to the extent that the various schemes create similar levels of regulation in the concerned jurisdictions. As noted in chapter 3, Article 6 of the PA provides potential avenues for countries to engage in “cooperative approaches” which may further facilitate the proliferation of carbon pricing instruments as well as increased coordination/harmonisation of them. Yet, given that the detailed rules for Art. 6 will only be elaborated as part of the Paris Rulebook, it is still too early to make a definitive judgment (Luhmann and Arens, 2016).

Beyond that, a few mostly voluntary institutions try to orchestrate target setting, whether for cities (Covenant of Mayors and Carbon Neutral Cities Alliance) or for businesses (RE100).

The rule-setting could be also important with respect to a global phase-out of coal mining and use. To the extent that coal is an international commodity, potential spill-overs (e.g. price effects) could

³⁰ Of course the attempt was not exclusively focused on power sector emissions but much broader. A more successful Copenhagen agreement arguably would have resolved some of the power sector related competitiveness concerns mentioned above.

³¹ The EU with its European Emission Trading Scheme has been considered as a single jurisdiction and was therefore excluded from the analysis.

be addressed by common rules. In this regard we do not see any international institutions that establish common rules in this regard with the possible exception of the PCPA. The PCPA has set itself ambitious targets, but whether these will be translated into formal rules that are implemented remains to be seen.

We do observe some progress with respect to a very different yet also necessary type of rules and standard setting: the setting of international technical standards. This includes for example the efforts of regional power pools in Africa that aim to further integrate and harmonise the interconnected power grids of their respective member countries.

All things considered, the global climate governance sub-complex for the power sector does not fully satisfy the governance demands for rule-setting we have identified. Considering the limitations of what global governance can reasonably be expected to deliver, we would still rate the *rule-setting* function as **low-medium**.

4.3.3. Transparency and Accountability

Generally, transparency is relatively high in the power sector. Major institutions like the IEA, IRENA, World Bank and REN21 to a large degree complement each other and collectively provide a high degree of transparency. A limitation to this is that the legitimacy of two of the most informative sources – IEA and REN21 – is somewhat limited. The IEA is an organisation under the OECD and hence has a strong focus on OECD countries. While it provides information on non-member countries, this data is less frequent, and potentially less accurate. Also, non-members may consider the IEA information insufficiently authoritative. Finally, IEA statistics and many of the more detailed IEA products require a hefty subscription fee that may actually inhibit the data being used by a wide range of actors, especially within civil society.

The REN21 Global Status Reports ensure a high degree of rigor through a well-organised scientific process that brings together a large number of contributors and an even larger number of reviewers. Yet it lacks the kind of political processing that makes the IPCC, for example, a highly authoritative source of information.

A number of more specialised institutions also contribute to transparency and accountability. These include the Covenant of Mayors that contributes information on power supply at municipal level and RE100 which provides transparent information of use of renewable energy by subscribing companies.

The transparency and accountability function specifically focuses on information that supports rule setting and implementation (see Oberthür *et al.*, 2017). This relates to two issues. On the one hand there is a need for a basic level of transparency in order to be able to formulate and coordinate collective goals and individual targets. With the information provided from the existing governance complex, a lack of basic transparency should not hinder more advanced rule setting in the power sector. On the other hand, transparency and accountability are required to track progress on the implementation of collectively agreed targets and built trust. As stated above, there is still a lack of

such collectively agreed goals that go beyond the basic overarching goals of the PA and the SDGs. Hence there is no need for further transparency on that matter. Those institutions that engage in coordinated target setting at the transnational level (e.g. the Western Climate Initiative, RE100 and the Covenant of Mayors) have their own, tailored, transparency arrangements.

Consequently, we consider that the overall rating for the transparency and accountability function is **high** in the power sector.

4.3.4. Means of Implementation

The identified key governance demands with respect to means of implementation include arrangements for risk sharing for capital-intensive investments, capacity building as well as transfer of renewable energy and energy storage. Various institutions provide these governance functions, particularly financial support and capacity building. Financial means of implementation are provided first and foremost by the Multilateral Development Banks, especially in developing countries. However, their role is not unambiguous. MDBs have also been accused of impeding the process towards sustainable energy systems by continuing to fund fossil-fuel projects (Kim and Urpelainen, 2013; Wright, Holmes and Barbe, 2017). The World Bank's commitment to stop funding upstream fossil fuel investments highlights how this may be changing.

Alongside the MDBs, numerous other institutions provide more targeted finance. These include the Africa Renewable Energy Initiative, with a regional focus, and Mission Innovation and the Breakthrough Energy Coalition with a focus on research and innovation. While Mission Innovation holds the potential to become a key institution in the area, its future is somewhat uncertain. The United States was a key driver of the initiative, not only contributing a major share of the budget but also providing staff for its secretariat (Sanchez and Sivaram, 2017). In the Trump era, it is highly questionable whether the US engagement in Mission Innovation will continue. Initially, Trump's proposed budget would have slashed funding for clean energy research (Foehringer Merchant and Pyper, 2018), but after negotiations in the Congress the budget for clean energy research was actually significantly increased (Morello and Guglielmi, 2018). While this seems to suggest that the US will contribute financially to the targets Mission Innovation set out, it is still uncertain whether other countries will be able to compensate for the lack of US leadership.

But are the available means of implementation sufficient to meet the enormous investment needs to transform global power systems? While current growth rates for renewable energy are in line with the required pace to embark on a 1.5°C compatible pathway (see Kuramochi et al. 2018), it is unclear whether this high level of growth (25-30%) can be maintained and for how long. The investment challenge is enormous: in order to save a chance of limiting global warming to well below 2°C investments, around USD 20 trillion need to be shifted from investments in fossil fuel infrastructure to renewables and energy efficiency in the 2015-2050 period, and investments of an additional USD 27 trillion need to be attracted compared to current levels of investment (IRENA, 2018).

Overall the governance institutions in place are probably sufficient. However, the actual financial means may not suffice to sustain current growth in renewable energy. As chapter 3 has highlighted as well, this needs to be set against the continued funding of unsustainable fossil-fuel infrastructure.

The number of institutions providing capacity building is even higher than with respect to financial means of implementation. These include SE4All, the International Solar Alliance, the Clean Energy Ministerial, IRENA with its various regional initiatives, as well as the technology-specific institutions such as the Global Bioenergy Partnership, Global Geothermal Alliance, Global Solar Council and Global Wind Energy Council. For private businesses, capacity building is provided by the Global Sustainable Electricity Partnership, among others. Overall, there is ample governance supply. While the plethora of capacity-building institutions may suggest a high degree of specialisation among the institutions and hence a broad range of aspects are covered, it also bears the question whether the resources for capacity building are spent efficiently. There is perhaps room for improvement in better coordinating or orchestrating the various efforts (see chapter 10).

All in all, the governance function means of implementation for the energy sector fulfils the demands under 4.1 to a **medium to high** degree.

4.3.5. Knowledge and Learning

There are a plethora of inter- and transnational institutions that serve the knowledge and learning governance function. Among the key suppliers are the IEA (specifically through the World Energy Outlook, Energy Technology Perspectives reports and various TCPs). IRENA is also very important as an information hub.

Further relevant initiatives are REN21, the International Solar Alliance, the Clean Energy Ministerial, Energy Cities, and the International Solar Alliance, to name a few. However, most of these are concerned with technological knowledge. Social scientific knowledge production, related *inter alia* to socio-economic and cultural implications of energy transformations seems underrepresented. Nevertheless, overall we conclude that the knowledge and learning governance function is being fulfilled to a **high** degree. Also, knowledge with respect to the increased temperature goal (1.5°C) is still somewhat limited and many models that inform analyses, such as the IEA's periodic reports, is still based on 2°C scenarios. The 2018 IPCC Special Report on 1.5°C may help to close this gap.

4.4. Conclusion and Recommendations

The climate governance complex for the power sector is highly populated with many diverse institutions. There is however no central and/or coordinating institution. When compared to other sectoral systems, the governance complex for power is perhaps still the most 'complete' in terms of governance supply meeting the identified needs (see chapter 10). This is particularly true for transparency, knowledge and learning, and means of implementation (with some limitations on finance). Significant shortcomings remain, however: while the signal is strong and clear for the phase-in of renewable energy, it is somewhat vague when it comes to the phase-out of coal and virtually absent when it comes to oil and particularly gas. Arguably, however, the issue of phase-out

of fossil fuel infrastructures will become more and more central as renewable energy technologies approach global breakthroughs and begin to challenge the incumbent fossil-fuel based system. The increasing recognition of the importance of “just transition” (Obergassel *et al.*, 2018) can be seen as highlighting this.

But what is the right forum to address these issues? Goldthau (2017) suggests that the G20 is well placed to play a central role in mediating imminent conflicts between the winners (low carbon technology leaders) on the one hand and losers (fossil-fuel producers and heavy consumers) on the other hand. While we agree that the G20 is the right place to set the agenda for fossil fuel phase-out and initiate talks, it may not be the right forum to resolve consequent conflicts. It may be the right place because it brings together the key winners and losers of the energy sector transformation, but its ad-hoc nature, limited formalisation as well as its limited representativeness suggest otherwise. Others have proposed to engage in ‘supply side climate policy’, i.e. policies that restrict the production/extraction of fossil fuels, also in the context of the UNFCCC (Asselt and Kulovesi, 2017; Piggot *et al.*, 2017; Verkuijl *et al.*, 2018) (see chapter 6 on extractive industries).

Given its strong focus on GHG emissions in general and the historically minor role that sector-specific perspectives played in the negotiations³², the UNFCCC is perhaps not the right place to develop and negotiate a global vision and/or roadmap for the power sector (or indeed any other sector). The NDCs and the long-term low-emission strategies that Parties are invited to prepare in accordance with Art. 4.19 of the PA (implicitly) enlist national governments in developing such visions, but not in an internationally coordinated manner. On the other hand, the UNFCCC could still take up visions developed at other international fora and, for example, “take note” or “endorse” them by way of a COP decision. This would help to raise the profile of such sectoral visions and further institutionalise them thus amplifying the signal and guidance provided. Article 22 of the PA would in principle even allow formal inclusion of such visions as amendments to the PA.³³

Finally, the IEA could also be the right institution to take on a leading and/or orchestrating role within towards governing the transformation of the power sector, at least in principle. The IEA has substantial analytical capacity and already serves as a knowledge broker. It also has strong convening power (Heubaum and Biermann, 2015) which it could utilise even more broadly to foster international coordination particularly with respect to the required decline and ultimately phase-out of fossil fuel consumption in the power sector.

³² While the GHG monitoring and reporting do provide a sectoral disaggregation, these sectors (e.g. Energy sector) are not aligned with the sectoral systems that guide the analysis of this report. Exceptions are perhaps agriculture and forestry which have received somewhat more explicit attention recently (Dinesh *et al.*, 2017).

³³ A formal amendment would of course require a steep and stony path to first adopt and then ratify the amendment in a context in which unanimous decision making is the norm.



But in its current form, the IEA's capacities to do so are limited mainly by two aspects of its historic legacy. The first regards its affiliation with the OECD. IEA full membership (and hence full voting rights in the governing bodies) is restricted to OECD members. The second aspect regards the IEA's historic focus on fossil fuels. Founded as a 'buyer's club' to counterbalance OPEC, even today a membership requirement is that members need to hold oil reserves for up to 90 days. But this legacy is not only a problem when it comes to broadened membership; it is also a question of credibility. In the past, the IEA has rather promoted the production and consumption of fossil fuels while in the future it will be necessary to restrict their use.

Arguably, the IEA has come a long way to leave behind this legacy with the broadening of its issue portfolio and the "opening the doors" strategy to welcome associated countries (Heubaum and Biermann, 2015; Elkind, 2017). While these efforts are laudable, they will only go so far. In order to become a truly leading institution, the IEA would have to leave this legacy fully behind and attract a much wider membership. Being part of the OECD system may discourage many developing countries and emerging economies from joining the IEA and providing it with a more global mandate. Former IEA's Deputy Director Ambassador Jones described the situation of the IEA as an autonomous agency of the OECD as follows: "It's like being 35 years old and still living with your parents" (quoted in Lesage, Van de Graaf and Westphal, 2010, p. 52). Maybe it is time to move out?

4.5. Annex: Overview of Institutions and their respective Contribution to the Governance Functions

GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
GOVERNANCE NEEDS					
<i>results based on the analysis of sectoral transformation challenges</i>	<i>Signal for low-carbon investments in energy infrastructure</i>	<ul style="list-style-type: none"> - <i>coordinated target setting (decreasing importance due to increasingly competitive renewable energy technologies)</i> - <i>coordination at the regional level (especially grid development)</i> 	<i>required to support collective action function</i>	<ul style="list-style-type: none"> - <i>risk sharing for capital intensive investments in sustainable power systems, especially in developing countries</i> - <i>international transfer of renewable energy and energy storage technologies</i> - <i>administrative and technological capacity building</i> 	<i>sharing of good practice policies e.g. on market designs and long-term planning</i>
GOVERNANCE SUPPLY					
Overarching Institutions					
UNFCCC/Paris Agreement	Focus PA's 1.5 degree Celsius long-term temperature goal; goals of peaking emissions as soon as possible and net zero emissions in 2 nd half of this century; 5-yearly global stocktakes	Focus NDCs	Focus Regular reports of countries' GHG emissions and tracking progress made in implementing and achieving NDCs; transparency framework under the PA	Focus Global Environmental Facility (GEF); Green Climate Fund (GCF); Climate Technology Center and Network (CTCN)	

GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
Sustainable Development Goals – SDG 7	Focus Targets 7.2, 7.a, 7.b		Indirect Global indicator framework		
Sustainable Energy for All	Focus ensuring universal access to modern energy services, doubling the share of RE in the global energy mix, doubling the global rate of improvement in energy efficiency		Focus Global Tracking Framework to benchmark progress	Focus financial or in-kind contributions; national strategies and investment plans	Focus regional and thematic hubs; Global Energy Efficiency Accelerator Platform; Energising Finance report series
G7	indirect 2015 announcement to decarbonise global economies in the second half of the century				
G20		focus 2009 commitment to phase out inefficient fossil fuel subsidies (but lacking implementation)			
World Trade Organisation				Indirect removing trade barriers through Environmental Goods Agreement	

GOVERNANCE FUNCTIONS:		Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
Energy-specific IGOs						
International Energy Agency	Indirect authoritative energy models and projections		Focus regular energy statistics; IEA Access to Energy database.		Focus World Energy Outlook; IEA research and analysis of clean energy technologies; Annual Energy Technology Perspectives reports; Technology Collaboration Programme	
International Renewable Energy Agency	Focus create a collaborative platform for increased deployment of solar energy technologies to enhance energy security & sustainable development	Indirect IRENA statute		Focus capacity building: Renewable readiness assessments		Focus provide authoritative information, analyses and data on renewable energy; advise and support countries in their national and regional efforts; promote the economic, social and environmental benefits of renewables; develop collaborative stakeholder partnerships for energy transformation; annual reviews, statistics, Global Atlas, technology briefs
REN21 – Renewable Energy Policy Network for the 21 st century						Focus Global Status Report Renewable energy: Collection of relevant

GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
					information RE statistics, markets and policies; catalysing discussion and debate; development of thematic networks
Multilateral Development Banks					
World Bank	Indirect contribution pledge to stop financing the upstream of oil and gas; aligning funding policies with well below 2°C target underwrites overarching signals with “hard currency”		Indirect contribution Working with about 70 countries on improving transparency and governance in their industries, focus on sustainability and fostering private sector investment	Focus Support of various strategic global partnerships and programs; Attract increased private sector participation and investment	Focus Working to build global knowledge on energy access; extensive statistical database; global tracking framework (collaboration with SE4All)
African Development Bank	Indirect contribution aligning funding policies with well below 2°C target underwrites overarching signals with “hard currency”			Focus (financial) support for regional member countries	Indirect contribution Fostering knowledge transfer
European Bank for Reconstruction and Developments	Indirect contribution aligning funding policies with well below 2°C target underwrites overarching signals with “hard currency”			Focus	

GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
European Investment Bank	Indirect contribution aligning funding policies with well below 2°C target underwrites overarching signals with “hard currency”			Focus	
Asian Infrastructure Investment Bank	Indirect contribution aligning funding policies with well below 2°C target underwrites overarching signals with “hard currency”			Focus	
Inter-American Development Bank	Indirect contribution aligning funding policies with well below 2°C target underwrites overarching signals with “hard currency”		Indirect contribution Project/ Progress Monitoring Report and Loan Results Report	Focus	Indirect contribution international seminars; workshops; studies
New Development Bank	Indirect contribution aligning funding policies with well below 2°C target underwrites overarching signals with “hard currency”			Focus Financial and technical support	
Climate Investment Funds				Focus Clean technology Fund (CTF);	

GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
				Scaling Up Renewable Energy in Low Income Countries Program (SREP)	
Informal Energy Alliances					
International Solar Alliance	Indirect goals: increasing the use of solar energy in meeting energy needs of prospective ISA member countries in a safe, convenient, affordable, equitable and sustainable manner	Indirect guiding principles for members		Focus coordinated actions to address the demand for financing and capacity building, network of correspondents by National Focal Points	Focus cooperation among members and non-member entities; coordinated actions to address the demand for technologies, innovation, research and development
Powering Past Coal Alliance	Focus Commitments to phase-out coal production and consumption	Focus Partners commit to phasing out existing traditional coal power in their jurisdictions, and to a moratorium on any new traditional coal power stations without CCS			Indirect contribution Mutually beneficial engagement, sharing of information , close cooperation with the private sector
Clean Energy Ministerial	Focus Goal: improve energy efficiency, clean energy supply and access worldwide			Focus Clean energy investments; Funding in research and development	Focus Regular meeting of energy ministers; provision of information and tools

GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
REEEP – Renewable Energy and Energy Efficiency Partnership				Focus facilitate investment in scalable projects; supporting governments to create favourable regulatory frameworks	Focus online knowledge hub reeegle.info
Mission Innovation	Focus Aim: reinvigorate and accelerate global clean energy innovation with the objective to make clean energy widely affordable	Focus Commitments by members to double their governments' clean energy research and development (R&D) investments over five year; development of strategies for clean energy innovation funding based on individual national resources, needs, and circumstances			Focus Information sharing; cooperation with private sector
Breakthrough Energy Coalition	Focus committed to building new technologies for a transition to clean energy			Focus Breakthrough Energy Ventures; Patient and risk tolerant private investors and financial institutions	
Institutions with Regional Focus					
Africa Renewable Energy	Focus		Indirect contribution	Focus	Indirect contribution

GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
Initiative	Achieve at least 10 GW of new and additional RE generation capacity by 2020; Mobilise the African potential to generate at least 300 GW by 2030		monitoring and assessment as cross-cutting work area	capacity mobilisation and building; mobilisation of finance for incentives and investments; and project development and support	Mapping of RE policies, regulations, experiences and programmes; Socio-economic and environmental assessments of RE technologies
Eastern Africa Power Pool		Focus framework for pooling energy resources, promoting power exchanges and reducing power supply costs			
Southern African Power Pool		Focus Interconnecting power grids in Southern Africa (see EAPP)			
West African Power Pool		Focus Interconnecting power grids in Western Africa (see EAPP)			
Western Climate Initiative	Indirect contribution collaboration among states and provinces to tackle climate change at a regional level	Focus establishing a regional emission trading scheme	Focus compliance tracking system; market monitoring of allowance auctions and allowance and offset certificate trading	Focus administrative and technical services to support the implementation of state and provincial gas emissions trading programs	

GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
Covenant of Mayors for Climate & Energy	Focus 2050 vision: accelerating the decarbonisation of their territories and allowing their citizens to access secure, sustainable and affordable energy	Focus adoption of a joint approach to tackling mitigation and adaptation to climate change; submitting a Sustainable Energy and Climate Action Plan (SECAP)			Focus networking platform; regular meetings
ICLEI – Local Governments for Sustainability - 100% Renewable Energy Cities & Regions Network	Indirect contribution by demonstrating leadership on the subnational level.	Focus recognising and highlighting cities and regions that commit to 100% Renewable Energy	Focus establishment of a regional platform for mapping and monitoring its goals		Focus Scenarios on technologies, strategies, and best practices
Carbon Neutral Cities Alliance	Indirect contribution striving for carbon neutrality	Focus ambitious long-term carbon reduction goals		Indirect CNCA "Innovation Fund"	Indirect Share lessons and best practices; address necessities to reach goals
Institutions geared toward the private sector					
RE100	Indirect	Focus Commitments to use 100% renewable electricity	Focus Annual disclosure of electricity data; reports on own progress; credibility and transparency requirements		Focus Peer-to-peer learning and technical guidance



GOVERNANCE FUNCTIONS:	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
Global 100% RE	Focus Showcasing the vision: 100% renewable energy in power, heating/cooling, and transport sectors globally, New investments in energy systems must be 100% renewable energy			Focus reports, workshops and good practice, peer learning among members	



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5. Energy-intensive Industries

Gauri Khandekar, Sebastian Oberthür and Tomas Wyns

5.1. 5.1 Transformation Challenges and Governance Demands

5.1.1. Current Status and Prospect

The global energy-intensive industry sector contributes 21 per cent of total global GHG emissions (IPCC, 2014a). Global industrial emissions have grown from 5.4 Gt CO₂eq in 1970 to 8.8 GtCO₂eq in 2010 or around 63 per cent (Kechichian et al., 2016). Emissions from the energy-intensive industry sector comprise mainly of direct energy-related emissions, indirect emissions from electricity and heat production, process emissions and a tiny percentage from waste/wastewater (IPCC, 2014a). Other GHG emissions from industry are mainly N₂O emitted during the production of ammonium and adipic acid and sulphur hexafluoride (SF₆) from aluminium production. The sector accounted for around 29 per cent of the final global energy consumption in 2012 (IEA, 2014b), more than 70 per cent of which comes from fossil fuels (Kechichian et al., 2016). Fossil fuels account for 74 per cent, 85 per cent and 85 per cent of the iron and steel, cement and chemical industries' energy consumption respectively (Kechichian et al., 2016). Aluminium is the only energy-intensive industrial subsector that relies mostly on electricity as its energy supply (Kechichian et al., 2016).

Table 5.1: GHG Emissions Overview of Energy-Intensive Industries in 2010

Sub-Sector	Total Emissions (in MtCO ₂)	% of Industry Emissions
Iron and Steel	2410	24.05 per cent
Cement (as part of non-metallic minerals)	1910	19.06 per cent
Chemicals	1880	18.76 per cent
Aluminium (as part of non-ferrous metals)	690	6.89 per cent

Source: Kechichian et al. 2016 (total emissions) and Ecofys 2013 (share of industry emissions)

This section focuses on four key energy-intensive industry subsectors: **iron and steel, cement, chemicals and aluminium** which constitute 68.76 per cent of industrial emissions (Kechichian et al., 2016); Table 5.1). These four subsectors have grown sharply in the past decades driven primarily by globalisation and dramatic growth in developing countries and countries with economies in transition. One of the most important raw materials used today, global **crude steel production**, stands at 1,628.5 million metric tonnes (Mt) (2015) (World Steel Association, 2017), up from just 200mt in 1950. **Cement**, the second most consumed material on the planet, has seen a dramatic growth – from 133mt in 1950 (U.S. Geological Survey, 2015) to nearly 4.1 billion metric tonnes in 2015 (Olivier, Janssens-Maenhout, Muntean, & Peters, 2016). The **chemicals industry**, the largest

amongst the industrial subsectors in monetary value, has also expanded significantly, from USD 171 billion in 1970 (Perlitz, 2008) to USD 4.1 trillion in 2013 (Consultancy.uk, 2015). Aluminium is a key enabling metal and is the world's third largest consumed metal after steel and copper, and production of new aluminium results in one per cent of total global annual GHG emissions (Tyabji & Nelson, 2012).

Over the past half century, industry emissions have risen sharply amongst the low to upper middle-income countries as compared to a gradual decline amongst high income countries. Some of the key exogenous trends driving developments in these subsectors have been the pursuit of growth in the developing world strongly supported by public policy incentives and globalisation, lower production costs, population rise alongside growing per capita income. Production growth of energy intensive materials (in particular steel and cement) in emerging economies is closely linked to large infrastructure construction and urbanisation.

Few countries dominate these industrial subsectors – China, the EU, the US, Japan and India. China is currently overwhelmingly the largest producer and consumer in all the four subsectors and one of the top five importers and exporters. Asia is the most important region accounting for nearly 65 per cent of steel use (World Steel Association, 2016), more than 75 per cent of global cement consumption, and 61 per cent of total global chemical sales. Production and demand is highly concentrated in Asia, although it is growing in other developing regions like the Middle East, Latin America and Africa. For instance, the most rapid growth in the cement sector is seen in Sudan, Peru, Nigeria, Turkey, Colombia, and Brazil (Kechichian et al., 2016). These “fastest risers” between 2003 and 2013 have compensated recent contraction in mature markets, such as the EU and the US. Industrialised nations, although innovative, face a comparative disadvantage in these subsectors given lower input (e.g. energy costs, labour or raw material) and larger domestic demand in the global south.

Next to a geographic concentration in Asia, these industries are also dominated by a few private sector companies. The World Steel Association lists 94 global steel companies who produced almost 60 per cent of the total global crude steel production of 1,628.5mt in 2015 (World Steel Association, 2017). Fifty of these companies are based in China while fourteen others are based in India (5), Japan (4), South Korea (3), Taiwan (1) and Australia (1) (World Steel Association, 2016). Similarly, just 10 companies produce almost half the world's aluminium. More than half of the top 50 chemicals companies are headquartered in just eighteen countries. Twelve are in the US, eight in Japan and six in Germany. BASF, headquartered in Germany is the world's largest chemical company since a decade, with USD 63.7 billion sales in 2015, down from USD 78.7 billion in 2014 (Tullo, 2016). The cement subsector is more speckled in comparison. According to the Global Cement Directory 2016, there were 2273 active integrated cement plants around the world in 2015 (Saunders, 2015).

Trade in the iron and steel and chemicals subsectors is highly globalised: nearly a third of all steel produced is traded (US Department of Commerce, 2016). In the aluminium sector, most aluminium products are traded with regions or countries. For instance, China which produces nearly half of global aluminium is self-sufficient, while no single country accounts for more than 13 per cent of the

import or export market (Ludwig & Van Houwelingen, n.d.). However, the trade intensity of products using aluminium (e.g. cars, laptops) is of a much higher trade intensity. Finally, the cement subsector is predominantly regional. Cement production is significantly local: virtually every country produces cement and only three per cent of global production is traded internationally (The Economist, 2013).

5.1.2. Deep Decarbonisation Potential and Drivers

The model used by the IEA's Energy Technology Perspectives (IEA, 2017a) shows that a 2°C scenario requires global direct CO₂ emissions from industry to be reduced by 44 per cent by 2050 and halved by 2060 compared with its baseline scenario. However, to reach net-zero CO₂ emissions at the system level, by 2060, which is required for a well below +2°C scenario, industry would need to further reduce its carbon emissions by 69 per cent by 2050 and 80 per cent by 2060 compared with the baseline scenario (IEA, 2017a).

Technology solutions for decarbonisation and modernisation across industrial sectors can be categorised broadly in three areas (Kechichian et al., 2016); energy efficiency improvements (in processes), low-carbon substitutes (for materials and fuels) and innovative and alternative processes.

For most existing industrial processes there still is an overall potential to improve energy and process efficiency (e.g. by closing old inefficient plants and investing in best available technologies) and best practice solutions already exist that focus largely on relatively easy retrofits which have quick paybacks (Kechichian et al., 2016). However, energy and process efficiency will meet the law of diminishing returns (i.e. more effort required to achieve lower gains), the closer these processes get to thermodynamic or chemical optimisation.

Low-carbon substitutes for materials and fuel inputs are being explored on a global scale (e.g. use of municipal waste and biomass in cement production). The future potential of this option can be significant in some sectors (e.g. biomass based feedstock or use of waste gases from other industries in chemicals production), but will depend on the (limited) availability of these substitutes (CEFIC, 2013, p. 112).

The **use of innovative and alternative processes** will be essential for deep decarbonisation of industrial sectors. This includes higher levels of electrification of energy intensive processes (using renewable energy sources) and the use of carbon capture, utilisation and/or storage. Table 5.2 below gives a brief overview of some major new (or improved) processes that would enable deeper emission reductions in industrial sectors.

Table 5.2: Deep Decarbonisation Options

Sector	Deep Decarbonisation Options
Steel	<ul style="list-style-type: none"> Improving energy efficiency beyond best available technologies New Smelting Reduction Technologies Direct Reduction of iron ore using natural gas or hydrogen Using electricity for iron ore reduction Use of biomass in steel production Higher levels of steel recycling (while maintaining quality) Use of waste gases from cokes/iron/steel production as feedstock for chemicals production Carbon capture and storage
Cement	<ul style="list-style-type: none"> Higher energy efficiency of processes and fuel switching (to low carbon fuels) Reducing clinker content in concrete Innovative changes to the composition of concrete Enhanced concrete and cement recycling Extend lifetime of concrete (e.g. through self-healing concrete) Carbon capture at process level or during concrete formation CO₂ utilisation
Chemicals	<ul style="list-style-type: none"> Major improvements in resource/energy efficiency of processes Higher use of (renewable) electricity e.g. for production of H₂ Higher use of biomass (waste), waste and recycled materials including utilisation of waste gases from e.g. steel industry and industrial symbiosis Development of advanced (plastics) recycling processes
Aluminium	<ul style="list-style-type: none"> Use of non-oxidising anodes in primary aluminium production in combination with highly efficient processes. Improvement of recycling technologies to maintain different aluminium type qualities Establishment of circular value chains and leasing of metals.

Source: Based on European Commission 2017a.

Next to the (process) technology solutions, deep emission reductions in industrial sectors will also require a **value chain approach** that covers the supply and value chains across different sectors. Steel, cement, chemicals and aluminium producers mostly make intermediate products and hence

have limited impact on the use of intermediate goods in the final consumer or other products (e.g. cars, aeroplanes, buildings). Therefore, reducing the basic materials' intensity in these end products through smarter design, efficient consumption and enabling a circular resource model will need to be part of the over-all mitigation efforts related to the emissions of the basic materials sectors. A **behavioural switch to a circular economy** can make its mark on the wider market and the carbon footprint of the industrial sector by reducing demand, recycling and underscoring greater efficiency. The concept of a circular economy which is "a continuous positive development cycle that preserves and enhances natural capital, optimises resource yields, and minimises system risks by managing finite stocks and renewable flows" (Ellen MacArthur Foundation, 2015) can potentially have a direct impact on emissions reduction³⁴. While the concept of a circular economy is pervading the regional level and at best the national echelon (mostly limited to certain sectors), it remains largely absent at the global level. A transition towards more circularity (recycling, waste to energy, and so on) would certainly aid decarbonisation efforts. However, circularity remains poorer in the developing countries than in the developed ones (see also Section 4.4 on the circular economy).

5.1.3. Main Challenges and Barriers toward Decarbonisation

Activating low-carbon interventions in industrial sectors depends on the presence of a combination of variables (Kechichian et al., 2016). These include the ability to provide quick paybacks from low-carbon investments and a minimal operational disruption; the capital expenditure (CAPEX) of the intervention together with access to finance (and the cost of capital); the cost of current inputs in processes compared to the low-carbon substitutes; a strong and globally implemented carbon policy (e.g. globally agreed price on carbon, a global emissions trading system, the linkage of regional emissions trading systems into a global emissions trading system, or common global standards) and the extent to which competitors around the world are implementing GHG mitigation measures.

The main barriers or challenges for deep decarbonisation are a combination of technological inertia, the high capital expenditure and risk associated with new (process) technologies, the reluctance to impose ambitious GHG regulations or CO₂ costs due to fear of loss of international competitiveness or impeding development and the complexity of global value and supply chains (Bennett & Heidug, 2014). Each is now examined in turn.

³⁴ Both steel and aluminium are 100 per cent recyclable without loss of quality and with a potentially endless lifecycle. Recycling aluminium requires around five per cent of the energy used to produce primary aluminium and emits as little as five per cent of the GHG emissions when compared to primary aluminium production (Kechichian et al., 2016). Steelmaking from scrap uses one-third of the primary energy and emits a quarter of the emissions as compared to steelmaking from iron ore (Cullen, 2010). However only a third of all aluminium produced today comes from old, traded and new scrap (International Aluminium Institute, 2009). Similarly, 650 million tonnes of steel are recycled globally every year or only less than one-third of global production.

Technological Inertia and R&D Mismatch

The basic materials industries such as the ones covered in this section almost all saw their major disruptive process innovations happen by 1970-1980 (Freeman & Soete, 1997). Large production installations mostly see incremental, but still important, improvements in energy efficiency and mitigation of GHG emissions. Since these sectors use large (and costly) process installations the investment cycles are long. This prevents an accelerated take-up of new breakthrough technologies, especially if these replace incumbent installations. Furthermore, the basic materials industries (with the exception of chemicals) have an over-all low R&D intensity (expressed as R&D expenditure over revenues) compared to other industrial sectors³⁵. One can even see an R&D mismatch with smaller new entrants in these sectors showing more interest in R&D but having lower means to do so compared to larger incumbent companies. These smaller companies also lack sufficient market access (into e.g. consolidated cement, steel and chemicals markets) to further their innovative products and processes.

High Capex and Technology Risk of New Breakthrough Process Technologies

Beyond the relative low R&D spending and the possible R&D mismatch there exists also an important barrier at the latter, demonstration to commercialisation, stage of R&D into low carbon technologies. These large-scale pilot and demonstration plants, the final steps towards commercialisation, require a high level of capital expenditure. At the same time, the still experimental nature of these installations comes with an important technology risk.

The innovative technologies, while promising, are therefore generally not yet deployable, financially less attractive, require longer paybacks and may necessitate longer operational shutdown periods to integrate changes in production process/existing assets. Some promising technology options may therefore never become mainstream solutions.

Competitiveness and Development Concerns

Across most countries in the world there is resistance by these industrial sectors to externalities being priced (fully) in or being faced with a stringent regulatory environment related to GHG mitigation. In industrialised nations, incumbent producers fear that a high(er) price on CO₂ emissions and/or a full exposure to a CO₂ price would, in the absence of similar measures in most other countries around the world, deter further investments, leading to so called investment leakage. Commonly accepted regulations and standards (like procurement policies, customs exemptions, labelling schemes) could create a global level playing field which could foster competitiveness in the right direction (Kechichian et al., 2016).

In developing countries (that see high levels of growth in basic materials production), on the other hand, introducing a price on CO₂ emissions is often seen as stunting development and the construction of necessary infrastructure for an increasing and more affluent population.

³⁵ See the JRC's EU and global R&D scorecards 2016 <http://iri.jrc.ec.europa.eu/scoreboard16.html>

Notwithstanding these concerns, a growing number of industrialised and developing countries are adopting a form of carbon pricing. While it is hard to quantify or even prove the above-mentioned concerns, they are clearly part of the political discourse and hence shape both domestic and international positioning and policies.

Global Complex Value Chains vis à vis the National Bottom-Up Approach of the Paris Agreement (PA)

Finally, as stated before, deep decarbonisation in industrial sectors will require addressing the whole value and supply chains related to these industries. Over the past decades these value chains have grown to become more complex but also more global in scale. This issue is connected to the problem of accounting for embedded emissions (i.e. the GHG emissions embedded in imported goods). In practice, this means that a basic materials company is not (always) able to track and control the end use of its products. This makes closing value chains (circularity) difficult and/or expensive. It therefore prevents the wide-scale introduction of new business models such as the transition from a sales-based model to one in which basic materials are leased and returned to the original producer for re- or up-cycling. Future governance for these highly globalised sectors operating across borders does not fully match the approach under the PA which asks each country to develop *nationally* determined commitments and long-term decarbonisation plans.

Some of the above-mentioned barriers can be negatively reinforcing. For instance, the low R&D intensity of (many) energy intensive industries in combination with the large CAPEX need for breakthrough technologies. The high technology and financial risks related to these technologies can, in case of failure, hamper the competitiveness of companies and hence make them more risk averse.

5.1.4. The Promise and Potential of International Cooperation

Guidance and Signal

A clear international ‘decarbonisation’ objective with firm timelines and differentiated (national, regional and global) mitigation pathways could provide important guidance to decision-makers in industrial sectors. This could be achieved through the **construction of global roadmap(s) for decarbonisation of energy intensive industries**, e.g. built up from national, regional and existing sectoral roadmaps. These roadmaps should present an integrated view of how the industries can transform their supply, production and value chains while maintaining competitiveness (Ahman et al., 2016) and not infringing economic development.

Given the disparities highlighted between regions, **each economic region may need a low carbon roadmap** including trajectories for the industrial sectors which need to be embedded within the other parts of the economy that form the downstream demand for the products of the energy intensive sectors. Resource efficiency linked to a (global) circular economy will need to be a part of the development of such roadmaps. Coordinating these (sectoral) global and regional roadmaps with national decarbonisation plans (developed under the PA) will be a requirement.

Setting Rules to Facilitate Collective Action

Given the globalised nature of energy-intensive industries, there is a clear rationale for **international regulation** (to address competitiveness and carbon leakage concerns). Collective action to enable the decarbonisation of industrial sectors can be realised through (a combination of) different (regulatory) instruments. Regulation could take the form of **carbon pricing** (be it a (coordinated) CO₂ tax or a global emissions trading system, e.g. through linking regional trading systems) or (coordinated) international regulations and/or standards. These can be targeting the production processes (e.g. CO₂ emission limits per tonne of product produced) or the consumption side (limit on embedded emissions in final product; see Neuhoff et al. 2014). Short of international agreement, national and regional frontrunners can pave the way to broader approaches. **Regulating embedded emissions in final products** could help create a level playing field between global industrial producers because ‘end of the value chain’ pricing would not discriminate between local and foreign production.

Transparency and Accountability

For any international regulatory approach, it is important to have **common monitoring, reporting and verification (MRV) standards and metrics** for industrial emissions, preferably even including the whole supply and value chain, as a basis for comparing and verifying efforts. Transparency of GHG impact in semi- and finished products across complex and global value chains would require common/global GHG accounting standards.

Means of Implementation

Global cooperation on innovative technology deployment (including the financing thereof) is urgent. According to the IEA, holding temperature increase to well below 2°C will require OECD countries to transfer innovative technologies for industry to non-OECD countries where new capacity installations increase the potential to widely deploy innovative industrial process technologies. This has to happen very soon to avoid carbon lock-in/stranded assets (IEA, 2017a). Processes and platforms enhancing bilateral and multilateral diffusion of technology and research cooperation – such as the Mission Innovation³⁶ initiative – could foster such cooperation.

Such international cooperation would also need to address the high capital cost and risk associated with large industrial breakthrough technologies. One option would be R&D cooperation that combines the knowhow and finance present in different countries and at different stages in the technology readiness level. Such an approach could make use of the different stages of industrialisation around the world to make use of available resources efficiently. While potential for building new large low-carbon demonstration plants particularly exists in emerging economies, more advanced economies could pioneer circular economy related technologies. Such international innovation program could be implemented through a global industrial innovation fund in combination with coordinated international technology projects (along the lines of the ITER nuclear

³⁶ <http://mission-innovation.net>

fusion project). Leveraging private capital to enable these investments will require the active participation of large national or regional investment banks.

Knowledge and Learning

To the extent the aforementioned technology cooperation involves the development of innovative technology, it will also support the **creation of technical knowledge**. Beyond that, decarbonising industrial sectors (at a global level) will also require a **significant investment in circular economy policies** and the realisation of domestic enabling conditions for industrial innovation (e.g. innovation and industrial policies). **Global coordination and dissemination of knowledge and learning** in relation to industrial decarbonisation is therefore relevant, in particular given the complexity of supply and value chains of industrial sectors. For instance, sharing best practices on circular economy, industrial and innovation policies through a **global knowledge & learning depository/platform** can accelerate the implementation of enabling conditions in a wider group of countries.

For decarbonisation efforts in the energy intensive industries, all the governance functions identified can play a critical role. Apart from transparency and accountability which ranks medium high in importance, all governance functions are deemed to rank high (see Table 5.3).

Table 5.3: Synthesis of governance demands for energy-intensive industries

Sector	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
Energy Intensive Industries	Sectoral decarbonisation objectives and related national, regional, global roadmaps	International emission limits and/or carbon pricing (production or consumption)	Required to monitor and verify implementation of rules	Financial support/incentives and technology transfer	<ul style="list-style-type: none"> • Global knowledge and learning platform(s) • International R&D
Grading	High	High	Medium High	High	High

5.2. Governance Supply

In the energy intensive sector, not only is there a very limited number (10 altogether of which 8 are international institutions and 2 are sectoral platforms) of international organisations/institutions that address decarbonisation, but also, their work on decarbonisation is scarce. No single international organisation/institution can be credited with a sole focus on decarbonisation on the energy intensive sector alone or fulfilling all the identified governance functions satisfactorily. The most sectorally relevant institutions/initiatives are the UNFCCC and in particular the PA, the Cement Sustainability Initiative (CSI), the Group of 20 (G20), the International Energy Agency (IEA), United Nations Environment Programme (UNEP), United Nations Industrial Development Organisation (UNIDO), Mission Innovation and the World Bank (WB). The table below provides a quick overview

of the relevant institutions and which governance functions their activities most relate to. It is observed that the delivery of means of implementation and knowledge and learning are the governance functions most performed by far. A detailed overview of the institutions is provided in table 5.4 (appended).

The criteria of fairness and social acceptability to ensure a just transition entail regional strategies, acceleration of the deployment of breakthrough technologies, involvement of trade unions and employers, investment in skills and boosting local support for decarbonisation (ETUC, 2016). For a just transition, forward-looking regional policy frameworks implemented locally will be crucial for reducing industrial emissions without losing industrial jobs. Breakthrough technologies will play a crucial role in assuaging competitiveness concerns and achieving decarbonisation in the energy intensive sectors. With the recognition that there cannot be a one-size-fits-all strategy every region will have to prioritise and invest in technologies including carbon capture and storage (CCS), carbon capture and use (CCU), and electrification of industrial processes for a low-carbon industry (IEA, 2017a). For a just transition, engagement and social dialogue with stakeholders, especially trade unions and employers, will be crucial for addressing the various impacts decarbonisation. Investing in skills among the workforce would be crucial to ease the transition to decarbonisation (circular economy, renewables, new technologies, and so on). Likewise, building public support for decarbonisation would be equally important. Greater public preference for low carbon industrial products would encourage business leaders to make a step change towards decarbonisation.

The assessment reveals that overall, **performance of the governance functions performed by sectorally relevant international organisations/institutions is weak**. There is no one single organisation that covers decarbonisation in the energy intensive sector as whole. Although some institutions like CSI do focus on one sub-sector of the energy intensive sector, similar entities for other energy intensive subsectors remain amiss. While UNIDO does have a dedicated industry focus, its emphasis is broader than just the energy intensive sector, lacks focus on the decarbonisation of the sector and as such, its impact is dispersed given limited capacity and financial means.

5.2.1. International Institutions

The **UNFCCC** and the **PA** are the most relevant given their role in three specific regards: (1) The PA laid down the global objective of holding temperature increase to well below 2°C/limiting warming to 1.5°C as well as the mitigation objective of phasing out net GHG emissions. (2) The UNFCCC has put in place a fundamental accounting and reporting system in the form of national GHG inventories that are mandated by the UNFCCC/PA. (3) The 5-yearly periodic global stocktakes of climate action is a mechanism that can create political moments and catalyse more ambitious climate action across the entire global climate regime complex and along all governance levels.

The signal set by the PA may however prove less effective for the energy intensive industry. Given a lack of measures and alternatives available for the sector to take action to fully phase out GHG emissions, energy-intensive industries could assume that some undefined level of emissions may continue in the long-run and be offset by negative emissions in other sectors.

The system of reporting under the UNFCCC and the PA holds particular potential. Mandatory national GHG inventories contain separate emission data for the energy-intensive industries that can provide a basis for tracking progress of the sector as a whole, in individual countries and in groups of countries/regions. Sector relevant mechanisms for capacity building have also been undertaken inter alia through the CDM in a couple of sectors. The Technology Executive Committee of the UNFCCC has so far contributed via papers, thematic reports and dialogues (UNFCCC Technology Executive Committee, 2016, 2017). Yet much remains to be desired as regards knowledge diffusion and learning under the UNFCCC.

The UNFCCC provides general guidance (for all sectors) but that guidance (as concerns sectoral decarbonisation objectives and related national, regional, global roadmaps) is not targeted enough for the energy-intensive sector given the critical challenges to decarbonisation which includes above all the strategic nature of the sector (primary industry), lack of feasible alternatives (business models, alternative greener energy sources at scale, process emissions), and competitiveness concerns (both amongst business and national governments). The lack of sector-specific emission-reduction targets, firm timelines and differentiated mitigation pathways (including roadmaps), makes the signal provided by the UNFCCC for the sector low.

The **IEA** is a Paris-based autonomous intergovernmental organisation established in the framework of the Organisation for Economic Co-operation and Development (OECD). The IEA works closely with member countries and others on various aspects of the energy intensive sector (energy efficiency, transition to low carbon, technology transfer, sharing of knowledge and best practises, sustainability options and strategies and so on). The IEA promotes knowledge and learning through its various analysis, technology roadmaps, modelling and data on the Energy intensive sector (IEA, 2013, 2018). It also hosts workshops and seminars which provide a platform for energy intensive industry stakeholders. Its annual Energy Technology Perspectives (ETP) reports (IEA, 2006-2017) and Technology Roadmaps (IEA, 2009-2017) in particular focus closely on the energy intensive sector. Its various decarbonisation focused technology roadmaps, data and statistics generate important knowledge.

The IEA also plays a sectorally relevant role in capacity building through its Technology Collaboration Programmes (TCPs) (IEA, 2016a). IEA implementing agreements provide a framework for members and stakeholders to collaborate by sharing research on breakthrough technologies, fill existing research gaps, build pilot plants and to carry out deployment or demonstration programmes along any technology-related activity in the energy intensive sector that supports energy security, economic growth, environmental protection and engagement worldwide. The Industrial Energy-Related Technologies and Systems (IETS) is such an Implementing Agreement established in 2005 with the aim “to foster international co-operation among OECD and non-OECD countries for accelerated research and technology development of industrial energy-related technologies and systems”. The IETS co-operative activities include “scientific research, technology and systems research and development, demonstration and deployment, technology and systems foresighting, technology and systems assessment of policies and consequences, and dissemination of information” (IETS, 2012). The IEA works with governments around the world to develop effective,

realistic, and well-integrated low-carbon climate and energy policies and strategies in the energy intensive sector (IEA, 2017).

The **G20** has delved more into the financial and trade aspects of energy intensive industries and less on decarbonisation. Energy intensive industries were addressed overwhelmingly in terms of anti-dumping and countervailing initiations (30-50 percent of all investigations in each six-month period). In December 2017, the G20 forum pledged to do its best to phase out subsidies and cut over-capacity in the steel industry (Darabhsaw, 2017). Although curbing over-production has been addressed in D4.1 as a factor in controlling rising emissions in the sector, given the political weight of the G20 and the fact that it includes the largest producers and consumers of energy intensive industry products, much more could be done in terms of sustainability. The G20 has hardly contributed to the decarbonisation of the energy intensive sector except for soft, nonbinding pledges/declarations regarding anti-dumping, curbing overproduction and phasing out subsidies which is insufficient to address barriers to decarbonisation. G20 members moreover are accused of spending four times more public finance (soft loans, guarantees from governments, subsidies) on fossil fuels than on renewables (Doukas et al., 2017) and the forum has still not set a target date for phase-out of fossil fuel subsidies. The G20 which represents three-quarters of the world's GHG emissions (Burck et al., 2016) has not exploited its potential (Victor et al., 2017).

UNEP has worked closely with governments around the world, policymakers and stakeholders on developing laws, best practises and case studies for industrial efficiency (UNEP Handbook for Drafting Laws on Energy Efficiency and Renewable Energy, Best Practices and Case Studies for Industrial Energy Efficiency Improvement, UNEP Technical Reviews and Guidelines (UN Department of Public Information, 2013)). At COP23 in Bonn, UNEP unveiled its Law and Climate Change Toolkit aimed at government policy makers responsible for developing laws that help implement the PA. UNEP's International Resource Panel set up in 2007 has a dedicated Metals Working Group purposed to build knowledge. UNEP also produces a significant number of reports (example its annual Emissions Gap Report (UNEP, 2017)) and funds research into low carbon strategies in the energy intensive sector (KLH Sustainability, 2017) which add to knowledge and learning.

Although UNEP provides financial support for research in low carbon strategies in the energy intensive sector, the relative impact of its activities is low given also that it does not solely focus on the energy intensive sector. Nonetheless on knowledge and learning, the breadth of UNEP activities (including its capacity building activities), its climate change toolkit for the PA, a dedicated metals working group and its various reports and data is vast.

UNIDO promotes industrial development and environmental sustainability and its work resonates strongly with UNSDG 9 - "Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation". Of all UN bodies, UNIDO focuses closest on the energy intensive sector. UNIDO works with countries to reduce their consumption of natural resources, greenhouse gas and other emissions and industrial wastes in industrial processes, builds capacity of industry stakeholders (albeit of current emitters), and promotes more resource-efficient and cleaner industrial processes (UNIDO's projects total USD 52.2 million grant funding and an additional USD

574 million in co-financing but which also include technologies not promoting decarbonisation) (UNIDO, 2015). UNIDO fosters technology transfer, generates data and statistics and facilitates platforms and partnerships for collaboration. UNIDO's programs target industrial energy efficiency including policy and development standards (e.g. introduction of ISO 50001 in energy intensive companies – currently operational in 17 countries, planned in further 10 as of May 2016 (Matteini, 2016), capacity building, training and awareness-raising, technology demonstration and upscaling (Matteini, 2015). UNIDO has also set up knowledge sharing platforms for member states, such as the Vienna Energy Forum (VEF).

Mission Innovation, established in 2015, is an intergovernmental platform consisting of 22 countries and the European Union (EU) with an aim to accelerate global clean energy innovation. Member countries have committed to doubling public R&D investments over five years while catalysing greater private sector investment in transformative clean energy technologies. Although the forum is relatively new, it is worth including given the potential it represents. Mission Innovation work programme includes the development of technologies which could have an important impact on the energy intensive sector (CCS, Hydrogen, bioenergy, and so on), set up issue-specific platforms, laboratories and roadmaps, and currently convenes workshops and stakeholder dialogues. Given the platform is relatively new and thereby its activities are in the early stages of implementation, it may be too early to assess the impact of its functions.

At the **WTO**, Article XX has permitted some exceptions to the non-discrimination principle for environmental motives (among others), on the condition that the measures in question are not “a means of arbitrary or unjustifiable discrimination” or a “disguised restriction on international trade.” Yet, while Border Adjustment Taxes, which includes a combination of import tariffs and export subsidies, would have been a far more effective method of environmental control, it clashes with the WTO's Article I (Most Favoured Nation provision) and Article III (National Treatment Provision). However, scholars like Pauwelyn (2012) believe that carefully designed carbon border adjustment tax could be permissible under the WTO provided that the tax or duty on imports can be construed as an internal measure (or border measure equivalent to an internal tax) and they avoid origin-based discrimination. In the absence of border adjustment taxes or equivalent measures, energy intensive industries could relocate from countries with emissions commitments or relevant policies (e.g. taxes) to countries without such commitments or policies (Frankel et al., 2008), although evidence for such carbon leakage has remained inconclusive to date (Naegele & Zaklan, 2017).

Multilateral Development Banks (MDBs): The potential role of MDBs like the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank Group (IDBG), and the World Bank Group (WBG) in decarbonisation of the sector is significant since a large amount of finance will be required for the transition. The IEA (2016b, pp. 102) estimates that US\$ 35 Bn of annual energy efficiency investment alone in energy-intensive industry is needed by 2020. However, a joint report from the above mentioned MDBs published by EIB (2016) on MDB climate finance reveals that while the combined MDB climate finance for 2016 was US\$ 6,5 Bn (*constituted of US\$ 27 Bn in climate finance and US\$ 38 Bn in net climate co-finance along with MDB*

own resources), only 1 percent of MDB adaptation finance (or US\$ 60 Mn) went to industry (extractive, manufacturing and trade). Activities eligible for industry climate finance include: “industrial energy efficiency improvements through the installation of more efficient equipment, changes in processes, reduction of heat losses and/or increased waste heat recovery and/or resource efficiency” (EIB, 2016).

The **World Bank (WB)** is an international financial institution that provides loans to countries of the world for capital programs. The WB provides various means of implementation (capacity building, financial support) and fosters knowledge and learning (stakeholder platforms, publically available data). The WB has financed numerous projects targeting the energy intensive sector in particular as regards energy efficiency (conservation and diversification), heat and gas recovery and waste reduction (World Bank). The WB too has funded fossil fuel projects around the world: the total portfolio across the World Bank Group institutions being worth around \$280bn (Isaac, 2017). The WB has brought together stakeholders on similar issues, while its extensive publicly-available data contributes to knowledge and learning. The WB also has its own set of guidelines for emission levels used in making decisions regarding provision of World Bank Group assistance, including Multilateral Investment Guarantee Agency guarantees. The WB also issues Environmental, Health, and Safety (EHS) Guidelines for the Energy intensive sector, which are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP) (International Finance Corporation, 2007).

5.2.2. Transnational Sectoral Platforms

The **CSI** is a transnational sustainability programme (the largest ever by a single-industry sector), by 24 major cement producers whose operations span more than 100 countries and accounts for around 30 percent of the world’s cement production (CSI, 2014). The CSI provides four governance functions: guidance and signal, transparency and accountability, means of implementation, and knowledge and learning. The CSI has adopted as a membership-wide goal, the reduction of CO₂ emissions by 20 to 25 percent by 2030 compared to business as usual (CSI, 2016). The CSI was set up with an agenda to develop a CO₂ Protocol and relevant tools for the cement industry (project delivered to more readily assess sectoral emissions), develop a climate change mitigation strategy, publish targets and progress and provide transparency and accountability by ensuring its members make public their baseline emissions. The CSI also developed a set of guidelines for the responsible use of conventional and alternative fuels and raw materials in cement kilns.

CSI has endeavoured to set up an action plan to enhance overall energy efficiency; scale-up good quality alternative fuels and raw materials, including relevant waste from other sectors in a circular economy approach; further reduce the clinker content in cement to minimise the share of the energy intensive part of the process; develop new cements with reduced net CO₂ emissions over the full life cycle; engage the full value chain to identify and minimise emissions; and evaluate green technologies such as CCS-U. In 2009, CSI in collaboration with the IEA developed a cement industry technology roadmap, the first sector-specific report of its kind, which offered a pathway for the industry to half CO₂ emissions by 2050 (House of Commons Environmental Audit Committee, 2013).

The **International Council of Chemicals Associations (ICCA)** is a platform for the global chemical industry, whose members account for more than 90 percent of global chemical sales and employs more than 20 million people worldwide. Although ICCA does not provide any decarbonisation target, like the CIS, ICCA has developed membership-wide guidelines for assessing and reporting avoided emissions (ICCA, 2013). The ICCA's Responsible Care initiative (implemented by 58 chemical associations in more than 60 countries worldwide) reports that its members have reduced GHG emissions by 34 percent since 2006 (along with a value chain accounting approach which includes the buildings, transport and lighting sector, this amounts to 3 billion tons of GHG emissions per year) (ICCA, 2015).

5.3. Assessing the Governance Complex

Guidance and Signal Function

Although the UNFCCC and the CSI (for the cement sub-sector) provide some level of guidance to the energy-intensive industries, neither provides a firm, definitive guidance and signal toward decarbonisation (i.e. a sectoral 'decarbonisation' target with firm timelines and regional and global mitigation roadmaps). The UNFCCC signal is a general one for all sectors and will have a longer trickledown effect in terms of low carbon strategies being developed by industry. The CSI's membership-wide emissions reduction target of 20-25 percent by 2030 and relevant roadmap provides a signal to the cement subsector but is not sufficient for decarbonisation. The CSI's ability to enact dramatic change is further circumscribed given the guidance is not binding, competitiveness concerns amongst industry owners and pressure on political leaders to avoid carbon leakage. Overall, the guidance provided to the sector can be deemed as medium-low.

Setting Rules to Facilitate Collective Action

The absence of any international rules or regulations (international emission limits and/or carbon pricing) represents a fundamental gap in efforts towards decarbonisation of the sector. The G20 provides some soft non-binding form of rule setting in terms of declaration to phase out subsidies and cut over-capacity in the steel industry but it remains non-obligatory process and insufficient to address decarbonisation of the sector. The overall provision of rules to facilitate collective action is assessed as low.

Transparency and Accountability

Transparency and accountability has been identified in section 1 as those measures required to monitor and verify the implementation of rules. Only the CSI and ICCA provide modest transparency and accountability in the cement subsector and chemicals sector respectively: the CSI through its CO₂ protocols and tools and ensuring its members make their baseline emissions public and ICCA through its membership wide guidelines for assessing and reporting avoided emissions. Transparency and accountability in the sector is hence deemed as low.

Means of Implementation

A number of international organisations/institutions provide different means of implementation: financial support/incentives and technology transfer. These include the CSI, IEA, WB, UNEP, UNIDO and Mission Innovation. The Energy Breakthrough coalition which consists of private investors and

financial institutions also invests in breakthrough energy ventures but it remains unclear how much finance (and for what) is provided by the group. Although their work on providing means of implementation is relevant and targeted enough on the energy intensive sector, decarbonisation in the sector will require much more in terms of finance, technology (development, deployment, transfer) and capacity building. Currently, finance by MDBs, the WB, and UNIDO also is problematic since it serves to establish carbon lock-in (with finance provided for expansion of fossil-fuel based energy intensive industries). It can therefore be concluded that means of implementation provided to sectoral decarbonisation is low.

Knowledge and Learning

Global knowledge platforms, stakeholder dialogues, and R&D are key to global coordination and dissemination of knowledge and learning in relation to industrial decarbonisation given the complexity of supply and value chains of industrial sectors. The CSI, IEA, WB, UNEP, UNIDO and Mission Innovation all make an important contribution to knowledge and learning in the energy intensive sector. The provision of knowledge and learning to the sector can be assessed as low. In particular, greater R&D will be needed for the development of low-carbon technologies and low-carbon alternatives.

5.4. Conclusions and Recommendations

The analysis exposes three key facets. First, there is a palpable absence of a single overarching international organisation/institution which performs all relevant governance functions targeted towards decarbonisation in the energy intensive sector. Second, the number of institutions involved in supporting the climate transition of the sector remains notably limited (especially when compared with other sectoral systems). Third, while most governance functions are being performed to some extent by one organisation or the other, there is a clear undersupply of international governance in the sectoral system; there remains tremendous scope for international/transnational institutions to contribute to advancing the decarbonisation of the sector. Concrete emission reduction targets or credible roadmaps for the sector at large (on a global level) remain missing. International rules (international emission limits and/or carbon pricing) and mechanisms to ensure transparency and accountability remain virtually absent. While different institutions provide various means of implementation, finance, technology development and capacity building remain insufficient for effectively driving the sector toward decarbonisation.

What is more, several international institutions like the WB, other MDBs, UNIDO and the WTO engage in activities that constitute impediments to the decarbonisation of the sector. The WB, other MDBs and UNIDO finance the expansion of energy-intensive industries and hence for the perpetuation of business as usual. Even if fostering the most efficient available technologies (which is not always the case and can hence be further strengthened), this creates carbon lock-in as the installations that are established will emit GHGs for years and decades to come. The WTO for its part impedes the design of effective measures to address carbon leakage concerns such as border tax adjustments (while also providing an international forum for potentially coordinating responses that can be compatible with trade rules).

The fact that even financing the most efficient available technologies creates carbon lock-in points to a crucial **priority area of international cooperation** that is fundamental for any efforts to decarbonise energy-intensive industries: **advancing R&D efforts to find and pilot new, breakthrough zero-emission technologies and bring them to the market**. Only once these technologies are available, can support for fossil-fuel based technology be realistically phased out. And it is with such zero-emission technology that the issue of trade disciplines becomes most relevant (and potentially solvable if the resulting products can be distinguished from “old”, high-emission products).

Several of the institutions contributing to sectoral governance could in principle be used to fill existing governance gaps. For example, UNIDO, the UNFCCC/PA, the G20 and the CSI could all engage in defining sectoral decarbonisation objectives (“guidance and signal”), agreeing on international emission limits, monitoring emissions (“transparency and accountability”) and addressing the priority issue of R&D (“means of implementation”). However, each of them has particular advantages and drawbacks. The UNFCCC/PA presumably has a limited potential to engage in sectoral initiatives given its preoccupation with the overall international governance framework (and given the fact that it has already “outsourced” other sectoral governance tasks – e.g. ICAO, IMO, Montreal Protocol. Given its established system of reporting and review, it may have a particular advantage when it comes to transparency and accountability (i.e. the monitoring of emissions). Its added value may, beyond that, also be in doubt because of its global reach whereas governance of most energy-intensive industries would only require cooperation of a more limited number of countries/players. The G20 would in this sense possibly be more suitable, but has so far hardly been used for the required more structural cooperation (and has proven largely ineffective in addressing fossil-fuel subsidies). UNIDO constitutes a potentially promising venue (although it is not usually considered a “strong” international institution). The CSI on its part remains limited in scope, membership (including lack of government participation) and authority.

Given this institutional landscape, there is hence a case to be made for **exploring the creation of new, subsector-specific institutions that could serve to address the identified governance gaps and potentials**. For such subsector-specific institutions to have the potential to deliver on the needs identified, they would presumably require participation by key governments (for ensuring authority of agreed decarbonisation objectives, setting rules and coordinating R&D support) as well as relevant companies (that frequently constitute multinational operations). Most of the subsectors would require coordination and cooperation by a limited number of countries and companies to cover the largest part of production (and consumption). The CSI may constitute a model for sectoral initiatives to some extent, but it may itself also have to be further developed (e.g. including enhanced involvement by governments) in order to deliver on the governance needs more fully. Related sub-sectoral initiatives could be launched by individual players, but may also be launched through (“spin-offs”) existing institutions such as the G20, UNIDO or Mission Innovation. Sectoral involvement could for example be pursued through existing industry associations such as the world councils on chemicals and steel. (Sub-sectoral initiatives may also in principle be combined in a single dedicated international institution for the decarbonisation of energy-intensive industries, but

the added value of such a combination may need further assessment (e.g. different actors would need to be brought together for different subsectors).

Financing needs are particularly prominent with respect to R&D for zero-emission breakthrough technologies. Government cooperation and existing financial institutions could be activated for such efforts – together with existing initiatives such as Mission Innovation and the Energy Breakthrough Coalition. Upon zero-emission technologies becoming more widely available, it will be important to ensure that existing financial institutions such as the WB and MDBs provide funding exclusively for such technologies (rather than for “old” technology).

Knowledge and learning is already supported by most of the existing institutions. New subsector-specific initiatives (see above) could also contribute their share.

The UNFCCC and the PA could probably best assume an overarching supervisory function in the evolving sectoral institutional complex. While the UN climate regime would in principle possess the authority to also engage in sectoral initiatives, it may not be best suited for branching out in this way (also because of its comparatively slow movement and limited decision-making capacity due to the need to achieve a global consensus). The UNFCCC does already collect GHG emission data, including from energy-intensive industries, which provides an entry point for overall checking of progress and contributing to “transparency and accountability” (and contributing to capacity building as regards data collection and reporting). Beyond that, implementing rules could request or encourage countries to include sectoral objectives and measures in their “nationally determined contributions” and their low GHG emission development strategies, including for energy-intensive industries.

At first sight, the decarbonisation of the energy-intensive industries seems to raise **equity issues** to a comparatively limited extent. Production facilities would still be required (but would use different technologies). To the extent that the response would succeed in also reducing demand for the relevant products (because of increased circularity), demand for energy-intensive products could decrease and social effects like loss of employment may result. Given an existing general trend of increasing demand for the relevant products, this would, however currently seem a rather remote prospect. Having said that, the industrial restructuring implied by decarbonisation is likely to result in certain winners and losers (currently uncertain) depending on the outcome of the race to climate-friendly breakthrough technologies. Current international debates on how to address global overcapacity in steel production capacity may give a foretaste of the political ramifications of any such effects. Coordinating related R&D efforts could provide a means to carefully and timely manage such effects in a targeted manner.

5.5. References

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[http://www.worldbank.org/en/search?q=Energy+intensive+industries&label=projects¤tTab=](http://www.worldbank.org/en/search?q=Energy+intensive+industries&label=projects¤tTab=1)
[1](#)

Table 5.4: Supply of international governance functions for energy-intensive industries.

Governance Functions		UNFCCC/Paris Agreement	CSI	IEA	G20	WB	UNEP	UNIDO	Misssion Innovation	ICCA
Guidance and Signal	· Sectoral decarbonisation objectives and related national, regional, global roadmaps	1.5/2°C goal	<ul style="list-style-type: none"> • CO₂ emission reductions by 20-25 percent by 2030 • Climate change mitigation strategy • Cement industry technology roadmap to half CO₂ emissions by 2050 							
Setting Rules	· International emission limits and/or carbon pricing (production or consumption)		<ul style="list-style-type: none"> • Action plan to enhance overall energy efficiency 		<ul style="list-style-type: none"> • Anti-dumping and countervailing initiations • Declaration to phase out subsidies and cut over-capacity in the steel industry 					
Transparency and Accountability	· Required to monitor and verify implementation of rules		<ul style="list-style-type: none"> • CO₂ Protocol and relevant tools • Members make public their baseline emissions 							Guidelines for assessing and reporting avoided emissions
Means of Implementation	· Financial support/incentives and		<ul style="list-style-type: none"> • Scale-up good quality alternative fuels and 	Technology Collaboration		Projects targeting energy efficiency	Funds research into low carbon strategies in the	<ul style="list-style-type: none"> • Builds capacity of industry stakeholders, training and 	Fosters technology development,	

	technology transfer		raw materials <ul style="list-style-type: none"> • Further reduce the clinker content in cement and develop new cements with reduced net CO2 emissions over the full life cycle 	Programmes		(conservation and diversification), heat and gas recovery and waste reduction in the energy intensive sector	energy intensive sector	awareness-raising. <ul style="list-style-type: none"> • Provides project funding for more resource-efficient and cleaner industrial processes • Fosters technology transfer, technology demonstration and upscaling 	transfer and upscaling	
Knowledge and Learning	<ul style="list-style-type: none"> • Global knowledge and learning platform(s) (policy learning) • International R&D 		Guidelines for the responsible use of conventional and alternative fuels and raw materials in cement kilns	<ul style="list-style-type: none"> • Analysis, technology roadmaps, modelling and data • Workshops and seminars 		<ul style="list-style-type: none"> • Stakeholder Dialogues • Publicly-available data 	<ul style="list-style-type: none"> • Toolkit for developing laws to implement the Paris Agreement • UNEP's International Resource Panel Metals Working Group Reports, case studies, data	<ul style="list-style-type: none"> • Reports, data and statistics • Facilitates platforms and partnerships for collaboration such as Vienna Energy Forum (VEF). 	Stakeholder Dialogues	

6. Fossil-Fuel Extractive Industries

Tim Rayner

6.1. Introduction

The potential role of *international* institutions in addressing the supply-side of climate policy, i.e. reducing fossil fuel extraction at source, is only just beginning to receive the scholarly attention it merits (van Asselt 2014). Fossil fuel production and consumption decisions, as with energy policy questions more broadly, are closely linked to national sovereignty and perceived national interests (Van Asselt and Kulovesi 2017), even in relatively well-integrated regions such as the EU. As Newell (2014: 414) has noted, ‘intergovernmental and public control over the actors and processes which extract and burn most carbon is either weak and indirect or often non-existent’ (cited in van Asselt 2014). While this enduring feature of global governance appears unlikely to change much for the foreseeable future, it is important to understand its dynamics and contemplate international-level responses that can contribute towards critical climate goals.

Extractive industries range from the most carbon-intensive coal sector, to oil and gas as less intensive forms. Analytical coverage in this chapter is not exhaustive. With limited space, most consideration is given to oil and especially coal, the most carbon-intensive fuel. In terms of the governance landscape, a series of bilateral and regional economic agreements (including investment treaties and trade agreements) have some relevance to energy-related decisions, but are not (yet) included in detail in this analysis. Moreover, it needs to be borne in mind that fossil fuel extraction is also potentially influenced by the success of institutions promoting renewable energy, as well as practices in the finance sector, covered in chapters 4 and 3 respectively. Following analysis by van Asselt (2014), certain relevant regional-level organizations (such as APEC) will be identified, but not considered in detail. Also for reasons of space, while fairness aspects related to ‘just transition’ are touched on, the legitimacy and ‘social acceptability’ of relevant institutions and processes is not (but see conclusions chapter for further reflections).

The internal performance of fossil-fuel extractive industries’ emission reduction efforts (as opposed to the end use it supplies) also needs to be highlighted as a component of the transformation necessary to be consistent with long-term temperature targets. Recent evidence has suggested the problem of fugitive emissions from production sites is greater than previously believed (Nature 2018). However, for reasons of space we do not address activities of companies at any length, although relevant activities are included in Table 3.1 (at the end of this chapter).

The chapter is structured as follows. First, the current status, trends and prospects for the sector are set out. Section 6.2 highlights what needs to change to decarbonise the sector, along with barriers to those changes. The potential benefits, in principle and in the abstract, of international cooperation are then set out according to the governance functions. Potentially relevant institutions/ initiatives are presented in section 6.3, followed by an assessment of their combined effects in terms of how far key governance functions are fulfilled (6.4 and 6.5). Finally, recommendations are offered (6.6).

For reasons that are explained below, the issue of fossil fuel production subsidies is treated separately as a distinct challenge.³⁷

6.2. Transformation Challenges and Governance Demands

6.2.1. Current Status and Prospect

Remaining within a below 2°C carbon budget (let alone 1.5°C) requires most global fossil fuel reserves to remain unexploited. McGlade and Ekins (2015) find that a third of oil, half of gas and over 80% of coal reserves should remain untouched from 2010 to 2050 (see fig. 6.1). Achieving this, however, is a daunting challenge. Investment in fossil fuel extraction and delivery more than tripled between 2000 and 2014, and remains the largest share of world energy investment (IEA 2016a). In 2012, the IEA warned that on current trends, enough new fossil fuel-based infrastructure – mines, power plants, pipelines, refineries etc. – would come online by 2017 to lock-in the remainder of emissions allowable assuming a 2°C carbon budget (IEA 2012). Fossil fuel extraction and trade are widely perceived as central to energy security and economic development, especially in developing countries with large unmet energy needs (Manley *et al.* 2017, Whitley and van der Burg 2015). Both production and consumption of fossil fuels continue to be widely subsidised. Major economies continue to subsidise investment in fossil fuel exploration and extraction on the order of \$18-70 billion per year (SEI 2018). Multinational companies in the sector(s) are significant wealth generators and underpin the returns to many pension funds in developed counties. Given this context, climate policy, at domestic and international levels, has focused almost exclusively on curtailing *demand* for fossil fuel energy, neglecting *supply* - at least until recently. But it is increasingly recognised that effective climate policy requires action on both (SEI 2015, Green and Denniss 2018).

Governments own over 50% of global production of fossil fuels through majority-stake or full ownership of producing companies (Whitley and van der Berg 2015). National Oil Companies (NOCs) control 80 - 90% of proven global oil reserves (up from <10% in the 1970s), with most engaging International Oil Companies (IOCs) in a variety of contractual arrangements. Because of this shifting ownership, IOCs have focused on hard-to-access (e.g. deepwater) and hard-to-recover (e.g. oil sands, shale oil) reserves that cost more than the current price of oil to develop (Holmes 2017).

Global coal production has grown since 2000, particularly in China (see Figure 6.2). While the world's biggest producer and user succeeded in reducing its consumption in 2016 for the third consecutive year, 2017 saw a rise, with a corresponding effect on emissions from the power sector (Financial Times 2018). China is also reducing its substantial subsidies to coal power, although the figure is still double what is received by renewables.³⁸

³⁷ The author gratefully acknowledges assistance in the form of an interview with Harro van Asselt of the Stockholm Environment Institute. The usual disclaimers apply.

³⁸ The value of Chinese government subsidies to coal-fired generation was estimated as at least CNY 252 billion (USD 37.7 billion) in 2014 and CNY 120 billion (USD 18 billion) in 2015 (Denjean *et al.* 2016).

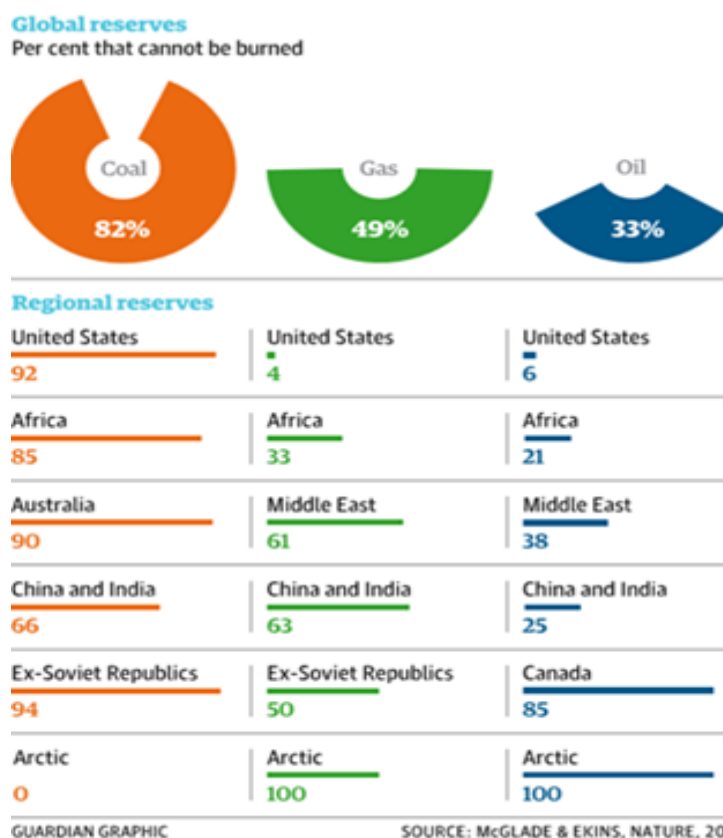


Figure 6.1: ‘Unburnable’ fossil fuels to remain within 2°C carbon budget.

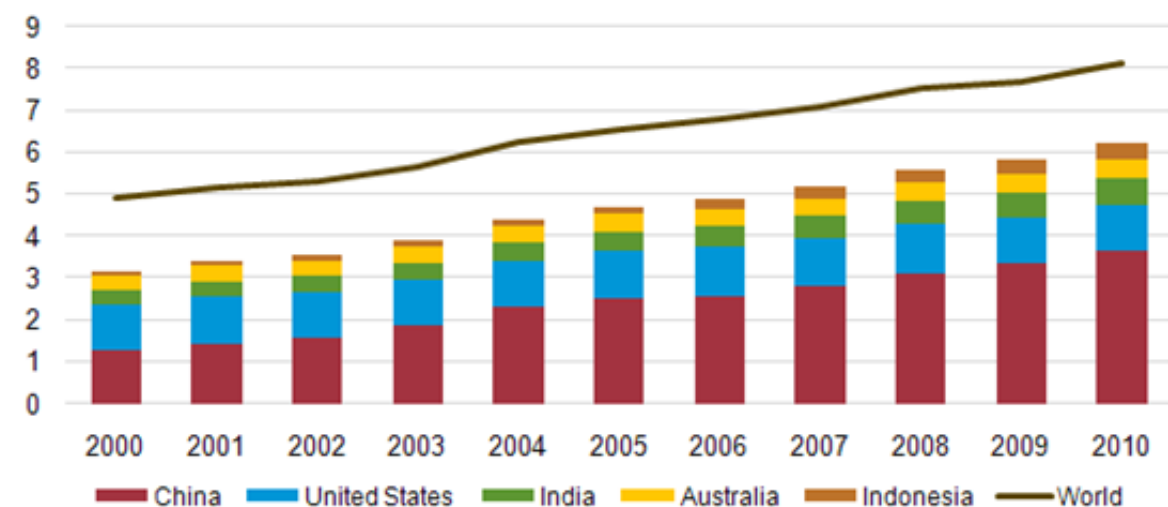


Figure 6.2: Output of top 5 global coal producers (billion short tons). *Source:* US Energy Information Administration. <https://www.eia.gov/todayinenergy/detail.php?id=3350>

While production has increased, global consumption of coal looks set to level out (Figure 6.3).

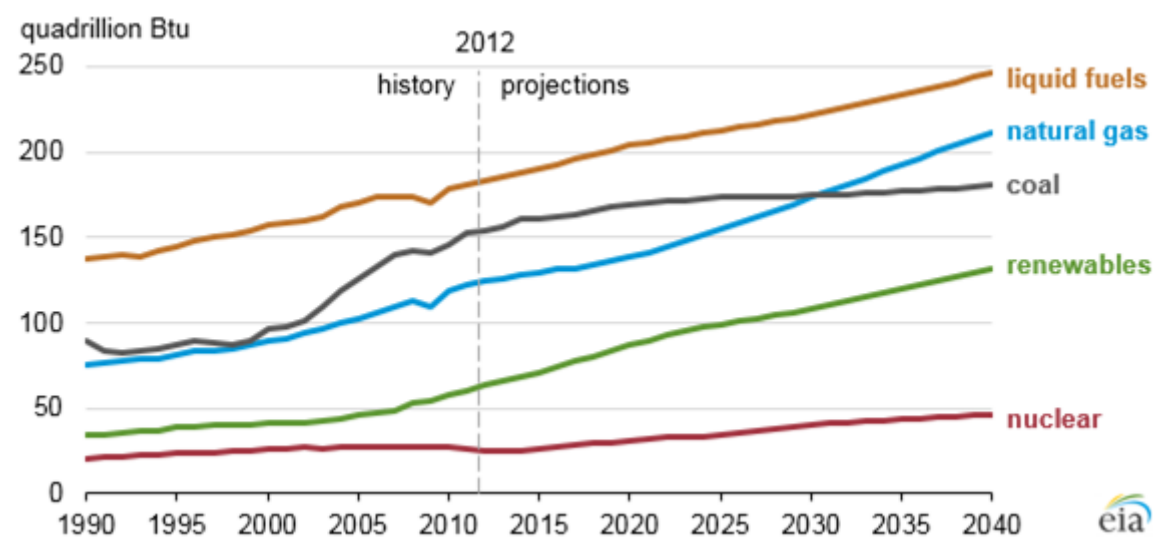


Figure 6.3: World energy consumption by source, 1990 – 2040. *Source:* US Energy Information Administration: <https://www.eia.gov/todayinenergy/detail.php?id=26212>

A particular focus in this section is the **role of production subsidies** to fossil-fuel extractive industries, and prospects for their reduction. This is because extraction (and current consumption levels) depend to a significant extent on subsidy. Continuing current levels of subsidy to production globally has been estimated to lead to the emission of over 37 Gt CO₂ from 2017 to 2050 that would otherwise not occur - roughly equivalent to burning all proven US and Norwegian oil reserves (Gerasimchuk *et al.* 2017). Removing such subsidy therefore constitutes a significant, albeit indirect, policy instrument to reduce fossil fuel extraction. Public finance for exploration of new reserves averages \$13.5 billion annually across the G20 (Doukas *et al.* 2017). Consumption subsidies also undermine mitigation efforts, potentially making other sectors of the economy (e.g. transport) more dependent on fossil fuels (Manley *et al.* 2017). Other damaging effects of production and consumption subsidies include undermining the attractiveness of low-carbon investments, discouraging private R&D on new low-carbon energy technologies, and obstructing technology transfer (Whitley and van der Burg 2015). Subsidies tend to lock-in patterns of activity, preventing dynamic responses to changing circumstances (*ibid*). Although originally intended to be short-term, they often become embedded in planning and expectations, prices (including of capital), resource allocation etc., creating new vested interests.

Though estimates vary - because precise definitions are not agreed - the IEA estimates that fossil fuel subsidies (FFS) amounted to US\$493 billion in 2014 (up from US\$300 billion in 2009) and exceed renewable energy subsidies by more than four to one (IEA 2015). Estimating their extent is complicated by substantial data gaps because of limited transparency at the national level, and a full accounting of global energy subsidies (for all types) has never been completed. As a result, it is likely that existing figures are under-estimates (Whitley and van der Burg 2015). Production is supported by a wide range of subsidies that include, *inter alia*: direct payments; preferential access rights to

energy deposits; credit and insurance support; caps on liabilities; tariffs; government ownership of power generation (Koplow and Charles 2010). Consumption subsidies may improve access to affordable energy, but tend to benefit higher income groups disproportionately (Whitley and van der Burg 2015).

The fossil-fuel extractive industry sector has shown notable signs of destabilisation in recent years. After the strong growth between 2000 and 2014 noted above, more recent estimates of ‘brown’ (i.e. high-carbon) finance put global investments in oil, gas and coal supply in 2015 at USD 900 billion: a decline of 18% from the USD 1.1 trillion in the peak year 2014 (OECD/IEA 2016). It remains to be seen whether this is a lasting change. In the oil and gas sector, demand is falling in many regions as energy efficiency measures take effect. In future, substitution with other fuels, the development of lower cost low-carbon technologies as well as increased efficiency will further reduce demand, and also limit price rises in the longer term (Holmes 2017). Declining oil prices from 2014 have encouraged Middle Eastern and North African (MENA) countries to undertake economic diversification efforts; all regional oil exporters now have strategies in place (Tagliapietra 2017). Many have seen the recent drop in oil prices as a ‘once-in-a-generation opportunity’ to slash subsidies and introduce a carbon price. However, others warn that falling commodity prices lead to increased calls for production subsidies, as demonstrated by lobbying from UK North Sea oil producers for tax breaks (Whitley and van der Burg 2015).

Alongside various multi-lateral institutions that are now pressing for more concerted decarbonisation (see below), shareholder activism and court action represent further and increasing challenges to ‘business as usual’. For example, a 2017 shareholder resolution requires annual assessments of the impact that the Paris long-term goal will have (by reducing oil and gas demand) on Exxon’s business (Darby 2017). Large, global asset managers BlackRock and Vanguard voted in favour. However, institutional investors are unlikely to divest *en masse*. Instead, annual assessments are more likely a first step towards energy companies diversifying into cleaner technology or returning money to shareholders (Darby 2017).

6.2.2. What Needs to Change?

Precise recommendations for ‘roadmaps’ towards decarbonisation of extractive industries depend on the scenario envisaged for wider mitigation efforts (for example, how widespread will carbon capture and storage technology become, how far will growth in e-mobility disrupt the oil market) and economic/ societal pathways.³⁹ As noted above, McGlade and Ekins (2015) offer one possible breakdown, sectorally and by region, of what needs to be left ‘in the ground’. This makes clear that the biggest ‘contribution’, in terms of assets left unrecovered, will need to be from coal, given its higher carbon content. Action on coal must also be rapid: under a least-cost strategy, OECD countries would need a complete phase by 2030, China by 2040 and the rest of the world, including the majority of emerging economies, by 2050 (Climate Analytics 2016).

³⁹ On potential disruption to oil markets caused by changes in the transport sector, see Arbib and Seba (2017), and further discussion in chapter 7.

For oil, there is a degree of consensus that exploration does not need to stop entirely in the lowest-income countries (Manley *et al.* 2017, Tagliapietra 2017), out of concern for either efficiency, or fairness, or potentially both. Costs of development and extraction vary significantly across different geology, so it may be worthwhile for certain countries to allow exploration for reserves that may be less expensive to extract - even after a carbon tax is factored in (Manley *et al.* 2017, Tagliapietra 2017). In the IEA's '450 scenario' (consistent with a 50% chance of 2°C), demand falls sharply after 2020. Lower production costs that allow export competitiveness to be maintained mean that Middle Eastern exports, however, are assumed to continue at 2020 levels until 2040 (IEA 2016b). But lower prices over this timescale will see oil rents decline significantly. Thus, oil exporting MENA countries' entire economic, social and political models must change (at a time of significant demographic change), to transform them from 'rentier states' into more economically diverse 'production states' (Tagliapietra 2017).

Extractive fossil fuel companies also need to take greater responsibility for the emissions associated with extraction processes. The IEA estimates that oil and gas extraction processes emit roughly 76 million tonnes of methane per year globally, and that three-quarters could be eliminated with current technologies if companies fixed or replaced leaky equipment. Implementing measures that pay for themselves would be equivalent to reducing carbon dioxide emissions by 160 billion tonnes by 2100 — nearly 47 times the current annual emissions of the EU (Nature 2018).

6.2.3. Main Challenges and Barriers toward Decarbonisation

As noted at the outset of this chapter, decisions about fossil fuel production and consumption are closely linked to national sovereignty and perceived interests, and energy policy questions more broadly remain largely the prerogative of national decision-makers (Van Asselt and Kulovesi 2017). A combination of social, political, institutional, and economic factors lie behind the apparent 'lock-in' of ongoing investment in fossil fuel extraction and delivery (SEI 2018).

The likelihood of 'stranded' (i.e. unexpectedly devalued) assets (Schlösser *et al.* 2017) raises public policy concerns about financial instability and a growing pension deficit, particularly in developed countries (Holmes and Orozco 2017). Unlike the large coal-based energy companies, their oil and gas counterparts – both international and national – can be regarded as 'too big to fail'.⁴⁰ Countries are more vulnerable than private companies. Diversification by IOCs could potentially address developed country governments' concerns around loss of oil revenue and the need to shore up of companies in the short term through tax credits. On the other hand, pension funds and insurers would need to develop other sources of reliable returns as dividends paid by the oil companies dwindle (ibid). The situation for countries is more challenging: not only is it more difficult to shift capital and capabilities, they are also tied, geographically and constitutionally, to ownership of reserves which

⁴⁰ For example RWE's market capitalisation is around US \$8.4bn compared to Exxon Mobil's US \$314.5bn (Holmes 2017).

cannot be sold outright but only licensed to companies for development. By contrast, companies could, if they wanted, run down their existing reserves in less than 15 years (Manley *et al.* 2017).

A further obvious challenge relates to equity considerations and the importance of securing a ‘just transition’ (Hermwille 2017). But ‘while there is growing interest ... in supply-side climate policy options, the attendant equity questions have received relatively little attention’ (Kartha 2016: 1). Trillions of dollars in ‘foregone rents’ may be at stake, constituting a substantial share of GDP in many cases (*ibid.*). Control over fossil resources is unevenly distributed among countries, and often also among regions and individual economic entities within them. So too are the benefits of exploiting them. That some stand to lose much more than others from any future constraints on extraction (McGlade and Ekins 2015) constitutes a huge challenge to multi-lateral efforts.⁴¹

Phasing out of coal, oil, and gas ‘would have to be planned and executed in a proactive, long-term way and systematic new economic perspectives would have to be developed for the affected regions’ (Hermwille 2017: 38). As noted above, coal would need the most rapid action. But to date, a lack of incentives encouraging economic diversification is evident (Tagliapietra 2017). For MENA oil exporters, this problem is exacerbated by private investors’ unwillingness to invest in non-oil, potentially import-substituting sectors, for fear that when oil prices rise, so will value of the currency of foreign exchanges, making exports less competitive.

On the specific issue of FFS, though widely recognised as desirable from efficiency and climate protection perspectives, their removal also raises serious equity issues. Benefits of subsidy reform – particularly in the short term – will be unevenly distributed and strongly dependent on the approach and complementary (compensatory) measures adopted (Whitley and van der Burg 2015). Complementary measures should aim to improve the competitiveness or viability of those who stay in the sector(s), support those who want to leave the industries or to diversify into other activities, and take into consideration the potential of the private sector to create new opportunities (*ibid.*: 37-8). FFS are particularly high in the MENA region, where they are estimated at 13% of GDP and 35% of government revenues (*ibid.*).

Researchers have identified several reasons for the persistence of production subsidies (Whitley and van der Burg 2015), together creating a dangerous inertia. A principal reason for lack of progress regarding both producer and consumer subsidies is *lack of information*. A 2015 inventory of fossil fuel subsidies uncovered about 800 types of subsidy, mainly in national budgets, but even that did not cover all factors causing artificially lower prices (OECD 2015). Most are not clearly identified in standard government budget documents (Whitley and van der Burg 2015). In order for governments

⁴¹ Edenhofer *et al.* (2013) estimate the value of the GHG emission endowments that are created by establishing a cap-and-trade system (‘climate rents’) at around US\$1 trillion per year. They argue that ‘a major and so far perhaps underappreciated challenge of climate policy negotiations is to deal with what may be largest distributional negotiations the global community has ever engaged in’. As Kartha (2016) notes, this applies even more to fossil fuel extraction rents.

to be fully accountable for their commitments, there is an urgent need for more transparent and comparable information. The important role of special interests also needs mention. Because the benefits of subsidies are often concentrated, while the costs are spread across the general population (i.e. consumers and taxpayers), political leaders face asymmetric incentives. The lack of countervailing a lobby strengthens vested interests' chance of blocking subsidy reforms (Asmelash 2017). The economic and political power of the fossil fuel sector has enabled them to strongly influence domestic (and indeed international) climate and energy policies, and to be successful shapers of public opinion (Karthi 2016). A further implicit reason lies in the weakness of institutions: governments sometimes subsidise fossil fuels because they lack other effective means and institutional capacity to implement more targeted policies (Whitley and van der Burg 2015).

The main challenges to multilateral action will be to define what constitutes FFSs, achieve transparency about their application, bridge the developed-developing country gap, and to set out enforceable obligations with implementation timelines (Asmelash 2017). The cross-cutting nature of the issue means that the global effort to phase out FFSs lacks an obvious, single institutional home at the international level (ibid).

6.2.4. Promise and Potential of International Cooperation

It is increasingly recognised that climate policy needs to work on the 'supply side' of fossil fuel extraction, as well as demand side for the products themselves (and tackling associated emissions once combusted). If not, free riders in terms of mitigation effort will benefit from cheaper fossil fuels, as market price adjusts to a lowering of overall demand. Green and Denniss (2018) put forward a range of further arguments why working on supply and demand together helps 'cut with both arms of the scissors'. This section attempts to describe the role and importance of each international governance function, first for extractive industries in general, then specifically concerning FFS reform, summarising the results in Table 6.2 and Table 6.3. Given its relative novelty in climate policy communities, we start with the importance of improving knowledge and learning on fossil-fuel supply-side questions.

Knowledge and Learning

To help overcome the current inertia over the 'supply-side' of climate policy, Kartha (2016) suggests improving knowledge and understanding around particular questions, the current absence of which prevents strong recommendations on improved international cooperation being made in this chapter. Such improved knowledge could begin to shift engrained perceptions of the 'national interest' in fossil-fuel production-reliant countries. Relevant questions include, *inter alia*:

- i) How far does fossil fuel extraction really contribute to development, given side-effects of environmental and human rights impacts, concentration of wealth and power, Dutch disease⁴² and geopolitical instability?

⁴² A situation where growth in national income from natural resource extraction damages other sectors of a country's economy, by raising the value of the currency.

- ii) What are the distributional impacts of policies constraining extraction? When are domestic steps sufficient, and when might international support be appropriate to help alleviate regressive impacts?
- iii) What 'just transition' lessons can be learned from other sectors? What obligations may some nations bear to support just transitions in other nations?
- iv) Which countries' resources should stay in the ground, and which should be exploited, and how to decide this given a particular overall carbon budget: based on economic efficiency, ethical principles, a combination, mediated by tradeable "extraction rights"? Is there a role for command-and-control approaches, e.g. a 'coal non-proliferation treaty'?⁴³

Guidance and Signal Function

In principle there is a clear need to signal the resolve of governments and others, indicating likely policy trajectories to business, investors and other actors at all levels. Consensual and deliberate transition away from extraction of fossil fuels requires a common understanding of its necessity and urgency. Strong international signals can help to achieve this, based on the learning and knowledge described under the previous heading. Pension funds and insurers, for example, would need to develop other sources of reliable returns as dividends paid by the large oil companies dwindle. Strong signals from global institutions would facilitate this.

Setting Rules to Facilitate Collective Action

Ideally targets would be set and implemented through a global instrument, or instruments, recognised as equitable. As elaborated in the previous work package deliverable (Oberthür *et al.* 2017), 'agreement on collective action requires agreement on the contribution of each individual party and hence on a burden-sharing'. To date, international climate negotiations have focussed on determining *who can emit* how much from fossil fuels. Theoretically, they could go on to ask *who can extract* how much in terms of fossil fuels, establishing a form of 'burden sharing agreement'. For example, the *Kyoto 2* concept (Tickell 2008) suggests a global system whereby the bulk of GHG production rights are allocated by regular global auction open to all bidders, as close as practical to the point of fossil-fuel production. Producers of fossil fuels and industrial greenhouse gases would need to hold sufficient rights to match their production. Auctioning of permits could credibly raise a sum of about €1 trillion per year for a multi-purpose Climate Change Fund. Such a bold re-orientation of current international efforts, requiring cooperation from fossil fuel companies whose businesses it would compromise, would clearly be a great challenge to negotiate.

⁴³ See e.g. <https://thinkprogress.org/a-simple-proposal-a-coal-power-non-proliferation-treaty-a7132622a7dd>

Transparency and Accountability

Global regulation would require monitoring and verification of implementation. It makes most sense to discuss this predominantly in terms of FFS (see dedicated discussion below).

Capacity Building, Technology and Finance (Means of Implementation)

It has been suggested that the problem of lack of investment in boosting the private sectors of MENA countries, which perpetuates their status as ‘rentier’ rather than ‘production’ states could be remedied by strategic investment by sovereign wealth funds (Tagliapietra 2017). This would require ‘strong governance and forward-looking visions on the part of governments’ (ibid), and would benefit from international-level coordination. The same can be said of countries currently heavily dependent on other domestic fossil fuel resources.

6.2.5. International Cooperation on Fossil Fuel Subsidy (FFS) Reform

In the more specific field of FFS reform, the following governance functions can be highlighted as requiring attention if the kind of barriers we have identified are to be addressed seriously, and as areas where feasible, international-level policy actions are conceivable.

Knowledge and Learning, and Transparency and Accountability

As noted above, one of the main challenges is to define what actually constitutes FFSs, to pre-empt denials that they even exist.⁴⁴ Then, international institutions will be in a position to help address them. As Whitley and van der Burg (2015) observe, while domestic reforms can proceed without internationally comparable data, this information can facilitate valuable lesson learning and evaluation of progress, creating peer pressure and enabling cross-country comparisons of the effectiveness of different interventions on FFS. Whitley and van der Burg set out a range of possible initiatives, from mandatory to voluntary. Mandatory reporting on fossil fuel subsidies (following the model for agriculture) is conceivable. Country commitments to transparency can also be widened and strengthened when governments already committed to reform insist on subsidy reform in bilateral or multilateral trade agreements (ibid).

Guidance and Signal Function

⁴⁴ Saudi Arabia, for example, has reported that it had no inefficient fossil fuel subsidies and therefore ‘phasing out inefficient fossil fuel subsidies does not apply to Saudi Arabia’ (G20 2010, quoted in Smith and Urpaleinen 2017).

Language on phasing down “high-carbon investments and fossil fuel subsidies” could be included in the key negotiated outputs from international processes.

Setting rules to Facilitate Collective Action

Some suggest that stronger international regulatory steps beyond voluntarism will be necessary to turn apparent commitments into genuine action, which is maintained even in the face of e.g. oil price shocks, public protest, and changes of political regime. ‘Without any mechanism that ties their hands, reluctant governments often find it easier to renege on their voluntary commitments’ (Asmelash 2017: 347; cf. Tagliapietra 2017). Others (Smith and Urpeleinen 2017) regard peer pressure through international organisations, rather than binding commitments, as more feasible.

Capacity Building, Technology and Finance (Means of Implementation)

There is a strong need for this function to be fulfilled in terms of FFS reform. Whitley and van der Burg (2015) suggest the need to increase technical and financial support for national efforts, and to ensure climate finance is not used to support fossil fuels. Resources and finance for ‘complementary measures’ in developing countries, such as support for health services, education, social protection, energy-sector development and economic diversification, need to be linked to subsidy reform processes, either in terms of institutional arrangements or careful timing. It will be important to not only increase these resources, but also foster linkages between existing support mechanisms and the processes of FFS reform.

International institutions can put in place financial and other economic incentives, particularly for developing countries: for example, by indicating clearly that fossil fuel subsidy reform is part of a country’s mitigation portfolio, the likelihood increases that such actions can be eligible for support. Even though national-level subsidy reform is more likely to be triggered by economic and fiscal motivations, the climate regime could strengthen the case for reform by offering these incentives (van Asselt and Kuvoleski 2017).

Overall, the primary channels for greater international ambition and action on FFS reform may be summarised as: ‘bodies for reporting, tracking and accountability; financial and technical support, which must be diverted from providing subsidies and towards reform; multilateral and bilateral agreements (including on trade); and a greater understanding of the processes being undertaken by regions and countries that are already leading by example in reforming subsidies to fossil fuels’ (Whitley and van der Burg 2015: 3).

Table 6.1: International sectoral governance requirements by function and strength of need (Unless otherwise stated, the need for the functions is the same for the broader issue of phasing down extracting industries and for FFS reform).

Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
High	High	Medium High (FFS reform)	Medium-High	Medium
<ul style="list-style-type: none"> • Phase out of fossil fuel extraction asap after 2050 • Phase out of fossil fuel subsidies by firm deadline 	<ul style="list-style-type: none"> • Global regulation of FF extraction (rights) • Agreement on FFS phase down/out 	<ul style="list-style-type: none"> • Global regulation would require T&A to monitor/ verify implementation (but activities possess relatively high intrinsic transparency) • Internationally comparable data can facilitate learning and evaluation of progress, creating peer pressure enabling comparisons of effectiveness of interventions 	<ul style="list-style-type: none"> • Technical and financial support for national reform efforts (transition away from FF extraction) 	<ul style="list-style-type: none"> • Definition of FFS • International comparable data on FFS • Enhance policy learning r.e. 'national interests.

6.3. Governance Supply

6.3.1. Existing Governance Institutions/ Initiatives of Relevance

While national policies play a key part in governing fossil fuels and any transition away from them, international institutions can also influence behaviour, constrain activity, and shape expectations in relevant ways (van Asselt 2014). A wide array of international institutions influence the behaviour of state and non-state actors regarding extraction, and of states in terms of production subsidies, but a single, dominant institution is lacking. We cover extraction in general terms first, then consider the related issue of subsidy separately (see section 6.3.2). The results are summarised at the end of this chapter in tables 6.2 and 6.3, respectively.

Intergovernmental/ International Organisations (IOs)

UNFCCC/Paris Agreement (PA): The mandates of the UNFCCC and PA can be interpreted as encompassing fossil fuel supply. Even with favourable assumptions about prospects for carbon capture and storage technology, the need for a steep reduction in supply is implied by the PA's goal to hold temperature increase 'well below' 2°C and achieve net zero emissions by the second half of the century (Piggot *et al.* 2017). Explicit reference to fossil fuels is, however, conspicuous by its absence in the PA. Despite their combustion contributing the large majority of GHG emissions, the text does not describe how production or combustion may be phased down, either globally or by individual countries. Instead, in keeping with past UNFCCC approaches, states are left to develop specific climate policies and measures in accordance with their own national circumstances (Piggot *et al.* 2017).

In principle, the UNFCCC/ PA does offer the architecture within which governments could act on fossil-fuel extraction. For example, a country that already plans to reduce GHG emissions by a certain percentage could also plan to reduce its production of fossil fuels by a specific percentage, expressing this through Nationally Determined Contributions (NDCs) or Long-Term Low-Greenhouse Gas Emission Development Strategies (LTS) (due to be submitted by 2020), with ambition depending on national circumstances. Financing or capacity building components could also be communicated in this way. Beyond headline goals, countries can identify specific policy options, e.g. removing production subsidies, production and export taxes, restricting exploration, or limiting finance (Lazarus *et al.* 2015).⁴⁵

Also worthy of mention are the **UN Sustainable Development Goals (SDGs)**, Goal 7 of which highlights access to affordable, reliable, sustainable, and modern energy, Goal 12 responsible production and consumption, and Goal 13 tackling climate change (though without mentioning fossil fuel production explicitly).

Along with other development banks and export credit agencies, the **World Bank** can play an important direct role by either financing fossil fuel (extraction) projects or choosing not to. As noted in chapter 3, citing the PA temperature goals, at the 2017 *One Planet Summit* the World Bank Group (WBG) made a series of announcements⁴⁶, including an end to finance for upstream oil and gas projects after 2019. This built on previous commitments to restrict public finance for coal projects (which itself helped generate additional commitments in other forums and growing global momentum towards a phase-out). WBG also announced greater ambition in its Climate Change Action Plan, to increase transparency regarding portfolio GHG emissions, and a new partnership with

⁴⁵ Some countries have already taken steps to limit fossil fuel supply. India's 'cess' on coal production, for example, taxes locally produced and imported coal.

⁴⁶ <http://www.worldbank.org/en/news/press-release/2017/12/12/world-bank-group-announcements-at-one-planet-summit>

Canada and the International Trade Union Confederation (ITUC) to provide analysis and support for a just transition away from coal in developing countries.

The G20 and G7 groupings are of obvious relevance. The G7 - the seven major advanced economies as reported by the International Monetary Fund (including the EU) - has pledged to end all fossil fuel use by the end of the century (G7 2015). G20 and G7 commitments on FFS reform will be noted in section 6.3.2.

Other IOs include groups of energy producers and consumers, such as the International Energy Agency (IEA), the International Energy Forum, the Organization of the Petroleum Exporting Countries, and the Gas Exporting Countries Forum and the Energy Charter Treaty (Van Asselt 2014). The **Energy Charter Treaty** brings together around 50 energy exporters and importers from the Eurasian continent, with a view to facilitating investments in, and trade of, energy and energy products (irrespective of carbon content of energy source). Its investor-state dispute settlement provisions, whereby corporations can sue governments where national policies entail 'loss of future profits', are particularly relevant. This diversity of bodies makes for a fragmented governance picture, with organisations working towards sometimes-conflicting goals (see section 6.4).

Transnational/ Hybrid Initiatives

A variety of private, company-led transnational initiatives exist, notably the **Oil and Gas Climate Initiative** (OGCI), as well as hybrid public-private efforts, such as the Climate and Clean Air Coalition's **Oil and Gas Methane Partnership**. These generally focus on emissions arising from companies' internal operations. While potentially significant in terms of dealing with short-lived climate forcers (methane etc.), and acting in the short-term to contribute to a Paris-compatible pathway, their neglect of the issue of end-use effectively renders them negligible in relation to the overall scale of the greenhouse problem (Collier and Venables 2014).

Among an emerging field of NGO/civil society initiatives, the **Unfriend Coal Network**, is a notable global coalition of NGOs and social movements that is pressuring insurance companies to divest from coal and support the transition to clean energy. Elsewhere, 340 NGOs signed the **Lofoten Declaration** demanding an organised withdrawal from fossil fuel production under the leadership of, and with dedicated support from, high-income producing countries (Lofoten Declaration 2017).

Also worthy of mention is the **Powering Past Coal Alliance** (PPCA), launched in November 2017, and already noted in chapter 3. Although focused on electricity production and not strictly targeting extraction *per se*, this commitment to abandon coal-related investments that has attracted both state and non-state signatories (placing it in the 'hybrid' category) has generated great interest as a signal that coal is increasingly out of favour, with clear implications for its extraction.

6.3.2. International Governance Activity on Fossil-Fuel Subsidy

Energy subsidies are usually established by national or sub-national governments, but raise important questions for international trade, climate change, energy security and economic

development. As such, they fall under the remit of several IOs, which can be said to constitute an energy subsidy regime complex (van der Graaf and Van Asselt 2017 – see their table 1), taking in, *inter alia*, the World Trade Organisation (WTO), UNFCCC, G20, International Monetary Fund (IMF), World Bank, OECD, IEA, OPEC, Global Subsidies Initiative (GSI) and Friends of Fossil Fuel Subsidy Reform (FFFSR). For space reasons, the discussion below focuses on some of the principal actors from different categories in the work package’s database.

The **WTO** remains the only multilateral organisation to administer a legally binding agreement on subsidies. Under the WTO, energy can be governed as both a good or as a service. Fossil fuels count as goods under WTO law, falling under the GATT. Energy-related services such as the transportation and distribution of energy fall under the General Agreement on Trade in Services (GATS). In addition, WTO disciplines on subsidies, and in particular the WTO Agreement on Subsidies and Countervailing Measures (SCM), are relevant. Even within the WTO, therefore, energy governance is notably fragmented. Nevertheless, the WTO could potentially play a role in addressing fossil fuel development. However, subsidies for fossil fuel consumption and production have barely been raised in the WTO (unlike other IOs discussed below). Existing rules of the SCM Agreement appear to be inadequate to discipline FFSs (van Asselt 2014). No fossil fuel subsidy has been challenged by a Member, and notification rates of subsidies have generally been low, due to a lack of commitment (possibly due to fear of starting a trade dispute), a lack of clarity about which subsidies need to be reported, or inherent difficulties of estimating them (Casier *et al.* 2013; van Asselt 2014).

Under the **UNFCCC**, one of the first intergovernmental responses to calls for FFS reform came when the Kyoto Protocol included it, albeit implicitly, in the non-exhaustive list of climate policies and measures. Article 2.1(a) (v) of the Protocol refers to: ‘Progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas emitting sectors that run counter to the objective of the Convention and application of market instruments’ (UN 1998).

The **G20** (G20 2009) committed to phasing out ‘inefficient FFS,’ and encouraged national strategies to do so, while protecting the most vulnerable. The G7 pledged (G7 2016) to phase out their support for fossil fuels by 2025. Along with the **G20**, the **OECD** and **IEA** have been IOs most concerned to reduce FFS. Collaboration between the OECD and the IEA, which have in the past largely assessed different countries, has enhanced transparency and learning on the issue.⁴⁷ A new report (OECD 2018) which for the first time combines figures from these key IOs, suggests that FFS totalled at least \$373bn globally in 2015, and that reductions in more developed countries have stalled in recent years, with most reform instead occurring in developing nations such as Indonesia and India. The **Friends of Fossil Fuel Subsidy Reform** is an informal group of non-G20 countries working to build political consensus on the importance of reform, notably in the context of the WTO (see section 6.5).

⁴⁷ The IMF also weighs in on the subject of energy subsidies, reaching a much higher estimate than other IOs (US\$5.3 trillion) by including the value of external costs (IMF 2015).

Also relevant are the UN **SDGs**, where FFS reform is suggested as a means of implementing Goal 12, to 'ensure sustainable production and consumption patterns (Merrill and Chung 2014). Indicator 12.c.1 requires tracking of the 'Amount of fossil fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels'. Reform here is highlighted as a measure that could generate large savings through which the achievement of various SDGs could be financed.

Among a range of NGOs, the **Global Subsidies Initiative** (GSI) is a significant player, working with countries to implement subsidy reform, and tracking G20 and APEC countries' commitments in phasing out inefficient FFS.

6.4. Assessing the Governance Complex

The fragmented global energy governance architecture may lead to conflicting objectives and policies. Goals of the IEA, for example, may favour lower oil prices, impeding decarbonisation. Conversely, mitigation policies might undermine the objectives of energy-specific institutions for whom continued production and use of fossil fuels remains a priority. Recent research has raised concerns about the effect of the Energy Charter Treaty in deterring ambitious climate policy, and lack of transparency even about how many disputes it may be considering (Eberhardt *et al.* 2018). Where inconsistencies and trade-offs between different institutions' objectives occur, no international arbiter exists to manage them (Dubash and Florini 2011; Van Asselt 2014).

Conflicting objectives may occur *within* single institutions, as well as between them, particularly those such as the IEA whose remit encompasses the energy 'trilemma'. The G20 has been criticised for double standards. In 2017, financing from G20 governments for overseas coal projects reached a five-year high, totalling at least \$13 bn in loans, credits, and guarantees. Of course, this was not a collective decision by G20, but the sum of individual country decisions, and in particular those made by the financial institutions of China, Japan, India, and Korea (Chen 2018). Japan has even claimed that its support for several coal projects in Asia counted as climate finance (Chen *et al.* 2016).

Fragmentation in global energy governance is understandable given, *inter alia*, the diverse objectives of energy policy. And although several international institutions are of (potential) relevance in governing fossil fuel development, their influence on energy policy decision-making is rarely direct. Instead, incentives to spur or limit fossil fuel extraction tend to operate through market price signals (e.g. OPEC export quotas influencing oil prices, which may influence extraction). The influence of the climate change regime to date is also indirect: at best, it could be argued that in seeking to increase the social cost of carbon, it has limited fossil fuel development (van Asselt 2014).

Guidance and Signal

While anti-fossil fuel norms are strengthening (and expressed in significant forums such as the G7/G20), failure to mention them explicitly in the PA is a significant weakness, undermining this critically important governance function. Fossil fuel supply is not an explicit part of guidance documents on NDC development; neither are fossil fuel supply strategies a separate category in

synthesis reports of multiple NDCs. ‘As long as fossil fuel supply is not explicitly tied to climate change, some producers can be “strategically ignorant” about the impact of extracted fuels on GHG emissions, or the pace of change necessary ...’ (Piggot *et al.* 2017: 9). The territorial approach followed by UNFCCC and IPCC in its guidance on inventories is also problematic in this regard, in that it rewards actions that reduce emissions domestically, but not those (such as restricting fossil fuel exports) that might have an effect beyond a country’s jurisdiction.⁴⁸

Although recent announcements from the World Bank and PPCA highlight a degree of strengthening in anti-fossil fuel norms, the signal offered by the governance complex as a whole remains relatively weak regarding the need to reduce extraction to levels consistent to respect the PA’s long-term temperature goal. More broadly, a lack of incentives encouraging economic diversification is evident (Tagliapietra, 2017).⁴⁹ Where the need for guidance and signal was assessed as high, the overall delivery must be assessed as **low**.

Rules to Facilitate Collective Action

As explained above, agreement on rules facilitating collective action requires agreement on the contribution of each individual party and hence on burden-sharing. It not only requires an understanding that collective action is required or beneficial but also what each individual actor’s fair contribution should be. For reasons elaborated above, this is severely lacking.

At the level of extractive industry companies themselves, rules to control emissions from production processes tend to be voluntary. The OGCI, for example, is essentially aimed at technical dialogue and knowledge exchange, not rule setting or enforcement.

Thus, where the need for this governance function was assessed as high, the overall delivery by the existing governance complex must be reported as **low**.

Transparency and Accountability

Given the relative absence of specific rules relating to fossil fuel extraction, there is a corresponding absence of mechanisms to ensure transparent implementation of those rules. However, international institutions have served to publish estimates of the scale of extraction (and also of fossil fuel subsidisation - see below), and as the profile of the issue grows, attempts are being made to include it in the forthcoming Global Stocktake.

⁴⁸ NB. there is an overlap to reconcile on this aspect in future work with other governance functions: ‘rules’ and transparency/accountability.

⁴⁹ For MENA oil exporters, this problem is exacerbated by private investors’ unwillingness to invest in non-oil, potentially import-substituting sectors, for fear of making exports less competitive when the value of the currency rises on foreign exchanges in response to higher oil prices.

Where the need for the governance function was assessed as high, the overall delivery by the existing governance complex must be scored as **low**.

Means of Implementation

The extent to which institutions, including multi-lateral development banks and Sovereign Wealth Funds are willing to finance transitions by fossil-fuel extracting and exporting countries, beyond the rhetoric, is not easy to determine. While the Global Environment Facility (GEF) and the Green Climate Fund (GCF) operate to a general remit of supporting decarbonisation, no international fund dedicated specifically for the purpose of phasing out fossil-fuel extractive industries exists. It also needs to be borne in mind that many fossil-fuel extracting countries in principle have significant capacity to engineer their own transformations, were social/political conditions to allow. What is easier to identify is 'brown finance' that continues to support extraction of fossil fuels (see chapter 3), which arguably must also be weighed in scoring this function. Evidence suggests that most MDBs spend almost as much on fossil fuel-related investment as they do on energy-related climate projects. Funding for fossil fuels from the main MDBs exceeded \$5bn in 2016 (Wright *et al.* 2018). Apart from the WBG, already mentioned, only the Asian Development Bank (AsDB), European Bank for Reconstruction and Development (EBRD) specify strict conditions on coal mining in their policies; others have no exclusions (Wright *et al.* 2018).

The OGCI's billion-dollar investment fund, investing in promising technologies and business models that have the potential to significantly reduce GHGs from extraction processes, must also be weighed in the assessment.⁵⁰ Overall, however, where the need for the governance function was assessed as medium-high, the overall delivery by the existing governance complex can probably most accurately be scored as **low**.

Knowledge and Learning

Institutions including OECD, IEA, IMF, UNEP and the WBG have published estimates of the scale of extraction and also of fossil fuel subsidisation (see section 6.5). Such institutions have also developed and sought to share alternative development pathways that fossil-fuel dependent economies could consider.

In their closing statement at COP 23, the world's 47 least developed countries requested that the Talanoa Dialogue include 'managing a phase out of fossil fuels'. Such discussion could have the effect of further advancing understanding of the importance of the supply-side of climate policy, and increased spread of anti-fossil fuel norms (Green 2018). Submissions to the process from research institutes such as the Stockholm Environment Institute (SEI) and International Institute for Sustainable Development (IISD) have raised the profile of the issue. Further research is required to establish how far the process was able to engage with fossil fuel supply-side issues.

⁵⁰ See http://climateinitiativesplatform.org/index.php/Oil_and_Gas_Climate_Initiative

Where the need for the governance function was assessed as medium, the overall delivery by the existing governance complex can be scored as **low-medium**.

6.5. Assessment of Governance Functions in Fossil Fuel Subsidy Reform

The various institutions involved in phasing out 'inefficient' fossil fuel subsidies (G20, IEA, OECD) can be considered to (indirectly) target fossil fuel development; however, most of their initiatives are still at the stage of enhancing transparency about the level of such subsidies, rather than developing concrete measures to phase them out. Moreover, most attention has been paid to *consumer* rather than *producer* subsidies (van Asselt 2014).

Guidance and Signal

Guidance and signal is present in the aggregate of institutions and initiatives in this case, but is undermined by a continuing inability to agree on a common definition of fossil fuel subsidy. The result, manifest in the G20's compromise of a commitment to phase out 'inefficient' FFSs, allows countries to define the term as narrowly as they wish. Eight out of the G20 countries claim to have no such inefficient FFSs (Asmelash 2017).

Outside the G20, pressure from the Friends of Fossil Fuel Subsidy Reform via a Communiqué (FFFSR 2015) calling for the elimination of FFSs in the context of PA, offers some degree of signal. In December 2017, a Ministerial Statement by 12 WTO Members (coordinated by the FFFSR) at the Buenos Aires Ministerial Conference, called on the WTO to 'achieve ambitious and effective disciplines on inefficient fossil fuel subsidies that encourage wasteful consumption including through enhanced WTO transparency and reporting that will enable the evaluation of the trade and resource effects of fossil fuel subsidies programmes'.⁵¹ (The Ministerial Statement also notes that any efforts to phase out fossil fuels must take into account the needs of the poor). The 12 endorsing WTO members, supported by the FFFSR, also encouraged the rest of the international community to follow their lead.⁵² This is the first time the WTO has accepted a Ministerial Statement specifically targeting fossil fuel subsidy reform.

Where the need for the governance function was assessed as high, the overall delivery by the existing governance complex can reasonably be scored as **low-medium**.

Rules for Collective Action

A shortcoming of intergovernmental agreements to eliminate FFSs has been the lack of clear-cut commitments. As well as being non-binding, commitments have been vague and indefinite. According to Asmelash (2017: 359), it is 'desirable to clearly and explicitly set out each and every

⁵¹ <https://www.norway.no/en/missions/wto-un/our-priorities/trade/wto-world-trade-organization/mc11-ministerial-declaration-on-fossil-fuel-subsidy-reform/>

⁵² Currently no EU countries are signatories.

country's commitment to phase out FFSs. Perhaps the most effective way to do so is to ban certain FFSs and/or impose a quantitative limit on the overall level of subsidies a country may provide'. It should also be highlighted how certain WTO rules on FFS that could in principle be applied have not been invoked. Where the need for the governance function was assessed as high, the overall delivery by the existing governance complex can be scored as **low-medium**.

Transparency and Accountability

Voluntary country peer reviews of inefficient FFS are conducted under auspices of G20 and APEC as a solution to the failure to agree on a common definition. The US, China, Germany and Mexico have already undergone this process, which is chaired by the OECD. In themselves, however, such mechanisms are unlikely to be sufficient to improve transparency (Casier *et al.* 2014). The G7's FFS phase-out pledge included no systems to ensure accountability. Analysis by the OECD (2018) has improved transparency, and allowed the extent of subsidies in countries which deny applying them to be better identified by the likes of *Carbon Brief* (see Timperley 2018). Gaps in this OECD analysis remain, however, e.g. on credit support – whereby governments offer support to investment in the production of fossil fuels, thus increasing access to credit or lowering the cost of borrowing. (Nor does it include any estimates for the cost of externalities, which the IMF has included to produce far higher estimates of the value of FFS).

Adoption of indicator 12.c.1 within the SDGs, covering “Amount of fossil fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels” bodes well for the future, but for the time being, overall, the overall of this function can reasonably be scored as **low-medium**.

Means of Implementation

World Bank works with countries to implement subsidy reform; IMF may include reform as condition for lending. Global Subsidies Initiative (GSI) works with countries to implement subsidy reform. Where the need for the governance function was assessed as medium-high, the overall delivery by the existing governance complex can be scored as **low-medium**.

Knowledge and Learning

Institutions including OECD, IEA, IMF, UNEP, WBG, have served to publish estimates of the scale of extraction and also of fossil fuel subsidisation. In addition to the voluntary country peer reviews noted in the transparency/accountability discussion above, the Global Subsidies Initiative (GSI) operates a dedicated website for tracking the progress of the G20 and APEC countries in phasing out inefficient FFS over the medium term, and has established a worldwide network of Civil Society Organisations working on subsidy reform. In addition, a group of the organisations listed above, along with UNEP, has established the Green Growth Knowledge Platform and the Green Fiscal Policy Network, which facilitate online-based knowledge sharing, bilateral study visits and international meetings. The World Bank's Energy Sector Management Assistance Programme (ESMAP) is also developing a website to facilitate knowledge sharing through public and confidential channels among governments. 'The sharing of positive experiences of reform through these means could

prove a powerful way to communicate the benefits of reform, and raise the ambition of reform processes' (Whitley and van der Burg 2015: 42). The Bank's Climate Action Peer Exchange brings together finance ministers to discuss FFS reform.

Where the need for the governance function was assessed as medium, the overall delivery by the existing governance complex can be scored as **medium**.

6.6. Conclusions and Recommendations

Gaps are particularly evident in **terms of guidance and signal and rules to facilitate collective action** (including the burden-sharing element of the latter), but also **transparency and accountability** and **means of implementation**. The discussion focuses on these aspects, once again separating general points from those more specifically related to subsidy reform. Conclusions related to the (potential) role of the EU, and further reflections on the importance of equity and just transition can be found in chapter 10.

6.6.1. Institutional Implications of a Phase Out of Fossil-Fuel Extraction

Despite decision-making responsibility ultimately resting with sovereign states, urgent consideration needs to be given to how the development benefits of fossil fuel resources can be optimised within the shrinking carbon budget that the PA's 1.5C goal necessitates. Some fossil-fuel-dependent states may in effect have to become stranded (Manley *et al.* 2017), and the process by which they transition from this, diversifying their economies, requires careful analysis and 'complex international negotiation and coordination' (Schlösser *et al.* 2017). Both the G20 (Goldthau 2017; Schlösser *et al.* 2017) and the UNFCCC (with UNEP) are strong candidates to oversee these processes. However, both would need to gear themselves up significantly to be credible and legitimate leaders of this global transition (SEI 2018). These processes, by which these complex transitions can be negotiated and coordinated, cannot be confined to official climate-policy related channels, but must also extend to development cooperation and governance of finance where, as chapter 3 noted, improved information about climate-related risks is needed to guide investment. The G20's regular meetings of finance ministers would need to become the steering committee for the low-energy transition (Goldthau 2017).

Beyond the regular climate regime, development cooperation channels have potential to foster an inclusive debate to inform and encourage decisions based on a sound assessment of opportunities and threats of various options and on comprehensive consultation of actor groups (Schlösser *et al.* 2017). In the immediate-term, a report from GIZ has suggested that stranded asset risks should be considered in *development* policy processes at UN level, including SDGs, UNEP Green Economy & Finance Initiatives etc, and in ODA donor forums, such as OECD, multilateral development banks, Sustainable Energy for All, G7 (Schlösser *et al.* 2017). Bilateral and regional initiatives such as North-South or South-South partnerships should also take up the issue (*ibid*). To begin more serious discussion within the fossil-fuel sector, a project task force in the *OECD Policy Dialogue on Natural Resource-based Development* could offer a suitable forum for evidence-based deliberations and formulating recommendations (Schlösser *et al.* 2017). A corresponding subject group in the

Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development could also identify appropriate ways to involve stakeholders from the oil and gas sector (ibid).

The UNFCCC

As the central international forum for addressing climate change, **the UNFCCC** is well-placed in principle to articulate the rationale and logistics for phasing down fossil fuels. While not the only possible venue, an obvious benefit of governing through the UNFCCC (compared with other international energy or trade organisations) is its near-universal participation by states, including countries that both produce and consume fossil fuels (van Asselt 2014). As noted above, the UNFCCC's mandate can also be interpreted as encompassing fossil fuel supply, as the need to phase out fossil fuels is implied by the agreed goal to pursue efforts to limit global warming to 1.5°C, as well as achieve net zero emissions.

Improving the provision of **guidance and signal** and **rules facilitating collective action** are closely inter-related endeavours in the UNFCCC. Articulating fossil-fuel phase-down pathways and actions can have broader effects on how the problem of climate change is framed and understood, which ultimately could help ratchet mitigation ambition. The PA offers a framework through which, in principle, countries could move in this direction. Piggott *et al* (2017: 7) point to 'processes through which the articulation of a pathway away from fossil fuels could enhance ambition', such as the process of Long-term Strategy (LTS) development. Alongside the NDC process, LTS development provides an ideal opportunity for countries to plot a managed decline in fossil fuels (including production), incorporating trajectories for production and investment that are consistent with a 1.5°C goal. This could form the basis for a "climate test", where proposed fossil-fuel infrastructure is assessed against national commitments and development trajectories (ibid).

As noted above, the established territorial approach to accounting for emissions does not recognise or reward actions such as restricting fossil fuel exports. An alternative accounting framework based on extraction-based emissions would be needed to monitor the alignment of fossil fuel supply with climate goals and help send a more appropriate signal. Given that the development of a standardised methodology and capacity for territorial emissions accounting has been hard-won, an extraction-based accounting system should arguably be established *in parallel* (Piggott *et al.* 2017).

A range of elements where the PA offers further, future possibilities are identifiable. In terms of the **transparency and accountability** function, the global stocktake, for example, could include an assessment of fossil fuel supply against the 1.5-2°C goals. In terms of **means of implementation**, the Paris Committee on Capacity-Building could expand its current technical and capacity-building efforts to include tools and support for more supply-focused actions. The PA acknowledges that some mitigation measures (or 'response measures') may have negative social and economic impacts. It therefore calls on Parties to 'take into consideration in the implementation of this Agreement the concerns of Parties with economies most affected by the impacts of response measures, particularly developing country Parties' (UNFCCC 2015b; Article 4.15). Historically, it has been oil-producing countries that have expressed most concern about such impacts, and used them to argue for less ambition (Chan 2016). More recently, labour unions have become more vocal, calling for

consideration of the impacts on workers in extractive industries, and the need to plan a transition towards cleaner jobs (ILO 2015; ITUC 2015). The UNFCCC's forum on the "impact of the implementation of response measures" offers a platform with obvious potential to discuss challenges involved in the transition away from fossil fuel production, and how to proceed in an equitable fashion. The forum has developed a work programme focusing on 'economic diversification and transformation' and 'just transition of the workforce, and the creation of decent work and quality jobs' (UNFCCC 2015a).

Eventually, the GCF and GEF could become more active in channelling the funds to enable transition away from reliance on fossil-fuel extraction, as part of their wider role financing low-carbon development (see chapter 3). Rules to restrict levels of fossil-fuel subsidy, potentially set in other venues (see below), could free up large funds to finance such transitions: annual FFS levels represent more than six times the 'financing gap' between national pledges and the \$100 bn goal (Merrill *et al.* 2017). Redirecting such subsidies would allow for a win-win, reducing GHG impacts and freeing up funds for low-carbon development.

The UNFCCC could also do more to recognise and encourage efforts by non-state/ non-Party actors, for example by adding supply-side aspects to the NAZCA portal, which currently neglects them. The Just Transition Fund, set up by several philanthropic foundations, shows how non-Party stakeholders can also provide support for the transition (SEI 2018), with potential to be scaled-up.

More broadly, and in summary, UNFCCC should continue to:

- **Recognise countries' supply-side actions**, to ensure a public signal of countries' climate commitments, enabling debate and discussion about whether such commitments are fair and ambitious, and reducing the chances of policy reversal.
- **Foster norms and intensify moral pressure**. 'UNFCCC can help normalise the idea that transitioning away from fossil fuel extraction and production is a necessary part of climate policy, by highlighting the actions nations are already taking, and providing opportunities for social learning about policies to limit fossil fuel development. Intensifying moral pressure ... can be a key tool for ratcheting ambition to help meet Paris goals' (Piggott *et al.* 2017: 8; cf. Green 2018).
- **Clarify and strengthen signals** to financial markets. By providing a venue for more clearly articulating fossil fuel phase-down trajectories, the UNFCCC could aid in producing a stable, predictable, investment pathway.
- **Support planning for a just transition**, as a space for nations to explore the tensions associated with a planned, or managed, decline in fossil fuels (Piggott *et al.* 2017).

Despite these possibilities, given the tendency of the UNFCCC to gridlock, it may be that **smaller coalitions of the willing** will first need to form on a mini-lateral basis, implementing their own sets of rules. For example, a moderate coal export tax levied in coordination by the four largest (steam) coal exporters, Indonesia, Australia, South Africa and Colombia, could bring net benefits to the exporters, as well as reductions in emissions (Richter *et al.* 2015). The resultant rise in traded coal prices would reduce coal consumption, while exporters raise potentially tens of billions of dollars per

year in revenue. This could be used to support the structural transition in coal mining regions and/or low-carbon R&D. The larger the coalition, the less leakage to non-participating countries. Who would initiate/ coordinate such a grouping remains an open question. Tying it to Paris goals, though not essential, would make more explicit the need for other countries to address fossil fuel supply (Piggott *et al.* 2017).

As a final point, action through initiatives by oil and gas corporations themselves must remain a component of transformation of the sector. The Extractive Industries Transparency Initiative (EITI)⁵³ could potentially be expanded to improve monitoring of company initiatives. But apart from being inadequate in itself, such ‘in-house’ action is arguably itself dependent on broader transformation, without which the necessary technological and economic innovations within companies will not be achieved (Schlosser *et al.* 2017: 38).

6.6.2. Fossil-Fuel Subsidy Reform

Here, it is possible to contemplate a range of possible reforms to existing institutions or new initiatives, covering the gaps in governance functions identified. Whitley and Van der Burg (2015: pp.43-49), for example, offer a range of options depending on the preferred degree of ambition and compulsion. The main challenges to multilateral action will be to define what constitutes FFSs, achieve transparency about their application (thereby exposing vested interests to greater public scrutiny/ awareness), address the concerns of developing countries and oil exporters, before setting out enforceable rules with implementation timelines (Asmelash 2017). It is important to note however that consensus on the most appropriate formulator and enforcer of any new rules, or whether they can feasibly be the subject of a dedicated multilateral agreement, has not necessarily yet emerged. Given how entrenched they can be in national political economy, a commitment to progressively eliminate FFSs is certainly more feasible than an outright ban. The cross-cutting nature of the issue means that the global effort lacks an obvious, single institutional home at the international level. Arguably, a single international organisation is needed to coordinate otherwise fragmented efforts, provide a forum for negotiations towards an international agreement, and oversee its implementation (Asmelash, 2017). On the other hand, the consensus in the literature appears to be sceptical regarding the likelihood of binding multilateral agreements being reached (see e.g. Smith and Urpaleinen 2017), but more favourable towards regionally-based initiatives like APEC (cf. Droege *et al.* 2018), or other progressive ‘clubs’.

Regarding transparency, recent OECD analysis has reinforced the message that ‘[w]hile several international organisations and NGOs develop their own data repositories of support measures for fossil fuels, ... greater coordination is necessary in order to deliver a strong message to policy makers’ (OECD 2018). Further coordination is needed and can be improved, especially as inconsistencies in definitions and data are sometimes used as an excuse to postpone action. Greater

⁵³ Currently excluded from our database as insufficiently oriented to climate-related issues.

coordination efforts could also help move towards a consensus on key concepts, such as the conditions under which support to fossil fuel is not considered as ‘inefficient’.

The UNFCCC

One way to widen and strengthen country commitments could be to include language on phasing down fossil fuel subsidies in the negotiated outputs of the UNFCCC (Whitley and Van der Burg 2015). By indicating clearly that fossil fuel subsidy reform is part of a country’s mitigation portfolio, the likelihood increases that such actions can be eligible for support. Even though national-level subsidy reform is more likely to be triggered by economic and fiscal motivations, such incentives from the climate regime could strengthen the case for reform (Van Asselt and Kuvoleski 2017). Although it may be unrealistic to expect UNFCCC to set standards to phase out or reform FFS (owing to the historic inability to specify policies and measures Parties should take), it could in theory begin to address them in at least six ways (van Asselt and Kulolesi 2017):

- i) voluntary reporting of subsidies and their reform by Parties;
- ii) including FFS reform as a nationally appropriate mitigation action (NAMA);
- iii) including FFS reform in NDCs;
- iv) discussing FFS reform as a measure with high mitigation potential in future technical expert meetings (TEMs) (as part of ‘workstream 2’—focusing on scaling up climate action before 2020);
- v) reviving the idea, removed from COP21 negotiating texts, of reducing support for high-emissions investments in the context of future climate finance discussions;
- vi) reiterating the G7 commitment to phase out inefficient fossil fuel subsidies by 2025.

The WTO

Several commentators see an important opportunity for the WTO, the only body with a definition of subsidies that has been tried and tested through a vigorous negotiation process. When the E15 Task Force on Subsidies (see Whitley and Van der Burg Section 8.1.3) examined the extent to which the WTO Subsidies and Countervailing Measures (SCM) agreement could address fossil fuel (and renewable energy) subsidies, it noted shortcomings in terms of tackling dual energy pricing and production subsidies, and concluded that the adoption of a **new multilateral agreement** on subsidies or trade remedies **within the WTO framework** would be the best response (Espa and Rolland 2015). Several suggestions have been made that could help the WTO enhance transparency without requiring changes in its legal framework (van Asselt 2014; Casier *et al.* 2013), including:

- a new subsidiary body under the SCM Committee to examine whether notifications are in line with the actual support provided;
- a new notification template providing further details on subsidies in a standardised fashion; and
- allowing NGOs to report on the level of non-actionable subsidies.

The WTO could do more to incentivise subsidy reform. Incentives could arise if a subsidy clearly qualified as either “prohibited” or “actionable”, allowing other WTO Members to take action under Article 4 or 7 of the SCM Agreement, respectively (van Asselt 2014). According to Gerasimchuk and

Bacchus (2017), it is also only a matter of time before the first lawsuit over FFSs is put before the WTO's dispute settlement body, with the proposed Adani coalmine in Australia one potential case.

While it seems quite unlikely that WTO Members will be able to renegotiate the subsidies regime to take into account the climate impacts of FFSs, the issue could be worked on by a smaller group of WTO Members, potentially involving several Friends of Fossil Fuel Subsidy Reform. However, unless this group engages the countries responsible for the largest subsidies, the effectiveness of such a plurilateral agreement would be limited (Van Asselt 2014). Ultimately, commitment needs to be 'complemented by clear and explicit country-specific benchmarks and timelines for implementation', which in turn requires an effective enforcement mechanism (Asmelash 2017: 359).

6.7. References

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Table 6.2: Supply of international governance functions regarding extractive industries (key global-level institutions/ initiatives – not including subsidies)⁵⁴

Governance Functions		UNFCCC/ Paris Agreement/ other UN (Inter-gov)	WBG/ IMF (Intergov/ public)	G7, G20 (inter-gov)	IEA/ OECD (inter-gov)	OGCI IPIECA (private)	GMI (hybrid) GGFRP Zero Routine Flaring 2030 (hybrid)	CCAC Oil and Gas Methane Partnership (hybrid)	NGOs (e.g. Lofoten Declaration, 'Unfriend Coal', Oil Change) (civil soc)
Guidance and Signal	Phase out of extraction ASAP after 2050	1.5/ 2°C (indirect) signal UNSDGs	No finance for upstream oil/gas projects (from 2019)	G7 (soft) pledge (2015) to end all fossil fuel use by 2100.	IEA warnings on 'unburnable carbon', 'lock-in'	Signatory company CEOs accept PA goals	2030 signal?		Pressure on e.g. insurance companies, investors
Setting Rules	Global regulation of FF extraction (rights) Phase-in periods for dev. countries/ compensation for cost-raising measures	GAP (but see: Impact of Response Measures Forum)							

⁵⁴ NB. Some individual organisations/ initiatives, currently clustered into columns, will be considered individually in further work to be undertaken

	'In-house'/ operational GHG management						Voluntary GGFRP offers collaborative Global Standard on flaring reduction	Voluntary commitment	
Transparency and Accountab- ility	<ul style="list-style-type: none"> Global regulation would require To track progress, create peer pressure 	<i>Check forthcoming provisions r.e. global stocktake</i>	Increased transparency re. own portfolio GHG emissions			Designed reporting process that enables voluntary pooling of efforts and comm. of progress			
Means of Implemen- tation	<ul style="list-style-type: none"> Technical/ financial support for national reform (away from FF extract/n) 	<i>Potential role for GCF?</i>	Analysis/ support for just transition (WB partnership with Canada/ ITUC)		.	Operates a billion-dollar (project-based) investment fund		Each company covers cost of own participation	<i>ITUC Just Transitions Centre?</i>



Knowledge and Learning	<ul style="list-style-type: none"> Enhance policy learning re. 'national interests' 	<p>UNEP publish estimates of scale of extraction</p> <p>Various UNFCCC Response Measures Forum work progs on economic diversification, just transition.</p>	<p>Published estimates of the scale of extraction</p> <p>Analysis/ support for just transition (partnership with Canada/ ITUC)</p>		<p>Published estimates of the scale of extraction</p> <p>.</p>	<p>Sharing of best practices and industry collaboration</p> <p>Developing industry guidelines on GHG reporting, good practices on EE and GHG management</p>	<p>GMI: builds capacity, develop strategies and markets, remove barriers to project development for methane reduction in Partner Countries</p>	<p>Emphasis on companies learning by doing and achieving continuous improvement over time.</p>	<p>e.g. convening side-events at COPs/ inter-sessionals.</p> <p><i>ITUC Just Transitions Centre?</i></p>
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Table 6.3: Fossil fuel (production) subsidy reform (key institutions/ initiatives, FFS-related) ⁵⁵

Governance Functions		UNFCCC/ Paris Agreement/ UNSDGs (Inter-gov)	WTO (Inter-gov/ Public)	WBG/ IMF (Intergov/public)	G7/G20/ APEC/ EU (inter-gov)	IEA/ OECD (inter-gov/ public)	FFFSR (intergov/ public)	NGOs (e.g.) GSI (civil soc)
Guidance and Signal	Phase out of FFS by firm deadline	PA offers weak signal – art 2.1c on finance. UNSDGs Goal 12c (weaker)	Buenos Aires Ministerial declaration (2017).		G20 (2009) committed to phasing out ‘inefficient FFS,’ encouraged national strategies G7 (2016) pledge to phase out support for fossil fuels by 2025 (Soft declarations).	Broad commitments on FFS (but no deadline).	Communiqué calling for the elimination of FFSs in the context of PA (2015). Buenos Aires declaration (2017)	
Setting Rules	Agreement on FFS phase down/out Phase-in periods for dev. countries/		Administers legally binding agreement on subsidies (but SCM Ag. currently inadequate).		(EU state aid rules)			

⁵⁵ NB. Some individual organisations/ initiatives, currently clustered into columns, will be considered individually in further work to be undertaken.

	compensation for cost-raising measures							
Transparency and Accountability	<ul style="list-style-type: none"> Required for monitoring of FFS reform To track progress, create peer pressure 	<p>Check forthcoming provisions r.e. global stocktake.</p> <p>SDG indicator 12.c.1: "Amount of fossil fuel subsidies per unit of GDP etc</p>	<p>SCM Committee (under-used)</p> <p>Trade policy review mechanism offers opportunities.</p>	<i>Country info collected?</i>	Voluntary self-reporting and peer-review mechanisms	Datasets compiled in collaboration between the OECD and the IEA		<p>Tracking progress of G20 and APEC countries phasing out inefficient FFS, attempting to raise in Talanoa process.</p> <p>(produced a set of guidelines for peer review of FFS).</p>
Means of Implementation	<ul style="list-style-type: none"> Technical + financial support for national reform efforts 			World Bank works with countries to implement subsidy reform; IMF may include reform as lending condition.		.		GSI works with countries to implement subsidy reform.
Knowledge and Learning	<ul style="list-style-type: none"> Definition of FFS International comparable data (esp. on FFS) Enhance policy learning re. 'national interests' 	<p><i>Stocktake/ Talanoa dialogue?</i></p> <p><i>Side-events?</i></p>	Committee on Trade and Environment shared knowledge.	<p>IMF and WB both research and publish estimates.</p> <p>ESMAP Website to facilitate knowledge sharing</p> <p>WB: Climate Action Peer Exchange on FFS reform</p>		<p>Collaboration between the OECD and the IEA.</p> <p>Published estimates.</p>	Organisation of roundtables at G20 and UNFCCC meetings.	Tracking progress of G20 and APEC countries in phasing out inefficient FFS.

7. Land Transport

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7.1. Transformation Challenges and Governance Demands

7.1.1. Current Status and Prospect

The land transport sector includes domestic as well as transboundary road, rail and pipeline transport. International aviation and maritime transport are addressed in a separate chapter. Domestic aviation and waterways transport are also not covered by this chapter as challenges and strategies differ substantially from land-based transport.

The sector is one of the largest and fastest-growing emission sources worldwide. In 2015, transport accounted for nearly a quarter of energy-related global CO₂ emissions (8 Gt) (International Energy Agency, 2017). Emissions from transport have more than doubled since 1970, growing faster than emissions from any other energy-end-use sector. Passenger transport accounts for about 60 per cent, and freight transport for about 40 per cent of global transport energy demand. Without changes to current trends, global GHG emissions from transport are set to again double by 2050. Nearly all growth in the transport sector, both passenger and freight, is expected to occur in developing countries and emerging economies due to growth in incomes, populations and freight transport. Emissions in developed countries are projected to hardly decrease from 2011 levels if current trends persist (IPCC, 2014). Even scenarios assuming substantial improvements in vehicle efficiency and some modal shifts project global transport emissions in 2050 that are still at 2015 levels (Lah, 2017).

Conventional transport is under pressure not only for climate policy reasons. Transport also is a strong contributor to local noise and air pollution, oil imports are a heavy burden on many economies and congestion is a problem in many cities. Therefore, multiple economic, social and environmental benefits can be achieved by moving to more sustainable transport systems (Eckermann et al., 2015). At the same time, conventional vehicle technology based on the internal combustion engine is increasingly exposed to competition from battery electric vehicle technology, which is advancing rapidly in terms of cost effectiveness, battery recharging times and the driving range. China, France, India, the Netherlands, Norway, the UK have decided to phase out or even outright ban sales of new diesel or gasoline vehicles starting from 2025 to 2040 (Chrisafis & Vaughan, 2017; Stumpf, 2017). Some manufacturers have realised their future target market is in electric mobility. Volvo, for example, announced that from 2019 onwards, all of its new vehicles will be electric or hybrid (Ewing, 2017).

Current strategies in the sector to foster more sustainable forms of transport focus on providing mobility services and managing transport demand, rather than providing only infrastructure. Such strategies often rely on the *Avoid-Shift-Improve* framework towards infrastructure and service (Bakker, Zuidgeest, de Coninck, & Huizenga, 2014; Sims et al., 2014; SRU, 2005):

Avoid travel or reduce travel-length: Ideally, settlement patterns and transport infrastructure should be designed in a way that minimises the need to travel, and minimises the length of travel in case of unavoidable travels. This can be achieved by compact and integrated city planning with mixed land use. For freight, this also means avoiding empty trips through improved logistics as well as infrastructural planning and decisions if (parts of) raw materials or pre-products can be sourced nearer to the areas of production or refinement.

Shift travel to more climate-friendly modes: If travel cannot be avoided, policies should encourage or regulate that low-emission transport options are favoured over high emission ones. For passenger transport, this means to encourage walking and bicycling for shorter travels, and public transport use for longer travels. The policy toolbox encouraging shifting includes incentives for shifting to other modes (pull measures) and disincentives, including fiscal, for using motorised personal automobiles (push measures). For freight, this can mean incentivising shifting long distance freight to rail and water transport, and short distance freight delivery can be optimised through efficient supply chain management and using non-motorised transport for deliveries within the destination.

Improve vehicle and fuels technology and efficiency: Technologically, both fuels and vehicles have not yet reached their limits of energy efficiency. In the medium term, land transport should entirely shift to zero-emission vehicles. In the short term, policies incentivising lighter and small vehicles, high fuel efficiency and fuel economy can yield higher uptake of efficient vehicles.

A key rationale for this three-fold approach is seeking a balance between meeting mobility demand and managing energy intensity. The objective is provision of access and mobility, not just the provision of transport infrastructure. Isolated technology shifts of the propulsion systems of the vehicles would fall short on delivering wider socio-economic benefits and would be less cost-effective (ITF, 2009). A comprehensive strategy can also address other key policy issues such as congestion and the excessive amount of urban space currently occupied by automobiles (Rudolph, Koska, & Schneider, 2017).

Policy measures should be designed in packages in order to avoid trade-offs. For example, increasing fuel taxes without providing modal alternatives and measures to ensure a supply of efficient vehicles can negatively affect mobility and transport affordability and thereby engender strong political resistance. Combinations of measures, such as taxation, vehicle efficiency standards, provision of modal choices, and compact city design, have the potential to address multiple political objectives and avoid opposition from relevant veto players (Lah, 2017).

The potential direct and indirect savings to society from decarbonisation of the land transport sector is estimated at around USD 50 trillion to 100 trillion by 2050. These savings result from lower fuel consumption and reduced need for vehicle purchases and infrastructure. Further benefits to the society namely health, safety and quality of life, are not a part of the above savings (IEA, 2012; Lah, 2017).

The combination of electrification, automation and sharing options may yield the potential for substantial disruptive change. Mobility-as-a-service models that already change mobility behaviour include ride-sharing and e-hailing, bike-sharing and car-sharing and on-demand bus services. Further impetus would be provided by the emergence of self-driving cars, which could enable electric robotic taxis. A key message of recent analyses on the potential impact of mobility scenarios that rely on automation, electrification and sharing options is that the integration of all three elements is vital to make a positive contribution to CO₂ mitigation targets and wider sustainable development objectives (ITF 2017). The main contribution to travel demand management and CO₂ emission reductions is based on the sharing element (Fulton, Mason, & Meroux, 2017).

7.1.2. Main Challenges and Barriers toward Decarbonisation

Despite the substantial sustainable development benefits that may be achieved, a variety of challenges and barriers need to be overcome. A fundamental challenge is the longevity of human settlement patterns and transport infrastructure. Once put in place, physical infrastructure determines transport demand profiles for decades. Human settlement patterns and transport infrastructure designs in many industrialised country cities currently lock in high transport demand levels (Driscoll, 2014; Figueroa, Lah, Fulton, McKinnon, & Tiwari, 2014). At the same time, the rapid urbanisation that is ongoing in the global South poses a great risk of further emissions lock-in. Based on projections for declining population densities, and economic and population growth, world-wide urban land cover is expected to expand by 56–310 % between 2000 and 2030 (Seto et al., 2014).

Business as usual – incremental approaches and less structured, quasi-automatic urbanisation – would lead to growth of highly unsustainable cities. What is required is transformative strategies departing from conventional infrastructure patterns (WBGU, 2016). For example, in many cities worldwide ‘segregated land-use’ is enshrined in their urban planning practices. In these cities different types of land use (residential, commercial, manufacturing, service, recreational) have been purposefully kept separate. The result is a higher need to travel for various needs. Another practice in many cities is the provision of urban areas for automobile friendly infrastructure, such as parking spaces, wide motorways and extending existing road capacities (United Nations Human Settlements Programme, 2013). A related problem is the use of cost-benefit analyses as basis for transport investment projects as currently often practiced. Currently, these analyses often focus on economic and transport objectives that can be expressed in monetary values and tend to neglect long-term environmental and social impacts of motorisation (Næss, 2006; Rudolph et al., 2015).

The ability of urban areas to steer their development onto a low-emission course depends on their governance, technical, financial, and institutional capacities. While the most accessible mitigation opportunities are in rapidly urbanising areas where urban form and infrastructure are not locked in, their capacities are often already overstretched by tasks such as providing decent habitation for their rapidly growing populations (Seto et al., 2014; WBCSD, 2010).

Furthermore, the car manufacturing and oil industries will need to substantially change their business models, as these currently strongly rely on fuels and technologies that will have a diminishing role in a decarbonising sector. Many traditional European car makers made substantial

investment in internal combustion engines,, which create technological lock-in effects to a certain extent (Skeete, 2017). In countries with a strong historical background as car producers, industry policy objectives inhibit the radical transformation of the sector that would be needed to move away from individual car ownership towards multimodal mobility services (Alam, Hyde, Duffy, & McNabola, 2017; Ross Morrow, Gallagher, Collantes, & Lee, 2010).

Two other barriers are "techno-political" in nature: Customers are currently faced with standardisation problems in zero-emission vehicle systems, as there are currently no real standards set for charging, e.g. currents, connectors etc., which vary widely across manufacturers, countries, and even models (Pereirinha & Trovão, 2016). The other one concerns the change in infrastructure that is needed - current infrastructures are strongly geared towards servicing combustion engines (fuel stations etc.). In order to foster a change e.g. towards electrical propulsion, the infrastructure needs to be changed almost completely. Another "socio-technical" barrier to change can be the absence of viable alternatives - as much depends on infrastructures, especially rural or remote areas may face difficulties of access (no public transport, no railway lines for freight transport etc.).

At a cultural level, vehicle ownership is often connected with a sense of personal freedom, and an attachment to the vehicle. Moreover, in many countries cars are seen as a status symbol. However, there are signs of change. In some countries such as Germany, young adults take their driving license later, own less cars and behave more multimodal than young fellow countrymen and countrywomen 10-20 years ago (ifmo, 2011; infas & DLR, 2008). The challenge here is to consolidate and reinforce these trends.

7.1.3. The Promise and Potential of International Cooperation

Guidance and Signal

Transport is currently not sufficiently addressed in national climate action. 87% of current NDCs identify transport as an important source of GHG emissions and area for action (Löhr, Perera, Hill, Bongardt, & Eichhorst, 2017). In practice, however, the envisaged contributions as they relate to the transport sector often fall short of what would be required to achieve the objectives of the Paris Agreement (PA) (for the G20 countries, see Vieweg et al., 2017). Even countries that have achieved strong reductions in their overall emissions such as the UK or Germany have hardly seen a dent in transport emissions (Evans, 2016; Umweltbundesamt, 2017). Given the long-term path dependencies in the transport sector, this situation needs to change quickly. International governance should therefore endeavour to send signals that action in the sector is crucial and beneficial.

As evident from national discussions about ending the use of combustion engine vehicles, targets and timetables can be a strong lever to redirect sectoral developments. International agreement on a target to phase out the use of fossil fuels in the transport sector would make the overall global climate policy targets more palpable for actors in the sector. A sectoral decarbonisation target would support the shift to zero-emission vehicles but also support avoid and shift strategies as these minimise the need for energy inputs in the first place while ensuring access. International

cooperation could set a common roadmap for the sector, with differentiated decarbonisation target years for different countries with different levels of development.

Agreement on a new paradigm centred on transit-oriented development and prioritising public, shared and non-motorised transport over individual motorised transport could be even more effective as it would tackle some of the underlying drivers of transport emissions.

Setting Rules to Facilitate Collective Action

Governance challenges in the transport sector are mostly not of a 'collective action' nature. Nonetheless, international governance could establish a number of obligations of conduct to promote emission reductions.

International governance could help to focus attention on the so far neglected transport sector by requiring countries to have sectorally differentiated short- and long-term climate strategies, with specific targets and measures for transport. The transport sector should be further broken down to passenger and freight transport to fine-tune targets and measures. In addition to sectoral targets, these climate strategies should ideally also describe current and envisaged measures to facilitate the tracking of action.

To be compatible with the PA's 1.5°C limit, countries' long-term strategies should aim to fully decarbonise transport by 2050 at the latest (Sterl et al., 2016). In line with the UNFCCC's principle of common but differentiated responsibilities, countries with high economic capability and high historic responsibility for contributing to climate change should aim for earlier decarbonisation dates.

Fleet emission standards and fuel economy standards are a commonly used policy instrument. They set future target values well in advance and thereby allow manufacturers to develop and deploy the technologies needed to meet the respective target level, a prerequisite to ensure compliance with climate change mitigation strategies (Damert & Rudolph, 2018). International governance could help to have all countries introduce such standards, and to have them converge globally over time. As many original equipment manufacturers (OEMs) have production sites and significant market shares all over the world, ambitious *regional* emission standards may *globally* foster the production and sale of energy and carbon efficient vehicles.

Furthermore, in line with the PA's goal to make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development (Article 2.1(c)), it would be very helpful if countries started a process on reforming priorities and criteria for funding transport infrastructure. In a first step, countries could commit to provide transparency on transport spending, identifying how much spending goes into unsustainable transport and how much into sustainable transport. In the next step, countries could commit to shift funding from unsustainable to sustainable transport infrastructure. More domestic funding for sustainable transport could also be mobilised by charging the real social and environmental cost of transport, e.g. through carbon pricing, congestion charging, road and parking pricing.

Transparency and Accountability

Transparency requirements in the transport sector would likely vary with the scope of international cooperation, and consequently the rules set. Agreement to require sectorally differentiated short- and long-term climate strategies should be accompanied by requirements to provide sectorally differentiated accounts of national emissions, measures taken and their impacts. In the medium term, these requirements will need to be differentiated according to the capacity of countries. Countries with little capacity should first prioritise producing robust emission inventories; ex-post evaluation capacities can then be gradually built up.

A focus on the need to bend the curve in transport emissions could be re-enforced by including a sectoral breakdown in global reviews of current climate efforts. Looking not only at aggregate emissions but also at the sectoral level would put developments in the transport sector on the global agenda in regular five-year intervals.

Means of Implementation

Commitments to reform national transport infrastructure funding as discussed above should extend to the international provision of means of implementation. All provision of support should be made compatible with the PA, prioritising non-motorised, public and shared transport. A reform could also be made a condition for the provision of support. Countries could be required to first redirect their domestic resource from unsustainable to sustainable transport in order to qualify for the provision of support.

Many urban areas in the world are committed to do more on climate change but lack resources and institutional capacities to deliver low-carbon mobility systems. Increased provision of means of implementation could therefore unlock substantial potential for more action. Resources should in particular be used for strengthening administrative and planning capacity.

Knowledge and Learning

Current studies indicate that many developing/emerging countries mimic infrastructure developments of industrialised countries, albeit at often a much grander scale (Arndt et al., 2014). International cooperation on best practices through partnerships such as city networks, research institutions and NGOs, can help support the implementation of low-carbon transport measures. This can include common technical knowledge, but could also extend to exchanges on policies that have shown high effectiveness. While policies will always need to be shaped according to national circumstance, policy dialogues will provide useful starting points for transport decarbonisation.

The findings are summarised in Table 7.1 below.

Table 7.1: Synthesis of Governance Demands

Sectors	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
Transport	<ul style="list-style-type: none"> Signal that action in the sector is crucial and beneficial, moving away from focus on aggregate emissions International transport decarbonisation target and roadmap New mobility paradigm (transit-oriented development & prioritising public and non-motorised transport) 	<ul style="list-style-type: none"> Require sectoral breakdown in short- and long-term strategies, with transport further broken down to passenger and freight Long-term strategies to aim to reduce transport emissions to zero by 2050 at the latest Global introduction and convergence of fleet emission standards Commitment to environmental fiscal reform Harmonisation of technical vehicle standards 	<ul style="list-style-type: none"> Robust sectoral emission inventories National accounts of measures taken and their impacts Transparency on public transport spending Sectoral breakdown in global climate reviews 	<ul style="list-style-type: none"> Make all finance, technology and capacity building compatible with the PA Require redirection of domestic resources to qualify for support Provide resources directly to urban level 	<ul style="list-style-type: none"> Learning partnerships on technologies and policy design (including policy integration with other sectors such as power and urban settlements)
Grading	• High	• Medium-High	• Medium-High	• High	• Medium-High

7.2. Governance Supply

This section provides a structured overview of existing/active international institutions relevant to the transport sector. The below table provides an overview of the relevant institutions and which governance functions their activities most relate to. A detailed overview of the institutions is provided in Table 7.2 in the annex to this paper.

Table 7.2: Overview of institutions

■ main activity | □ secondary activity

Initiatives	Acronym	Guidance / Signal	Setting Rules	Transparency / Accountability	Means of Implementation	Knowledge and Learning
C40	C40	■	■	□	□	■
Clean Energy Ministerial	CEM	■	■		□	□
Electric Vehicles Initiative	EVI	□	□			■
EV100	EV100	■	■	□		□
EV30@30	EV30@30	■	■		■	■
Global Covenant of Mayors for Climate and Energy	GCM	□	■	■		□
Global Fuel Economy Initiative	GFEI	■		□	■	■
ICLEI - Local Governments for Sustainability	ICLEI	□	■		□	■
International Association of Public Transport	UITP	■	□	□	□	■
International Energy Agency	IEA					■
International Renewable Energy Agency	IRENA	□				■
International Transport Forum	ITF	■				■
Low Carbon Technology Partnership initiative	LCTPI	■				■
MobiliseYourCity	MobiliseYourCity	□	□		■	■
Paris Process on Mobility and Climate	PPMC	■		□		■
Partnership on Sustainable Low Carbon Transport	SLoCaT	■				■
Sustainable Mobility for All	Sum4All	■	□	■		■
Transformative Urban Mobility Initiative	TUMI	□		□	■	□
Transport Decarbonisation Alliance	TDA	■	■			□
United Nations Development Programme	UNDP				■	■
United Nations Economic Commission for Europe	UNECE	□	□			□
United Nations Environment Programme	UN Environment/ UNEP					■
United Nations Framework Convention on Climate Change	UNFCCC	■	■	■	■	■
United Nations Human Settlements Programme	UN-Habitat	■		■	■	□
United Nations Secretary-General Advisory Group on Sustainable Transport		■				■
United Nations Sustainable Development Goals process	SDG process	■		■		□
Urban Electric Mobility Initiative	UEMI	■	■	□	□	■
World Bank Group	WBG	■		■	■	■
Organisation for Economic Cooperation and Development	OECD					■
Other Multilateral Development Banks	MDBs	□			■	■
Zero-Emission Vehicle Alliance	ZEV Alliance	■	■			

7.2.1. International Institutions

United Nations System

The **PA** in Article 2.1(a) has set the objective for the international community to hold the increase in the average global temperature well below 2°C above pre-industrial levels and to make best efforts to stay below 1.5°C. In addition, to achieve this objective, Article 4.1 sets out the aim to achieve a global peaking of GHG emissions as soon as possible, to undertake rapid reductions thereafter, in order to achieve a balance of emissions and removals by sinks in the second half of the century. Given that current emission trends are widely out of step with these objectives, the PA thereby signals that strong mitigation action is needed. Furthermore, the 5-yearly cycle of global stocktakes, which are to be followed by enhanced NDCs, also operates to send a signal that more ambitious

action is needed. However, the Paris objectives and the ‘ambition cycle’ do not contain a sectoral breakdown and thereby do not provide sector-specific orientation.

Under the **UNFCCC**, transport sector activities may receive financial support through the financial mechanism (which is operated by the Global Environment Facility and the Green Climate Fund). The UNFCCC system also provides capacity building through its Climate Technology Centre and Network (CTNC). Donor countries also provide direct bilateral support to fulfil their commitments to provide means of implementation to developing countries. In terms of knowledge diffusion, the Technical Examination Process (TEP) is of particular importance. Under this process, a series of expert meetings have been held to collate and synthesise good practice policies for a variety of sectors including transport. (secretariat UNFCCC, 2018).

Most recently, the UNFCCC has sought to play an orchestrating role. Under the so-called Lima-Paris Action Agenda, which was subsequently further developed and rebranded into the “Marrakech Partnership for Global Climate Action” (MPGCA), the UNFCCC organised a series of high-level events to showcase particularly successful initiatives by non-state and subnational actors. At each of the two most recent COPs, a full day was devoted to low-carbon transport. These events were repeatedly used to announce new initiatives by other institutions also considered in this report (Global Climate Action, 2018; Marrakech Partnership, 2018).

The **United Nations Sustainable Development Goals (SDGs)** are the result of a process launched by the United Nations Conference on Sustainable Development in Rio de Janeiro (Rio+20), to “end poverty, protect the planet and ensure prosperity for all”. In relation to the transport sector SDG 9 and SDG 11 are especially important. Both speak to the transformation challenges discussed above. SDG 9.1 sets a target to “[d]evelop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.” SDG 11.2 aims to “[b]y 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations (...)”. To be able to evaluate and observe the progress on the SDGs, a global indicator framework was established (Agenda for Sustainable Development, 2018).

The **United Nations Human Settlements Programme (UN Habitat)** has the goal to promote and implement socially and environmentally sustainable human settlements. The adoption of the New Urban Agenda (NUA) in 2016 sets a focus on providing better public transport, tackle urban challenges and increase public spaces and therefore contributes to the implementation of the Avoid-Shift-Improve approach. This is also the guiding principle for the Urban Electric Mobility Initiative (UEMI), which is led by UN-Habitat. To track developments in the field of urbanisation and to monitor the NUA and the SDGs, the Global Urban Observatory (GUO) unit was established (UN Habitat website, 2018). Additionally, UN HABITAT provides capacity building and technical assistance to support the development and implementation of sustainable urban mobility plans and investment strategies, aims at including financing partners therein, and also offers stakeholder consultation

processes, international expertise, best practises and a global database of policies, laws, decisions and practices relating to the urban environment (Global Urban Law Database, UrbanLex).

The **United Nations Economic Commission for Europe (UNECE)** is also worth mentioning especially because of its permanent working party, the **World Forum for Harmonization of Vehicle Regulations (WP 29)**. It provides a global framework for harmonising regulations for vehicles in the context of road safety, environmental protection and trade (UNECE website, 2018c). In addition, the Transport, Health and Environment Pan-Europe Programme (THE PEP) aims at empowering national and local governments to implement and take into consideration policies on sustainable mobility (UNECE website, 2018b). Furthermore, UNECE established the ForFITS Model, which is a tool that facilitates comparisons of scenarios with and without implementation of transport policies (UNECE website, 2018a).

The **United Nations Environment Programme (UNEP)** contributes to climate governance in the transport sector by means of four particularly relevant initiatives: The E-mobility Programme, the Global Fuel Economy Initiative (GFEI) - in partnership with the IEA -, the Partnership for clean fuels and vehicles (PCFV) and the Share the Road Programme.

- The E-mobility Programme aims at implementing electric mobility strategies and roadmaps (UNEP website, 2018b).
- The GFEI aims at stabilising GHG emission from the global light and heavy duty vehicle fleet by 2050 (UNEP website, 2018c).
- The PCFV aims at at an decrease in vehicle emissions by supporting both cleaner fuels (through the lead campaign and the sulphur campaign) and cleaner vehicles (through the vehicle campaign) (UNEP website, 2018a).
- The Share the Road Programme aims to promote policies that encourage investments in walking and cycling infrastructure. (UNEP website, 2018d)

All four predominantly provide knowledge and learning concerning their respective thematic focus. In addition, the E-mobility Programme and the Share the Road Programme also provide targeted capacity building and technical assistance.

Multilateral Development Banks

Multilateral Development Banks (MDBs) provide, as part of their portfolios, financial assistance to large transport and infrastructure projects in developing countries. For example, the **African Development Bank's (AfDB)** objective is to support inclusive and green growth within Africa and identified the provision of sustainable transport infrastructure as one area of priority. Another example is the **Asian Development Bank (ADB)** that aims at implementing transport projects in Asia that fulfil the requirements of the Avoid-Shift-Improve approach. (ADB website, 2018) Especially noteworthy is the **World Bank Group** as an active player in the area of sustainable transport. At the end of the fiscal year 2016, there were 493 active World Bank transport projects with total net commitments of \$57.7 billion, representing close to 20% of the total lending portfolio. Furthermore, it launched the Leaders in Urban Transport Planning Program (LUTP) which provides participants with knowledge and learning to explicitly tackle the complexity of urban transport, as well as the

initiative Sustainable Mobility for All (Sum4All) to support implementation of transport-related SDGs, which includes knowledge provision as well as a global tracking framework to measure progress (World Bank website, 2018b).

At the Rio+20 conference in 2012, eight MDBs (African Development Bank, Asian Development Bank, CAF–Development Bank of Latin America, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank, Islamic Development Bank, and the World Bank) pledged to provide \$175 billion of loans and grants for more sustainable transport in developing countries by 2022. They also developed common arrangements for measuring and monitoring their transport projects (World Bank website, 2018a).

Other International Organisations

The **International Transport Forum (ITF)** is an international organisation that is administratively hosted by the OECD but is politically independent. Its membership of 59 countries extends beyond OECD countries and includes a number of emerging economies. It essentially is a think tank for transport policy and operates through global dialogues and providing a platform for discussion and pre-negotiation of policy issues. Its annual summit in Leipzig is the largest global meeting of transport ministers. The ITF launched the Decarbonising Transport project to establish a commonly acceptable pathway to achieve zero transport emissions by around 2050 (ITF website, 2018). Currently, it is in the phase of establishing a modelling framework with relevant data and a catalogue of measures and of assessing the effectiveness of these measures, which are supposed to be finalised by October 2018 and May 2019 respectively.

The **International Energy Agency (IEA)** was established under the OECD but acts as an autonomous body for policy advice. It comprises 30 member countries. Its scenarios on energy provision/use and related GHG emissions and other analysis are widely seen as authoritative. The IEA's Mobility Model Partnership (MoMo) provides historical data and quantitative analyses. Also relevant are the IEA's Technology Collaboration Programmes (TCPs): Advanced Fuel Cells TCP, Advanced Motor Fuels TCP, Clean and Efficient Combustion TCP and the Hybrid and Electric Vehicle TCP. Their main activities focus on research, studies, information exchange, policy recommendations and establishing pilot projects.

Furthermore, the IEA closely cooperates with the **Clean Energy Ministerial (CEM)**, a global forum consisting of 24 countries and the European Commission, and the IEA hosts its Secretariat. The CEM mainly focuses on the transition to clean energy. Nevertheless, there are two initiatives that are also relevant for the transport sector: The Electric Vehicle Initiative (EVI) and EV30@30, the latter of which builds on and extends the scope of the former. EV30@30 has set the goal of reaching a 30% sales share of electric vehicles by 2030 and collects pledges to contribute to this goal from governments, local authorities, the private sector and civil society (CEM website, 2018). The CEM also provides technical assistance and capacity building as well as policy research and global networking to exchange information, experiences and best practices.

The **International Renewable Energy Agency (IRENA)** similarly provides relevant analysis, showing that the transport sector has the potential to quadruple its current 3% share of renewable energy by 2030. IRENA's analyses focus on the topics Electric Vehicles and Liquid Biofuels (IRENA website, 2018).

7.2.2. Transnational Institutions and Initiatives

There is a host of different transnational initiatives that bring together a wide range of actors both public – different level governments – as well as private – corporate and civil society. We have divided the various initiatives into institutions formed under the Marrakech Partnership for Global Climate Action and others.⁵⁶

Marrakech Partnership for Global Climate Action (MPGCA) Transport Initiatives

As mentioned above, the MPGCA gathers a range of initiatives relevant for transport. In the following we will describe the ones that are most formalised in terms of membership and follow-up on actions.

C40 Cities consists of over 90 megacities from Africa, Asia, Europe, Latin and North America. Its overarching aim is to tackle climate change, reduce greenhouse gas emissions and climate risks by implementing urban actions. Transport relevant initiatives include the Clean Bus Declaration (C 40 Cities, n.d.), which commits the 22 signatory cities to introduce over 40 000 clean technology buses by 2020. In addition, it organises three networks that set rules for their respective thematic focus: The Bus Rapid Transit (TRT) Network, the Low Emission Vehicle (LEV) Network and the Mobility Management Network.

MobiliseYourCity is a partnership created by the governments of France and Germany and supported by the European Commission to support local governments in developing countries to plan sustainable urban mobility in order to develop more inclusive, liveable and economically efficient cities and reduce GHG emissions. 100 cities and 20 national governments are to be engaged in deep transformational actions through the implementation of Sustainable Urban Mobility Plans (SUMP) supported by National Sustainable Urban Mobility Policies and Programmes (NUMP). MobiliseYourCity aims to assist cities in their efforts to cut at least 50% of their urban transport related emissions by 2050 compared to business as usual (Mobilise Your City Website, 2018).

The **Transformative Urban Mobility Initiative (TUMI)** was started by the German government and unites institutions on sustainable mobility, city networks and think tanks including the ADB, UN-Habitat, SLoCaT, C40 Cities and GIZ. It aims at modifications in policy making and investment

⁵⁶ It is difficult to cluster the wealth and diversity of institutions relevant for the transport sector into meaningful categories. The proposed categorisation is by no means exclusive nor exhaustive. What is more some of the listed institutions may have a scope that exceeds the narrow focus of one of the proposed categories. Nevertheless, we deem the categorisation helpful and adequate for the analysis.

decisions to reach sustainable urban mobility. Its main activities are offering capacity building for leaders in developing countries and providing technical and financial assistance for innovations. Under the initiative, the German KfW committed to provide USD 1 billion to sustainable transport projects (TUMI website, 2018).

The **Declaration on Climate Leadership** by members of the **International Association of Public Transport (UITP)** includes public transport authorities and operators, policy decision-makers, research institutes and service industries. They pledge “to demonstrate ‘climate leadership’ and make a voluntary commitment to reduce emissions/strengthen climate resilience within their city/region in support of UITP’s goal to achieve a doubling in the market share of public transport worldwide by 2025.” They declared to assist governments by offering technical knowledge and by monitoring and reporting the implementation of SDGs. Activities include capacity building, knowledge development, development of policy-recommendations, monitoring and reporting (SloCaT website, 2018b).

The **Global Fuel Economy Initiative (GFEI)** was founded to assist governments and transport stakeholders to promote greater fuel economy. Using the skills and expertise of the GFEI partners (the IEA, UNEP, the ITF, the International Council on Clean Transportation (ICCT), the Institute for Transportation Studies at UC Davis, and the FIA Foundation), the GFEI Toolkit team work to establish a baseline in each country; present policy options and case studies; and enable all stakeholders to engage in the policy process. The GFEI is actively engaged in processes such as the UNFCCC, G20 and Post 2015 framework – to promote fuel economy as part of energy efficiency, whilst backing-up this advocacy and capacity building with research.

The **Urban Electric Mobility Vehicles Initiative (UEMI)** by UN-Habitat and the EU-funded SOLUTIONS project aims to help phasing out conventionally fuelled vehicles and increase the share of electric vehicles in the total volume of individual motorised transport in cities to at least 30% by 2030. The UEMI is to be implemented in the overall context of better urban planning and a balanced Avoid-Shift-Improve approach in the context of the New Urban Agenda with a particular focus on improving access and mobility. The UEMI is an active partnership that aims to track international action in the area of electric mobility and aims to initiate local action through the provision of tools and guidelines. The current 23 cities engaged in the programme have a combined population of over 46 million people covering key emerging economies.

Other Programmes and Initiatives

There are a large number programmes and initiatives that deal with certain aspects of the decarbonisation of the land transport sector. This section provides a short summary of selected initiatives.

Decarbonising Transport was officially launched at the ITF's 2016 Summit on "Green and Inclusive Transport" in the presence of 47 partners and supporting organisations, on 19 May 2016. The International Transport Forum and the Wuppertal Institute are implementing a project as part of this



partnership to support emerging economies in the development of decarbonisation pathways and policy actions at the local and national level.

The Partnership on Sustainable Low Carbon Transport (SLoCaT) is a partnership of UN organisations, multilateral and bilateral development organisations, NGOs, foundations and partners from the academic and business sectors. Its general goal is to integrate aspects of sustainable transport into global policies. It focuses mainly on the transport sector in developing countries. For the years 2017 and 2018, SLoCaT's workplan concentrates on the processes of the SDGs, the PA and the New Urban Agenda and the areas rural transport, urban transport, transport and climate change and equity (SLoCaT website, 2018a). SLoCaT is also currently developing a Global Status Report, the first version of which is to be published in early 2019.

SLoCaT is also one of the initiators of the **Paris Process on Mobility and Climate (PPMC)**, and the **Transport Decarbonisation Alliance (TDA)**, which aim to bring together actors and countries active in the area of low-carbon transport. Both of these initiatives aim at achieving net-zero emission transport by 2050. While the PPMC focuses on transparency, knowledge and learning, the TDA requires its members to formulate ambitious short (2020), medium (2030-2040) and long term (2050) action plans.

The **Carbon Neutral Cities Alliance** is a collaboration of 20 large international cities that want to achieve long-term carbon reduction goals, inter alia by establishing sustainable modes of transportation as a new standard. Therefore, they defined a number of commitments in the "Framework for Long-Term Deep Carbon Reduction Planning", like providing financial incentives to use carbon-free vehicles and to avoid driving in certain places or investing in alternative transportation modes (Carbon Neutral Cities Alliance, 2018, pp. 92–93).

The **Global Covenant of Mayors for Climate and Energy** represents over 6 800 cities in 57 countries with the common goal to work towards decarbonisation, increased capacity for adaptation and secure, sustainable and affordable energy for the citizens by 2050 (Global Covenant of Mayors website, 2018b). In order to participate, cities have to commit themselves to reduce CO₂ emissions by at least 40% by 2030. (Global Covenant of Mayors website, 2018a) Since transport is one of the key sources of emissions in cities, the Covenant also pledged to support initiatives in the transport and mobility sector. Members also commit to implement strategic action plans. These plans are registered and publicly available and actions are reported regularly in a standardised format (Global Covenant of Mayors website, 2018c).

7.3. Assessing the Governance Complex

This section will discuss to what extent the governance demands are collectively being satisfied by the governance complex as described above.

Generally, the governance complex that is relevant for the decarbonisation of the transport sector is characterised by a large number of institutions which host an even larger number of governance

initiatives. There are however, hardly any institutions that emerge saliently as hubs or core institutions in what appears to be otherwise a relatively fragmented governance landscape.

Another key insight is that the climate governance sub-complex on transport is highly dynamic. A number of in part very promising institutions have only been created very recently and yet have to demonstrate their efficacy in delivering what they have promised in terms of providing the required governance functions.

Guidance and Signal

The transport sector is in high need of increased attention, with limited efforts so far to bend the sector's emissions curve. As evident from national discussions about ending the use of combustion engine vehicles, targets and timetables can be a strong lever to redirect sectoral developments. International agreement on a target to completely end the use of fossil fuels in the transport sector could send a signal to all car manufacturers to focus their production on new technologies. Moreover, as discussed in section [0], a sectoral decarbonisation target can probably only be achieved if road transport volumes are reduced to minimise the need for energy inputs in the first place.

There currently is no multilaterally agreed target to decarbonise the transport sector. While the PA aims at globally peaking GHG emissions as soon as possible and achieving net zero emissions by the second half of the century, this target is not broken down to the individual sectors. The only formal intergovernmental forum of transport ministers is the International Transport Forum (ITF). It aims to establish a commonly acceptable pathway to achieve zero transport emissions by around 2050. The ITF has no global authority as it covers only 59 countries, but these include all the major emitting countries. However, the ITF is mainly a think tank and has no mandate to take binding decisions.

Nonetheless, the message that the sector needs to decarbonise seems to be taking hold, as evidenced by the high number of related initiatives. Two of them explicitly aim at contributing to achieve a net zero transport sector by 2050: the Paris Process on Mobility and Climate, and the Transport Decarbonisation Alliance. In addition, as one piece of decarbonisation, a number of institutions aim at making zero-emission vehicles the new standard, including EV30@30, EV100, the Urban Electric Mobility Initiative (UEMI), and the Zero-Emission Vehicle Alliance.

The SDGs and the New Urban Agenda can be seen as enshrining a new mobility paradigm prioritising public and non-motorised transport. Both have been adopted under the aegis of the UN and thus enjoy global authority. It remains to be seen to what extent the new paradigm will be reflected in actual implementation. What can be said is that a number of institutions work explicitly on promoting implementation of these two Agendas, including the International Association of Public Transport, MobiliseYourCity, Sustainable Mobility for All and TUMI. Again, these initiatives cannot replace, but complement governmental action.

Governance supply with respect to the *guidance and signal* can therefore be rated as **medium**. International governance has adopted a new urban mobility paradigm, and while there is no globally

accepted decarbonisation target for the transport sector, a number of institutions are working towards establishing one.

Setting Rules

Governance challenges in the transport sector are mostly not of a 'collective action' nature. Exemptions are technical standards and possibly regulations such as carbon pricing. The World Forum for Harmonization of Vehicle Regulations under the United Nations Economic Commission for Europe (UNECE) is working on a system of vehicle regulations that deal with technical aspects that affect international trade of vehicles and in that sense also relate to factors such as vehicle efficiency and emissions.

While the PA requires Parties to submit NDCs and invites them to develop long-term climate strategies, there are currently no requirements for Parties to have a sectoral breakdown in their NDCs or long-term climate strategies. Nor are there international commitments towards reforms of national transport infrastructure spending, fuel and vehicle taxation or introduction/harmonisation of fleet emission standards.

There is quite some coordination happening on other policies and regulation, largely driven by individual programmes and initiatives covering specific areas of low-carbon transport, such as promotion of electric vehicles. There is a high number of institutions that collect various forms of commitments from their members. For example, several initiatives aimed at promoting zero-emission vehicles, such as ,EV30@30 or EV100, require their members to aim for certain market shares and/or to put in place enabling measures. Several city networks, such as C40 and the Global Covenant of Mayors, similarly require their members to aim for certain emission reductions, develop climate strategies and/or implement specific measures. However, it is not always easy to judge what is a rule that is actually codified and potentially enforceable by the respective institution, and what remains a vague expression of intent.

In summary, the governance supply in the area of setting rules can therefore be rated as **low**.

Transparency and Accountability

The need for transparency on national emissions, measures taken, and their impacts is currently largely covered by the UNFCCC's rules on national emission inventories, national communications and international expert reviews. It can be expected that the implementation rules currently being negotiated for the PA will further strengthen transparency. Agreement under the PA to require sectorally differentiated NDCs from Parties would similarly have transparency in-built through the PA's transparency framework.

By contrast, Article 13 of the Agreement does not provide for reporting on or review of long-term strategies communicated by Parties. Such a review system therefore still needs to be established.

The Global Stocktake under the PA may play a critical role in ensuring that the latest science and progress in climate action are globally considered every 5 years in order re-emphasise the need for enhanced action. The modalities of the Global Stocktake have yet to be agreed. A focus on the need to bend the curve in transport emissions could be re-enforced by including a sectoral breakdown in the Stocktake. Looking not only at aggregate emissions but also at the sectoral level would put developments in the transport sector on the global agenda in regular five-year intervals.

Outside the UNFCCC, there is a surprisingly strong focus on measuring and reporting developments in the sector. Key institutions include the Sum4All initiative that is developing a global tracking framework, the UN HABITAT Global Urban Observatory (GUO) as well as the global tracking framework that is planned under the PPMC. Due to its relatively recent launch, however, the actual reporting mechanism of the latter has yet to be established. These initiatives may become key contributors to transparency. The SDG process should be mentioned as well, because it includes indicators for targets 9.1 and 11.2 (see above).

There so far are no initiatives to require countries to provide transparency on their transport spending.

In summary, the governance supply in the area of transparency and accountability can therefore be rated as **medium**.

Means of Implementation

With respect to financial resources, the sub-complex for governance in transport is on the one hand well developed. The MDBs and national institutions are directing substantial resources towards the sector. Moreover, all MDBs have criteria and/or principles with respect to sustainable transport.

However, it is worth mentioning that these principles are not always consistent and some doubt remains whether the principles are followed in the lending practice by all actors at all times. The MDBs also still provide substantial support to the utilisation of fossil fuels. According to Oil Change International, the AfDB, the ADB, the European Bank for Reconstruction and Development, the European Investment Bank, the Inter-American Development Bank and the World Bank Group provided more than USD 7 billion in 2015 to fossil fuel projects, accounting for 22% of the MDBs' energy financing, and more than USD 83 billion in the period between 2008 and 2015, accounting for 30% of MDBs' energy financing. (Oil Change International, 2017a) In 2016, the volume was USD 9 billion, 2 billion more than the year before (Oil Change International, 2017b). International funding for alternative transport modes may also indirectly be an incentive for national governments to focus their national budget on road transport extension.

Positively, in 2017 the World Bank announced to stop financing upstream oil and gas projects and also the AfDB reports a trend towards decreasing their fossil fuel financing – according to Oil Change International it decreased from 47% to 12% of energy financing between 2008 and 2015. (World Bank website, 2018c).

Capacity building to establish emission inventories and to plan and executive sustainable transport measures is the subject of many activities but still a challenge. The duration of many projects is too short to build capacity sustainably. Also, in many cases international consultants are employed instead of building local capacity (interview response).

In summary, the governance supply in the area of means of implementation can therefore be rated as **medium**.

Knowledge and Learning

The field of knowledge creation and diffusion is probably the most active of the governance functions among institutions involved in the transport sector. Almost all institutions contribute in one way or another. This includes the UNFCCC with its Technical Examination Processes that regularly focuses on transport, spans to the PPMC that engages in a social media campaign to spread knowledge about “20 quick win actions” and includes the IEA that engages in coordinated research and development activities under its various Technology Collaboration Programmes. Some institutions promote peer learning (e.g. the Transport Decarbonisation Alliance) which can also be considered a form of capacity building. However, as with capacity building, the geographical coverage and sustainability of initiatives has room for improvement (interview response).

In summary, the governance supply in the area of knowledge and learning can therefore be rated as **medium-high**.

7.4. Conclusions and Recommendations

The analysis reveals that while some governance demands identified in section 7.1 are already being delivered by the international system, others are not. While guidance and signals to move towards more sustainable transport are being provided, the rule-setting, transparency and means of implementation functions are not being provided to the extent that would be desirable and necessary for the decarbonisation of transport and mobility. Also, while a high number of knowledge sharing, capacity building and implementation support initiatives have been established, the sustainability of many initiatives depends on project-based funding.

The EU, its member states and other progressive countries may therefore wish to consider to take targeted initiatives to close the governance supply gaps that currently exist in those areas. Given that there is no transport-specific international institution with a mandate to establish legally binding rules, the UNFCCC is probably the best avenue to strengthen the international rule-setting and transparency/accountability functions. The EU could work to establish requirements to have a sectoral breakdown in NDCs and long-term strategies, with transport further broken down into passenger and freight categories. The EU could also work to have a sectoral breakdown included in the Global Stocktake and to strengthen national reporting and international review on national transport emissions as well as on measures taken and their impacts. Furthermore, the EU could make its own provision of means of implementation compatible with the PA and work towards analogous policies within the multilateral financial institutions.

One area where the EU could promote the need for more ambitious action in the transport sector by itself is fleet emission standards. The EU already has established such standards and is currently in the process of revising them. Due to the importance of the EU market, establishment of ambitious standards would help shift global car manufacturing and all producers wanting to sell into the EU would need to comply with these standards. As manufacturers have production sites and significant market shares all over the world, an ambitious EU emission standard could thereby globally foster the production and sale of energy and carbon efficient vehicles.

Currently, however, EU standards are too weak to play this role. In Germany, the national government aims at reducing transport emissions by 44.7 Mt CO₂-eq. by 2030. The new standards proposed by the European Commission in 2017 would contribute only a reduction of about 3.5 Mt CO₂-eq. in Germany, while more ambitious standards would have the potential to contribute up to 20 Mt CO₂-eq. (Agora Verkehrswende, 2018). Given the EU's role as a lead market, it would be highly beneficial not only from an EU perspective but also from an international perspective if the on-going negotiations led to a substantial strengthening of the Commission's proposal.

The difficulty of agreeing on ambitious EU standards suggests that the EU's potential to lead by example and push for strong policies internationally may be limited. Ambitious countries may therefore have to come together independently of the EU. The Transport Decarbonisation Alliance already constitutes such a come-together, and it provides some of the governance demands that have been identified, as do many of the other transport sector initiatives. Most of them provide clear emission targets for the transport sector, and provide knowledge and policy support.

However, the size of each of the initiatives is limited and a more coordinated approach would help boosting the impact across the sector.

The areas that would need strengthened support by all initiatives are transparency and means of implementation. In line with Article 2.1(c) of the PA, countries could commit to provide transparency on their transport spending and to shift resources from unsustainable to sustainable transport investments, nationally and internationally.

Furthermore, countries could push for the adoption of analogous policies in the multilateral financial institutions. In addition, initiatives could add the provision of means of implementation to the scope of their commitments. That is, developed country members could pledge to provide specified amounts of funding to sustainable transport projects in developing country members. As noted above, recipient countries should be required to in parallel shift their own resources from funding unsustainable to sustainable transport infrastructure.

7.5. References

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7.6. Annex: Overview of Governance Demands and Supply (Land Transport sector)

GOVERNANCE DEMANDS		GOVERNANCE FUNCTIONS				
		GUIDANCE AND SIGNAL	SETTING RULES	TRANSPARENCY AND ACCOUNTABILITY	MEANS OF IMPLEMENTATION	KNOWLEDGE AND LEARNING
		High significance	Medium-high significance	Medium-high significance	High significance	Medium-high significance
		<ul style="list-style-type: none"> - Signal that action in the sector is crucial and beneficial, moving away from focus on aggregate emissions - International transport decarbonisation target and roadmap - New mobility paradigm (transit-oriented development & prioritising public and non-motorised transport) 	<ul style="list-style-type: none"> - Require sectoral breakdown in short- and long-term strategies, with transport further broken down to passenger and freight - Long-term strategies to aim to reduce transport emissions to zero by 2050 at the latest - Global introduction and convergence of fleet emission standards - Commitment to environmental fiscal reform - Harmonisation of technical vehicle standards 	<ul style="list-style-type: none"> - Robust sectoral emission inventories - National accounts of measures taken and their impacts - Transparency on public transport spending - Sectoral breakdown in global climate reviews 	<ul style="list-style-type: none"> - Make all finance, technology and capacity building compatible with the PA - Require redirection of domestic resources to qualify for support - Provide resources directly to urban level 	<ul style="list-style-type: none"> - Learning partnerships on technologies and policy design (including policy integration with other sectors such as power and urban settlements)

GOVERNANCE SUPPLY						
UN Institutions						
United Nations Framework Convention on Climate Change (UNFCCC) and Paris Agreement (PA)	International treaties to address climate change.	<p>Focus</p> <p>The PA:</p> <ul style="list-style-type: none"> - aims to hold global temperature increase to well below 2°C and pursue efforts to limit the temperature increase to 1.5oC - aims to reach global peaking of GHG emissions as soon as possible, rapid reductions thereafter, achieve balance between sources and sinks of GHGs by 2nd half of century 	<p>Focus</p> <p>Parties to the PA are required to prepare, communicate and maintain successive and ever-more ambitious NDCs every five years, and pursue domestic mitigation measures with the aim of achieving the objectives of such NDCs</p>	<p>Focus</p> <p>Parties to the UNFCCC and the PA are required to provide regular reports on their actions and GHG emission inventories</p>	<p>Focus</p> <p>Developed country Parties are required to provide means of implementation</p> <p>These are partly provided through the UNFCCC's Green Climate Fund; other funds are subject to UNFCCC guidance but managed by outside institutions</p>	<p>Focus</p> <p>Example: Technical Examination Process (TEP): series of expert meetings to collate and synthesise good practice policies, including for the transport sector</p>

United Nations Human Settlements Programme (UN HABITAT)	<p>The UN agency for human settlements and sustainable urban development. Cities and Climate Change Initiative (CCCI) seeks to enhance the preparedness and mitigation activities of cities in developing countries.</p> <p>Habitat conferences taking place every 20 years, with the most recent one in 2016 adopting the New Urban Agenda</p>	<p><u>Focus</u></p> <p>Goal: promote and implement socially and environmentally sustainable human settlements and adequate shelter for all</p> <p>New Urban Agenda aims to set a shared vision and new global standard for sustainable urban development</p>	<p><u>Focus</u></p> <p>Global Urban Observatory (GUO), specialised statistical unit for global monitoring of the Habitat agenda</p>	<p><u>Focus</u></p> <p>Global Urban Observatory Network (GUO-Net): worldwide information and capacity-building network consisting of national and city-level institutions that function as National and Local Urban Observatories to support the implementation of the New Urban Agenda; knowledge, advocacy and technical assistance to support the development and implementation of sustainable urban mobility plans and investment strategies; strengthen technical capacity of local and national governments</p>	<p><u>Some contribution</u></p> <p>package of knowledge, advocacy, and technical assistance to support national governments and local authorities; consultation processes of stakeholders; provide international expertise and best practices; UrbanLex: global database of policies, laws, decisions and practices relating to urban environment</p>
United Nations Development Programme (UNDP)	<p>Mandate to address issues around poverty, inequalities and exclusion, including sustainable transport. Integrated concepts</p>			<p><u>Focus</u></p> <p>Identify and operationalise financing solutions; capacity</p>	<p><u>Focus</u></p> <p>Offering integrated solutions supporting the uptake of sustainable</p>



	combining renewable energy and energy efficiency measures with aspects of urban design like mobility, transport and waste.		building through transport projects	transport technologies and systems; research and publications
United Nations Environment Programme (UNEP)	UNEP provides four transport relevant initiatives: the E-mobility Programme, the Global Fuel Economy Initiative (GFEI), the Partnership for Clean Fuels and Vehicles (PCFV), and the Share the Road Programme.			<p>Focus</p> <p>network and country contacts to promote electric mobility</p> <p>PCFV unites resources and efforts of 73 organisations from developed and developing countries, the fuel and vehicle industries, civil society, and experts on cleaner fuels and vehicles; supporting the development of electric mobility strategies;</p> <p>Share the Road programme: development of tools, provision of in-country support, advocacy for non-motorised transport</p>



United Nations Economic Commission for Europe (UNECE)	Regional Commission of the United Nations to support economic integration throughout Europe. It offers "policy dialogue, negotiation of international legal instruments, development of regulation and norms, exchange and application of best practices as well as economic and technical expertise, technical cooperation for countries with economies in transition."	<u>Some contribution</u> Amsterdam Declaration includes four priority goals on environment- and health-friendly transport, sustainable mobility, reducing GHG emissions	<u>Some contribution</u> World Forum for Harmonization of Vehicle Regulations (WP 29) provides framework for globally harmonised regulations on vehicles	<u>Some contribution</u> The Transport, Health and Environment Pan-European Programme encourages national and local governments to pursue an integrated approach to policymaking
United Nations Secretary-General Advisory Group on sustainable transport	Mandate to provide recommendations on sustainable transport actionable at global, national, local and sectoral levels.	<u>Focus</u> Outreach/messaging to influential actors		<u>Focus</u> Provision of concrete policy recommendations on sustainable transport
United Nations Sustainable Development Goals (SDGs) process	17 goals adopted by the UN member states at the UN Sustainable Development Summit to address poverty, inequalities and climate change until 2030.	<u>Focus</u> especially Goal 9 and Goal 11 are consistent with governance demands for transport sector	<u>Focus</u> UN- Habitat Guide to assist national and local governments to monitor and report on SDG 11; Global Urban Observatory; global	<u>Some contribution</u> United Nations Conference on Sustainable Development (Rio+20); High Level Advisory Group on Sustainable Transport (HLAG-ST);

		indicator framework			Global sustainable transport outlook report to reflect policy recommendations by HLAG-ST; first international conference on sustainable transport in Nov 2016
Other International Institutions					
Clean Energy Ministerial	High-level global forum of ministers from 24 countries and the European Commission that aim to improve energy efficiency, provide clean energy supply and clean energy access. The CEM supports policies and programs that are relevant in the context of the transition to a global clean energy economy.	<u>Focus</u> Aim to signal importance of clean energy and efficiency; for transport with particular emphasis on electric vehicles	<u>Focus</u> Efforts of EV30@30	<u>Some contribution</u> Efforts of EVI and EV30@30	<u>Some contribution</u> Annual CEMs provide possibility for networking, to share lessons and best practices. Efforts of EVI and EV30@30
Electric Vehicles Initiative (EVI)	Initiative under the CEM with 14 member governments and coordinated by the IEA to accelerate the deployment of electric vehicles.	<u>Some contribution</u> Aim: facilitate the global deployment of 20 million electric vehicles by 2020	<u>Some contribution</u> Support the development of national deployment goals		<u>Focus</u> Share experiences, best practices and policies; information sharing on public investment in research, development

					and demonstration programs; data update as PDF graphic; public workshops; engaging private sector stakeholders
EV30@30	Builds on and extends the EVI. Its redefined goal is to achieve collectively at least 30% new electric vehicle sales by 2030.	<u>Focus</u> Goal: implement electric mobility, meet the global climate goals for 2050; campaign should expand and develop further the EVI	<u>Focus</u> Collecting commitments from governments; 30% sales share of EVs by 2030	<u>Focus</u> Policy and technical assistance; training and capacity building	<u>Focus</u> Facilitate the exchange of experiences and best practices; increase policy research and information exchange
International Energy Agency (IEA)	Intergovernmental organisation established under the framework of the OECD. Its ambition is to provide reliable, affordable and clean energy also beyond the scope of its member countries.				<u>Focus</u> Provision of highly influential energy system scenarios The Mobility Model Partnership (MoMo) provides data on transport modes, fuels and regions and develops projections to 2050 for the transport and energy sector Technology Collaboration

			<p>Programmes (TCPs): Advanced Fuel Cells TCP, Advanced Motor Fuels TCP, Clean and Efficient Combustion TCP, Hybrid and Electric Vehicle TCP</p> <p>Participation in EVI and GFEI</p>
International Renewable Energy Agency (IRENA)	Intergovernmental organisation focusing on the implementation of renewable energy.	<p><u>Some contribution</u></p> <p>Aim to signal the need to shift to renewable energy, including for transport</p>	<p><u>Focus</u></p> <p>Provision of knowledge on electric vehicles and liquid biofuels</p>
International Transport Forum (ITF)	The ITF is a politically autonomous OECD organisation with 59 member countries. It serves as a think tank for transport policy and a platform for global dialogues in the context of transport and organises the Annual Summit of transport ministers	<p><u>Focus</u></p> <p>Decarbonising transport initiative to establish a commonly acceptable pathway to achieve zero transport emissions by around 2050</p>	<p><u>Focus</u></p> <p>annual summit; provision of scenarios (Transport Outlook Project); integrated and sustainable urban transport roundtable to explore viable strategies</p>
Organisation for Economic Cooperation and	International organisation with the mission to promote policies to improve the		<p><u>Focus</u></p> <p>Studies to identify instruments and other</p>

Development (OECD)	economic and social well-being of people around the world.					approaches for reconciling transport and environmental policies; OECD Working Group on Transport; OECD database on environmental policy instruments
World Bank Group	Largest multilateral development bank to reduce poverty and support growth and development in developing countries. The World Bank initiated the Leaders in Urban Transport Planning Programme (LUTP) and the Sustainable Mobility for All initiative (Sum4All).	<u>Focus</u> two overarching goals: end extreme poverty and promote shared prosperity by 2030; extend mobility to improve access to economic and social opportunities; act on climate change according to the PA; after 2019 no financing of upstream oil and gas	<u>Focus</u> SuM4All	<u>Focus</u> 493 active World Bank projects with total net commitments of USD57.7 billion, representing nearly 20% of the total lending portfolio (end of the fiscal year 2016)	<u>Focus</u> LUTP; SuM4All	
Other Multilateral Development Banks		<u>Focus</u> Commitments to sustainable transport		<u>Focus</u> Financing transportation and infrastructure projects; training of staff and clients	<u>Focus</u> international seminars, workshops, studies	

GOVERNANCE FUNCTIONS						
		GUIDANCE AND SIGNAL	SETTING RULES	TRANSPARENCY AND ACCOUNTABILITY	MEANS OF IMPLEMENTATION	KNOWLEDGE AND LEARNING
Transnational Institutions						
C40	Network of megacities taking action to reduce greenhouse gas emissions. It is committed to implementing meaningful and sustainable climate-related actions locally that will help address climate change globally. Their global field staff works with city governments, supported by technical experts across a range of program areas, facilitating active exchange and collaboration across cities.	<u>Focus</u> Aim to signal that city-level action on transport is important	<u>Focus</u> E.g. Clean Bus Declaration to have over 40, 000 buses with clean technologies by 2020; Bus Rapid Transit (BRT) Network to introduce, improve and transform BRT systems; Low Emission Vehicle (LEV) Network to increase incentives for LEV	<u>Some contribution</u> The Bus Rapid Transit (BRT) Network with the focus area “Benchmarking and measuring”	<u>Some contribution</u> The Bus Rapid Transit (BRT) Network with the focus area “Financing mechanisms and business models”	<u>Focus</u> The BRT Network with the focus area “Communications”; The LEV Network with the focus area “Citywide LEV strategy”; sharing of best practices and policies relating to the focus areas
EV100	Initiative by the Climate Group gathering 16 companies from around the world to work to establish	<u>Focus</u> Goal: make electric transport the new	<u>Focus</u> Member companies need to make a public	<u>Some contribution</u> Annual reporting cycle to monitor members’		<u>Indirect contribution</u> Sharing of best practices; engagement and

	electric vehicles as a standard by 2030.	standard by 2030	commitment to at least one of three defined 2030 targets: Integrate electric vehicles into directly owned or leased corporate fleets; Establish requirements in service contracts for electric vehicle usage; Support staff and customers to use electric vehicles by installing charging infrastructure at all premises	progress	dialogue between governments and other stakeholders
Global Covenant of Mayors for Climate and Energy	The Covenant of Mayors represents 6,800 cities in 57 countries committing to climate action	<u>Some contribution</u> vision for 2050: accelerating decarbonisation, strengthening capacity for adaptation, provision of secure, sustainable and affordable energy for citizens; transport/ mobility as one initiative	<u>Focus</u> reduce CO2 emission by at least 40% by 2030; adopt an integrated approach to tackling mitigation and adaptation to climate change; implementation of strategic action plans	<u>Focus</u> action plans are registered and publicly available; actions are reported regularly and standardised relating to NDCs, the PA and current and future impacts	<u>Some Contribution:</u> Founders Council with subsidiary technical working groups
Global Fuel Economy Initiative	Partnership of the International Energy Agency (IEA), the United Nations Environment Programme	<u>Some contribution</u> goal: stabilisation of greenhouse gas		<u>Some contribution</u> Collection of data on vehicle efficiency to	<u>Focus</u> in-country capacity <u>Focus</u> data and research

	(UNEP), the International Transport Forum (ITF), the International Council on Clean Transportation (ICCT), the Institute for Transportation Studies at the University of California-Davis, and the FIA Foundation. It aims at improvements in fuel economy and the maximum deployment of vehicle efficiency technologies. GFEI provides analysis, advocacy, policy support and tools.	emissions from the global light duty vehicle fleet through a 50% (from today's level) improvement of vehicle fuel efficiency worldwide by 2050 (30% improvement of new car fuel economy by 2020 and 50% by 2030)	measure progress; track and report on efficiency trends and the uptake of technologies	building	analysis	
ICLEI - Local Governments for Sustainability	Network of over 1,500 cities, towns and metropolises in 86 countries committed to building a sustainable future.	<u>Some contribution</u> EcoMobile City (Sustainable Urban Mobility) Agenda as one of ten Urban Agendas, establishing principles to achieve reductions in greenhouse gas emissions and energy consumption	<u>Some contribution</u> EcoMobility Alliance: cities to implement urban mobility strategies	<u>Some contribution</u> support local and subnational governments to access finance and to implement local financing mechanisms	<u>Focus</u> advocacy activities; provision of newsletters, regional updates on activities, case studies, training guides and fact sheets	
International Association of	Worldwide network of public transport stakeholders Especially its	<u>Focus</u> Aim: global promotion of public transport,	<u>Some contribution</u> Commitment by members to support	<u>Some contribution</u> tools and material to support UITP members	<u>Some contribution</u> Training programmes	<u>Focus</u> global centre of knowledge and know-



Public Transport	Declaration on Climate Leadership contributes to global climate governance.	doubling market share of public transport worldwide by 2025	governments at all levels by providing them with technical knowledge and delivering action on the ground; support monitoring and reporting of SDG implementation	to report on SDG11.2 implementation at the company, national and sector level	how on public transport solutions Advise to policy-makers
Low Carbon Technology Partnership initiative (LCPTi)	The Low Carbon Technology Partnerships initiative (LCTPi) is comprised of over 160 companies and 70 partners who are committed to accelerating the transition to a low-carbon economy. Led by the World Business Council for Sustainable Development (WBCSD) and supported by We Mean Business partners, LCTPi offers a collaborative platform for businesses and policymakers to scale up deployment of business solutions to a level and speed that are consistent with limiting global warming to below 2°C.	<u>Focus</u> Aim to highlight need for low-carbon technologies			<u>Focus</u> Low Carbon Freight: principles and demonstration projects, identifying new solutions Low Carbon Transport Fuels: demonstration projects of companies across the technology spectrum and value chains

MobiliseYourCity	Partnership created by the governments of France and Germany and supported by the European Commission to support 20 developing country governments and 100 cities in addressing transport related challenges. Its goal is to decrease transport related GHG emissions in member cities by at least 50% by 2050. MobiliseYourCity acts on the New Urban Agenda and UN's 2030 Agenda (especially SDG 11).	<u>Some contribution</u> Goal: reduce global urban passenger transport CO2 emissions by almost 40% by 2050; development and implementation of transport policies consistent with the Avoid-Shift-Improve approach	<u>Some contribution</u> at least 100 cities should commit to implement a Sustainable Urban Mobility Plan by 2020; reduce transport related GHG emissions by at least 50% by 2050 within these cities; at least 20 developing or emerging countries should commit to implement a National Urban Mobility Policy (NUMP); implementation of low carbon transport policies to: reduce the amount of urban trips with conventionally fuelled transport, promote a modal shift and structural change in vehicle use, improve vehicle energy efficiency; members have to sign the MobiliseYourCity Charter	<u>Focus</u> methodological framework, capacity building, technical assistance, access to financing	<u>Focus</u> international reference platform
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Paris Process on Mobility and Climate (PPMC)	Platform with currently 150 members, including multi- and bilateral development organisations, financing institutions, civil society and foundations, academia and the business sector) that aims to unite all organisations and initiatives acting on transport and climate change.	<p><u>Focus</u></p> <p>Aim to emphasise the importance of sustainable transport in the context of the UNFCCC.</p> <p>Aim to contribute to systematic transformation of world transport over the next 40 years to achieve a net-zero-emission economy</p> <p>Proposed Global Macro Roadmap and Common Framework on Transport, Sustainable Development and Climate Change</p>	<p><u>Some contribution</u></p> <p>plans to introduce a global tracking framework with country-level indicators for mobility access, efficiency, safety, climate responsiveness and air quality</p>	<p><u>Focus</u></p> <p>social media campaign: WeAreTransport with key messages; 20 proposed quick win actions</p>
Partnership on Sustainable Low Carbon Transport (SLoCaT)	Multi-stakeholder partnership of over 80 organisations (including UN organizations, Multilateral and Bilateral development organisations, NGOs and Foundations, Academia and the Business Sector).	<p><u>Focus</u></p> <p>Goal: integration of sustainable transport in global policies</p> <p>2030 vision of the Sustainable Transport Community proposes targets on access, air</p>		<p><u>Focus</u></p> <p>improves the knowledge on sustainable low carbon transport, helps develop better policies and catalyse their implementation</p>

		pollution and GHGs (peak by 2020, then decline of 2% p.a.)			
Sustainable Mobility for All (Sum4All)	Global initiative by the World Bank and 40 partners (multilateral development banks; UN Agencies, Programs, and Regional Commissions; bilateral donor organisations; NGOs; global civil society organisations; academic institutions) to implement transport-related SDGs and foster innovation.	<u>Focus</u> Goal: transform the transport sector by making mobility equitable, efficient, safe and clean; roadmap of actions for the international community; closely linked to Sustainable Development Goals	<u>Some contribution</u> SuM4All Charter	<u>Focus</u> Global Tracking Framework to monitor global progress towards the goals of SuM4All and to track process on transport-related SDGs	<u>Focus</u> development of a global roadmap of actions; provision of country specific data
Transformative Urban Mobility Initiative (TUMI)	Initiative started by German government including ADB, CAF, UN-Habitat, SLoCaT, ICLEI, C40 and others.	<u>Some contribution</u> Goal: transition towards sustainable urban mobility and therefore a shift in policy making and investment decisions		<u>Limited contribution</u> Project-level monitoring; impact will be monitored and reported regularly	<u>Focus</u> Aim to enable 1 000 urban change makers to plan and implement modern mobility concepts, support innovative pilot activities in cities across the globe; measures to fulfil the Avoid-Shift-Improve approach KfW commitment to mobilise one billion USD to build and modernise
					<u>Some contribution</u> Webinars, e-Learning courses, workshops and conferences

		sustainable urban mobility infrastructure				
Transport Decarbonisation Alliance (TDA)	Multi-stakeholder alliance of countries, cities, regions, and private sector companies initiated by the PPMC, the Netherlands, Costa Rica, Portugal, France, Michelin, Alstom and Itaipu Binacional. Its overarching goal is the achievement of a net-zero emission transport sector by 2050+.	<u>Focus</u> Goal: transition to a net-zero emission sector by 2050+	<u>Focus</u> members have to formulate ambitious short (2020), medium (2030-2040) and long term (2050) action plans or be in the process or committing to do so			<u>Focus</u> support countries, cities and companies in their peer group communities; encouraging more coordinated action forum to exchange good practices and common challenges
Urban Electric Mobility Initiative (UEMI)	UEMI has more than 20 partners including UN-Habitat, the IEA, ICLEI, development agencies, research institutes and NGOs	<u>Focus</u> Goal: Contribute to phase out of conventional vehicles, to be replaced by at least 30% electric vehicles by 2030; to widen the concept of urban sustainability; and a 30% GHG emissions reduction in urban areas by 2030	<u>Focus</u> gather commitments from local and national governments as well as businesses on e-mobility targets; Commitments to strive towards 30% GHG reduction in urban areas by 2030 and towards the implementation of at least 30% electric vehicles by 2030	<u>Some contribution</u> aims to track international action	<u>Some contribution</u> provision of tools and guidelines to implement local action	<u>Focus</u> open forum for knowledge transfer and support; initiate a process of dialogue



Zero-Emission Vehicle Alliance	Collaboration of Germany, the Netherlands, the UK and 11 US states and Canadian province that aim at the introduction of zero-emissions vehicles to reach their climate change commitments	<p><u>Focus</u></p> <p>Goal to achieve 100% ZEV passenger vehicle sales in their jurisdictions by 2050</p>	<p><u>Focus</u></p> <p>commitments to provide purchase incentives, plan for and invest in growing ZEV infrastructure, perform public outreach, implement policies that require the deployment of ZEVs, lead by example through, perform and commission research and development</p>
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8. International Transport

Tim Rayner⁵⁷

8.1. Transformation Challenges and Governance Demands

8.1.1. Current Status and Prospect

Global aviation (domestic and international combined) currently produces around 2% of global CO₂ emissions; global shipping about 3% (Gençsü and Hino 2015).⁵⁸ In combination, however, the international shipping and aviation sectors constitute a significantly growing share of global emissions; growing by around 80% in terms of carbon emitted between 1990 and 2010, while growth of other sectors in the world economy was approximately 40% (CDIAC 2013a; 2013b; UNFCCC 2013, cited in Bows-Larkin 2015). In part this was driven by rapid growth in emerging economies, but also arose as a consequence of the lack of coverage of these sectors in the national mitigation policies of UNFCCC Annex I nations (Bows-Larkin 2015). High growth is likely to continue. Shipping's CO₂ emissions have been forecast to rise by 50-250% by 2050 without additional policies (IMO 2014). For aviation, a range of scenarios is possible in which CO₂ emissions rise by up to 515% between 2000 and 2050 (Gudmundsson and Anger 2012), although more typical figures are around 220% (Bows-Larkin 2015). Strong growth of air travel in Latin America and Asia in particular means that emissions from developing countries are likely to account for more than half of global aviation emissions by 2020.

The implications for the global temperature targets are serious: a 50% chance of avoiding 2°C entails a reduction of 71–76% by 2050 for aviation, calculates Bows-Larkin (2015). Using the principles of fair share and taking into account efforts of comparable sectors, Paris temperature goal compliance by international shipping arguably requires 70-100% absolute emissions reduction by 2050, or 90-100% carbon intensity per tonne-km, both compared to 2008 levels (T&E 2018). For international shipping, this must be complemented with a peaking of absolute annual emissions at or below 2008 levels in the immediate future (ibid).⁵⁹ Under current policy and projections, assuming that total

⁵⁷ The author gratefully acknowledges the time given through interviews by Tristan Smith (UCL), Faig Abbasov (T&E) and Alejandro Piera. Any factual errors are the author's own responsibility.

⁵⁸ However, aviation's non-CO₂ emissions at high altitudes intensify the impact of aviation emissions on global warming, making them much greater than that of CO₂ alone. Black carbon emissions, inter alia, from ships are also rising (Azarra *et al.* 2015).

⁵⁹ Working out the details of a fair contribution from the sectors is complex. Further work is needed to clarify an appropriate contribution from the sectors based on their unique, comparative circumstances, the likelihood and timing of technological breakthroughs, etc. However, debates over what would constitute fair contribution need not delay action, as the basic message from the Paris Agreement is that all sectors must decarbonise as rapidly as possible, and make all reasonable efforts to achieve full decarbonisation.

emissions fall sufficiently to hold warming at 2°C, the international transport sectors combined could contribute nearly 40% of total CO₂ output by 2050 (Cames *et al.* 2015). Governance efforts to contain or reverse these trends face the difficulty of allocating responsibility for international emissions, which make up the majority of emissions, but which are not covered by domestic policies.

The structure of the aviation industry – featuring two dominant manufacturers and a few key airlines – is somewhat conducive to decarbonisation efforts (Bows-Larkin 2015). In the case of shipping, a complicated industry structure - many ship builders, owners, operators, shippers, charterers and end-users – makes steps to encourage decarbonisation more problematic (*ibid*). Trade flows and globalisation represent important exogenous trends driving sectoral developments. Total international seaborne cargo, for example, has risen from 2.6bn. tonnes in 1970 to 9.5bn. tonnes in 2013 (Gençsü and Hino 2015). Many stakeholders suggest that because the maritime industry serves demands originating in other sectors, management of the demand for shipping should not be attempted directly. Following Bows-Larkin (2015), in the discussion below we distinguish technological aspects from practice/operational and demand-side aspects.

In aviation, concern over energy costs has driven development and relatively widespread deployment of better technology in the form of efficient gas turbine engines. Opportunities for ongoing improvements are, however, in decline. The industry's own targets (see below) suggest that technological developments overall offer a 1–2% annual improvement in fuel efficiency. In terms of practices/ operations', unlike shipping aviation continues to be largely oriented towards leisure passengers. Industry pressure to expand airport capacity has met with success. While increases in airport capacity (and improved air traffic control) can reduce fuel consumed per passenger-km, they carry the risk of rebound effects, maintaining or raising growth rates, increasing absolute energy consumption (Bows-Larkin 2015).

Relatively high engine efficiency makes shipping a relatively low-carbon freight mover. Nevertheless, a wide range of incremental technologies, many of which could be retrofitted, are yet to be widely exploited (IRENA 2015). Efficiency can be disaggregated into technical design and operational aspects; even ships with similar design efficiencies can have vastly different operational efficiencies (Gençsü and Hino 2015). Speed is a critical factor: a 10% reduction corresponds to a 27% drop in fuel use per unit of time (*ibid*).⁶⁰

⁶⁰ 'Slow steaming' practices, widely adopted during the 2007–2012 recession, reduced daily fuel use by an average of 27%, but by over 70% in some ship size categories (IMO 2014).

8.1.2. What Needs to Change to Phase-Out Greenhouse Gas Emissions?

For both aviation and shipping, a balance needs to be struck between ‘in-sector’ action, by which decarbonisation is treated as an exclusive responsibility for the sectors in question, and ‘out-of-sector’ collaboration with others towards a global GHG reduction goal (Chircop *et al.* 2018), e.g. through off-setting schemes. This may be justifiable where short-term reduction opportunities are scarce.

Overall, progress in both sectors has been slow. The International Energy Agency’s assessment of progress towards interim 2°C scenario targets in 2025 warns that international shipping is ‘off-track’ while aviation shows some improvement but more effort is needed (IEA 2017). Although lower carbon alternatives certainly exist, phasing out GHG emissions entirely in these sectors is a distant prospect. Mitigation potentials vary significantly: while shipping has many technological and operational options that could be effective in the short to medium term, aviation does not. In this section, we again distinguish technological measures from those based on operations and demand management. We begin with shipping.

Meeting the IEA’s 2°C scenario requires, initially, that the global shipping fleet improve fuel efficiency per vehicle-km at an annual rate of 2.3% between 2015 and 2025 (IEA 2017). Improvements to efficiency in existing and new ships are possible through a wide range of incremental technologies. It is estimated that ships’ energy consumption and CO₂ emissions could be reduced by up to 75% by implementing existing technologies and applying available operational measures, almost completely decarbonising maritime shipping by 2035 (International Transport Forum 2018). Currently available efficiency technologies could roughly halve the average fuel consumption per vehicle kilometre of new ships (IEA estimate based on Smith *et al.*, 2016). This will need to be complemented by the use of advanced biofuels (IEA 2017). In addition, pioneering wind power technologies - include Flettner rotors, kites, and rigid sails - could offer fuel savings of up to 50% (IRENA 2015).

In terms of alternative fuels, liquefied natural gas (LNG) cuts the emissions intensity of operations in the short term, and is favoured by the sector as a transitional fuel; a suitable bunkering network is rapidly evolving on established routes. However, a fleet-wide switch to LNG would not deliver sufficient decarbonisation, and risk further carbon lock-in. Biofuels are currently the most viable alternative for replacing, or blending with, fossil fuels. Although experience with their use and the scale of their application in the shipping sector is still minimal, recent technology learning regarding second and third generation biofuels give them the highest long-term penetration potential (IRENA 2015).

Various concepts and prototypes exist for electric and hydrogen fuel cell-powered vessels. However, emission savings depend on the primary source of energy being used. Potential for solar-power has also been noted (IRENA 2015), as well as for alternative fuels such as hydrogen and ammonia. Development of hydrogen fuel cell technology has made significant advances, although sustainability of production is critical (IRENA 2015). At least in principle (real world feasibility being another matter!), nuclear power could have a significant decarbonising effect (Walsh *et al.* 2017;

International Transport Forum 2018), benefiting from development of modular reactors in the power sector.

Successful marine mitigation, requires consideration of the interdependencies between ship speed, level and pattern of demand for services, and the extent and rate of innovation in propulsion technology. Given relatively slow rates of technological innovation. 'it is difficult to foresee how deep decarbonisation can be achieved without an immediate, fleet-wide speed reduction; and a land-based energy-system transition strongly influences shipping demand, which in turn, influences the extent of required low-carbon propulsion technology change' (Walsh *et al.* 2017: 32). Reducing power requirements improves the proportion that could be provided by renewable technologies (IMO 2014, Psaraftis & Kontovas 2013).

The scale of the technological challenge for aviation is much greater. Here, emission cuts cannot be made by reducing speed or introducing renewable energy sources, but require a fundamental shift in design, e.g. open-rotor engines or prop-fans, which could cut fuel intensity by up to a 50% (Akerman 2005), but which are currently held back by high noise and vibration levels. New construction materials can also deliver better fuel efficiency, but real benefits only materialise as the fleet renews. Although biofuels are regularly touted, and initiatives and research partnerships are under way to scale up renewable jet fuel and reduce costs (Gençsü and Hino 2015) they fail to address the impact of contrails on cloud formation and aerosol deposition (Smith 2015), and provoke aforementioned sustainability concerns. Less controversially, wider efficiency improvements are possible and cost-effective.⁶¹ Recent initiatives have raised the prospect of hybrid-electric flight, at least over short distances.⁶²

Arguably, the sector repeatedly succumbs to technology 'myths', which 'must be recognised, confronted and overcome as a critical step ... to sustainable aviation climate policy' (Peeters *et al.* 2015: 40). Bows-Larkin (2015) suggests that for aviation to contribute fairly to delivering a 2°C target, annual demand growth must reach zero by 2025 at the latest, and decrease by 4-6% p.a. thereafter. Given its controversial nature, demand reduction is regularly overlooked as a policy option. Although investments in high-speed rail may serve to reduce demand for air travel, its role is limited in that around 80% of all aviation emissions are from flights over 1,500 km (ATAG 2014). Technological innovations, such as video-conferencing, can also serve to manage demand in some circumstances, saving time and money for businesses and individuals.

To summarise, '[o]nly electrical propulsion, demand reduction ... or offsetting remaining emissions will enable full decarbonisation of the aviation sector' (Cates *et al.* 2015: 41). Biofuels could also contribute, if sensitively handled.

⁶¹ The fuel efficiency of the least and most efficient US airlines differed by 27% in 2013 (Gençsü and Hino 2015).

⁶² Airbus, Siemens and Rolls Royce are partnering to develop a prototype hybrid electric plane, where at least one of the aircraft's four gas turbine engines is replaced with a two megawatt electric motor. The aim is to have a demonstration model running by 2020 (Cuff 2017).

8.1.3. Main Challenges and Barriers toward Decarbonisation

With shipping, a complex set of barriers to the adoption of lower carbon energy (including improved efficiency measures) can be categorised in terms of organisational/structural, behavioural, market and non-market factors (IRENA 2015). This complexity, in part, reflects the unique and international nature of the shipping industry, with underlying constraints and factors beyond the ability of individual states to modify (ibid). Historically, most ship building has occurred in jurisdictions without climate targets, with many diverse manufacturers, as well as charterers, owners, operators, and other global stakeholders (Bows-Larkin 2015).

With regard to organisational, structural and behavioural barriers, limited R&D financing, particularly for initial proof-of-concept technologies, is a major factor, together with ship owners' concerns over the risk of hidden and additional costs, as well as opportunity costs of renewable energy solutions. Historically, a lack of reliable information on costs and potential savings of specific operational measures or renewable energy solutions has been noted (Gençsü and Hino 2015; IRENA 2015). The fundamental market failure is one of split ('landlord-tenant') incentives between ship owners and hirers, limiting the motivation of owners to invest in solutions since benefits may not accrue to the investing party. Investors tend to be risk averse. Significant levels of fleet turnover/ retrofitting must be achieved, the maintenance of which across extended periods has historically proved difficult (Walsh *et al.* 2017). The capital-intensive nature of maritime retrofit technologies poses a significant barrier. Ship financing is a concentrated industry, with the top 40 banks holding more than 90% of the world's \$500 billion in shipping debt. Many of these are reducing their shipping commitments, leaving shipping companies with restricted access to capital and credit (Stulgis *et al.* 2014). Sufficiently rapid fleet-wide retrofit arguably also requires adequate global dry-docking services and opportunities for demonstrating new technologies (Walsh *et al.* 2017: 39). Moreover, widespread uptake requires extensive knowledge exchange to ensure correct operation. North-South technical co-operation and transfer of technology may be necessary. Early-adopters would need to be strongly incentivised (ibid). Furthermore, the shipping sector's low public profile results in less societal pressure to change.

In terms of specific technologies, the high potential of advanced biofuels to transform the shipping sector ultimately depends on a number of factors, including the global availability of sustainable feedstock. Lack of cost-effective and reliable low-pressure storage options for hydrogen fuel cells remain critical issues (IRENA 2015). In terms of slow steaming, compensation in the form of increased ship size or numbers to maintain freight flows might be required to ensure acceptability to the industry. Global supply chains must be capable of accommodating speed reductions over all journey legs (Walsh *et al.* 2017), which might require restructuring of some industries.

The simpler industry structure of aviation, compared to shipping, means that other things being equal, incentivising change should be relatively practical (Bows-Larkin 2015). However, significant commercial, technological and cultural barriers exist here too. For example, current prices of biofuels are around three times higher than conventional jet fuel. Although the industry favours off-setting measures, uncertainty exists over long-term availability and cost of credits (Gençsü and Hino 2015). Flying is higher in public consciousness than the shipping of goods - making demand

management a sensitive issue. A perceived ‘right to fly’ apparently extends even to those with otherwise pro-environmental behaviours (Alcock *et al.* 2017).

For both international shipping and aviation, the power of incumbent actors in the political institutions involved in sectoral governance (see below, and chapter 10) is a further important challenge to decarbonisation. Shipping industry groups have embraced the ‘fair share’ concept for emissions reduction (Darby 2016), but insist that any outcome must not inhibit development. Refusal of large developing countries to accept reduction targets (at least until 2014), in particular China, Brazil and India, has also impeded progress. Overall, the aviation industry may be regarded as trying to drive some relatively limited kinds of change – such as off-setting – in order to head-off more fundamental change that would be more detrimental to its interests (Gonçalves 2017).

Another barrier affecting decarbonisation efforts in both sectors is the major perverse subsidy at the international level constituted by the absence of taxation of aviation and shipping fuels (the reasons for which are explored below), lowering the incentive for reducing fuel use. In the shipping sector, although marine fuel represents 50% or more of a ship’s operating cost, the fact that it is untaxed is one factor behind the lack of progress in shipping efficiency, particularly design efficiency (Gençsü and Hino 2015). In discussions of measures to internalise carbon externalities for both aviation and shipping, such as carbon taxation, compensating developing countries for the economic harm they might suffer – ensuring that they bear ‘no net incidence’ – is widely recognised as critical to their acceptability (IMF 2011).

8.1.4. The Promise and Potential of International Cooperation

Since the vast majority of aviation and shipping activity takes place across national borders, international harmonisation of policy responses is essential to effective governance. Imposition of stricter requirements, for example, on ships registered in one jurisdiction may simply prompt owners to re-register elsewhere, harming one state’s competitive position to little environmental benefit. Meanwhile, the transaction costs of national regulatory variation can be high for shipping companies. Given its complexity, directly influencing change in the international shipping sector is arguably most effectively encouraged by combining global-led policies with measures implemented at the port-state level (Bows-Larkin 2015; cf. IEA 2017).⁶³ Strong global competition also makes international cooperation essential for raising mitigation ambition in the aviation case (Gençsü and Hino 2015: 3). In the following, the importance of each of the governance functions identified in the previous work package deliverable (Oberthür *et al.* 2017) is identified (the results summarised in Table 8.1 below).

⁶³ *Port State* is the country where a vessel enters, with whose laws it must comply when in Port.

Guidance and Signal

Given the projections for emissions growth, and the trends towards international aviation and shipping taking up more and more of the available carbon budget, there is a significant need to signal more strongly what level of emissions constitutes the sectoral 'fair share(s)'.

Setting Rules to Facilitate Collective Action

There is also significant need for regulation (standards, rules) at international level to incentivise and facilitate global-scale action. In both shipping and aviation, emission limits could be implemented globally by market-based instruments such as taxation and emissions trading, or more direct technological regulation – or some combination. International agreement to tax aviation and shipping fuel (with revenues potentially recycled into low-carbon R&D) could facilitate collective action. In principle it is also possible for states to remove tax exemption from bilateral air service agreements. The emergence of new technologies will likely require adequate standards (agreed upon by global institutions and ship classification companies). In shipping, requiring verified vessel efficiency ratings, taking into account the effect of new technologies, may incentivise the installation of such technologies through enhancing the resale value of a vessel. In both aviation and shipping, ensuring that offset schemes and/or the production of alternative fuels adhere to high quality and sustainability standards is critical to avoid side-effects.

Addressing distributional equity (esp. North-South) is also necessary to ensure meaningful international agreements can be reached, and may be promoted by phasing in measures over time for certain actors, or by finance and technology transfer (see also 'means of implementation' below). Rules related to operational measures e.g. slow steaming may also need compensatory measures of some kind.

Rules relating to demand management in the aviation sector, though highly controversial, could in principle include moratoriums on airport expansion, additional price mechanisms to curb growth, even the implementation of an individual carbon quota scheme that includes flights. However, states would probably also need to accept responsibility for a portion of international aviation emissions for such policies to be enacted (Bows-Larkin 2015).

Transparency and Accountability

To the extent that international regulation is introduced, implementation would require appropriate transparency (monitoring and verification) and accountability (enforcement). International, industry-wide efforts are needed to improve transparency and strengthen incentives, including on use of alternative fuels and to account for changes in life-cycle GHG emissions, in order to assess progress toward achieving global goals. A degree of transparency is also required before rules can be set, in order to be able to set meaningful policy targets.

Means of Implementation (Capacity Building, Technology and Finance)

As noted above, in the shipping sector a mixture of action at global and port-state level has been recommended to implement change. Ports should provide, *inter-alia*, shore-based power facilities, electric charging systems and bunkering facilities for alternative fuels. Decarbonisation through either retrofitting or new construction requires capital that ship-owners often will not invest. While increased uptake of new technologies can bring capital costs down, the technical risk perceived with currently immature technologies can further drive up the capital cost. Both state and private sector actions can be effective in addressing these significant barriers, incentivising innovative solutions and combating the ‘landlord-tenant’ problem. The ‘savings as a service’ model in which technology is rented and paid for entirely out of fuel savings, avoiding up-front costs, offers particular potential (International Transport Forum 2018: 37). In addition, the needs of developing countries (especially SIDS and LDCs) for access to financial resources and technology have been acknowledged in debates at the International Maritime Organisation (Chircop *et al.* 2018). A global carbon pricing mechanism could raise a substantial amount, part of which could be earmarked to stimulate further decarbonisation of the sector, including via research and development (International Transport Forum 2018 – see also ‘knowledge and learning’, below).

Concerning aviation, the policy, technological, and supply-chain support for bio-jet fuel development effort has been compared to what was required in the U.S. and Brazil to establish conventional biofuels such as bioethanol and biodiesel for road transportation (IRENA 2017). Industry has called for global subsidies as well existing state biofuel subsidies to be extended to aviation. There is also a significant need to support developing countries (where aviation growth is highest) in implementing initiatives to reduce emissions from the sector, potentially enabling more effective participation, for example, in market-based mechanisms.

Knowledge and Learning

In the shipping case, governance needs are in large part related to highlighting the *current availability of already effective* technology, and financing its deployment. Given the market failures noted above, particularly in shipping, significant international level measures are needed to overcome lack of reliable information on costs, correct operation and potential savings of specific operational measures or renewable energy solutions. The IEA has highlighted how for shipping, demonstrating zero emission technologies and use of low carbon fuels are key RD&D challenges, the latter of particularly critical importance to delivery of 2°C scenarios (IEA 2017: 91). A short-term priority is to ‘transform the experience with the use of low carbon fuels, develop technical specifications of low carbon fuels’ (ibid).

(Joint) R&D for low-carbon aviation technologies, involving airlines, governments and other stakeholders has been recommended, particularly for new aircraft design and sustainable biofuels. Internationally coordinated public sector involvement is necessary due to industry concerns over commercial confidentiality (Piera, interview). The IEA (2017) suggests that for aviation, developing energy efficient technologies and demonstrating commercial feasibility of innovative aircraft configurations are critical. In shipping, neither firms nor national governments (for the most part)

have a track record of financing R&D (Smith, interview), suggesting the need for international governance to prompt this. For both shipping and aviation, increased production of advanced biofuels from sustainable waste and residue feedstocks is a key RD&D challenge identified by the IEA.

A further element of knowledge and learning that should not be neglected is the need to sensitise developing/ emerging economies to the significance of climate change and potential co-benefits from developing mitigation policies. Global institutions, including those involving NGOs, have an important role here (Piera, interview).

8.1.5. Interlinkages with Other Sectoral Systems

Decarbonisation of international shipping can be greatly facilitated by wider decarbonisation efforts. For a country such as the UK (in 2010), up to 50% of tonnage imported may be fossil fuels. Reductions of fossil fuel consumption and the growth in biomass/biofuels could therefore have a significant impact on overall shipping demand (Mander *et al.* 2012, Bows-Larkin 2015). Wider decarbonisation of the electricity sector is also necessary if alternative fuels are to be manufactured in a sustainable way.

Inter-linkages are also evident in terms of the potential effects of slow steaming. While compensation in the form of increased ship size or numbers to maintain freight flows might help ensure acceptability to the industry, the effects on global supply chains might require restructuring of some industries. 'By 2050, an adequately decarbonised shipping sector will look very different to the present system and if achieved, it will be within the context of wider energy system decarbonisation across the globe' (Walsh *et al.* 2017).

Regarding aviation, long-term availability and cost of offset credits depends on linkages with carbon markets associated with other economic sectors. Scarcity issues also arise for both aviation and shipping in terms of the need to compete for supplies of biofuel with alternative uses (Gençsü and Hino 2015).



Table 8.1: Type and strength of international sectoral governance demands and potential contribution of international institutions

	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of implementation	Knowledge and Learning
Importance	High	High	High	Medium (aviation) High (shipping)	Medium (aviation) Medium-high (shipping)
Potential contribution	<ul style="list-style-type: none"> • Global limits and phase-out of (net) emissions 	<ul style="list-style-type: none"> • Global limits on emissions • Internalisation of externalities in fuel prices /carbon pricing/ trading • Operational prescriptions (e.g. speed limits) • Technological prescriptions/ standards (e.g. for new fuel types). • Phase-in periods for developing countries/ compensation for cost-raising measures. 	<ul style="list-style-type: none"> • To ensure effective implementation of international rules 	<ul style="list-style-type: none"> • Access to capital/finance, e.g. to implement retrofits (shipping) • Technical cooperation/ technology transfer (shipping) • Incentivising of early technology adoption • Institutional capacity building 	<ul style="list-style-type: none"> • (Joint) R&D for low-carbon technologies/ fuels. • Improved information on costs/ savings/ correct operation of new technologies and operational measures (shipping). • Sensitising opinion in developing/ emerging economies to significance of climate change and policy co-benefits

8.2. Governance Supply

While all governance functions are of at least medium importance, guidance and signal, rules to facilitate collective action, and transparency and accountability may be regarded as of particularly high importance to both shipping and aviation. So too, for the shipping sector, is ensuring adequate means of implementation. The following discussion therefore focuses on these aspects.

The international aviation and shipping sectors began to experience pressure to decarbonise from 1997, when the Kyoto Protocol (Art. 2.2) first assigned responsibility for their emissions to the International Civil Aviation Authority (ICAO) and International Maritime Organisation (IMO) respectively. Emissions from these sectors continue to be handled primarily by these UN bodies; explicit references to both aviation and shipping were included in the draft of the Paris Agreement (PA) but dropped at a late stage, presumably to smooth adoption of the text (Reuters 2015). While the ICAO and IMO do not have climate protection as their primary function (Gonçalves 2017), contacts with other international organisations that do can be significant. The ICAO's Committee on International Aviation Environmental Protection (CAEP) (est. 1983), for example, has an ICAO Council mandate to work closely with the UNFCCC Secretariat and IPCC. Likewise, the IMO regularly makes submissions to UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) meetings. Also worth noting is the inclusion in the UN resolution adopting the 2030 Agenda for Sustainable Development (UNSDG) of a commitment to policies promoting sustainable transport systems (UNGA 2015). In the following text, the governance landscapes pertaining to international shipping and aviation are examined in turn. The findings are summarised in **Table 8.2**.

8.2.1. Intergovernmental/ International Organisations (IOs) in the Case of Shipping

As noted above, there is a degree of interaction between international shipping and the UNFCCC. While its emissions are not (yet) included in any NDCs under the PA, Parties may choose to include them, and such emissions are captured under the collective goals and the Global Stocktake. The expectation at time of writing is that the IMO will facilitate the determination of shipping's fair contribution, within the spirit of the PA (Chircop *et al* 2018).⁶⁴

In addition to the mandate from Kyoto, the Convention on the **International Maritime Organization**, and the UN Convention on the Law of the Sea (UNCLOS) arguably also provide the IMO with competence to regulate GHG emissions (Shi 2014).⁶⁵ The IMO has invoked these competences to regulate such emissions within its Marine Environment Protection Committee (MEPC), where three categories of policy instrument have been discussed: technical, operational and market-based measures (MBMs) (Shi 2016: 134).

⁶⁴ Detailed rules for the Global Stocktake are currently being negotiated. It is unclear at this stage whether the rules will include any obligation to report on emissions from the sector beyond the current guidelines for preparing national inventories.

⁶⁵ In Part XII of the Convention, Article 192 establishes a generic duty for all States to protect and preserve the marine environment. (As an integral part of the corpus of international environmental law, the Paris Agreement serves to inform the content of Article 192).

The 1973 International Convention for the Prevention of Pollution from Ships, as amended by and incorporated in the Protocol of 1978 (MARPOL), is the most important international convention for prevention of vessel-source pollution. Technical regulation occurs in annexes and ancillary codes (which may be mandatory or voluntary) and guidelines. Implementation and enforcement is a responsibility of all State Parties. Annex VI covers GHG emissions and, although optional, includes 88 states representing 96.16% of global tonnage.

In terms of rules facilitating collective action, IMO design efficiency standards were introduced in 2011 for ships built from 2013 onwards (IMO 2015). The Energy Efficiency Design Index (EEDI) is the first mandatory GHG emissions reduction regime for an entire industry. It is non-prescriptive and performance-based; as long as the required energy-efficiency level is attained, ship designers and builders are free to use the most cost-efficient solutions. To incentivise the development and take-up of mitigation technologies, the regulation has set 3 targets, known as phases, each requiring that ships progressively emit less CO₂ per unit of transport work. The most stringent - Phase 3 - requires new ships built after 2025 to be 30% more efficient. Currently, the EEDI mandates a 1% annual improvement in global fleet efficiency from 2015 to 2025 (IEA 2017). The IMO also requires all ships to use a Ship Energy Efficiency Management Plan (SEEMP) to identify what energy-saving measures have already been undertaken and what further steps are possible, and to have procedures to monitor and evaluate efficiency.

As steps towards greater transparency and accountability, data collection on fuel consumption of ships is being increased in a 'three-step approach' (IMO 2015), moving from data collection, to analysis, then potentially to further regulations. From 2019, ships over 5,000 tonnes will have to collect and report data on fuel oil consumed through their flag state to the IMO. Data e.g. on distance and time travelled will also be collected. It is projected that the introduction of a global data collection system for CO₂ emissions from shipping will lead to emissions reduction and to energy savings (ref),⁶⁶ although it is yet to be decided whether this system should be voluntary or mandatory.

In contrast to the format of other sectoral analysis chapters in this report, it makes sense here to include specific reference to the regulatory framework developed by the **European Union**. This is because of its (potential or actual) extra-territorial reach. the Commission has proposed a systematic and gradual three-step approach for integrating maritime GHG emissions into the EU's existing commitments. After the creation of an emissions monitoring, reporting, and verification (MRV) system for ships using EU ports (step one), and the creation of reduction targets in the maritime sector (step 2), a third step contemplated the eventual introduction of some form of market-based measure. The EU's emissions trading scheme (ETS) can in principle include maritime emissions of

⁶⁶ Development of a Global Data Collection System for Maritime Transport, submitted by Austria, Belgium, Bulgaria et al., MEPC 68th Session, Agenda Item 4, IMO Doc MEPC 68/4/1, 3 March 2015, para 12.

vessels not just trading between EU ports, but also those beyond. Moreover, the EU has developed Monitoring, Reporting and Verification (MRV) provisions that are further advanced than the IMO's (ENDS Europe Daily 2017a), enabling large ships calling at EU ports to report their CO₂ emissions and fulfil their obligations under the EU's wider MRV Regulation.⁶⁷ An EU-wide port charging scheme currently under consideration⁶⁸ could offer incentives for greener ships. The EU also funds development of LNG technology and infrastructure (Smith, interview).

8.2.2. Shipping-Related Transnational Initiatives

Various transnational private governance 'green shipping' initiatives have emerged as the result of growing consumer concerns, increasing retail shipper demands (for cleaner fuels, lower emissions, etc); and increased regulation. The industry-led **Clean Cargo Working Group (CCWG)** and the environmental NGO-led **Sustainable Shipping Initiative (SSI)** are increasing business knowledge and transparency and aiming to change behaviour. The CCWG works with over 40 ocean freight carriers and cargo owners to analyse/compare their shipping efficiency (Gençsü and Hino 2015). Several independent initiatives currently address the lack of information/ transparency in the industry (*market failures*). For example, the organisations **RightShip** and **Carbon War Room** provide a rating system for over 70,000 vessels that grades each ship on design efficiency from A to G. The **Clean Shipping Index** provides a similar service, rating carriers on all pollutants.

8.2.3. Intergovernmental/ International Organisations (IOs) in the Case of Aviation

As noted above, following its designation as such by the Kyoto Protocol, the ICAO is the key actor. Through the adoption of its standards and recommended practices (SARPs), it has been instrumental in laying down the foundations allowing international civil aviation to evolve.

At the 37th ICAO Assembly in 2010, following increased signs of industry commitment (see discussion of transnational initiatives below), governments acted to set two **aspirational goals**: to improve fuel efficiency by **2% per year**, maintaining the goal from 2020 to 2050, and to deliver 'carbon-neutral growth' (CNG) from 2020 onward, principally by 'offsetting'. A system of **State action plans**, essentially seeking to induce States to monitor their aviation emissions and identify reduction measures, was adopted to aid achievement of the aspirational goals (Piera 2016). The **CO₂ standard**, as agreed in 2017, will apply to new aircraft designs from 2020, and to those already in production as of 2023; those which by 2028 do not meet the standard will no longer be able to be produced unless sufficiently modified. The ICAO's adoption of a framework for market-based mechanisms (MBMs) has led to the much higher profile, 3-stage global scheme known as **CORSIA** ('Carbon Offsetting and Reduction Scheme for International Aviation'). This aims to stabilise CO₂ emissions by 2020, and offset emissions exceeding a sectoral baseline - the average of total CO₂

⁶⁷ This law requires large ships to monitor their CO₂ emissions and fuel consumption from 1 January 2018; a year later, they will have to submit annual emissions reports to the Commission (European Parliament 2015).

⁶⁸ Based on Regulation (EU) 2017/352) establishing a framework on market access to port services and financial transparency of ports.

emissions between 2019 and 2020 - thereafter (ICAO 2016a). Biofuel can be used instead of offsets to meet CORSIA obligations. CORSIA's phased approach recognises the differing capabilities of Member States and seeks to minimise market distortion. The Pilot Phase (2021 to 2023) is completely voluntary. The First Phase (2024 - 2026), is also voluntary, but automatically includes Pilot Phase participants. Participation in the Second Phase (2027-2035) will be mandatory for all States whose 2018 revenue tonne-kilometres (RTKs) exceed 0.5% of the industry total.⁶⁹ CORSIA's route-based approach should ensure that all operators are treated equally on the same route.

As with shipping, the EU is also an international actor worthy of note. The EU's ETS scheme can (and does) incorporate aviation, not just within the EU, something which has significantly shifted the regulatory landscape at global level.⁷⁰

8.2.4. Aviation-Related Transnational Initiatives

Ever since the EU announced its intention to incorporate aviation into its ETS, the airline industry, led by the International Air Transport Association (IATA), has been active in addressing climate change issues (Piera 2015). The Air Transport Action Group (ATAG) was founded by the Airport Council International (ACI) Europe (representative of European airports), setting industry-wide goals through collaborative action across the aviation sector. Airports, airlines, air traffic management organisations, the manufacturers of aircraft and engines and partners across the supply chain are involved. Through this body, the industry has committed to carbon neutrality and fuel efficiency targets. In 2009, it agreed to: further improve fleet fuel efficiency by 1.5% per year (2008 - 2020); cap net sectoral emissions at 2020 levels; and halve net emissions from 2005 levels by 2050 (ATAG 2014).

An initiative listed as *Collaborative Climate Action Across the Air Transport World* appears in the NAZCA database⁷¹, in effect summarising the joint activities of ICAO and ATAG. Launched via ICAO, this hybrid initiative is said to support short-, medium- and long-term goals to cut emissions from aviation. Apart from the introduction of a global market-based mechanism (CORSIA), it supports developing new, more efficient aircraft technology and sustainable alternative fuels while promoting and deploying operational improvements to reduce CO₂ emissions from aircraft already in service. It calls for better use of infrastructure, especially in air traffic management.

⁶⁹ Further, any State whose cumulative share of RTKs falls into the top 90% in the industry should be included. The participation of LDCs, SIDS and LLDCs will be entirely voluntary. ICAO plans to review CORSIA every three years from 2022 onwards, thus allowing room for adjustments.

⁷⁰ Directive 2008/101/EC indicated the EU's intention to include all European and foreign aircraft operators flying to and from airports situated in the EU within the EU ETS with effect from 1 January 2012.

⁷¹ The NAZCA database was introduced in chapter 1.

8.2.5. Potential Conflicts among International Institutions

Emission reduction opportunities in both shipping and aviation cases must be pursued in an institutional context that isn't always conducive to mitigation efforts. In the international shipping sector, two important international law principles, Common but Differentiated Responsibility (CBDR) and 'No More Favourable Treatment' (NMFT), can at times appear at cross-purposes, and constitute an obstacle to consensual rule setting. The debate on applying them to GHG emissions has been a constant undercurrent in IMO-level negotiations. The CBDR principle, underlying the UNFCCC, requires developed States to bear greater responsibility, while NMFT requires port states to enforce applicable standards *uniformly*. The latter principle has been consistently applied to all IMO treaty instruments (Shi 2016). While developing states have for the most part insisted that CBDR should be applied to regulating shipping emissions, many developed country counterparts favour NMFT (Chircop *et al.* 2018). Consequently, the IMO's energy efficiency measures were adopted by a majority vote in 2011 rather than by consensus, with developing countries complaining that the CBDR principle had not been respected fully and objectively (Shi 2016: 125). According to Chircop *et al.* (2018: 50), however: 'The reality is that international shipping emissions cannot easily be attributed to any particular territory and if ships registered under the flags of developing States were to be excluded or given preference, the whole purpose of reducing emissions from international shipping would be undermined'.

In overcoming this conflict, the potential for certain kinds of MBM to offer a compromise is regularly highlighted. Here, however, some IMO Member States have flagged a potential conflict between such measures and WTO rules. Somewhat reassuringly, however, WTO representatives have remarked to the effect that the trade body could not challenge a global agreement facilitated by the IMO, and that trade rules should not be invoked to stall progress tackling climate change.⁷²

In the aviation case, according to a 2012 Assembly resolution (A38-18), in developing a 'global scheme' (which became CORSIA), ICAO must take into account the (seemingly potentially contradictory) principles of CBDR, special circumstances and respective capabilities (SCRC), non-discrimination, and equal and fair opportunities (Piera 2015). Although 50 (developed) States filed reservations against including CBDR in the resolution, the principle now forms an integral part of ICAO's guiding principles on MBMs. SCRC evolved from the premise that CBDR leads to market distortions and, as such, conflicts with the Convention on International Civil Aviation (Chicago

⁷² The GATT permits notable exceptions, which could serve to justify an MBM that might otherwise be found in violation of the MFN and national treatment principles. These include measures 'necessary to protect human, animal or plant life or health' and measures 'relating to the conservation of exhaustible natural resources, if such measures are made effective in conjunction with restrictions on domestic production or consumption'. If a measure is captured under either of those specific exceptions, it can be justified provided that it is not 'applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade' (Chircop *et al.* 2018).

Convention) that founded ICAO. It ‘represents a laudable attempt to incorporate a workable principle into the ICAO domain that would recognise the different circumstances and level of development of States while minimising market distortions’ (Piera 2015: 74).

The Chicago Convention (effective since 1947), whose primary objective is to facilitate the expansion of global civil aviation, does not mention environment. Despite environmental protection being recognised in new strategic objectives for 2013-16, this remains problematic. In cases of conflict, development would most likely trump environment (Piera 2016). Fuel taxes are one of the principal market-based options for reducing energy consumption and thus GHGs. However, the Chicago Convention prohibits the taxing on arrival of fuel already on board an aircraft. This prohibition, taken to avoid the dangers of double taxation, was subsequently widely extended by governments to become a general tax exemption for fuel on international flights. The prohibition was further enshrined in a very large number of bilateral aviation agreements. In 1996, the ICAO Council adopted a Resolution strongly recommending that any environmental levies States may introduce take the form of charges rather than taxes. Taxes were viewed as levies to raise general government revenues to be applied for non-aviation purposes, whereas charges were seen as levies to defray the costs of providing facilities and services for civil aviation. The ICAO Assembly’s endorsement of this position in 2001 effectively rules out any further work on the use of kerosene taxation at international level (although a few countries maintain taxes on domestic aviation fuel) (Piera 2016).

8.3. Assessing the Governance Complex

8.3.1. Shipping

Guidance and Signal

While the Paris Agreement (PA) does not refer to international shipping emissions (not even renewing the mandate to the IMO), the IMO is (finally) responding to long-standing pressure on it to act. Most recently, this pressure was expressed through the Paris ‘One Planet’ summit (2017), which saw 35 countries adopt the *Tony de Brum Declaration*⁷³, reiterating the PA’s global temperature commitments (Timperley 2017b). A set of seven strategic directions for the 2018-2023 period have been adopted by the IMO Assembly, including one dedicated to ‘developing appropriate, ambitious and realistic solutions to minimise shipping’s ... impact on climate change’ (IMO 2017). At the 72nd session of the MEPC (April 2018), a target was agreed as part of an Initial Strategy (due to be revised in 2023) to reduce sectoral emissions by *at least* 50% on 2008 levels by 2050. This falls short of calls from e.g. the Marshall Islands for complete decarbonisation by 2035, or from EU member states for 70–100% by 2050, but could still help achieve the ‘below 2°C’ temperature goal if other sectors and countries are able to reduce emissions faster to compensate. Moreover, the ‘at least’ wording signals that ambition could be further ratcheted in future. The agreement also calls for emissions ultimately to be phased out completely, though without any timeline.

⁷³ A total of 44 had signed by April 2018.

Where the need for the governance function was assessed as high, recent positive developments suggest that the overall delivery by the existing governance complex can be scored as **medium**.

Rules to Facilitate Collective Action

Although the IMO initial strategy proposes a host of measures which *could* be developed and implemented in future, including MBMs and enhanced energy efficiency measures, it is thin on specifics for the time being. The revised GHG strategy due in 2023 is set to include short-, mid- and long-term “further measures” for reducing emissions, along with an implementation schedule.

The most significant achievement of the IMO’s MEPC to date has been the adoption of technical and operational measures in the form of amendments to Annex VI of MARPOL in 2011 and 2014. However, initiatives promoting decarbonisation noted above have often been limited in scope (Gençsü and Hino 2015). The effectiveness of the apparently significant EEDI requirements is weakened by their application solely to new vessels under construction, meaning that by 2020 15% of the global fleet at best will be regulated. Furthermore, the long standing ‘flags of convenience’ system of open registry (whereby ship owners can choose the nation with the lowest standards to register their vessels) facilitates a continuing implementation gap as states ‘competitively postpone adopting standards’ (Lister 2015: 125). For its part, the SEEMP does not require actual implementation of any of the identified efficiency measures; nor that a goal be set or met (Gençsü and Hino 2015). Given that the EEDI and SEEMP only entered into force in 2013, their precise mitigation effectiveness will take time to establish. Even with full implementation, however, shipping emissions have been projected to increase fourfold compared with 1990 (Shi 2016). As with aviation, the failure to levy any tax on international marine fuels represents a major weakness in the policy instrument portfolio to tackle emissions. Nor is there any regulation of speed at present. Transnational initiatives, while showing promise, are disappointing in relation to the overall scale of the challenge, suffering from relatively low levels of ambition, transparency issues and concerns about data reliability (Scott *et al.* 2017).

Where the need for the governance function was assessed as high, the overall delivery by the existing governance complex can therefore be scored as **low**.

Transparency and Accountability

Under the UNFCCC system, emissions from international transport are reported under the category of international bunker fuels, associated to the country in which a plane or e.g. cargo vessel was fuelled. This form of accounting has obscured responsibility for emissions, be it operators of the planes/vessels, the country of origin or the country of destination of the transported goods. Transparency aspects are gradually improving, however, notably being addressed by the IMO’s on-going three-step data collection process and related action by the EU, where the Commission has used its legislation as an attempt to spur the IMO to agree a global solution. The advent of improved satellite monitoring has potential to facilitate much greater transparency in the near future (Amos 2018). IMO rules are not as stringent as the EU’s, using metrics that are too limited to allow the real

operational efficiency of individual ships to be established (Abbasov, interview). Moreover, there is a risk that the EU's system may be diluted in any integration of the two systems.

Where the need for the governance function was assessed as high, the overall delivery by the existing governance complex can, for the time being, be scored as **low-medium**. (See also discussion of knowledge and learning, below).

Means of Implementation

The IMO's Initial Strategy refers to encouraging technical cooperation, research and development and capacity-building activities, in a list of candidate measures. At the time of writing it is too early to judge what this will amount to. The IMO currently operates programmes geared at building technical cooperation (GLOMEEP) and capacity building (Capacity Building for Climate Mitigation in the Maritime Shipping Industry, or GMN). GloMEEP is a joint Global Environment Facility (GEF)-UNDP-IMO Project, launched Oct. 2015, with a USD 2 million budget. GMN is a joint IMO-EU EUR10 million project (running from 2015 to 2019) to promote energy efficient technologies in the sector by establishing 5 Maritime Technology Cooperation Centres (MTCCs) in 5 regions worldwide. The performance of these programmes is uncertain, but the sums involved appear **low**.

International development banks (including the European Investment Bank, which operates the EUR 750 million Green Shipping Financing (pilot) programme with financial institutions in France, the Netherlands and Nordics), have yet to gear up the the scale of the challenge. As well as committing greater resources to alternative fuels, an important aspect of the challenge will be to reduce (currently generous) support to short-term - but ultimately counter-productive - solutions, namely LNG (Smith, interview).

Other finance for refitting ships is available from transnational initiatives. Innovative self-financing models – such as the Sustainable Shipping Initiative's 'Save As You Sail' (SAYS) and the Self-Financing Fuel Saving Mechanism (SFFSM) driven by Carbon War Room and University College London (Stulgis *et al.* 2014) - have potential to enable the adoption of retrofit technologies, thereby reducing fuel payers' operating costs, while requiring zero capital expenditure. While useful in addressing potential financing obstacles, lack of industry demand for these retrofits has hampered their diffusion (Smith, interview).

MARPOL's Annex VI Chapter 4 includes provision for promotion of technical cooperation and transfer of technology relating to the improvement of energy efficiency of ships, based on State request. The IMO enacts this through its Ad Hoc Expert Working Group on Facilitation of Transfer of Technology for Ships. However, this provision arguably faces the challenge of intellectual property rights, which are not readily transferred by commercial actors seeking to maintain market competitiveness. These issues have arisen in relation to efforts to address the role of technology and technology transfer under the UNFCCC. The technology mechanism first announced under the Copenhagen Accord, is continuing with development and dissemination of climate related technologies under the PA.

Where the need for the governance function was assessed as high, the overall delivery by the existing governance complex should probably, for the time being, be scored as low (particularly since resources are arguably being mis-allocated to LNG infrastructure development).

Knowledge and Learning

Work within the IMO (supported by the OECD) analysing potential impacts of different policy instruments has been relatively well advanced. The challenges lie more in RD&D and, equally if not more important, clear demonstration of the benefits of currently available technologies (IEA 2017: 91; Walsh *et al* 2017: 39). Research and development of advanced low-carbon fuels continues to be significantly under-funded (Smith, interview). This arguably reflects lower visibility and lobbying weight of their (would-be) manufacturers, compared to oil and gas majors promoting use of LNG.

The IMO's on-going three-step approach, gathering and analysing data on fuel consumption/emissions, is addressing the deficit of information. The EU's MRV legislation is dramatically improving the quality of information within the industry. As noted above, several independent initiatives also currently address the lack of information/ transparency in the industry, helping to foster an environment in which efficiency is monitored, prioritised and rewarded. For example, RightShip and Carbon War Room provide a public rating system, grading over 70,000 vessels on design efficiency (from A to G). Charterers representing almost a quarter of global non-containerised shipments have begun factoring efficiency into their vetting process as they decide which ships to charter. Currently, however, these voluntary initiatives lack industry-wide influence, and a single, standardised methodology (Gençsü and Hino 2015; Scott *et al.* 2017).

Where the need for the governance function was assessed as medium-high, the overall delivery by the existing governance complex can be scored at best as **low-medium**.

8.3.2. Aviation

Guidance and Signal

Relative to the challenge of 'Paris-compliance', the signal sent by international governance institutions is falling well short. This is even without factoring in the almost complete neglect of aviation's *non-CO2* emissions (Timperley 2017a) including NOx, contrails and water vapour, where the science has matured significantly. In 1999, the International Panel on Climate Change (IPCC) estimated the total historic climate impact of aviation to have been two to four times higher than for CO2 alone (IPCC 1999). The significance of the signal being sent to the industry by its own body, ATAG, including its goal of halving net emissions from 2005 levels by 2050 is debatable, particularly given the high apparent willingness to rely on offset schemes.

Overall, therefore, where the need for this governance function was assessed as high, overall delivery by the existing governance complex must be scored as **low**.

Rules to facilitate Collective Action

This assessment takes into consideration the CO₂ standard, State action plans and the CORSIA ‘global scheme’. Although there are others, along with the aspirational goals, these topics ‘adequately illustrate the challenges faced and the political implications involved’ (Piera 2016: 2).

1. The CO₂ standard (2017) may be criticised for its applicability only to wholly new aircraft types, at least at first. It perpetuates the incrementalism of the initial commitment to 2% annual improvement in fuel efficiency, which critics equated to ‘business as usual’. Even that, however, was not implemented; efficiency has improved at approximately half the targeted annual rate, due in part to low fuel prices (Kharina and Rutherford 2015). However, the new standard could in principle be tightened.
2. Arguably, ICAO’s requirement for State action plans represents a success story (see also transparency/ accountability). These plans are *in the process* of changing states’ attitudes; many are beginning to address aviation’s climate impact for the first time (Piera 2016).
3. CORSIA: During the initial pilot phase and the first implementation phase (2024 – 2026), the scheme will only apply to airlines from states voluntarily opting in. Several large States, including Brazil, India, Russia and Saudi Arabia have opted out (for various reasons). Starting with the second phase (2027 to 2035), exceptions will apply only for least developed countries, land-locked and small island developing states, and those with low levels of activity.

ICAO’s goals are non-binding, and not assigned or ‘attributed’ to particular states or aircraft operators. Instead, all states are encouraged to strive collectively to achieve them (Piera 2016: 20).⁷⁴ CORSIA’s early focus on tackling sectoral rather than individual airline emissions growth carries risks. Until operators begin to be assessed by their own emissions, incentives to make individual reductions via technological or operational means will be lower than they could be (Chircop *et al.* 2018: 76). Offsetting also risks ‘free-riding’ on other sectors’ efforts, allowing technological and operational stagnation while emissions continue to rise (ibid).

Annual aviation CO₂ emissions are set to rise approximately 1 bn tonnes by 2030, of which CORSIA could offset between zero and 0.3 billion depending on the way the offsetting rules are set (UNEP 2017). The risk of the effectiveness of the offsetting regime being compromised by implementation issues is real, and reliance on forestry projects provokes opposition. Similarly, reliance on biofuels could be counterproductive; standards designed to ensure sustainability are currently under development and remain controversial. Critics, including IEA (2017), have called for a more stringent

⁷⁴ This was done to delink ICAO’s goals from the notion of binding emissions reduction commitments applicable at the time under the UNFCCC/Kyoto regime (Piera 2016: 20).

CORSIA to be complemented with fuel carbon taxes (which, as with shipping, are conspicuously absent).

Meaningful demand management, required if aviation is to become Paris-compliant, is nowhere to be found. Nevertheless, international aviation is given a **Low-medium** on this function because of ICAO's significant progress that, in principle, can allow further steps (Piera 2016).⁷⁵

Transparency and Accountability

State action plans were designed in part to improve monitoring and thereby transparency. Concerns about accuracy of data, over-emphasis on technological and operational measures, or in some cases, lack of evidence that concrete measures have been put in place (Piera 2016: 19) mean that it is not yet possible to determine actual GHG emission reductions as a result of the actions plans. These concerns notwithstanding, Piera (2016) considered that development of the plans constitute one of ICAO's major achievements.

In the case of CORSIA, ICAO still needs to finish detailed design work on monitoring, reporting and verification (MRV), emission units criteria (EUC) and registries. Thereafter, IT systems will be needed to enable airlines to track how many credits they need, and to enable governments to check whether or not they have bought them (WWF 2017). Beginning in 2022, the CORSIA scheme will be reviewed every three years, in what might be considered a counterpart to the PA's Global Stocktake, though the details are still to be elaborated.

Enforcement issues are also of significant concern, with responsibility being placed on states with varying levels of capacity and commitment (Piera, interview). A further concern centres on credit criteria, vital for ensuring offsets really reduce emissions without side-effects, and accounting rules, to ensure these credits aren't being double or triple counted. Rules are still under development. In theory, ICAO could screen out offset project types with low environmental integrity and risks to sustainable development and still meet its goal. Many countries and airlines, however, want maximum possible supply of offset credits at lowest possible cost.

Once new developments have become public (June 2018?), a score for delivery of this function can be offered.

Means of Implementation

In terms of institutional capacity building, ICAO runs a comparatively large technical cooperation programme, primarily designed to assist developing countries "in remedying their deficiencies", including non-compliance with technical standards and recommended practices (SARPs), lack of

⁷⁵ NB. This scoring will need to be reviewed once decisions on detailed rules for the implementation of CORSIA have been announced (June 2018).

appropriate aeronautical infrastructure, and insufficient regulatory oversight (Piera 2015). As part of the efforts to provide further assistance to States and facilitate access to financing for States' action plans, ICAO established partnerships with the EU, the United Nations Development Programme (UNDP) and the Global Environment Facility (ICAO 2016b).

For aviation biofuels, supply chain development and measures to reduce cost premiums are still somewhat lacking.

Where the need for the governance function was assessed as medium, due to lack of transparency about levels of investment and support being offered (and the project's capacity to research it), the overall delivery by the existing governance complex cannot currently be scored.

Knowledge and Learning

(Joint) R&D for low-carbon technologies/fuels, involving airlines, governments and other stakeholders is reported to be happening to some extent through Air Transport Action Group, (Collaborative Climate Action across the Air Transport World). Precise details, however, are hard to obtain. ICAO also operates a Global Framework for Aviation Alternative Fuels (GFAAF) which offers a Database for relevant activities and supports Initiatives and Projects. However, the IEA warns that the development of CORSIA, though in many ways welcome, 'could come at the expense of reduced pressure for R&D solutions that could be achieved within the aviation industry itself' (IEA 2017). Where the need for the governance function was assessed as medium, due to lack of transparency about levels of investment and support being offered (and the project's capacity to research it), the overall delivery by the existing governance complex cannot currently be scored.

8.4. Conclusions and Recommendations

Despite some notable improvements in recent years, the most critical international governance functions for decarbonisation are a long way from being adequately fulfilled for both shipping and aviation sectoral systems. EU institutions have pressed for greater policy ambition on both international aviation and shipping, with some effect, and look set to continue to do so (see chapter 10 for further discussion). This section sets out some options for addressing some of the key gaps identified in the governance landscape, which the EU may be able to endorse, taking shipping and aviation in turn.

8.4.1. Shipping

Although **guidance and signal** is now significantly stronger following the agreement at MEPC 72, the maritime sector may eventually need to confront the issue of whether to maintain an 'in-sector' decarbonisation focus (Chircop *et al.* 2018), or work collaboratively with other sectors to integrate its efforts into the PA's global net zero emissions goal, requiring closer coordination with the UNFCCC. The rate of reduction from peak emissions to full decarbonisation or emission neutrality may also need to be further specified. These elements could all be based on IPCC analysis, including in particular the 1.5°C scenario analysis due later in 2018. Adjustments to the sector's long-term goal could be made over time, based on clearly established factors such as changes to the way parties

approach and define the long-term goal, changes to the IPCC's understanding of the potential contribution of negative emissions, and actual global progress toward decarbonisation (Chircop *et al.* 2018: 87). The credibility and visibility of the signal towards decarbonisation will be critical to avoid 'lock-in' to sub-optimal solutions like LNG, which would ultimately fail to deliver sufficient emission reductions and risk an eventual 'stranding' of shipping assets.

With the adoption of an initial climate strategy, the IMO's role as the primary venue for developing appropriate response measures is secure for the foreseeable future. To fill the evident governance gap on **rules facilitating collective action** in shipping, the IMO needs to develop and adopt new, concrete measures, with the ability to review and update them. To be politically acceptable, developing countries (especially SIDS and LDCs) will need to have access to financial resources and technology and effects on international trade should be handled sensitively. The actions needed cut across diverse economic sectors at national and regional as well as global levels, and requiring involvement of regulatory bodies at all levels; at times they may also require action from regulators in other sectors. The IMO will need to define appropriate roles for its Member States and for private industry actors (Chircop *et al.* 2018). Although challenging, there are reasons to believe the IMO has potential to develop its role in this direction (see discussion of 'IMO as orchestrator', below).

Among others, the IEA (2017) and OECD (International Shipping Forum 2018) have suggested modification of **existing rules**, in particular increasing the ambition of the EEDI, including expanding it to include operational efficiency standards for *existing* ships. This would require swift action to ensure the adequate collection of data along trading patterns of individual vessels (highlighting how improved transparency is a pre-condition for stronger rules). Upgrading the EEDI framework could also serve to incentivise alternative fuel and hybrid machinery designs in the medium term, with the ultimate goal of transitioning to full decarbonisation of vessels (T&E 2018). Low-carbon fuel standards could be developed for the shipping sector, similar to the fuel standards that have been developed for road transport (International Transport Forum 2018).

Some low-carbon alternative measures are currently more expensive than oil-based marine propulsion because external costs, including climate change, remain unpriced. This market failure could be addressed by a carbon levy on bunker fuels, currently under consideration as a potential new global rule.⁷⁶ Industry bodies prefer an IMO initiative to a potential regional patchwork of regulations that might otherwise emerge (Darby 2016). An MBM adopted on the basis of consensus within the framework of an international maritime convention is also less likely to generate conflict with the WTO regime. IMF analysis of the global economic implications of the Paris agreement suggested that international shipping and aviation fuels should have a levy applied for both revenue-raising and emission-reducing reasons, proposing US\$30 per tonne CO₂ (IMF 2016). To improve political acceptability, around half of the revenue is proposed to be set aside for developing countries as compensation for trade losses; the remainder would support the Green Climate Fund (see chapter 3). However, such a figure is likely to be too low to deliver the scale of absolute emission reductions required (Smith 2016).

⁷⁶ The need for carbon pricing would be less pressing if strong standards were to be developed.

With the exception of a few large developing countries such as China and India, most national industries have welcomed the adoption of MBMs, although they have different preferences on the precise form (Shi 2016: 125). Large developing States may not be intransigent, however, with evidence that China would accept a compromise position provided that the CBDR principle could be incorporated (Shi 2016: 125). Certain MBM types submitted as proposals to the IMO (including the rebate mechanism for a market-based instrument for international shipping and the port-state levy) have potential to incorporate elements of both the CBDR and NMFT principles (Shi 2016).

National or regional incentive schemes, with potential to be internationally coordinated, could complement carbon pricing at a global level. Co-ordinated port-level charging schemes with incentives for greener ships, for example, have very promising potential to reduce shipping emissions. An EU-level scheme under consideration would rate ships based on CO₂ data gathered as part of mandatory EU monitoring. Research suggests that offering energy/ CO₂-efficient vessels fee rebates of 20% at all ports could reduce GHG from sea trips within the EU by close to 4% a year by 2030 (COGEA *et al.* 2017).

Recalling that it is difficult to conceive of deep decarbonisation without an immediate, fleet-wide speed reduction' (Walsh *et al.* 2017), rules on slow steaming will require global-level agreement. To accommodate concerns of countries at the end of long supply chains, however, differentiations for various classes and potentially specific routes may also be necessary. Satellite tracking of ship movements can facilitate recording of speeds and ensure that compliance is straightforward. The advent of blockchain makes verifying and recording this easy and trustworthy (Abbasov 2017).

Regarding **transparency and accountability**, whatever the (currently uncertain) fate of the EU MRV provisions in the context of IMO action, ultimately regular reporting, review, and enhancement of the approach 'in sync' with reporting and review under the PA will be critical for the effective implementation of the IMO strategy' (Chircop *et al.* 2018). To address the significant governance gaps affecting **means of implementation**, development banks (including the EIB) have a big role in developing infrastructure and technology transition in an equitable manner. Governments might collaborate with financial institutions or encourage domestic development banks to develop targeted financial instruments for green shipping (International Shipping Forum 2018). Given that sufficiently rapid fleet-wide retrofit arguably requires adequate dry-docking services around the world (Walsh *et al.* 2017), consideration may need to be given the enhancing this capacity on the part of port-states.

Prospects for agreeing on the measures necessary for decarbonisation would be enhanced if the IMO could agree on greater transparency and integrity in its own policy-making processes, as well to reform its voting systems to less heavily favour certain flag states (all elements long subject to criticism from NGOs). Questions related to the importance of legitimacy and social acceptability of policy making institutions are considered further in chapter 10.

IMO as an Orchestrator

As noted above, there is a clear need for coordination across multiple levels and actors to deliver sectoral climate goals. The IMO's significant potential to orchestrate the range of green shipping private initiatives noted above, alongside international efforts to spur policy innovation, coordination and state regulatory cooperation, has been highlighted by Lister (2015). She suggests that the IMO would 'appear to possess the main success factors: a focal institution in the issue area of global maritime sustainability; in theory, convening power; the ability to delegate legitimacy; the resources to enable; and an organisational culture that although heavily bureaucratic, has recognised the need for reform through greater consultation and engagement of new actors (Lister 2015: 126). Although undoubtedly a focal international institution with the authority to govern, to date the IMO has lacked both the creativity and coercive power to get states to ratify, legislate and enforce compliance. Therefore, leveraging the efforts of organisations such as the CCWG or SSI to serve in an entrepreneurial role may help to produce governance benefits such as 'demonstration effects' through pilot projects and information dissemination to encourage learning and policy innovation, and pave the way for greater regulatory cooperation between states. Lending support to the SSI could provide the group with additional capacity for more focused advocacy and targeted pressure on national governments to regulate. Lister suggests that the IMO might also consider endorsing one or more transnational green rating schemes to help scale up their efforts.

8.4.2. Aviation

While the ICAO was somewhat faster than the IMO in developing elaborate decarbonisation measures, such as CORSIA, its headline decarbonisation targets now appear much less credible, and the measures to implement them less robust than those that the maritime sector is now contemplating.

The **guidance and signal** function requires significant additional effort, in particular to ensure that individual operators are incentivised, rather than – as occurs with CORSIA – the sector as a whole. Given improved science, climate change targets should take account of *non-CO2 impacts* that have not previously been accounted for or regulated due to uncertainty over their exact effects. WWF (2017) propose a simple multiplier (e.g. x2).

In terms of the prospects for strengthening **rules facilitating collective action**, options are limited by the current international legal framework, which '*de facto* immunises fuel used in international aviation from taxation' (Piera 2016: 28). In theory, this and other deficiencies in the governance framework could be addressed through substantial amendments to the Chicago Convention, the framing of which explicitly prioritises continuing growth of the sector above the environmental costs that this entails. This, however, is extremely unlikely. Short of this, more frequent Assembly meetings of ICAO could be considered, to provide more of a counter-weight to the Council (which adopts SARPs), whose membership is more limited and less progressive on environmental questions. Increased participation by ICAO member states is arguably a *sine qua non* for more ambitious climate action (Piera 2016: 8).

The IEA (2017), among others, has called for better alignment of the CO2 standard with the sectoral mitigation targets (carbon neutral growth by 2020, 2% annual efficiency improvement to 2050, and

halving of emissions by 2050), as well as clarifying the magnitude of the savings expected from CORSIA. From 2022, CORSIA's three-yearly review cycle, comparable to the PA's global stocktake, could in principle be used to ratchet up the scheme's ambition in light of new scientific evidence on progress towards achieving the long-term temperature goal. It will be important to maintain US participation, without which CORSIA's coverage of emissions (above 2020 levels) between 2020 and 2035 would drop from 77% to 56%. (WWF 2017).⁷⁷

Although demand management would appear to be unavoidable if aviation is to do its 'fair share' of decarbonisation, it is hard to imagine how this could be pursued at international level. Personal carbon quota schemes or frequent flier levies⁷⁸, which could in principle include international flights, would, as noted by Bows-Larkin (2015), require national-level action. A degree of demand management is conceivable by removing the exemption passenger flight tickets enjoy from VAT, something that could also bring fiscal benefits (see suggested recommendations to the EU in section 10.6). NGOs advocating that individuals restrict their flying are emerging, but any social movement in that direction has yet to gain significant momentum.

Concerning **transparency and accountability**, it is essential that ICAO develops registries and accounting mechanisms that can guarantee that any emissions reductions claimed by airlines under CORSIA are not also claimed by the host country towards their NDCs. This will require close collaboration across the two parallel sets of technical negotiations on the CORSIA in ICAO and Article 6 of the PA (WWF 2017). Controversial issues related to integrity of offsets must also be addressed, as well as sustainability standards for biofuels (discussed briefly below in a cross-sectoral context). The latest available draft at time of writing proposes that forest offsets and carbon credits sourced from the CDM should be eligible, despite major controversies with both these sources. Arguably, CORSIA should only accept credits from projects where the investment decision was made after the decision to proceed with CORSIA, an approach favoured by the EU (ENDS Europe Daily 2018). Long-term availability and cost of offset credits depends on linkages with carbon markets associated with other economic sectors. Some have also mooted the idea of making State action plans mandatory (Piera 2016).

To address the shortfall in terms of the **knowledge and learning** function, coordinated efforts by airlines, governments, manufacturers and other stakeholders should be made to increase R&D on low-carbon aircraft design. Similarly, governments and airlines should work together to advance renewable jet fuel technology to reach a commercial scale, while ensuring the delivery of real emission reductions compared with alternatives (Gencsu and Hino 2015).

⁷⁷ At time of writing, continuing US participation is still under review.

⁷⁸ <http://afreeride.org/>

8.4.3. A cross-sectoral consideration: biofuel sustainability

In both aviation and shipping cases, ensuring that the production of alternative, low-carbon fuels adheres to high quality and sustainability standards is critical to avoid side-effects, including those that erode supposed carbon emission reductions. Standard-setting bodies can have a role here: the ISO 8217 marine fuel standard (sixth edition), for example, currently makes a clear distinction between superior and inferior biofuel grades. Through blending mandates and fuel standards, governments have the leverage to create demand stability that could assist biofuel availability and uptake (International Transport Forum 2018). Stringent sustainability criteria for biofuels need to include direct and indirect effects on land use. Recent decisions in the context of CORSIA give significant cause for concern here (ENDS Europe Daily 2017, 2018). Scarcity issues also arise for both aviation and shipping in terms of the need to compete for supplies of biofuel with alternative uses. These issues are highlighted again in chapter 10.

8.4.4. Interactions with the UNFCCC

To enhance transparency and accountability, and potentially also knowledge and learning as a consequence, consideration could be given to the IMO, (and ICAO) or State Parties as part of their NDC submissions, reporting on sectoral emissions as part of the Global Stocktake. Alternatively, individual Parties could be asked to report on emissions from these sectors in their Article 13 inventories. Either way, as Chircop *et al.* (2018: 21) have noted, ‘it will be critical that accurate and consistent information about emission trajectories in the international shipping sector is available every five years starting in 2018. Ideally, this would lead to an assessment of what approaches have been implemented, which have been effective and which have not’. The same need to harmonise transparency and accountability functions across ICAO and UNFCCC has already been raised above.

Opportunities should also be explored for consistency and cooperation between ICAO and IMO sectoral initiatives, and institutions and instruments under the PA covering market mechanisms, finance and technology implementation, to assist in effective implementation of measures agreed under sector-related process. Chircop *et al.* (2018) suggest that traditional maritime regulation alone will likely not be sufficient for the required mitigation effort, and that novel measures and possible linkages with other global and regional regimes, for example to develop effective MBMs, may be needed. If IMO parties decide to explore an MBM that includes access to ‘out-of-sector’ reductions or offsets, it would be helpful to seek consistency with the emerging new Sustainable Development Mechanism under Article 6.4 of the PA. The technology mechanism affirmed in Article 10 of the Paris Agreement is dealing with climate technology transfer in a broad sense, and may offer valuable possibilities for cooperation and coordination.

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Table 8.2: Summary of activity under key governance functions for international transport.

Note: the table is under review in light of developments in sectoral governance in 2018.

International aviation and shipping										
Governance Functions		UNFCCC/ Paris Agreement (Inter-gov)	IMO (Marpol), (Inter- governmental/ Public)	ICAO (Intergovernmental/ public)	ATAG (private)	Clean Cargo Working Group (CCWG) (private)	Sustainable Shipping Initiative (SSI) (private/civil society)	RightShip/Carbon War Room (CSO/private)	The Clean Shipping Index (private?)	EU (public)
Guidance and Signal	<ul style="list-style-type: none"> Global limits and phase-out of (net) emissions 	1.5/2°C goal Tony de Brum Declaration.	'At least' 50% cut by 2020 (on 2008), total decarbonisation eventual goal (2018 IMO 'Initial Strategy')	Aspirational goals: - improve fuel efficiency by 2%/yr, 2020 to 2050, - 'carbon-neutral growth' from 2020.	Cut net emissions 50% from 2005 levels by 2050					<i>Negotiating position is strong guidance/ signal (willingness to act unilaterally, use market/ regulatory power)</i>
Setting Rules	<ul style="list-style-type: none"> Global limits on emissions Internalise externalities in fuel prices, carbon pricing/ trading Operational prescriptions (e.g. speed limits) Tech. prescriptions/ standards 		EEDI/ SEEMP	<ul style="list-style-type: none"> State action plans to monitor emissions, identify measures CO2 standard (2017) for new designs 						<i>EU ETS?</i>

	<ul style="list-style-type: none"> Phase-in periods for dev. countries/ compensation for cost-raising measures 	CBDR principle		<ul style="list-style-type: none"> CORSIA: stabilise CO₂ by 2020, offset thereafter (non-binding) (<i>Offsetting rules still to set</i>) 						
Transp. and Accountability	<ul style="list-style-type: none"> To ensure effective implementation of international rules 	<i>Global Stocktake to include aviation/ shipping?</i>	MRV provisions as part of 3-stage policy development.					RS Offers systematic and transparent means of comparing relative ship efficiency.		MRV provisions (tighter than IMO). (shipping)
Means of Implementation	<ul style="list-style-type: none"> Access to capital/finance, e.g. to implement retrofits (shipping) Technical cooperation/ technology transfer (shipping) Incentivising of early technology adoption Institutional capacity building 	<i>Technology Mechanism?</i>	IMO-EU Global MTCC Network (GMN) Project GEF-UNDP-IMO GloMEEP Project Partnerships with EU, UNDP and Global Environment Facility (GEF).	Partnerships with EU, UNDP, GEF, to develop State action Plans.	<i>'Collaborative Climate Action' (listed in NAZCA)?</i>	Catalysing/ partnering on projects that drive sustainability improvement.	'Save As You Sail' (SAYS) financing model.	Self-Financing Fuel Saving Mechanism (SFFSM) (Carbon War Room)		<ul style="list-style-type: none"> IMO-EU Global MTCC Network (GMN) Project Green Shipping Financing (pilot) programme (EIB-led) ICAO partnerships with EU, UNDP, GEF.

Knowledge and Learning	<ul style="list-style-type: none"> • (Joint) R&D for low-carbon technologies • Improved information on costs/ savings/ correct operation of new technologies and operational measures (shipping). • Sensitising developing/ emerging economies to significance of climate change and policy co-benefits 	<i>Global Stocktake to include aviation/ shipping?</i>			<i>‘Collaborative Climate Action’ (listed in NAZCA)?</i>	<p>Analyses/ compares efficiency of 40 ocean freight carriers/ cargo owners.</p> <p>Exchange best practice.</p>	Awareness raising.	<p>RS Offers systematic and transparent means of comparing relative ship efficiency.</p> <p>CWR supports Carbon Pricing Leadership Coalition (CPLC) Executive Briefing on internal carbon pricing for ship-financing banks.</p>	Independent labelling system of env. performance of ships/ shipping companies	
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9. Buildings

Gauri Khandekar and Sebastian Oberthür

9.1. Transformation Challenges and Governance Demands

9.1.1. Current Status and Prospect

The global buildings and construction sector accounts for more than half of global wealth (Global Alliance for Buildings and Construction, 2016). In 2010, the buildings sector accounted for 32 per cent of total global final energy consumption (51 per cent of global electricity consumption) and produced 19 per cent of global GHG emissions (including electricity-related, while direct emissions stood at 6.4 per cent of the global total) (Lucon et al. 2014, p. 687). GHG emissions from the building sector have more than doubled since 1970 (Lucon et al. 2014, p. 678). Most of the GHG emissions in the buildings sector are indirect CO₂ emissions that emanate from electricity use in buildings and are projected to grow 1.8 per cent a year through 2030 (Knox, 2015).

Population growth, urbanisation, rising per capita incomes, and climate change are key factors that will dramatically impact this sector and drive an increase of energy use. The United Nations Department of Economic and Social Affairs (UNDESA) estimates global population to grow to 9.7 billion by 2050 of which approximately 2.5 billion will be new urban inhabitants, mainly in Africa and Asia (UNDESA, 2015). Urban areas will comprise 85 per cent of growth in building energy use until 2050, 70 per cent of them in developing countries (Diana Urge-Vorsatz, Cabeza, Serrano, Barreneche, & Petrichenko, 2015). As global temperature rises, the demand for space cooling amongst warmer countries is expected to triple between 2010 and 2050 (IEA, 2013). Moreover, urbanisation is typically associated with a shift from traditional biomass fuels (such as wood and waste) to more modern fuels (such as natural gas or electricity), but also with greater potential for energy efficiency measures. Overall, the IPCC has warned that, in the absence of action, the use of energy in buildings could double or in worse case, triple by 2050 (Lucon et al., 2014). In order to meet the 2/1.5°C goal set out by the Paris Agreement (PA), the buildings sector would have to reduce energy and process-based CO₂ emissions by 60 per cent in 2050 compared to 2012 (Dean et al. 2016).

Spatial heating and cooling, cooking and water heating in the buildings sector account for the lion's share of the buildings sector's final energy consumption. In 2012, the respective shares in residential and commercial buildings were: 32 and 33 per cent for space heating, 24 and 12 per cent for water heating, two and 32 per cent for cooling and 29 per cent for cooking (residential buildings only) (IEA 2013 in Lucon et al. 2014, p.681). The relatively large share of cooking ensues as a result of the use of traditional biomass (in combination for water heating) by approximately 3 billion people with low conversion efficiencies in developing countries (IEA, 2013).

The buildings sector varies both regionally and within regions, depending on climate, economy, energy access, availability of energy sources, and energy-related policies (Knox, 2015). Per capita final energy use in buildings in countries like the US and Canada can be as much as five to ten fold higher than in Africa or Latin America per se (D. Urge-Vorsatz et al., 2012). Space heating continues

to dominate building energy use in OECD countries, while cooking and water heating account for nearly 60 per cent of building energy demand in non-OECD countries. In the non-OECD nations, consumption of delivered energy in buildings is estimated to grow by 2.1 per cent per year from 2012 to 2040, nearly three times the growth rate for the OECD nations (Knox, 2015). Three quarters of the final energy consumption for heating and cooling is fossil fuel based including the generation mixes for electricity used for heating and cooling, and for commercial heat. Renewables constitute the remaining portion, of which almost 90 per cent is traditional biomass (IEA, 2015).

Achieving the goals of the PA will require an ambitious mix of mainstreaming highly energy-efficient near-zero or net-zero energy and energy-plus buildings in new construction, a massive retrofit of the existing building stock and a switch to greener sources of energy in particular electricity from renewables (Dean et al., 2016). According to the CAT (2016), if all new buildings were to be zero-energy (by 2020 in OECD countries and by 2025 in non-OECD countries) alongside deep renovation rates (5 percent in OECD countries and 3 percent in non-OECD countries per year), the buildings sector would be compatible with the 1.5°C pathway. Although the buildings sector is currently one of the largest GHG emitting sectors, it offers large low-cost potential for reducing energy demand and associated emissions in all world regions by 2030 (Lucon et al., 2014). Although definitions vary, net-zero energy buildings (NZEBs) are buildings with on-site renewable energy systems (such as PV, wind turbines, or solar thermal) that generate an equivalent amount of energy as is consumed by the building (Lucon et al., 2014). In the case of energy-plus buildings, such renewable energy generation exceeds consumption.

Enormous potential for reducing energy consumption and GHG emissions can be realised through retrofitting existing buildings as well as, even more so, in constructing new buildings. Buildings envelopes are key. According to the IEA, a high-performance building envelope for existing and new buildings in OECD countries can reduce energy required for heating to 20-30 per cent of current consumption while it can boost energy savings potential for cooling between 10-40 per cent in hot countries (IEA, 2013). Holistic retrofits can result in 50–90 per cent final energy savings in thermal energy use in existing buildings, with the cost savings usually surpassing investments (D. Urge-Vorsatz et al., 2012). As regards new buildings, cost-effective technology and materials now make it possible to construct buildings that use 10–40 per cent of the final heating and cooling energy of conventional new buildings in all world regions and climate zones (D. Urge-Vorsatz et al., 2012).

Leadership in Energy and Environmental Design certification is the most widely used third-party verification for green buildings and ensures that buildings use one third less electricity (Knox, 2015). The World Green Building Trends 2016 study finds that globally, green building construction is steadily rising, most of the growth coming from emerging economies in Asia. Smart building technology spending is also expected to rise from USD 6.3 billion in 2014 to USD 17.4 billion in 2019 (Feblowitz & Levine, 2015).

As regards cookstoves, biomass used in open fire or basic cook stoves, still represents two-thirds of energy consumption for cooking globally. More efficient biomass stoves can deliver fuel savings of 30–60 per cent and chimney-included models can reduce indoor air pollution levels by 80–90 per

cent (D. Urge-Vorsatz et al., 2012). and transition from traditional biomass to modern fuels could save 3.5 EJ of energy, (or around or 34 per cent of total buildings energy consumption in 2010 (IEA, 2013).

9.1.2. Main Challenges and Barriers toward Decarbonisation

There is a palpable paucity of strong regulatory measures or incentives across all regions and countries, even though a number of affordable technologies and efficiency improvements that can help decarbonise the sector exist. Even in most developed countries, policies that mandate energy-efficient retrofits typically result in savings of only 20–40 per cent of the building energy use (Gunalp et al., 2017). Low efficiency targets risk resulting in a decades long lock in for energy use and corresponding GHG emissions (D. Urge-Vorsatz et al., 2012). Moreover, even in most developed regions like the EU where policies exist, implementation is poor (Boasson & Dupont, 2015). The rate of retrofitting in the EU is currently a mere one per cent annually, which would require a century to decarbonise the sector. Many OECD members have indeed pursued NZEBs for the past 10-12 years, but progress remains low including inside the EU (Boasson & Dupont, 2015; IEA, 2015). Introducing policies that mandate state-of-the-art deep retrofits could save 70-90 per cent of building energy use (Gunalp et al., 2017). At the policy level, ambition is low in non-OECD nations too, where the emphasis will be on new constructions rather than on retrofits.

The lack of training, awareness of existing technology costs and capacity building measures constitute an important non-financial barrier (IEA, 2013). The sector involves a large number of stakeholders (constructors, building product producers, building managers, architects, engineers, owners, occupants, investors, trades people, equipment manufacturers, suppliers, architects, lenders, insurers, codes and standards setters, zoning officials, realtors and others) (Boasson & Dupont, 2015; IEA, 2013) and is deeply fragmented (between the national or local level). Consumer-awareness programmes, standards and labelling while effective tools to encourage purchase of the most efficient available technologies, are not prevalent across the globe, in particular in developing countries. In the absence of awareness, easy access to knowledge and technology, and organised training, the large number of private construction companies may either entirely perceive otherwise affordable decarbonisation measures to harm their competitiveness in a highly competitive real estate market or overlook them entirely.

Transitioning to NZEBs globally will be difficult even though it may be the most efficient solution. NZEBs remain largely unaffordable, especially in the developing world. Moreover, there is a distinct lack of designers or builders with the necessary skills or experience to construct NZEBs. Technical challenges also inhibit the widespread construction of true NZEBs and NZEB communities given their suitability for only certain building types and settlement patterns, primarily low-rise buildings and less densely populated residential areas. Moreover, their economics are presently typically unfavourable, as opposed to high-efficiency buildings (D. Urge-Vorsatz et al., 2012). In a 2010 study cited by the IPCC only about 300 both commercial and residential net zero or almost NZEBs existed worldwide at the time (Lucon et al., 2014).

The continued widespread use of solid fuels — including wood, charcoal, coal, animal dung, and crop waste — for cooking and heating energy supply remains an important source of buildings sector GHG emissions. Globally, there remains a lack of adequate support for the sustainable production of clean biomass fuels and renewable fuel alternatives alongside the current focus on stove efficiency and emissions given that demand-side solutions alone are not enough (Putti, Venkata, Tsan, Mehta, & Kammila, 2015). The drive to increase the focus on clean cooking solutions remains arbitrary across the world. Globally, more than 3 billion people, particularly in rural areas in the developing world, still use solid fuels as their primary cooking and heating energy supply. And only about 200 million have access to improved or clean cookstoves (Putti et al., 2015). Access to finance, consumer education, quality standards, policy reform, and market intelligence will be needed for a transition to more efficient cooking and heating energy supply (Putti et al., 2015).

Although improving building efficiency is often profitable, investments are hindered by various barriers: “market barriers (like high initial costs and low priority of energy efficiency in decision-making – and market failures e.g. principal-agent problems, transaction costs, search costs, regulatory compliance issues) (IEA, 2013), split incentives, distorted energy price/tax regimes, limited access to financing, lack of information and awareness of benefits, regulatory failures, and so on (Lucon et al., 2014). Regulatory failures can include policies that have inhibited the deployment of technologies. For instance, in some countries, building codes prohibit the installation of solar thermal collectors on roofs or local regulations exist that may not foster innovative building solutions (IEA, 2013). Decision makers themselves at times do not have accurate or adequate information on varied aspects.

The principal-agent problem is also important especially in OECD countries where either building developers seek to minimise costs without the long-term interests of owners or occupiers in mind or where landlords make purchase heating and cooling equipment for tenants without regard to life-cycle costs (Murtishaw & Sathaye, 2006). Strong and diverse market oriented policies that can overcome these hurdles will help in catalysing potentially cost-effective investments (Lucon et al., 2014). The lack of robust data and large-scale demonstration projects that evaluates the performance of energy-efficient and low/zero-carbon technologies in each market segment also compose a barrier (IEA, 2011). Financial challenges also remain. According to the IEA (IEA, 2013), decarbonisation in the sector would require an estimated USD 31 trillion by 2050.

9.1.3. The Promise and Potential of International Cooperation

Guidance and Signal Function

A common international goal of full decarbonisation of the sector (e.g. early in the second half of the century) with targets differentiated by region could help to align the diversity of actors in the sector. This could be an important signal “to consumers and manufacturers, both to maximise efficiency and to limit the cost of future changes” (IEA, 2011). A well-defined global strategy for carbon neutrality of the buildings sector with differentiated targets can provide a roadmap for sustainable buildings subsectors (like heating and cooling, cooking, heating water, where challenges are indeed shared across a number of countries and/or regions) (Global Alliance for Buildings and Construction, 2016).

Setting Rules to Facilitate Collective Action

International regulation (technical standards and agreement on far-reaching decarbonisation objectives) can play a complementary role by addressing competitiveness concerns. Such concerns exist to the extent that decarbonising buildings cause significant net costs. This is under current market conditions (without full accounting of external costs of energy use and GHG emissions) especially the case for the more advanced transition to NZEBs. Having said that, many of the options for significantly reducing emissions in the sector do not involve significant net costs, but even generate net benefits. One challenge in developing any international rules will be to take into account the widely varying conditions in different countries and regions. An additional potential may exist with respect to the international harmonisation of certain building materials.

Transparency and Accountability

International agreement on differentiated targets/rules would require a transparency framework for performance assessment. Collection of data will be essential for regular tracking of progress.

Means of Implementation

The provision of adequate means of implementation like training, capacity building, awareness raising finance and investment can help address some of the key barriers to the decarbonisation of the buildings sector at the global level. International training, capacity building and awareness programmes for the large number of stakeholders involved in the buildings sector can help raise awareness and enhance skills and expertise. Such capacity building can help inform stakeholders in particular in low-mid income countries about otherwise overlooked affordable decarbonisation measures. International finance has a key role to play in delivering the enormous finance and investment required to bring about the transition in the buildings sector, in particular amongst low-mid income countries. International banks can help promote decarbonisation by prioritising green buildings through soft loans, better interest rates or green bonds (WEF 2011). Multilateral development banks can help ensure that investments are available in all countries/regions. A particular potential exists regarding the distribution of clean cookstoves that can help reduce emissions in the sector at a large scale in many developing countries.

Knowledge and Learning

Policy and technical knowledge platforms can help increase information and awareness, allow the sharing of best practices, enable diffusion of technical know-how, develop solutions to common concerns like the principal-agent problem and empower policy makers to develop effective policies and low-carbon technology priorities (IEA, 2013). These platforms can also help promote awareness and knowledge of available financial incentives for high-performing products and systems (IEA, 2015). A global database can help build and maintain reliable information, sectoral mapping, existing financial opportunities, climate compatible innovations, and a progress measurement system (Global Alliance for Buildings and Construction, 2016). The IEA also recommends an array of standardised information packages that can allow decision makers to compare the potential of technology



alternatives, identify performance targets and energy and CO₂ savings at the time of design or purchase (IEA, 2013).

There is a particularly high need for international governance institutions to provide a consistent guidance and signal towards decarbonisation of the buildings sector. The need for international institutions to provide the other identified governance functions is medium to medium-high (see Table 3.1) – while for example the need for regulation may be higher at other levels of governance.

Table 9.1: Synthesis of Demands for International Governance of the Buildings Sector

Sector	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
Buildings	Sector-specific decarbonisation target and sub-targets for subsectors (like heating, cooling, cooking and heating water)	International technical standards and agreement on far-reaching decarbonisation objectives	Monitoring of implementation of rules	<ul style="list-style-type: none"> - Training, capacity building and awareness raising - Finance and investment 	<ul style="list-style-type: none"> - Policy and technical knowledge platforms - Global database
Grading	High	Medium-High	Medium	Medium-High	Medium

9.2. Governance Supply

This section provides a structured overview of existing/active international institutions relevant to the buildings sector and the governance functions they perform. We have identified 13 existing/active international institutions which provide some governance to the buildings sector of which 5 are international institutions, 2 are regional and 2 are city networks. The table below provides a quick overview of the relevant institutions and which governance functions their activities most relate to. It is observed that the delivery of knowledge and learning is the governance function most performed by far. A detailed overview of the institutions is provided in the annex to this paper.

9.2.1. International Institutions

The G20. The IPEEC Secretariat oversees and coordinates the G20's energy efficiency work under the 2014 G20 Energy Efficiency Action Plan and 2016 G20 Energy Efficiency Leading Programme. Buildings feature as one of six priority areas outlined in the Action Plan and has a dedicated task group: the Buildings Energy Efficiency Task Group (BEET) which works under the G20 Energy Efficiency Leading Programme (G20, 2016). Through BEET, which is a collaborative platform for countries to research, inform and support the development and implementation of effective building energy efficiency policies, focusing closely on building rating systems and building codes, the G20 provides knowledge and learning. BEET has also developed a web portal to facilitate collaboration among participating countries on building performance metrics and building codes and further generates knowledge through various reports. In 2014, the Energy Management Working Group (EMWG) of IPEEC launched in July 2010 launched a consensus-based, international

certification scheme for ISO 50001⁷⁹ (IPEEC, 2018) 'Lead Auditor' which provides rules, while oversight by the EMWG provides transparency and accountability. 'Lead Auditor' also builds capacity among accreditation and certification bodies in participating countries to establish new personnel certification programs that are nationally relevant and internationally equivalent (IPEEC, 2016). Through the EMWG, energy ministries also share best practices, stakeholder (private industry, non-government organisations (NGOs), standards and accreditation bodies) are engaged, and national and regional energy and climate strategies are supported.

The International Energy Agency (IEA) launched in 1974, is a Paris-based autonomous intergovernmental organisation established in the framework of the Organisation for Economic Co-operation and Development (OECD). The vast majority of the IEA's work on decarbonisation in the buildings sector is based on knowledge and learning, and foster sharing of best practices through reports and stakeholder interaction. The IEA also conducts trainings (IEA, 2013a; 2015; 2018a), experts dialogues (IEA, 2018b) and workshops (IEA, 2011a; 2012; 2014) on various relevant issues. The IEA produces important knowledge on subjects like modernising buildings energy codes (IEA, 2013b), energy performance certification (IEA, 2010), energy efficiency policies (IEA, 2011b) and so on. It regularly produces technology roadmaps (IEA, 2013c; IEA, 2011c; IEA, 2013d; IEA, 2011d) which fill an important knowledge gap especially amongst stakeholders in developing countries and produces detailed pathways to Transition to Sustainable Buildings by 2050 (IEA, 2013e; IEA, 2018c).

The United Nations Environment Programme (UNEP) is an agency of United Nations and coordinates its environmental activities, assisting developing countries in implementing environmentally sound policies and practices. Supported by UNEP, a 'Common Carbon Metric' aims to allow emissions from buildings around the world to be consistently assessed and compared, and improvements measured thereby providing rules (UN Environment Programme, 2018c). It contributes means of implementation through numerous projects which target capacity building, training, raising awareness, finance and investment. The Sustainable Buildings and Construction Programme (SBC) was launched in 2015 to promote resource efficiency, mitigation and adaptation efforts, and the shift to SCP patterns in the buildings and construction sector (UN Environment Programme, No Year a). Its Sustainable Buildings and Climate Initiative (SBCI) launched in 2006 UNEP promotes and supports sustainable building practices on a global scale with a focus on energy efficiency and GHG emission reduction while its Sustainable Social Housing Initiative (SUSHI) and the Sustainable Buildings Policies in Developing Countries (SPOD) promotes sustainability in social housing programmes and helps governments at national and local levels to develop policy tools for mainstreaming sustainable construction and buildings approaches respectively.

⁷⁹ The ISO 50001 is applied by nearly 12 000 organisations at the end of 2015. According to the Clean Energy Ministerial (CEM), the implementation of ISO 50001 could potentially drive cumulative energy savings of approximately 62 exajoules by 2030 (in 2010, total global primary energy consumption was 550 exajoules), save USD 600 billion in energy costs and avoid 6500 million metric tons of CO₂ emissions.

The Sustainable Energy for All programme launched in 2011 is a global initiative to provide universal access to modern energy service, and double both the global rate of improvement in energy efficiency and the share of renewable energy in the global energy mix. The Energy Efficiency Accelerator Platform was established to help accelerate energy efficiency action in specific sectors, such as district energy, lighting, appliances, vehicle efficiency, buildings and industry (UN Environment Programme, 2016a). The District Energy in Cities Initiative, a partnership coordinated by UN Environment, supports market transformation efforts to shift the heating and cooling sector to energy efficient and renewable energy solutions. These are only a few examples of UNEP's work on means of implementation.

UNEP also helps building knowledge through reports, tracking progress, designing roadmaps in concert with government focal points and stakeholders (UN Environment Programme, 2018a) and financing projects. Its various programmes bring together sector stakeholders by providing a platform for dialogue and collective action, develops tools and strategies to better evaluate and implement sustainable building practices, and pilot projects. The NAMA for Buildings project started in October 2013 and has delivered stakeholder engagement to share experiences on assessment of existing building policies and identify priority opportunities for potential buildings sector NAMAs (UN Environment Programme, 2018d). A Global Status Report 2016 aims to track each year the progress made in the transition towards low-emission and resilient real estate, building knowledge (UN Environment Programme, 2016b), while the Handbook on Climate finance for cities and buildings helps raise awareness among local stakeholders regarding climate finance and its potential in the built environment, help local governments use climate finance mechanisms to increase the energy performance of their district while creating additional revenue, improve resource efficiency and support their wider climate strategies (UN Environment Programme, No Year b).

"A 'Quick Scan Tool' to assess policies in the building sector and scenarios to improve the current situation are being tested in two pilot cities, Nairobi (Kenya) and Ouagadougou (Burkina Faso)" (UN Environment Programme, 2018b). A Regional Sustainable Consumption and Production (SCP) Roadmap aims to promote resource efficiency, mitigation and adaptation efforts, and the shift to SCP patterns in the buildings and construction sector. The roadmap focuses on regional level support through national technical assistance packages at the sectoral/thematic level, regional and sub-regional policy dialogue, training and networking activities, building public private partnerships, and offering national training activities (UN Environment Programme, No Year). UNEP, with support of the Cities Alliance, is also developing a practical methodology for better integrating environmental concerns in strategic planning at the city level (UN Environment Programme, No Year c). UNEP is also working closely with UN-Habitat on sustainable urban planning and management through a 2007 joint Partnership Framework.

The United Nations agency for human settlements and sustainable urban development (UN-Habitat) seeks to promote socially and environmentally sustainable human settlements development and adequate shelter for all. UN-Habitat delivers mainly means of implementation and knowledge and learning through sharing of best practices and providing a platform for stakeholders. It channels finance from other sources to enhance the transition to low emission urban development

(Ministry of the Environment, Finland and UNEP, 2015). Through Its 10YFP Programme on Sustainable Buildings and Construction (one of the five initial 10YFP programmes adopted in Rio+20) it seeks to build and add to existing knowledge (UN Habitat, 2015).

UN-Habitat helps capacity development programmes in partnership with local government training institutes and universities. Its Habitat UNI initiative (UN Habitat, 2012) links it to universities worldwide and in addition to thematic hubs, its Global Urban Lecture series builds knowledge on decarbonisation of buildings sector. Its Habitat Professionals Forum (HPF) was established in 1999 as an inter-disciplinary partnership of Human Settlement Professionals and UN-Habitat to promote the delivery of sustainable urbanisation and equitable human settlements development. It provides a platform for Human Settlements NGOs and works amongst other targets, to deliver sustainable urbanisation, especially at the “grassroots”, in particular by building up capacity in countries without it (Habitat Professionals Forum, 2018).

Its initiatives seek to raise awareness and build knowledge. For instance, it's Cities and Climate Change Initiative (CCCI), active in 40 cities, supports city leaders and practitioners in addressing the impact of climate change (adaptation) and to help to reduce greenhouse gas emissions (mitigation) through vulnerability assessments, climate change action plans, and in some countries support towards policy processes that address climate change. Its World Urban Campaign (WUC) is an advocacy and partnership platform to raise awareness about positive urban change in order to achieve green, productive, safe, healthy, inclusive, and well-planned cities, driven by 180 partners and networks globally.

9.2.2. Multilateral Development Banks (MDBs)

Funding from MDBs like the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank Group (IDBG), and the World Bank Group (WBG) are key to decarbonisation of the sector. A significant amount of finance will be required for the transition. The IEA (2013) estimates that decarbonisation in the sector would require USD 31 trillion by 2050). However, a joint report from the above mentioned MDBs published by EIB (2016) on MDB climate finance reveals that while the combined MDB climate finance for 2016 was US\$ 65 Bn (constituted of US\$ 27 Bn in climate finance and US\$ 38 Bn in net climate co-finance alongwith MDB own resources), less than a fifth of the total adaptation finance (18 percent or around US\$ 1 Bn) of US\$ 6.2 Bn went to the “energy, transport and other built environment and infrastructure” (it is unclear how much was transferred to the buildings sector in isolation). Activities eligible for building sector climate finance include: energy efficiency improvements and audits (EIB, 2016). However, while they all have relevant finance programmes, the exact figure going to the buildings sector is unavailable.

The World Bank Group (WBG) is an international financial institution that provides loans to countries of the world for capital programs. Between FY2011 and FY2016, the WBG committed \$63 billion dollars, an average of more than \$10 billion a year, to more than 1,000 climate-related projects that help countries adapt to a changing climate and mitigate the impacts of climate change.

In the past decade, WBG has almost doubled its financial commitments for cities to an annual average of \$4.11 billion (FY2009–FY2013). WBG performs four governance functions: (issue specific) guidance and signal, rules setting, means of implementation and knowledge and learning. WBG provides a very focused guidance of transitioning to clean stoves and fuels. It provides rules through the development of green building codes and certification systems. A member of the World Bank Group, International Finance Corporation (IFC) is the largest global development institution that focuses exclusively on developing countries. It has also developed green building codes for numerous cities and countries. Although insufficient in aspiration, IFC's EDGE (Excellence in Design for Greater Efficiencies) is a green building certification system which offers certification for new housing, offices, retail, hospitals and hotels that achieve at least 20 percent reductions in energy, water and the energy used in making the building materials compared to conventional construction. The EDGE certification is currently used by more than 130 countries.

The WBG provides finance, investment, training, and capacity building and raises awareness. Since 2005, the IFC has invested about \$15.3 billion in long-term financing for energy efficiency, renewable power, and green buildings (the green building portfolio of commercial and residential buildings totals more than \$1.5 billion) (World Bank, 2018). In India, the IFC is planning to invest over US \$1 billion in next five years in creating green buildings, out of a total planned investment of around US \$5-6 billion to be injected into the country's climate change programs. IFC is also one of the earliest issuers of green bonds. Since 2014, the IFC supported 93 green bond eligible projects worldwide worth USD 3 billion. The IFC plays a leading role in developing principles, procedures, and guidelines for the global green bond market, providing the issuers and investors practical guidance in launching a credible green bond for sustainable construction projects (Shan et al., 2017). Since 2008, the World Bank has issued over USD 10 billion equivalent in green bonds supporting around 70 sustainable development projects around the developing world. To accelerating the transition to clean stoves and fuels, the World Bank has committed \$130 million across 13 countries benefitting 11 million people to date. Moreover, “through results-based financing (RBF), the World Bank has helped private companies to enter the clean cookstoves market in China, Mongolia, Lao PDR, Bangladesh, Uganda, and Kenya. In Indonesia, a pilot project provided incentives to 10 private suppliers to distribute 10,000 clean cookstoves” (World Bank, 2017).

Under its urban strategy, several resilient cities initiatives have been established which raise awareness of sustainable buildings and engage in capacity building (World Bank Group, 2016). By 2020, the WBG seeks to, through its Global Platform for Sustainable Cities, further integrate climate into urban planning and launch tools and knowledge products available for 30 cities by 2020 (World Bank Group, 2016b). From FY2011 to FY2015, WBG portfolio for climate funding in Africa was around \$1.7 billion per year, most of which focused on mitigation, mainly on energy and green buildings (World Bank Group, 2016b). Through its Global Platform for Sustainable Cities, the WB aims by 2020 to develop pilot programs in 15 cities that integrate low-carbon and climate resilient approaches to various elements of urban planning. The WBG performs knowledge and learning by reports, conferences, new technologies for training like the Open Learning Campus, “open data” approach, which help develop evidence-based policies. Open data are particularly important for DRM and climate change adaptation, considering the need to include risk information and data in

planning and design decisions (Shan et al., 2017). The WBG's Collaboration for Development (C4D) platform's ECCH Community of Practice (CoP) is a collaboration tool, aims to facilitate knowledge sharing, and stakeholder engagement on clean cooking and heating (Collaboration for Development, 2018). ESMAP is a partnership between the World Bank Group and 17 partners to help low and middle-income countries on sustainable energy solutions which emphasises knowledge and sharing and training. ESMAP's Tool for Rapid Assessment of City Energy (TRACE) which helps more than 80 cities globally use energy efficiently (ESMAP, 2018).

9.2.3. Other International/Global Institutions/Initiatives

The **Global Buildings Performance Network (GBPN)**, launched by the Climate Works Foundation in 2010, is a "globally organised and regionally focused organization" that advances building energy performance and works towards sustainable buildings. The GBPN is headquartered in Paris and has regional representation offices (in Beijing) and partner organisations (in Delhi, Brussels, Washington D.C. – partner organisation include mainly NGOs or foundations) which aims to provide policy expertise and technical assistance to stakeholders (international organisations, governments, industries, research institutes and NGOs). GBPN has project partners also in South East Asia, while their experts network includes Latin American and African expertise. GBPN pursues a "Deep abatement Path" with a sector specific target of 2.2 Gigatonnes of CO₂ (GtCO₂) abatement globally by 2030 and 3.2 Gt CO₂ by 2050 compared to today's carbon emissions and 80 percent energy demand mitigation from buildings globally by 2050 compared to 2005 levels. It has also developed locally adapted (country and region specific) implementation roadmaps (Global Buildings Performance Network, 2012) and guidelines to help develop sector-specific strategies (Global Buildings Performance Network, 2013a).

GBPN activities include policy analysis, capacity building, awareness raising and sharing of knowledge, data and best practices between regions. The GBPN fosters research and knowledge amongst diverse key stakeholders and helps them identify, adapt and implement policy best practices for low-energy, affordable and healthy buildings. It has created numerous on-line tools and engages in capacity building by providing venues for sharing and implementation of best practises and policies (Global Buildings Performance Network, 2013g), training (Global Buildings Performance Network, 2017a; Global Buildings Performance Network, 2017b; 2013h), building market intelligence (Global Buildings Performance Network, 2017c), workshops (Global Buildings Performance Network, 2013i) and widely accessible webinars (Global Buildings Performance Network, 2013j; Global Buildings Performance Network, 2014d) which explain technical details to a large number of stakeholders. Its web portal (Global Buildings Performance Network, 2015) supports more efficient international collaboration on building energy code implementation and is part of GBPN's 'Laboratory' (Global Buildings Performance Network, 2013k) - a knowledge platform on building energy performance policies globally – which also includes knowledge on buildings renovation and positive energy buildings.

The **Global Alliance for Buildings and Construction (GABC)** was set up at COP21, as part of the Lima Paris Action Agenda and includes 24 key countries (ministries) (mainly in the Americas, Europe, Russia and parts of Asia – state members in India, China and Australia) and 72 non-state

organisations (sub-national, non-governmental organisations and private sector) from all over the world (The Global Alliance for Buildings and Construction, 2018). The GABC guidance to the sector to remain by 2050 on a below 2 °C path or 84 GtCO₂ (from energy efficiency, fuel switching and renewable measures in buildings) reaching even up to cumulative saving of 250 GtCO₂ (when paired with increased investments in low-carbon power generation) (The Global Alliance for Buildings and Construction, 2016) (targeting 50 percent or more energy savings potential in 2050) via a low-carbon and energy transition through policies for sustainable, energy efficient buildings. The GABC has developed a global roadmap to this extent in collaboration with UNEP (The Global Alliance for Buildings and Construction, 2016).

The global roadmap seeks to set relevant targets for a low-carbon, energy efficient buildings and the construction sector, increase awareness, train building professionals, engage on workforce development and skills and training, support technology transfer, convene and facilitate events (round tables, workshops, and deal-flow events) in partnership with the G20 and UNEP. It also streamlines access to the large number of existing support programs, create a deal-flow database that includes project-ready assistance for policy action planning activities, identify funding to conduct market engagement and coordinate community engagement. The GABC has also set up various support programs, platforms, and tools. GABC does not provide finance but helps to identify investment barriers and existing solutions, promoting collaboration between public and financial sectors and drive harmonisation (in building codes, housing policies, property standards, and evaluations of performance) in order to enable and accelerate investments.

The **World Green Building Council (WorldGBC)**, founded in 1999, is a non-profit organisation and a coalition of national Green Building Councils (GBCs) (independent, non-profit organisations made up of businesses and organisations working in the building and construction industry) from 73 countries (spread across all continents) and representing over 49,000 property and construction companies (World Green Building Council, 2017). The WorldGBC has office in five regions Africa, Americas, Asia Pacific, Europe and the Middle East and North Africa (MENA) and endeavours to tailor its approaches according to regional capacities and needs. It is the largest international organisation focusing closely on green buildings. WorldGBC provides a 2050 sectoral decarbonisation target of limiting global temperature rise to 2 °C, reducing the building and construction sector's CO₂ emissions by 84 Gigatonnes and warranting all buildings be net zero emissions. WorldGBC promotes green building across the globe, engages in awareness raising and communication, builds capacity and knowledge, engages stakeholders through events and programmes, and generates new ideas and solutions that accelerate green buildings often through regional-specific projects.

It launched 5 new net zero building certifications under which 1.24 billion m² (an area roughly the size of the city of London) of green building space around the world have been certified by 2017 (World Green Buildings Council, 2017). It has various focused working groups (example an Asia Pacific one on achieving net zero carbon buildings by 2050) which works with key players in the region. Via its Building Efficiency Accelerator programme - a partnership of businesses, NGOs and multilateral organisations and led by the World Resources Institute - GBCs provide support and expertise to 25 cities across Europe, Asia, Africa and the Americas to reduce their buildings' energy

consumption and CO₂ emissions. Its net zero buildings awareness campaign recorded more than 250 events and activities around the world. It has also launched 8 national renovation strategies to renovate existing buildings to high standards of energy efficiency in Europe.

Low Carbon Technology Partnership initiative (LCTPi) is a climate leadership program of the WBCSD (a global, CEO-led organisation of over 200 leading businesses working together to accelerate the transition to a sustainable world) launched at COP21 in Paris that brings companies together to accelerate low-carbon technology solutions to stay well below the 2°C limit as outlined in the PA. Although it has a broad focus, in the buildings sector, LCTPi targets 65% of emissions reductions or 3-3.5 GtCO₂e/year for remaining well below the 2°C ceiling and reduce projected energy use in buildings by 50% by 2030 through energy efficiency in buildings (Low Carbon Technology Partnership Initiative, 2015). It engages in training and capacity building and finance through various initiatives and has developed platforms for stakeholder engagement. LCTPi has a dedicated Energy Efficiency in Buildings (EEB) Working Group which not only targets low carbon technology deployment, but also brings together buildings value chain stakeholders in 50 local markets. Between 2014 to 2016, 10 cities engaged through this process resulting in six new EEB platforms in Houston, Warsaw, Jaipur, Jakarta, Shanghai and Rio de Janeiro. The success of the 10 EEB pilot cities, will be expanded to 50 cities by 2020. LCTPi has also created a business-led approach Handbook on Energy Efficient Buildings. LCTPi also launched enabler projects on awareness. LCTPi fosters sharing of best practice on building efficiency to achieve national energy and climate goals.

9.2.4. City Networks

Local Governments for Sustainability (ICLEI) is the world's leading network of over 1,000 cities, towns and metropolises committed to building a sustainable future, impacting over 20% of the world's urban population. ICLEI provides means of implementation, helps build knowledge, fosters stakeholder engagement and the sharing of best practises and has tools which help diffuse knowledge. Its dedicated Buildings Efficiency Accelerator (BEA) programme is a public-private collaboration present in 33 cities across the Americas, Europe, Asia and Africa, that helps accelerate local government implementation of building efficiency policies and programs. Actions include implementing buildings codes, retrofits (including improvements in insulation and heating systems and installation of renewable energy systems), application of best practices in energy efficiency and so on (BEA, no date).

C40 Cities Climate Leadership Group (C40), launched in 2005, is a network of more than 90 of the world's megacities (representing over 650 million people and one quarter of the global economy) committed to addressing climate change. C40 supports cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change. It is the world's largest cooperative effort among mayors and city officials to reduce greenhouse gas emissions and climate risks in cities. C40 cities are required to commit themselves to a target of limiting global temperature rise to 1.5 °C. Although the target is broad, it is assumed to cover also the buildings sector. More specifically in the buildings sector, C40 focuses intently on training and capacity building, awareness, sharing of best practises, facilitation of peer-to-peer exchanges, collaborating on data management, policy and technical knowledge platforms which underscore

stakeholder engagement and has an open, interactive data source. It has a few dedicated networks which focus on energy efficiency of existing commercial and residential buildings, efficiency of municipal buildings, low-carbon district heating, cooling and Combined Heat and Power (CHP) systems, and sustainable infrastructure finance (C40, 2016). All these networks provide platforms for sharing best practices, collaborating on data management, promoting technologies, building awareness, and finding new solutions. It also produces numerous open access reports related to buildings sector decarbonisation and conducts events/workshops.

9.2.5. Regional Institutions/Initiatives

The **Renovate Europe** campaign (Renovate Europe, 2018) was initiated by EuroACE (The European Alliance of Companies for Energy Efficiency in Buildings) and is an industry-led political communications campaign calling for the reduction of energy demand of the EU building stock by 80% by 2050 compared to 2005 levels through legislation and ambitious renovation programmes which would bring the energy performance of the entire building stock in the EU to an NZEB performance level. Renovate Europe envisions achieving the target by tripling the EU's average renovation rate from the current 1% to 3% per year before 2020, ensuring that all renovations are deep or staged deep renovations and driving the formulation and implementation of an effective policy and legal framework. Beyond its campaign for a region-specific sectoral target, Renovate Europe produces reports and holds events which adds to sectoral knowledge and learning.

The **Asia Pacific Economic Forum (APEC)** is a forum for 21 Pacific Rim member economies that promotes free trade throughout the Asia-Pacific region. APEC program Nearly (Net) Zero Energy Building aspires to reduce APEC's aggregate energy intensity by 45 percent by 2035 compared to 2005 providing a very specific sectoral target. APEC's benchmarking system for data on energy use in commercial and industrial buildings (Feinberg, R. E. & Zhao, Y., 2001) provide rules for the region while its "Green Building Project" advances use of international standards. Its dedicated projects contribute by building awareness and promoting participation in developing technical requirements that facilitate trade in the sustainable construction of commercial buildings (ASTM International, 2011). APEC's "Green Building Project" advances green building and building energy efficiency provides means of implementation and fosters public-private collaboration.⁸⁰ APEC also builds knowledge and learning through its platforms. For instance, APEC program on NZEB involves 20 APEC members and covers a series of meetings, task group (since 2013), exchange of NZEB best practices, energy reduction results comparative studies, an APEC Nearly (Net) Zero Energy Building Roadmap Study, and progress reports and energy efficiency goals which vary by region, climate, energy sources and environmental goals (resilience, etc.) (Stinson, S., 2017). Another APEC Energy

⁸⁰ In addition to finance, the Project supports a variety of actions within individual economies like exchange of knowledge on green building codes and building information modeling (BIM), various guides (such as the APEC Green Building Code Infrastructure Guide, Start-Up Guide on Building Information Modeling, APEC Guide to Performance Metrics and BIM to support Green Building Objectives) and Building Codes and Standards which exchanges best practices on individual APEC member economies building codes that increase building performance.

Working Group is helping member economies optimise local building codes with the aim of making commercial buildings more energy efficient. APEC also provides a platform for energy officials from member economies who meet regularly to enhance commercial building energy performance and discuss nearly zero energy building development (Focus Taiwan, 2017).

9.3. Assessing the Governance Complex

This section discusses to what extent the governance demands are collectively being satisfied by the institutional complex as described above (and as summarised in table 9.2 below). The institutional landscape that is relevant for the decarbonisation of the buildings sector is characterised by a little more than a dozen or so institutions with insufficient reach and authority to decarbonise the sector. The greatest need identified in section 9.1.3 for decarbonisation of the sector was for international governance to provide guidance and signal in the form of a sector-specific decarbonisation target and sub-targets for subsectors (like heating, cooling, cooking and heating water) as well as regional specialisations. However, very few of the institutions identified define targets for the buildings sector, and where they do, the reach and authority of the targets remains unclear. Moreover, hardly any institution emerges saliently as a core institution for the building sector.

Guidance and Signal Function

Guidance to decarbonisation of the buildings sector has been identified as a sector-specific decarbonisation target and sub-targets for subsectors (like heating, cooling, cooking and heating water). These are variously provided by GBPN, GABC, WorldGBC, LCTPi globally, and APEC and RenovateEurope regionally. Moreover, the WBG provides a sub-sector specific targets calling for a transition to clean stoves and fuels while Renovate Europe calls for tripling the EU's average renovation rate before 2020. Overall, the global targets vary in emissions reductions quantities and energy consumption reductions, which leads to the lack of a firm, definitive guidance and signal (sectoral 'decarbonisation' target, sub-targets for subsectors). Most of the institutions/organisations' targets are compatible a 2°C target, but it is unclear whom their targets mainly seek to inform or whether they are authoritative enough to commit stakeholders and those outside of their engagement to sectoral decarbonisation. Overall, the provision of guidance to the sector remains low.

Setting Rules to Facilitate Collective Action

Section 1.3 has identified the need for international technical standards and agreement on far-reaching decarbonisation objectives in order to fulfil the function of rules setting. In the buildings sector, while a number of international institutions/organisations may provide variations of technical standards (WorldGBC' Green Buildings Certification Scheme, the G20's consensus-based, international certification scheme for ISO 50001, WBG's Green Buildings codes and Green Buildings certification system, APEC's benchmarking system for data on energy use in commercial and industrial buildings and its "Green Building Project" advances use of international standards), there is no global treaty/agreement on the decarbonisation of the building sector (which may be rather difficult to achieve). Little harmonisation exists, and the several certification schemes make up for

hardly any rules. For instance, according to the IEA (2016), “two-thirds of energy consumption from buildings being built today has no codes or standards applied to it”. Rules facilitating collective action can be assessed as low.

Transparency and Accountability

Transparency and accountability have been identified to be delivered through the monitoring of implementation of rules. The function is vaguely fulfilled by only two international institutions/organisations in the buildings sector. UNEP has developed a 'Common Carbon Metric' which aims to allow emissions from buildings around the world to be consistently assessed and compared, and improvements measured. The G20 through its Energy Management Working Group (EMWG) encourages the implementation of energy management systems. There remains limited knowledge and related means as to the progress actors are making towards decarbonisation of the buildings sector. In addition, the data is not easily accessible, and one can question whether the measure to ensure transparency and accountability is authoritative. Transparency and accountability as concerns sectoral decarbonisation remains low.

Means of Implementation

All the international organisations/institutions active in the buildings sector provide some measure of means of implementation, which has been identified in section 1.3 as training, capacity building, awareness raising, finance and investment. A number of online tools are available to train stakeholders, other international organisations/institutions build awareness and disseminate information, some conduct trainings, a number of them provide platforms for stakeholder engagement and a limited number provide finance. APEC, UNEP and the WBG are the only ones which provide the most significant finance and investments to the sector for decarbonisation. Finance however remains the most potent means of implementation. The IEA (IEA, 2013) estimates that decarbonisation in the sector would require USD 31 trillion by 2050. While exact figures of financing by MDBs for the buildings sector and its decarbonisation are not available, they may only provide a limited share of the overall requirements in light of the size of the global buildings stock and future growth. City networks in particular help foster awareness of the need for decarbonisation of the sector. Overall, the means of implementation available for sectoral decarbonisation can be assessed as medium.

Knowledge and Learning

Every single international institution/organisation in the buildings sector provides some means of adding to knowledge and learning. A number of them offer policy and technical knowledge platforms for sharing and curating global best practices. Some have created interactive online learning online tools, web portals and webinars which supports more efficient international collaboration. Likewise, almost all international institutions/organisations produce reports, roadmaps and host events which gather sector stakeholders. GABC has developed a global deal-flow database while UN-Habitat has set up a knowledge programme directly with universities worldwide. The amalgamated effort of all international institutions/organisations makes an important

contribution to knowledge and learning in the buildings sector. The provision of knowledge and learning towards decarbonisation of the sector can be deemed as medium.

9.4. Conclusions and Recommendations

International governance for the decarbonisation of the buildings sector remains highly **piecemeal and fragmented**. There is no central international institution guiding the sector toward carbon neutrality. Instead, the need for the various governance functions is met to varying degrees by about a dozen or so intergovernmental and transnational institutions (a relatively limited number compared with some other sectors analysed in this report). A clear and authoritative translation of the PA's decarbonisation goal for the buildings sector globally (e.g. NZEB as a general standard, including fast deep renovations of existing building stock) and regionally is clearly missing. There is also a dearth of efforts to define and agree on related technical standards and objectives (including for subsectors, such as heating, cooling, etc.). And capacity building and finance are in need of more encompassing strategy, including a clear positioning of international finance in efforts to comprehensively shift investments towards a decarbonisation of buildings.

As a matter of fact, the lack of appropriate international governance reinforces the **continuing carbon lock-in of the sector**. Without determined efforts at making new buildings (that will normally be in use for decades to come) climate-neutral and increasing the rate of climate-deep renovations of existing buildings, reaching decarbonisation of the buildings sector early in the second half of the century gets ever more difficult and possibly unfeasible (CAT, 2016).

Several of the institutions identified as contributing to the international governance of the sector could in principle help step up related international governance. As regards enhanced **guidance and signal as well as international standards**, the UNFCCC/PA, the G20, GABC, UNEP and UN-Habitat could in principle contribute to filling the existing gaps. Each of them has particular advantages and limitations. The UNFCCC/PA has global reach, but limited involvement of sectoral stakeholders and is generally focused on more overarching international governance (i.e. has limited capacity to address specific sectors). The G20 has a more limited membership that may prove problematic for a sector that has global reach. UNEP has limited reach towards the buildings sector. The GABC has the advantage of bringing governments and sectoral stakeholders together, but participation has so far remained limited and would have to be upgraded. UN-Habitat also has an appropriate sectoral focus, but has so far not proven capacity to address global standards for the buildings sector. It might also be possible to initiate a cooperative effort amongst several of the aforementioned institutions, thereby combining their strengths, to develop a common vision and certain technical standards guiding the decarbonisation of the sector.

The **finance sector** has particular importance for the decarbonisation of the buildings sector. After all, the decarbonisation of the buildings sector has been estimated to require total investments of more than USD 30 trillion by 2050 (IEA 2013). International financial institutions cannot be expected to bring about this financing (to which national and bilateral sources will also have to contribute), but they can play an important and catalytic part in the overall investment shift required. This would entail ensuring that their finance is clearly and exclusively directed at supporting building and

renovation programmes and projects that are climate-proof and Paris-compatible and hence result in NZEBs, and that they focus their financing on those regions and countries where need of international finance is most pronounced (especially in regions of the Global South). In this way, international financial institutions could become important pacemakers for the climate transition of the sector. This would be part of the broader agenda of reforming international financial institutions and “shifting the trillions” for an effective and accelerated climate transition (see separate chapter on the financial sector).

Transparency and accountability as well as **knowledge and learning** can also be further enhanced. In particular, UNEP’s efforts at developing and spreading a common carbon metric for buildings could be further developed and spread internationally; there is also further scope for developing standards for building certifications and codes (e.g. by ISO?); and the various initiatives to advance knowledge and learning (by virtually all the identified institutions) could be further networked and coordinated so as to ensure this crucial area maximises its contribution. To this end, it may be useful to consider the establishment of an overarching platform (“platform of platforms”) that provides information on relevant initiatives, including channels available for related capacity-building. This could be of use for several of the networks involved in concrete implementation on the ground, prominently including city networks. Several of the more overarching existing institutions could coordinate and operate such an overarching platform (UNEP, UN-Habitat, IES, GABC, GBPN), that could be carried by several of them in cooperation.

The **UNFCCC and its Paris Agreement** could, as with respect to other sectors, probably best assume an overarching supervisory function. While the UN climate regime could in principle engage in more targeted sectoral governance of the building sector, it may not be best suited for doing so (e.g., given its already heavy agenda and the limited potential to engage sectoral stakeholders). It may best discuss and provide input to related efforts undertaken by other, sectorally more specialised institutions. Data reporting may hold some promise to tracking progress in the sector. In particular, however, the UNFCCC could usefully request or encourage countries to **include sectoral objectives and measures in their “nationally determined contributions” and their low GHG emission development strategies**, including for the buildings sector (and to potentially take into account international standards (to be) developed by other sector-specific institutions – see above).

The decarbonisation of the buildings sector raises few direct **equity and fairness issues**. It is not prone to lead to the demise of particular regions or economic sectors. Rather, building sector decarbonisation is expected to help create additional employment and value in the construction sector. Having said that, equity issues lurk more indirectly. For example, strengthened buildings standards could raise upfront investment costs, which could constitute a burden on financially weaker building owners/house builders (especially in developing countries). This might require appropriate attention in the design of finance and other support schemes, including by international financial institutions/governance.

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Table 9.2: Summary of activity under key international governance functions for buildings

Functions	Guidance and Signal	Setting Rules	Transparency Accountability and	Means of Implementation	Knowledge and Learning
List of Institutions	Sector-specific decarbonisation target and sub-targets for subsectors (like heating, cooling, cooking and heating water)	International technical standards and agreement on far-reaching decarbonisation objectives	Monitoring of implementation of rules	<ul style="list-style-type: none"> • Training, capacity building and awareness raising • Finance and investment 	<ul style="list-style-type: none"> • Policy and technical knowledge platforms • Global database
Global Buildings Performance Network (GBPN)	<ul style="list-style-type: none"> • Reduce 2.2 Gigatonnes of CO₂ (GtCO₂) globally by 2030 and 3.2 Gt CO₂ by 2050 compared to today's emissions. • 80 percent energy demand mitigation globally by 2050 compared to 2005 levels. 	•	•	<ul style="list-style-type: none"> • Capacity building, awareness raising and sharing of knowledge, data and best practices between regions, • Numerous on-line tools • Training 	<ul style="list-style-type: none"> • Knowledge platforms • Global online resource as well as a tool on buildings energy performance scenarios • Venues for sharing and implementation of best practises • Workshops • Widely accessible webinars which explain technical details to a large number of stakeholders. • Web portal on building energy code implementation
Global Alliance for Buildings and Construction	<ul style="list-style-type: none"> • 84 GtCO₂ by 2050 • cumulative saving of 250 GtCO₂ • 50 percent or more energy 	•	•	<ul style="list-style-type: none"> • Increase awareness, • Skills and training • Support technology 	<ul style="list-style-type: none"> • Convene and facilitate events • Deal-flow database • Promoting collaboration between

Functions	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
(GABC)	savings potential in 2050			transfer • Streamline access to the large number of existing support programs	public and financial sectors • Various support programs, platforms, and tools
Renovate Europe	<ul style="list-style-type: none"> • reduction of energy demand of the EU building stock by 80% by 2050 compared to 2005 levels • tripling the EUs average renovation rate from the current 1% to 3% per year before 2020 	<ul style="list-style-type: none"> • 5 new net zero building certifications 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Produces reports and holds events
World Green Building Council (WorldGBC)	<ul style="list-style-type: none"> • 84 GtCO₂ by 2050 • All buildings be net zero emissions by when? 	<ul style="list-style-type: none"> • Green building certification scheme 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Net zero buildings awareness campaign • Capacity building • Support and expertise to 25 cities 	<ul style="list-style-type: none"> • Working group in Asia Pacific to advance net zero carbon buildings by 2050. • knowledge diffusion • Europe wide 'energy efficient mortgage' system EeMAP which brings together stakeholders.
Local Governments for Sustainability	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Fosters stakeholder engagement • Sharing of best practises 	<ul style="list-style-type: none"> • Tools which help diffuse knowledge

Functions	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
(ICLEI)				<ul style="list-style-type: none"> Financed projects 	
Low Carbon Technology Partnership initiative (LCTPi)	<ul style="list-style-type: none"> 65% of emissions reductions or 3-3.5 GtCO₂e/year by 2030 50 percent energy savings potential by 2030 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Training and capacity building and finance Projects on awareness Low carbon technology deployment Brings together buildings value chain stakeholders in 50 local markets 6 new eeb platforms (to be expanded to 50 cities by 2020) 	<ul style="list-style-type: none"> Energy Efficiency in Buildings (EEB) Working Group Handbook on Energy Efficient Buildings sharing of best practice on building efficiency to achieve national energy and climate goals. city-business collaboration model
C40 Cities Climate Leadership Group (C40)	<ul style="list-style-type: none"> Limiting global temperature rise to 1.5 °C (Broad goal) 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Training and capacity building Building awareness 	<ul style="list-style-type: none"> Sharing of best practises Facilitation of peer-to-peer exchanges Collaborating on data management Policy and technical knowledge platforms Open, interactive data source



Functions	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
					<ul style="list-style-type: none"> • Dedicated networks • Reports • Events, workshops
Asia Pacific Economic Forum (APEC)	<ul style="list-style-type: none"> • APEC program Nearly (Net) Zero Energy Building aspires to reduce APEC's aggregate energy intensity by 45 percent by 2035 compared to 2005. 	<ul style="list-style-type: none"> • Benchmarking system for data on energy use in commercial and industrial buildings • The “Green Building Project” advances use of international standards 	<ul style="list-style-type: none"> • Progress reports 	<ul style="list-style-type: none"> • Finance • Capacity building • Build awareness • “Green Building Project” • Funding to Building Codes Assistance Project. 	<ul style="list-style-type: none"> • Exchange of NZEB best practices, energy reduction results comparative studies • APEC Energy Working Group • Stakeholder processes • Public-private collaboration and facilitate technical solutions in addition to adopting best practices • APEC Nearly (Net) Zero Energy Building Roadmap Study
Group of 20 (G20)	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • In 2014, the EMWG launched a consensus-based, international certification scheme for ISO 50001. 	<ul style="list-style-type: none"> • Lead Auditor programme builds capacity among accreditation and certification bodies in participating countries 	<ul style="list-style-type: none"> • Buildings Energy Efficiency Task Group (BEET) • Web portal on building performance metrics and building codes • Reports • Energy Management Working

Functions	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
					Group (EMWG)
International Energy Agency (IEA)	•	•	•	•	<ul style="list-style-type: none"> • Foster sharing of best practices through reports and stakeholder interaction. • Conducts trainings, expert dialogues and workshops • Technology roadmaps • Detailed pathways to transition to sustainable buildings by 2050
United Nations Environment Programme (UNEP)	•	<ul style="list-style-type: none"> • 'Common Carbon Metric' aims to allow emissions from buildings around the world to be consistently assessed and compared, and improvements measured. 	•	<ul style="list-style-type: none"> • Capacity building • Raising awareness • Finances projects • Stakeholder collaboration • Pilots projects in developing countries • Projects targeting energy efficiency improvements energy service, and energy efficiency action. • A handbook on climate finance for cities and 	<ul style="list-style-type: none"> • Tracking progress • Designing roadmaps in concert with government and stakeholders • Platforms for dialogue and collective action • Tools and strategies to evaluate and implement sustainable building practices • Quick scan tool' to assess policies in the building sector and scenarios to improve the current



Functions	Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
				buildings helps raise awareness among local stakeholders	situation • Stakeholder engagement • Regional roadmap
World Bank Group (WBG)	<ul style="list-style-type: none"> • Transition to clean stoves and fuels 	<ul style="list-style-type: none"> • Green building codes • Green building certification system 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Provides finance • Green Bonds • Technologies for training like the Open Learning Campus • Training 	<ul style="list-style-type: none"> • Pilot programs in 15 cities on urban planning. • Reports, conferences, “open data” approach • Collaboration tool to facilitate knowledge sharing, and stakeholder engagement. • Knowledge and sharing
The United Nations agency for human settlements and sustainable urban development (UN-Habitat)	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Capacity building 	<ul style="list-style-type: none"> • Sharing of best practices • Platform for stakeholders • Links to universities worldwide • Thematic hubs • Toolbox • Advocacy and partnership platform

10. Synthesis, Conclusions, Next Steps

10.1. Introduction

This chapter offers a summary of the sectoral findings of preceding chapters, begins to draw out common themes, identify implications for key international governance actors, including the EU, and suggests promising pathways for future research. It is structured as follows. First, the findings regarding the adequacy of fulfilment of governance functions by the activity mapped in the sectoral system analyses are summarised and compared. Implications from each of the sectoral chapters for the work of the UNFCCC/ Paris Agreement (PA) are drawn out. Further cross-sectorally relevant findings are then offered, including some related to carbon pricing, and others to interplay between the climate and trade regimes. Then, in view of the conceptualisation of ‘adequacy’ presented in Deliverable 4.1, consideration is given to the importance of equity and ‘just transition’ in policy responses, and the social acceptability of policy-making institutions more broadly. Following this, some implications for the role of the EU are drawn out, particularly with a view to enhancing the prospects for upward ‘ratcheting’ of ambition in the ‘post-Paris’ climate regime.

As noted in Chapter 1, this deliverable should be regarded as a staging post on the way to a planned journal special issue or book project by the authors. Its findings will continue to be updated in the light of both emerging developments (such as imminent decisions related to international aviation) and reviewer comments (that time constraints have prevented from being acted upon fully). Several chapters are due to be presented at the forthcoming Earth System Governance (ESG) conference, Utrecht (5th - 8th November 2018), where the authors successfully proposed a dedicated panel session on *Assessing the Adequacy of the Global Climate Governance Complex après Paris*.

10.2. Comparative Findings on Sectoral Governance

The findings of this analysis highlight wide variation across the sectoral systems examined, in terms of how far important governance functions are addressed by the existing governance complex, summarised in Table 10.1 below.

Given the large number of relevant institutions and initiatives, in many cases the breadth of their contributions, and at times a lack of transparency over the detail of relevant actions, it has not always been feasible to arrive at an overall ranking (low, medium, high) of the ‘supply’ of each of the five governance functions. This applies to finance in particular, where, as the authors of chapter 3 note, a more detailed methodology would need to be developed before overall rankings can be offered in a non-arbitrary way. It also particularly affects international transport. In interpreting the scoring, it should also be stressed that some sectoral system analyses took more account of regional-level detail than did others (compare the detail on regional initiatives in the assessment of the power sector, for example, with relative lack of coverage in the extractive industries analysis).⁸¹

⁸¹ We hope to extend the analysis of extractive industries accordingly in future work.

Table 10.1: Summary of fulfilment of governance functions, by sectoral system

Note: FFS gives specific ranking of progress regarding fossil-fuel subsidy reform, under the extractives heading. International transport (S = shipping; A = aviation) has not been fully scored due to the need for more detail, or clarity regarding the outcome of current decision-making processes.

	Guidance and signal	Rules for collective action	Transparency and accountability	Means of Implementation	Knowledge and learning
Finance	N/A	N/A	N/A	N/A	N/A
Power	Med	Low-Med	High	Med-High	High
Energy-intensives	Med-low	Low	Low	Low	Low
Extractives	Low FFS: Low-Med	Low FFS: Low-med	Low FFS: Low-Med	Low FFS Low-Med	Low-med FFS: Low-med
Transport	Med	Low	Med	Med	Med-high
Int. transport	<i>S: Med</i> <i>A: Low</i>	<i>S: Low</i> <i>A: Low-med</i>	<i>S: Low-med</i> <i>A: tbc</i>	<i>S: Low</i> <i>A: tbc</i>	<i>S: Low-med</i> <i>A: tbc</i>
Buildings	Low	Low	Low	Medium	Medium

Much governance activity is evident in some sectoral systems, and regarding particular governance functions, as reflected in the great length of some chapter summary tables. However, there is a tendency for this activity to relate to the easiest functions to address, such as learning and knowledge building, or to take place in somewhat limited ‘niches’ carved out, for example, in the finance and transport sectoral systems. Across all sectoral systems examined, the assessments find the gap between governance demand and what is supplied is most serious in terms of the critically needed function of setting rules to facilitate collective action. Guidance and signal can also be seen as lacking, particularly in finance, extractive industries, energy-intensive industries, and buildings. The least contentious function, that of providing opportunities for knowledge dissemination and learning, is the one closest to being adequately fulfilled.

Of the sectoral systems we examined, the power sector appears the most advanced in covering the main international governance functions required of it – particularly regarding transparency and accountability, means of implementation (with some caveats on finance), and knowledge and learning. Its relatively advanced position can arguably be explained by considering that policy makers (both international and domestic) have been paying attention to it for longer, its public profile has been higher, it has been easier to deal with through national-level action (e.g. it is less prone to leakage), and that it has fit the dominant paradigm that demand for (rather than supply of)

fossil fuels needs to be targeted. Moreover, compared to some of the other sectors, it is easier to decouple from economic growth. Nevertheless, it still falls short in achieving critical governance functions to the extent necessary for sufficient decarbonisation. Significantly, while the signal is strong and clear for the phase-in of renewable energy, it is somewhat vague when it comes to the phase-out of coal-powered electricity generation and virtually absent when it comes to generation powered by oil and particularly gas.

Though it has proved difficult to measure it satisfactorily, the finance sector has made important progress in recent years, influenced by key policy entrepreneurs occupying senior positions in global institutions, who are well attuned to the dangers that climate change increasingly poses to the sector. Yet the crucial guidance and signal function is fulfilled in a mostly indirect or partial way, and financial means of implementation, though increasing, remain insufficient compared to global investment needs. As with the power sector, we find that phasing *out* support for ‘brown’ investments constitutes a tougher challenge than raising funds for investments in low-carbon alternatives. This clearly tallies with the findings on fossil-fuel extractive industries (chapter 6), as well as the transport related sectoral systems (chapters 7 and 8 respectively).

It is useful to ask why sectors other than electricity are lagging behind. As a non-exhaustive set of possible reasons, which can be elaborated in future work, this may be because they:

- are less easy to deal with through national-level action, due to difficulty of accounting for emissions (e.g. international transport) or globally complex value chains (energy-intensive industries);
- don’t fit the dominant paradigm that demand for (not supply of) fossil fuels is the issue (fossil-fuel extractive industries);
- are particularly difficult to decouple from economic growth/ patterns of development (all kinds of transport);
- are overseen by highly complex, often non-transparent sectoral governance institutions, into which attempts to mainstream climate concerns have only belatedly begun (finance).

Although much governance activity is evident for several sectoral systems, overall we are not convinced that this is of the most effective kind. In this, we echo recent findings on the extent and effectiveness of ‘polycentricity’ offered by Jordan *et al.* (2018).⁸² Often, as in the energy-intensives (chapter 5), transport (chapter 7) and buildings (chapter 9) cases, there is no central and/or coordinating institution. More effective mitigation will need greater co-ordination or orchestration effort, sometimes from the UNFCCC/ PA, but also from the likes of the G20. The recent agreement of an initial climate strategy by the IMO demonstrates that, faced with enough pressure (including from

⁸² While it is often assumed that the groundswell of new initiatives is cumulative, we would caution against this. Further research could usefully focus on how many initiatives have in fact ended, or essentially exist only ‘on paper’.

the EU's credible commitment to act unilaterally in the absence of multi-lateral action), sectors that do not fall under UNFCCC auspices can deliver meaningful action. In theory there could be lessons here for other sectors, such as energy-intensive industries. The findings of chapter 5 suggests that there may be a case for new, subsector-specific institutions that could serve to address the identified governance gaps and potentials.

10.3. Implications for the UNFCCC/Paris Agreement

Each of the sector-oriented chapters, as well as the dedicated assessment (chapter 2), draw some more specific conclusions with respect to the role of the UNFCCC/ PA, and offer some recommendations. Although the PA provides a strong overarching signal towards decarbonisation, to avoid ambiguity this arguably needs to be translated into more sectorally-specific targets and trajectories. Whether the role of formulating such targets and trajectories should fall to the UNFCCC, however, remains a moot point. Given its strong focus on GHG emissions in general and the historically relatively minor role that sector-specific perspectives have played in negotiations, chapter 4 suggested the UNFCCC is perhaps not the right place. Currently, the system of NDCs and LTSs that Parties are invited to prepare (implicitly) enlist national governments in developing such visions, but not in an internationally coordinated manner. On the other hand, the UNFCCC could still 'take note' or 'endorse' visions developed at other international forums in a COP decision, thereby raising the profile of such sectoral visions and further institutionalising them.

Chapters 2, 3, 6 in particular highlight the importance of a clearer and stronger signal about divesting from carbon-intensive investments and aligning all financial flows with climate goals, as set out in Article 2.1(c) of the PA. Potential opportunities to integrate the alignment of financial flows in the design of Paris 'rule book' can be identified, such as requiring NDCs to include finance-related commitments and policies, including reductions of fossil-fuel subsidies, introduction of carbon pricing instruments, and national legislation for mandatory climate-related financial disclosure. One of the main foci of the Global Stocktake could be assessing progress towards the long-term goal set out in Article 2.1(c), with information on financial flows relevant for this goal identified as relevant inputs, and recommendations and guidance to both Parties and non-Party actors in relation to achieving the goal becoming one of its main outputs (see chapter 3).

Its established system of reporting and review may give the UNFCCC/ PA particular advantage when it comes to further improvements in transparency and accountability in a range of sectors. One qualification to this point, however, emerges from the examination of fossil-fuel extractive industries chapter. The established territorial approach to accounting for emissions does not recognise or reward actions which might cause reductions 'offshore' (such as restricting fossil fuel exports). An alternative accounting framework based on extraction-based emissions would help ensure that such efforts are reflected in national accounts (Piggot et al. 2017). As chapter 6 suggests, an extraction-based accounting system could be established in parallel to monitor the alignment of fossil fuel supply with climate goals.

In terms of securing adequate means of implementation, while the amount of finance and the lack of 'bindingness' of the commitment constitute a major weak spot of the PA, the UNFCCC's financial

mechanism with the Green Climate Fund (see chapter 3) still constitute a potentially powerful lever. To fully employ it, the UNFCCC must collaborate with other international institutions. The World Bank and other MDBs are accredited entities to the Green Climate Fund and help to disburse the available funding; another candidate for closer coordination could be the Mission Innovation initiative to increase funding on research and innovation for clean energy (see chapter 2).

While it may be ideal for a single dedicated international organisation/institution to perform the most important governance functions, the need/suitability for the UNFCCC to become more active in specific sectoral arrangements varies depending on the characteristics of the system in question. The governance of most energy-intensive industries, for example, requiring cooperation of a relatively limited number of countries/players, may not require the global reach of the UNFCCC, making an institution such as the G20 a more suitable candidate. Smaller scale alternatives - institutions like the CSI for each energy intensive industry subsector - may also prove effective. Further research is needed on the question of where the absence of a single overarching international organisation/institution is really a critical impediment to progress.

Given the tendency of the UNFCCC to gridlock, it may also be the case that smaller coalitions of the willing will first need to form on a mini-lateral basis, implementing their own sets of rules, as suggested in chapter 6 on extractive industries. In the case of international transport, the prospect of continuing deadlock led to UNFCCC 'outsourcing' governance responsibility to the ICAO and IMO. Though progress in both has been slow, the 2018 agreement on an interim climate strategy for shipping arguably provides some vindication of that 'division of labour', at least in the case of the IMO. The UNFCCC need not be completely excluded, but, as noted above, can take note of or endorse visions developed at other international forums. In such cases of 'outsourcing', the findings of this analysis highlight the importance of coordination when it comes to accounting for emission reductions, in order to avoid double counting.

As noted in Chapter 3, UNFCCC-related events such as the *One Planet* Summit of 2017 can build political momentum, particularly for mobilising finance, to implement the PA (It also offered a platform for a growing coalition of actors in favour of acting on international shipping). A *One Planet* platform with annual summits is under discussion, and could provide a regular venue for making new pledges, setting targets, and tracking progress.

Issues relating to the UNFCCC's role in terms of 'just transition' are dealt with in section 10.5.1 below.

10.4. Further Cross-Sectoral Aspects

The research into different sectoral systems has revealed interesting linkages and dependencies between them, influencing the prospects for overall decarbonisation. As noted in chapter 5, for example, deep emission reductions from energy-intensive industries will require an approach that covers the supply and value chains across different sectors. Steel, cement, chemicals and aluminium producers mostly make intermediate products and hence have limited impact on the use of intermediate goods in the final consumer or other products. Therefore, reducing basic materials'

intensity in these end products through smarter design, efficient consumption and enabling a circular resource model will need to be part of an integrated mitigation effort related to the emissions of the basic materials sectors.

In the case of international transport, the pace of land-based energy-system transition will strongly influence demand for shipping, which in turn influences the extent to which low-carbon propulsion technology will need to be deployed (Walsh *et al.* 2017: 32). Wider decarbonisation of the electricity sector is also necessary if alternative fuels such as biofuel and hydrogen are to be manufactured in a sustainable way. Cross-sectoral interaction issues also arise for both aviation and shipping in terms of the need to compete for scarce supplies of biofuel with alternative uses, for example in the power sector. Given such competition, and the desire to minimise costs, continuing pressure to lower sustainability standards will likely be felt from some industrial interests. Regarding aviation, long-term availability and cost of offset credits depends on linkages with carbon markets associated with other economic sectors; chapter 8 noted pressures here too in terms of agreeing standards for the quality and integrity of credits. We return to these issues when highlighting implications for the EU, below.

As noted in the chapter on finance, investors and companies regularly call for more credible carbon pricing to correct policy and market failures. In this sense, it can be described as a governance *demand* actually emanating from actors making up many economic/ societal sectors (rather than the abstract sense in which our analysis has used the term). While the PA did not set an explicit, worldwide price, there is continued momentum for carbon pricing through existing and emerging initiatives beyond the UNFCCC. Chapter 3 noted how China's national 'cap and trade' carbon market is due to replace the European Union Emission Trading Scheme (ETS) as the largest carbon market in the world, and highlighted the Carbon Pricing in the Americas (CPA) platform. However, coverage of the global total of emissions under these schemes remains limited. The Carbon Pricing Leadership Coalition (CPLC), bringing together national and sub-national governments, businesses, and civil society organisations, has adopted and is working towards the long-term objective of a carbon price applied throughout the global economy that is in line with PA objectives, complemented by a high-level political Carbon Pricing Panel calling for raising carbon pricing coverage to 25 percent of global emissions by 2020 and 50 percent coverage by 2030, as well as a High Level Economic Commission that aims to identify Paris-compatible corridors of carbon prices (High-level Commission on Carbon Pricing 2017). The Commission's report joins others in highlighting the importance of reduction of fossil fuel subsidies as an essential element of carbon pricing. Currently, subsidies in effect constitute a *negative* price on carbon, offering a *negative* signal, hindering the achievement of climate targets.

10.4.1. Managing Climate-Trade Interactions

This section allows chance to reflect on what sectoral chapters have found in terms of possible conflicts or synergies between the climate regime as centred on the UNFCCC, and the trade regime centred on the WTO. Regulation of the response to climate change and world trade have proceeded predominantly in silos, thus with little consideration of issues of consistency between the two regimes (Bacchus 2017). In the case of inconsistencies between the two regimes, such as where a trade dispute arises, WTO rules and dispute settlement procedure are binding on WTO Member

States, in contrast to the voluntary nature of the NDCs and the absence of a dispute settlement system under the PA. To avoid potential conflicts, and in the absence of a carbon adjustment measure, Bacchus suggests that the WTO should consider adopting a ‘climate waiver’ to the regime’s rules.

The chapter on fossil-fuel extractive industries highlighted how existing rules expressed in the WTO Agreement on Subsidies and Countervailing Measures (SCM) appear to be inadequate to discipline FFSs. No fossil fuel subsidy has yet been challenged by a WTO Member, and notification rates of subsidies have generally been low, due to a lack of commitment (possibly due to fear of starting a trade dispute), a lack of clarity about which subsidies need to be reported, or inherent difficulties of estimating them (Casier *et al.* 2014; van Asselt 2014). The WTO could do more to incentivise subsidy reform, for example by clarifying precisely when a subsidy qualifies as either “prohibited” or “actionable”, allowing other WTO Members to take action under the SCM Agreement.

WTO rules also have potentially significant implications for action on international transport (Chircop *et al.* 2018). As noted in chapter 8, in overcoming possible conflict between CBDR and NMFT principles in the international shipping sector, the potential for market-based measures (MBMs) to offer a compromise is regularly discussed. However, some have flagged a potential relationship between such measures and WTO rules. Somewhat reassuringly, however, WTO representatives have remarked to the effect that the trade body could not challenge a global agreement facilitated by the IMO, and that its rules should not be invoked to stall progress tackling climate change.

GATT’s Article XX has permitted some environmentally-motivated exceptions to the non-discrimination principle where the measures in question are not “a means of arbitrary or unjustifiable discrimination” or a “disguised restriction on international trade”. Nevertheless, as chapter 5 noted, Border Adjustment Taxes that could ease the risk of energy-intensive industries relocating from countries with more ambitious mitigation policies to those with less stringent policies (carbon leakage) clash with the WTO’s Article I (Most Favoured Nation provision) and Article III (National Treatment Provision). While it may be the case that carefully designed carbon border adjustment tax could be permissible under the WTO, evidence for carbon leakage has remained inconclusive to date (Naegele & Zaklan, 2017).

As chapter 4 noted, the WTO is also relevant with respect to the trade of renewable energy and other low carbon technologies. Preferential trade agreements could play a strong facilitative role in promoting their deployment, but their potential is currently not being exploited according to some analysts (Lewis, 2014; Morin and Jinnah, 2018). In 2014 a group of 14 countries, including the US, EU, China and Japan started to negotiate a so-called Environmental Goods Agreement to reduce tariffs and trade barriers on low-carbon technologies (Van de Graaf and Colgan, 2016). In the meantime, the number of parties has increased yet the negotiations are slow and seem to have lost some of the initial momentum (Meyer, 2016; WTO, 2017).

Seen in this light, we suggest that the relationship between the climate and trade regimes is ambivalent, displaying potential for synergy as well as tensions. On the one side, WTO trade

disciplines hamper efforts at effective GHG emission mitigation, if only in the political discussion (Border Adjustment Taxes). On the other side, the WTO also provides a means to address FFS and a forum to develop a synergistic agenda for climate protection and international trade (Environmental Goods Agreement).

10.5. Fairness, Equity and Legitimacy Concerns in Policy and Institutions

Following the framework for ‘adequacy’ set out in D4.1, consideration also needs to be given to fairness and social acceptability of policy and policymaking in overall assessments of sectoral-system governance, particularly in terms of their implications for ultimate mitigation effectiveness. In the following, some reflections on how the ‘just transition’ agenda relates to the decarbonisation of the sectoral systems that this report has examined are first offered. Then, the question of legitimacy of the institutions implicated in decarbonisation responses is discussed.

10.5.1. Just Transition

As chapter 6 has noted, deeply significant, but as yet unanswered questions regarding an equitable decline in fossil fuel use include how to allocate the right to extract them in view of the remaining carbon budget, and how to support nations transitioning away from extractive economies. The question of fairness is notoriously fraught, and possible to frame in multiple ways when it comes to extraction/ supply side policies, e.g. based on historical extraction or per capita rights - if not on cost optimisation. What is clear is that mitigation in line with a 1.5°C temperature target would require the large-scale stranding of coal production and consumption assets, in particular, even with favourable developments in CCS technology (Spencer *et al.* 2018). Given existing economic structures, this will entail ‘stranded regions’ some states may in effect have to become ‘stranded nations’ (Manley *et al.* 2017). The process by which states (or regions within them) diversify their economies to make a transition away from fossil-fuel dependence, requires careful analysis and ‘complex international negotiation and coordination’ (Schlösser *et al.* 2017). Without this, the political viability of transition for such states and regions becomes, to say the least, problematic.

In terms of whether those who have most responsibility for present and past emissions, and/or most capacity to act, are currently shouldering responsibility, given the (announced) withdrawal of the US from the PA, and attempt to maintain coal production and consumption (and increase oil exploration), the answer is emphatically no. This may act as a deterrent to other large-scale fossil-fuel extracting states from acting more ambitiously. In terms of the reform of domestic fossil-fuel subsidies, there is evidence (OECD 2018) that reductions in more developed countries have stalled in recent years, with most reform instead occurring in developing nations, such as Indonesia and India. This may be regarded as problematic. At the global level, the contributions of major emitters to mitigation in the transport sector are not in line with their responsibilities and respective capabilities. Recent sales figures revealing an increase in the average emissions from new cars, despite regulation to bring the average down (particularly from the EU), reveal this in stark terms.

Complexities entailed in ‘just transition’ are both spatial and temporal: geographical disconnection between areas where jobs will be lost and areas where new jobs will be created, and temporal

disconnection for workers before new opportunities are presented. In the power sector, the main equity-related issue concerns the fate of those currently employed in coal-fired power stations. At first sight, the decarbonisation of the energy-intensive industries seems to raise equity issues to a comparatively limited extent: production facilities would still be required. To the extent that the response would succeed in also reducing demand for the relevant products (because of increased circularity), demand for energy-intensive products could decrease, causing employment. Chapter 5 suggests that the industrial restructuring implied by decarbonisation in energy-intensive industries is likely to result in winners and losers whose precise identities depend on the outcome of the race to climate-friendly breakthrough technologies. Coordinating R&D efforts could provide a means to facilitate careful and timely management of potentially negative social effects in a targeted manner.

The analysis of land transport suggests that the necessary shift to zero emission vehicles will entail major economic dislocation. Demand for oil would decrease massively, not only putting oil workers out of work, but also potentially destabilising entire oil-exporting countries. In addition, the value chains of EVs will be very different from those based on the internal combustion engine (ICE), potentially jeopardising employment in current value chains. Potentially this may affect not only producers of auto parts but also the entire steel industry, as EVs use much less steel than their ICE-based counterparts. A more optimistic reading of possible futures at the intersection of these sectoral systems would suggest that replacing the entire ICE-based fleet would have the net effect of raising overall demand for steel (at least during the transition). Moreover, new business and business models would be created through the circular economy, in which steel from scrapped vehicles would be recycled. Decarbonisation of the transport sector has the potential to enhance equity within societies, in particular the ‘avoid’ and ‘shift’ parts of the Avoid-Shift-Improve concept. Prioritising walkability and public transport will enhance the mobility of economically or physically disadvantaged people, as will the development of transport as a service.

Controversy continues in both aviation and shipping sectors over the question of fairness, and in particular whether those actors who have most responsibility for present and past emissions, and most capacity to act, are taking an adequate lead. In aviation, controversy has accompanied attempts to operationalise the aspirational goals for greater efficiency and carbon-neutral growth (CNG). These non-binding goals are neither assigned nor “attributed” to specific States or aircraft operators. Instead, all States are encouraged to collectively strive to achieve them. For some developing States that filed reservations, the fact that these goals did not set differentiated obligations made them unacceptable. Fairness concerns also arise over the CORSIA instrument’s requirement that developing countries offset the same percentage of emissions as developed countries until 2030, and potentially a higher percentage after 2030 (WWF 2017). As chapter 9 noted, several States declined to join the CORSIA pilot phase. Argentina, Brazil, Chile, India, Russia, Saudi Arabia, and Venezuela objected to CORSIA for various reasons, including a potentially disproportionately burden on developing countries (some of these have taken similar positions at the IMO). By giving a justification for opting out, it is arguable that failure to treat equity seriously in this case threatens effectiveness of the measures being put in place.

The needs of developing countries (especially SIDS and LDCs) for access to low-carbon technology have been acknowledged in debates at the International Maritime Organisation (Chircop *et al.* 2018). Without this, IMO efforts to introduce more ambitious regulation will run into political trouble. A further concern is voiced by exporters of certain perishable foodstuffs about loss of competitiveness resulting from imposition of slow steaming or other kinds of cost-raising regulations. Research suggests such concerns may be exaggerated (CE Delft 2017), and where genuine could be addressed through exemptions. In discussions of measures to internalise carbon externalities for both aviation and shipping, such as carbon taxation, compensating developing countries for the economic harm they might suffer - ensuring that they bear 'no net incidence' - is widely recognised as critical to their acceptability (IMF 2011). It also bears repeating that low-carbon innovation will create business opportunities, which can be a source of green growth and green jobs, not least in emerging economies.

The decarbonisation of the buildings sector raises few direct equity and fairness issues. It is not prone to lead to the demise of particular regions or economic sectors. Rather, building sector decarbonisation is expected to help create additional employment and value in the construction sector. Having said that, equity issues lurk more indirectly. For example, strengthened buildings standards could raise upfront investment costs, which could constitute a burden on financially weaker building owners/house builders (especially in developing countries). This might require appropriate attention in the design of finance and other support schemes, including by international financial institutions/governance.

As chapter 6 has noted, the UNFCCC negotiations include a Forum on the 'Impact of the Implementation of Response Measures', which in turn has developed a work programme focusing on 'economic diversification and transformation' and 'just transition of the workforce, and the creation of decent work and quality jobs' (UNFCCC 2015a). The preamble to the PA also recognises 'the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities' (UNFCCC 2015b). The 'response measures track' provides an obvious space for planning the transition away from fossil fuels. Indeed, the first UNFCCC technical report on 'just transitions' already acknowledges that the necessary fundamental change in the global energy mix will result in 'further job losses in the fossil fuel sector - in coal mining, in exploration and production of oil and gas, and at fossil fuel-powered power plants' (UNFCCC 2016a, p.31) (Piggot *et al.* 2017).

In addition to the UNFCCC, the G20 is also a strong candidate to oversee processes of transition at the global level, and handling the problem of 'stranded nations' (Goldthau 2017; Schlösser *et al.* 2017). However, both institutions would need to gear themselves up significantly to be credible and legitimate leaders of this global transition (SEI 2018). Processes by which these complex transitions can be negotiated and coordinated cannot be confined to official climate-policy related channels, but must also extend to development cooperation, and governance of finance where, as chapter 2 noted, improved information about climate-related risks is needed to guide investment.

10.5.2. Legitimacy

Means of implementation, in particular finance, are to a large extent channelled through the World Bank and other MDBs, who have long been criticised as donor-driven and for the social impacts of their projects. The World Bank-administered Global Environment Fund and Climate Investment Funds that channel resources largely through MDBs (see chapter 3) are likewise not fully accepted by developing countries and civil society, and accused of lack of responsiveness to developing country concerns over ‘ownership’. These concerns have implications for a range of sectoral systems covered in this report.

Chapter 4 suggests that in terms of the legitimacy of key sectoral governance institutions, the IEA may also be regarded as potentially problematic. While its assessments carry weight, the IEA’s legacy as an ‘oil buyers club’ arguably extends to a present day bias towards fossil fuels, expressed in apparent under-estimates of the potential of renewable energy. Along with this trust-related concern, the limited OECD membership list may also be highlighted as problematic. That said, the IEA is a prime candidate to take on a stronger role in sectoral decarbonisation efforts, as described in chapter 4, and could be separated from the OECD to attract a wider membership.

Beyond the IEA issue, criticism that the transnational governance landscape is dominated by northern initiatives/actors within those initiatives (Chan *et al.* 2018), holds true for the sub- and transnational initiatives considered in chapter 4, especially those focussing on local actors.⁸³ There is perhaps a need (and a potential role for the EU) to engage and support cities and regional governments in the global south, perhaps diffusing the Covenant of Mayors approach. But this will most likely require financial assistance as well as capacity building to enable local governments to meaningfully engage in such networks. Despite this possible criticism, there are quite a few initiatives that transcend the old north-south relationship, for example the variety of regional, African institutions, and particularly the Africa Renewable Energy Initiative (AREI).

In terms of legitimacy/ social acceptability of the institutions through which policy and governance occurs, both the IMO and ICAO are commonly subject to criticism. Over-representation in the ICAO Council of some regions, such as the Northern European States, (and Central and Latin America), and on the ICAO’s Committee on Aviation and Environmental Protection (CAEP) which makes key climate policy-related decisions, has attracted criticism (Piera 2016) and could be considered a priority for reform. Apart from representation, lack of transparency is a key legitimacy-related concern in this case. Submissions and inputs to the process of agreeing policy measures from ICAO members, including EU member states, won’t be made public until after the body adopts rules in June 2018.

In the case of shipping, the majority of the world’s commercial fleet is registered in only five states (Panama, Liberia, the Marshall Islands, Malta and the Bahamas), many of which are known as tax havens for ships. Together, these five contribute 43.5 per cent of the IMO’s total funding from 170

⁸³ We have not been able to explore this aspect for other sectoral systems.

member states. This gives potentially exaggerated weight in decision making, particularly when no checks and balances exist. National delegations to the IMO include industry representatives, who also take part in technical working groups. This inclusion explains the vocal opposition to sectoral emissions reduction targets from states, such as the Cook Islands, which might otherwise (given their vulnerability to climate impacts) be expected to take a progressive stance (Darby 2016). 31% of member states were represented in part by direct business interests at the most recent MEPC meeting, a degree of corporate representation in the policy making process that is exceptional among UN bodies (InfluenceMap 2017). Moreover, the IMO is also notoriously secretive in its meetings, with journalists and NGOs with consultative status unable to report freely. More positively, transparency about the IMO's administration is high, and information about the remit, powers and rules of procedure of its assembly, council and committees is easily accessible (Transparency International 2018).

The increasing importance of private green shipping programmes in shaping global business practice may also be highlighted. Among their limitations, a lack legitimacy and potential for undue corporate influence has been highlighted, in contrast for example to private transnational certification rule-making bodies in the natural resource and agriculture sectors (Lister 2015).

10.6. Core Issues for EU Leadership, Après Paris

The success of the PA in addressing climate change is contingent on how it now evolves over time (Kemp 2017). Most importantly, the concept of upward 'ratcheting' of emission reduction pledges is central to the eventual success of the agreement (as perceived not least by the EU). Several 'tools' by which this might be achieved have been noted in the literature. It is possible to adopt a broad definition of ratcheting, such that developments outside the UNFCCC regime also become relevant. Hale (2015), for example, usefully notes the following five potential 'ratcheting tools':

- 1) Agreeing to raise national contributions in regular, five-year cycles.
- 2) Agreeing to practical international review of country pledges that mixes accountability with support for implementation, tailored to countries' circumstances.
- 3) Supporting the groundswell of action from cities, companies, and other actors.
- 4) Continuing diplomatic efforts at the bilateral, mini-lateral, and sectoral levels.
- 5) Establishing a long-term goal and other policy signals that reinforce broader shifts in finance and technology.

The first and fifth of these tools are now embodied in the PA, while the details of the second remain to be agreed under the framework of the Paris 'rule book'. In terms of (4), following some important progress by the G7 and G20, the Montreal Protocol's widening to include HFCs, the Climate and Clean Air Coalition measures against short-lived climate pollutants, and the international shipping sector's agreement on an initial climate strategy (see chapter 8), attention may turn to international aviation, and energy-intensive sectors. Such "mini-lateral" and sector-specific deals provide concrete building blocks for countries to reach and exceed their national pledges, making it more likely that they will ratchet up action in the future. 'They are additive and complementary to the UNFCCC process, not an alternative to it' (Hale 2015: 4). Ideally, there is therefore a strong element of

interaction between the ‘tools’ outlined above: the ‘post-Paris regime may benefit from an upward spiral of climate actions in which domestic and transnational governance of climate change mutually reinforce one another. Building productive linkages across these spheres is, therefore, of central importance’ (Roger, Hale and Andonova 2016).⁸⁴

Adopting a broader conceptualisation of the ratchet mechanism allows for consideration of ways in which the EU could work to enhance the potential of a range of ‘tools’. Regarding tools 3 and 4 above, the literature (Hale and Roger 2014) is beginning to highlight interesting potential for new actors to engage in ‘orchestration’ activity, whereby states or international organisations multiply their influence by initiating, guiding, broadening, and strengthening transnational governance by non-state and/or sub-state actors (Abbott 2018). The World Bank, UNEP and the UK government have been noted as examples of orchestrators, but the concept remains ‘under-explored in the academic literature and underused by policymakers’ (Hale and Roger 2014: 61). Abbott and Snidal (2010) argue that orchestrators are likely to need cognitive, normative and executive influence. Hale and Roger (2014: 80) note how:

‘potential orchestrators will be relatively few—by definition, not everyone can be a focal institution—[but] many more states and IOs possess the capacity to orchestrate than do so. The European Union, for example, has not employed this strategy effectively, even though it would seem to be a logical way to advance EU goals in the face of multilateral gridlock’ (emphasis added).

Interestingly, in rejecting President Trump’s apparent offer to ‘renegotiate’ the PA, the EU pledged instead to bypass Washington to work with US business leaders and state governors to implement emission reduction commitments (Boffey *et al.* 2017). The feasibility of actors like the EU (and its individual member states) engaging more in orchestration activity, and the form it could take, should be explored further. Policy makers could strengthen new and existing international climate initiatives through technical and financial support; hosting of regular events to discuss and possibly launch new actions and initiatives in collaboration with non-state and subnational actors could fill current gaps in climate governance (Böbner and van Asselt 2017). Initiatives that help to strengthen insights into the *ex-post* performance of national climate policies could help improve implementation and the prospects of delivering NDC pledges. Supporting existing and new initiatives involving non-state and subnational actors in the Global South could further strengthen the EU’s credibility as a global climate leader (Böbner and van Asselt 2017: 12-13).

⁸⁴ Involvement of non-Party stakeholders in the global stocktake (and the 2018 Talanoa dialogue) is not only important for achieving greater transparency of their own actions. As Van Asselt and Böbner (2017) argue, non-Party stakeholders can also ‘offer insights into the mitigation potential in countries, identify untapped sources of financial, technological and capacity-building support, and consequently help identify ways to strengthen the ambition of Parties’ future NDCs’. Parties should therefore not just consider the role of non-Party stakeholders in the ‘input’ stage of the global stocktake, but also identify possible roles in the ‘output’ and ‘outcome’ stages.

This is not to under-estimate the importance of the EU's role in the inter-governmental climate regime as conventionally conceived. The literature has identified four main modes of (EU) leadership: structural, idea-based, directional, and instrumental (Parker and Karlsson 2014). *Structural leadership* 'relies on the capacity to take actions or deploy power-resources that create incentives, costs and benefits that may sway other actors to change their behaviour'. *Idea-based leadership* 'is characterised by problem naming and framing, agenda setting efforts and the discovering and proposing of joint solutions to collective problems'. *Directional leadership* means 'leading by example and demonstrating the feasibility, value, and supremacy of specific policy prescriptions'. *Instrumental leadership* refers to 'an actor's ability to promote the forming of coalitions, solve negotiation problems, and build bridges necessary to broker deals' (ibid). In the literature to date, this tends to refer to inter-governmental coalition building, but the concept could be widened.

A recent review of the impact of EU climate leadership has identified mixed and varied record of success associated with various leadership strategies. It suggests that the EU should practice multiple leadership modes, 'mainly because ... different leadership functions are important and are performed in different stages of the negotiation process' (Parker *et al.* 2017: 249). While Parker *et al.* had in mind inter-governmental negotiation processes, the idea that the lesson could apply more widely in a more polycentric setting is worth exploring further. We suggest a need to question why the Commission prioritises the initiatives it chooses to support, especially under Global Climate Action Agenda (GCCA)?⁸⁵ Is support for these initiatives the most effective way for the EU to adopt a leadership role beyond the UNFCCC. We suggest that a new research agenda should begin to examine how the EU's leadership style could respond to an increasingly polycentric climate governance landscape, where the UNFCCC is only one, albeit very important, venue for action, but where not all Member States may be members of other important venues for action (e.g. Friends of Fossil-fuel Subsidy Reform). In addition, where might the threat of EU unilateral action provide an effective option (as it has in international shipping and aviation cases).

10.6.1. Potential EU Role in Specific Sectoral Systems

Finance Sector

Given European 'weight' on global financial markets, the EU should use its Sustainable Finance Action Plan to promote the implementation of Article 2.1(c) in the UNFCCC and within its member states, while also seeking to influence the broader shift towards climate-aligned financial flows globally. This should include the setting of dynamic standards and metrics that are able to evolve over time and adapt to feedbacks from the physical world, such as in updating decarbonisation needs in terms of investments towards the 1.5°C goal.

⁸⁵ Through GCCA, the Commission supports: the Africa Renewable Energy Initiative (AREI); the Global Covenant of Mayors for Climate and Energy; Mission Innovation; the Climate and Clean Air Coalition; the G7 Climate Risk Insurance Initiative; the NDC Partnership: Working Together to Achieve Ambitious Climate Action While Enhancing Sustainable Development.

As carbon pricing initiatives expand around the world, the EU could explore collaboration and possible integration opportunities with its own ETS, while bearing in mind the importance of a wider portfolio of instruments. All of these can signal to investors, facilitating the adjustment of climate-related financial risks.

EU Member States could lead the way by building on the Task Force on Climate-related Financial Disclosures (TCFD) recommendations and creating mandatory regulations regarding carbon content and carbon risks disclosure within their jurisdictions.

Power Sector

Some EU member states (including France, the Netherlands, Finland, Denmark, Italy, Portugal and Austria), have already committed themselves to the phase-out of coal-powered electricity, and joined the Powering Past Coal Alliance. Germany, however, has not. The European Commission could consider becoming more pro-active here by initiating a post-2020, long-term plan for phasing out coal internally, as well as a move to support the new alliance as part of its external action (Droege and Rattani 2018). In order to help close identified governance gaps, the EU should consider:

- Placing decarbonisation of the power sector, including the phase-out of all fossil fuels, on the agenda of all appropriate international fora, in particular the G20, and looking for opportunities to link efforts to those of other sectors and/or issues such as security, trade.
- Seeking ways in which sectoral roadmaps and transformation visions can be taken up, endorsed, and meaningfully institutionalised within the UNFCCC and PA. This could include encouraging development of global or regional decarbonisation roadmaps by other institutions, such as the IEA.
- Exploring whether and how the IEA could become independent from the OECD and whether that independence would help to build trust and engage developing countries and emerging economies to broaden IEA's membership to become a truly global institution.

Energy-Intensive Industries

The EU is a key actor in the area of energy-intensive industries. It holds a significant share of relevant production (capacity) and is a key market for energy-intensive products. It also has important instruments to support and advance R&D for industrial low-carbon innovation (Horizon 2020, Innovation Fund, EUETS). Moreover, the EU and its member states (and their industries) are prominent and influential members of all existing relevant institutions. As such, the EU is well placed to play an active role in developing the sectoral climate governance landscape along the lines explored in chapter 5. It can in particular itself launch related public and public-private initiatives and coordinate with other key players to advance the development of international governance structures for decarbonisation in these sectors. It may also usefully support the building of broader international and transnational governance structures for this sectoral system by advancing bilateral

or plurilateral cooperation with key partners, for example in targeted R&D and the development and linkage/coordination of certain related policy instruments such as emissions trading systems.

Fossil-Fuel Extractive Industries

Regarding fossil-fuel extractive industries, and the subsidies they benefit from, the EU has made its own commitments which it could work harder to achieve, in keeping with its oft-professed climate leadership-by-example. Officially, Members States must phase out environmentally harmful subsidies (including those dedicated to fossil fuels) by 2020 (Gençsü *et al.* 2017), and end subsidies to uncompetitive hard coal mining by 2018 (EU Council Decision 2010). European governments have made parallel pledges to end fossil fuel subsidies under the G7 and the G20; Germany and Italy volunteered to be assessed under the G20 peer-review process (described in chapter 6). However, from 2014 to 2016, EU financial instruments and public banks are reported to have subsidised gas and oil production (within Europe and beyond) by over €3 billion per year on average (Gençsü *et al.* 2017).

In terms of its work through international organisations, as an important first step, the EU could promote enhanced transparency of FFS in the WTO, for instance by adopting a new notification template that provides further details on subsidies in a standardised fashion and allows NGOs to report on the level of non-actionable subsidies (Droege and Rattani 2018).

Working through bilateral/ regional trade agreements may also increasingly offer opportunities in the future governance of energy subsidies that the EU could promote. For instance, negotiations for an EU-Singapore Free Trade Agreement have included a notable provision on fossil fuel subsidies. This example shows that in the absence of progress at the multilateral level—or as a parallel effort—energy subsidy reform may well be driven by regional efforts (van der Graaf and Van Asselt 2017).

Transport

The EU, its member states and other progressive countries may wish to consider targeted initiatives to close governance supply gaps that currently exist particularly in rule-setting, transparency and means of implementation functions. The EU could work to establish requirements for a sectoral breakdown in NDCs and long-term strategies, with transport further broken down into passenger and freight categories. It could also advocate a sectoral breakdown to be included in the Global Stocktake, and a strengthening of national reporting and international review on national transport emissions, policy responses and their impacts. Furthermore, the EU could make its own provision of means of implementation compatible with the PA and work towards analogous policies within the multilateral financial institutions.

As chapter 7 noted, one obvious means to show leadership is through the EU's own fleet emission standards, currently in the process of revision. Due to the importance of the EU market, establishment of more ambitious standards would provide a kind of 'structural' leadership, incentivising a shift by all producers wanting to sell into the EU, fostering the production and sale of energy and carbon efficient vehicles globally. Currently, EU standards are too weak to play this role.

International Transport

EU institutions have pressed for greater policy ambition on both international aviation and shipping, with some effect, and look set to continue to do so.⁸⁶ At time of writing there are concerns that emerging CORSIA rules will contradict both the EU's 2007 ban on forest offsets being used in the EU ETS, and the European Parliament's vote to exclude palm oil from 2021 through the recast of the renewable energy directive. Campaigners have blamed the EU Commission for failing to push for greater transparency during ICAO negotiations. While the Parliament has no direct input to the ICAO's offset decision-making process, EU Aviation ETS legislation includes a timetable and review process that will allow it significant influence. If the offset process is not considered environmentally robust, the EU can bring the full EU ETS legislation back into force (ENDS Europe Daily 15/2/18). A further step that the EU could take unilaterally that would manage growing demand and also reduce a perverse subsidy would be to end passenger transport services' eligibility for reduced or zero VAT rates. Subjecting domestic, intra and extra-EU flight tickets to VAT at 15% would generate revenues in the order of €17 billion per year, presenting a major opportunity to easing the EU's ongoing budget issues, as well as beginning to internalise aviation's significant external costs (T&E 2018).

In shipping, the Commission has proposed a systematic and gradual three-step approach for integrating maritime GHG emissions into the EU's existing commitments. However, EU institutions have indicated a preference for the IMO to set targets and to adopt measures, and given progress apparent in that venue, it may be reasonable to give the global-level institution the benefit of the doubt for the time being. As an 'insurance policy', MEPs have proposed including shipping in the EU emissions trading system from 2023, if the IMO fails to agree a global measure. Ship operators would either have to buy ETS emissions allowances or contribute a corresponding amount to a new maritime climate fund. This would reinvest part of the revenue to make ports and ships cleaner and more fuel efficient. This prospect receded in November 2017⁸⁷ - but in principle could reappear. As noted in chapter 8, an EU-wide port charging scheme with incentives for greener ships has very promising potential to reduce shipping emissions. A further strong message emerging concerned the importance and urgency of switching funds away from the promotion of LNG infrastructures, and towards the small-scale developers of genuinely low-carbon alternative fuels that don't carry the same risks of 'lock-in'.

Buildings

The EU and its member states (and European sectoral stakeholders) are prominent and influential members of all relevant existing institutions. The EU is hence well placed to play an active role in developing the sectoral governance landscape along the lines explored [in chapter 9], including

⁸⁶ Many agree that it was ultimately bold action by the EU – temporarily including international flights from outside the EEA in the EU emissions trading scheme – that forced the ICAO to reiterate its commitment to action in 2013 (Gonçalves 2017).

⁸⁷ <http://www.seatrade-maritime.com/news/europe/threat-of-shipping-s-inclusion-in-eu-emissions-trading-scheme-recedes.html>

through pursuing targeted alliances to this end. Secondly, the EU is a key player in the construction sector and leading the development of the related regulatory framework, including the Energy Efficiency Directive, the Energy Performance of Buildings Directive, etc. as well as a plethora of national and local measures taken on this basis. The EU can play an active part in further developing these regulatory frameworks, and lead by example by accelerating the decarbonisation of the building sector (including by increasing the rate of retrofitting). It can also give a good example by including buildings in its low-GHG emission development strategy. In general, it can enhance its efforts to diffuse the lessons learned internationally in terms of best practice and capacity building, one key channel for advancing the decarbonisation of the building sector.

10.7. Future Research

Work remains to be done to refine the methodology by which rankings of the extent of attainment of governance functions can be offered in a more convincing way in some cases, and to update the database and 'scores' accordingly, in light of ongoing policy developments. Beyond this, several tasks for future research emerge from our analysis of the selected sectoral governance systems. To start with, the sectoral approach to understanding international climate governance can be further developed, including by considering in further detail multi-level interactions across various levels (local, national, regional and international), and what expectations it is necessary and reasonable to have regarding the international (including transnational) contribution to the whole. This might include investigation of the role different types of international initiatives, including "climate clubs" (i.e. governance efforts of smaller groups of countries/actors) might play in bringing about overall governance advances. A further task could be to pick up from the point made above regarding the need to question the assumption that the groundswell of new initiatives is cumulative. This should be treated as an empirical question, with future research usefully focusing on how many initiatives have in fact ended, or essentially exist only 'on paper'.

Closely related, future research could further systematise the investigation of the factors and driving forces that determine or affect the performance and effectiveness of sectoral governance systems in making meaningful progress toward decarbonisation. What endogenous/design and exogenous factors help advance the effectiveness of sectoral governance, and how might these factors be shaped and furthered? The design of particular governance initiatives in terms of participating actors (including intergovernmental, transnational and hybrid arrangements) and exact focus of activity may be part of the set of factors to be further explored, as is the broader institutional landscape in which such an initiative would be embedded (along with other factors such as the barriers to be overcome and the international constellation of power and interests).

Such a further deepened and systematised analysis would also provide a firmer basis for identifying policy options for the EU and other actors interested in advancing effective climate governance. This step of the analysis can further systematise the assessment of the political feasibility of different policy options (such as engaging in further efforts to advance orchestration of different governance arrangements, enhance certain particularly promising elements of the international governance landscape, or progress regional/national and bilateral efforts, possibly as a stepping stone to broader international change). In doing so, it would assist the EU (and other actors) in prioritising the

different options (that may not necessarily be incompatible, but may not all be pursued concurrently given resource constraints).

Several of the aforementioned tasks for pushing the research agenda of sectoral (international) governance forward will be further addressed in Task 4.3 of Work Package 4. This task is due to delve further into the sectoral governance of finance and investment as well as technology and innovation (in specific priority sectors), and will specifically investigate the potential for creating and advancing 'climate clubs' in a sectoral perspective.

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