

## Climate Action and Low-Carbon Economy



Kennedy Liti Mbeva<sup>1,3</sup> and Reuben Makomere<sup>2,3</sup>

<sup>1</sup>School of Social and Political Sciences, and Climate & Energy College, University of Melbourne, Melbourne, Australia

<sup>2</sup>Faculty of Law, College of Arts, Law and Education, University of Tasmania, Hobart, Australia

<sup>3</sup>African Centre for Technology Studies (ACTS), Nairobi, Kenya

### Definitions

**Climate change** is “any change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (UNFCCC 1992). The Intergovernmental Panel on Climate Change has described climate change as “any change in climate over time, whether due to natural variability or as a result of human activity” (IPCC 2014). The UNFCCC definition focuses on human-induced climate change, while the IPCC adopts a broader definition that includes both natural and human-induced climate change.

**Climate change impacts** are “the effects of climate change on human and natural systems” (IPCC 2018). These effects have detrimental consequences on the composition, resilience, and

productivity of natural and human systems (UNFCCC 1992).

**Climate action** includes responses by institutions, communities, or societies to respond to climate change (IPCC 2018). The main objective is to minimize GHG emissions that aggravate global warming and address the disruptions caused by climate change impacts (UNFCCC 1992).

**Climate change mitigation** refers to efforts to prevent or reduce the release of greenhouse gas (GHG) emissions into the atmosphere or to enhance the absorption of GHGs already emitted, thereby reducing the magnitude of future warming. This can be achieved through measures such as deployment of renewable energies and new technologies, enhancing energy efficiency, and improved sustainable agricultural and consumer practices (IPCC 2014; IPCC 2018).

**Climate intervention measures** include remedial measures such as solar radiation management (SRM) and deployment of carbon dioxide removal (CDR) techniques (Royal Society 2009; IPCC 2018; Royal Society 2018). SRM measures are distinct from mitigation or adaptation as their primary aim is to temporarily reduce or offset warming through deliberate modifications to the Earth’s ability to reflect sunlight and radiation (albedo). The net effect of these modifications is to increase the amount of solar radiation reflected from the Earth system therefore reducing the peak temperature from climate change. CDR is focused on reducing the concentrations of carbon dioxide or GHGs already in the atmosphere, as opposed to

reducing the amount of carbon dioxide or GHG emissions entering the atmosphere (mitigation).

**Means of implementation (MOI)** refers to collective actions toward realizing the objectives of the UNFCCC Convention and the Paris Agreement (Paris Agreement Article 14). Means of implementation includes capacity building, finance, and technology development and transfer.

**Low-carbon economy** refers to the development of an economy based on a low-emission pathway. This implies a low fossil fuel-based or decarbonized economy that has minimal output of GHG emissions (GHGs) particularly carbon dioxide, into the atmosphere (Carrasco 2014). Low-carbon economies possess key elements including low energy consumption, low carbon dioxide emissions, and low levels of pollution (Dou 2015).

## Introduction

In September 2015, the United Nations General Assembly adopted a resolution (Res. 70) that set out a global agenda of transforming the world toward sustainable development (UNGA 2015). The resolution set out 17 global Sustainable Development Goals (SDGs) and 169 targets that were to underpin this transformation agenda. Goal number 13 focused on climate change, with the objective to “take urgent action to combat climate change and its impacts”. Similarly, the adoption of the Paris Agreement on Climate Change, in December 2015, also marked a major milestone in international efforts to mobilize action toward responding to climate change. There is broad consensus that responding to climate change would require the development of a global economy that is based on a low-emissions pathway. The entry highlights the dynamic and broad variety of climate action across diverse regions, actors, institutions, and levels of governance and the linkages to the development of low-carbon economies.

Climate action has evolved both in definition and scope over the years. Initial focus was on reducing and stabilizing human-induced GHG emissions in the atmosphere (UNFCCC 1992). It

has been broadened to include other elements under the UNFCCC, such as adaptation to climate change, loss and damage, and support for means of implementation (MOI), through capacity building, climate finance, and technology development and transfer (UNFCCC 1992). Additionally, the scope of climate actors has also expanded over time from a primary focus on states and other parties to the UNFCCC and related agreements to non-state actors such as cities, private sector, civil society, and multilateral development institutions, among others (UNFCCC 2018).

While the discussion on implementing and scaling up climate action continues through various forums and at multiple scales of governance, it is becoming increasingly clear that considering scientific evidence, there is an urgent need to scale responses to climate change. This is especially considering increased intensity and frequency of adverse climate change impacts (IPCC 2018). It is also clear that ratcheting up of these responses will have to address diverse needs and circumstances of communities, countries, and regions. Adoption of the SDGs and entry into force of Paris Agreement reaffirmed countries’ commitment to climate action (UNFCCC 2016; Falkner 2016; Makomere and Mbeva 2018; Pauw et al. 2018).

General discussions on low-carbon economy have focused on the broader concept of the green economy, broadly defined as “an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (UNEP 2011, p. 1). Green economy tries to capture the broader efforts toward sustainability, with its three key components being the economy, environment, and society.

A more recent term, the blue economy, draws attention to oceans and other water resources; hence, it has a narrower focus. There are several definitions for blue economy. The most prominent is that advanced by the World Bank, whereby a blue economy “is understood here as comprising the range of economic sectors and related policies that together determine whether the use of oceanic resources is sustainable” (World Bank 2017, p. vi). Transition to a low-carbon blue economy

primarily involves reducing emissions from activities involving the use of ocean resources including the maritime industry. This entry incorporates both concepts in its reference to low-carbon economy.

The rest of the entry is arranged as follows. First, it sets the context by presenting the nexus between climate action and low-carbon economy. Next, it discusses the governance arrangements, categories of climate action, and the types of climate actors. Finally, it identifies the key issues emerging from this transition and concludes by identifying future research and policy directions.

## **Climate Action and Low-Carbon Economy Nexus**

The link between climate action and low-carbon economy involves several key elements. These include governance and economic implications of climate action on the global economy. Governance arrangements facilitate and regulate both climate action at all levels and the development of economies based on low-emission pathways. The economic implications of climate action not only drive decisions on the transition to low-carbon economies but also influence the rate of this transition at the international, national, and local level.

### **Governance**

There are several governance arrangements linking climate action to low-carbon development at multilateral, transnational, and sub-national levels. These range from multilateral agreements such as the UNFCCC and the Paris Agreement to national climate action plans and Nationally Determined Contributions (NDCs) of various countries. These governance arrangements have been important in elaborating on the linkages between climate action and the transition to a low-carbon economy. They have also played a critical role in galvanizing actors, actions, and resources toward climate compatible development, a key component of a carbon economy.

The Agreement also opened the door for countries to identify and include other stakeholders in the implementation of their NDCs (Hale 2016).

All the NDCs had a mitigation target chosen by the parties submitting them. An analysis of the aggregate impact of the NDCs, conducted by the UNFCCC, indicated that they would lead to a 3-degree temperature increase, much higher than the 2-degree target, and 1.5-degree aspirational target, of the Paris Agreement (UNFCCC 2016). The Paris Agreement is however designed to foster stronger action over time, using a “catalytic” approach of pledge-review-ratchet (Hale 2016). Parties are therefore expected to communicate their updated NDCs after every 5 years, with a view to strengthening them with each update. Following this logic, the aggregate impact of NDCs on mitigation should increase over time and get closer to the Paris Agreement’s temperature targets.

SDGs also embrace a “catalytic” approach, by adopting specific targets and establishing a high-level forum for review of progress on implementation. Specifically, SDG 13 (climate action) has targets on adaptation and resilience to disasters: integrating climate change measures into national policies, strategies, and planning; improving education and awareness on climate change; and mobilizing resources and enhancing capacity to respond to climate change.

Twelve indicators were then developed to track progress in implementation of the targets by 2030. Taken together, the Paris Agreement on Climate Change and SDG 13 not only form the backbone of the multilateral response to climate change but also underpin actions toward the development of low-carbon economies at international, national, and even local level.

Transnational climate governance has also emerged as an important way of strengthening climate action toward a low-carbon transition (Bulkeley et al. 2014; Andonova et al. 2017). While previous efforts to address climate change at the international level have focused on states, the rise of non-state actors has transformed the climate governance landscape. Increasingly, such actors work with each other, and with states,

across borders to address climate change. The Non-State Actor Zone for Climate Change (NAZCA) platform, for instance, lists numerous transnational initiatives on climate change, most of them focusing on mitigation (Chan et al. 2018, p. 139). This “regime complex for climate change” underscores the transformation from state-led to multi-actor and multilevel climate governance (Eckersley 2012; Jordan et al. 2018). Overall, the various climate governance approaches seek to broaden, catalyze, and strengthen climate action toward a low-carbon economy.

### Economic Implications

The transition to a low-carbon economy, through climate action, will have significant economic impacts. These impacts include demand side, supply side, value chains, and opportunity costs. On the demand side, climate action will have an effect on global consumption patterns. This will require a shift from carbon-intensive to low-carbon consumption, such as energy-efficient technologies (Mercure et al. 2018). On the supply side, extraction of fossil fuels will have to be limited or even ultimately stopped, as the next big step in climate policy (Erickson et al. 2018; McGlade and Ekins 2015). Similarly, financial investments will have to shift from the fossil fuel sector to the support, development, and uptake of low-carbon energy (Ansar et al. 2013; Hunt and Weber 2018).

Transition to a low-carbon economy will require a reduction in the carbon intensity of global value chains. For example, transportation of goods will need to be more energy efficient, and those goods will need to have lower levels of embedded carbon (Mercure et al. 2018). Finally, a just transition to a low-carbon economy will have to take into account the related opportunity costs. The question of who will have to forego exploitation of their fossil fuel resources, to keep within the carbon budget, will have to be resolved (McGlade and Ekins 2015; Newell and Mulvaney 2013). Furthermore, there will be need to enhance access to low-carbon technologies, especially by developing countries (Ockwell and Byrne 2016).

## Implementation of Climate Action and the Transition to Low-Carbon Economies

### Categories of Climate Action

In the pursuit of the objectives of the Convention and the Paris Agreement, there are several categories for climate action under the UNFCCC. These include climate change mitigation, climate change adaptation and climate resilience, loss and damage, and means of implementation.

#### Mitigation

There is a direct link between the increase in global average temperatures and the concentration of GHG in the atmosphere. A key component of the responses to global warming therefore is to decrease the amount of GHG emissions released into the atmosphere and reduce current concentrations of carbon dioxide by enhancing sinks (e.g., increasing the land cover of forests). There are several guiding provisions in the Convention and Paris Agreement that govern global efforts toward mitigation. State and non-state actors have a role to play in global efforts toward mitigation. The Convention, for instance, requires all parties to develop and implement programs aimed at mitigating climate change.

Mitigation actions could include policies, incentivizing programs for clean activities across all sectors and involving all types of actors, initiatives, and investment programs covering all sectors. Mitigation actions could also be translated into measures such as increased use of renewable energy, application of new technologies in areas like lighting and transportation, and behavioral adjustments like lifestyle change. Mitigation actions also include the conservation of natural sinks through expanding forests, and protecting oceans, so that they remove more carbon dioxide from the atmosphere (UNFCCC).

#### Climate Intervention Measures

Warnings from the UNFCCC and the IPCC that current mitigation efforts fall short of the Paris Agreement’s temperature targets (UNFCCC 2016; IPCC 2018) have opened and catalyzed debate on removing GHG emissions from the atmosphere through climate intervention

technologies. Climate intervention, sometimes referred to as geoengineering in some literature, broadly involves “. . . deliberate large-scale intervention in the Earth’s climate system, in order to moderate global warming” (Royal Society 2009; IPCC 2018). There are two main overarching categories of climate intervention actions: GHG removal, which involves the removal of GHG from the atmosphere, and solar radiation management (SRM), which aims to reflect some of the sun’s heat away from the Earth (Royal Society 2009). Carbon dioxide removal (CDR) is currently the most developed form of GHG removal. It is focused on the reduction of atmospheric carbon dioxide concentrations. Examples of CDR include ocean fertilization, ocean liming, and carbon capture and storage (Royal Society 2009; Lenton 2014; Talberg et al. 2018). SRM techniques on the other hand are focused on reducing warming through intercepting solar radiation before it reaches Earth’s surface. Some of the proposed methods include injecting particles into the stratosphere to deflect sunlight or spraying aerosols into low-lying marine clouds to make them more reflective (Royal Society 2009; Vaughan and Lenton 2011; Talberg et al. 2018).

Climate intervention measures however are complex, and the science of many climate intervention methods remains uncertain. It is broadly appreciated that deployment of these methods at a scale required to have the desired impact could have negative ecological and socioeconomic effects (Talberg et al. 2018). There are several governance concerns raised by climate intervention proposals. Some of these issues are common to other transboundary environmental issues, while others are distinct to the proposed interventions. The concerns include competing political institutions, perspectives, approaches, and values in governance of common natural resources. Some of the specific concerns with these proposals include the risk of moral hazard where they may potentially undermine global efforts for mitigation and adaptation (Reynolds 2015). Consequently, discussions on climate intervention require careful consideration at all levels of governance.

Several international environmental agreements are relevant to the governance of climate intervention measures. Climate intervention measures are loosely governed by agreements that were designed for other purposes, since there is no international agreement that primarily governs climate intervention measures (Talberg et al. 2018; Brent et al. 2018). These include the United Nations Convention on Biological Diversity (CBD), the United Nations Law of Sea Convention (LOSC), the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972 London Convention), and the Protocol to the Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (1996 London Protocol). International customary norms that deal with risk management, such as the no harm rule, due diligence, and the precautionary principle, are also relevant to the governance of climate interventions. However, climate intervention measures remain underdeveloped and pose risks to natural and human systems. Countries have therefore taken a cautious approach to adoption of these measures, for example, through forums such as the CBD and the London Protocol (for instance, Decision X/33 of the CBD, Article 6 bis London Protocol).

#### Means of Implementation

Support for means of implementation has always been a critical feature of international negotiations on global responses to climate change. Means of implementation consists of several elements, including climate finance, capacity building, and technology development. Developing and least developed countries require support to realize their climate action goals due to lack of capacity and resources. Support for means of implementation is based on the notion of the Common but Differentiated Responsibilities and Respective Capabilities (CBDR&RC) (UNFCCC 1992). CBDR&RC underpins calls for particularly developed countries to support countries that have contributed the least to climate change, are most vulnerable to the impacts, and have low adaptive capacity (Rajamani 2006).

Climate finance involves local, national, or transnational financing. It takes various forms, including grants, concessional loans, and commercial loans. It can also come from various sources including public, private and alternative sources such as multilateral development banks (MDBs). Large-scale investments are required to not only significantly reduce emissions but also enhance adaptation and climate change resilience. To facilitate the flow of climate finance to developing countries, financial mechanisms exist under the UNFCCC regime. There are several funds that have been set up to facilitate climate finance. These include the Green Climate Fund (GCF), the Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF), and the Adaptation Fund (AF).

Technology transfer from developed to developing countries, on the other hand, focuses on fostering access to technologies that would help respond to climate change by developing countries. These include renewable energy technologies, adaptation technologies such as drought resistance crops, and early warning systems. Practices that also advance climate action such as training on the use of climate technologies could also be included within the scope of climate technology transfer. There are several key institutions and mechanisms that support technology development and transfer. These include the Technology Mechanism, Technology Executive Committee, Climate Technology Centre and Network, Technology Framework under the Paris Agreement, and the Technology Needs Assessment Mechanism.

There is significant variation in the capacities of countries to effectively deal with climate change challenges and implement climate action (Weikmans and Roberts 2017). This makes it important to focus on building the capacity of these countries to effectively respond to climate change. Capacity building can take various forms, including creating awareness, improving technical capacity to monitor GHG emissions, and developing the adaptive capacity of developing countries and vulnerable communities, among others. Capacity building occurs at three main

levels: individual, institutional, and systemic level under the UNFCCC.

The UNFCCC regime contains several provisions that guide and govern capacity building actions. There are two main frameworks under the regime that underpin efforts to enhance capacity building especially in developing countries. One is primarily focused on developing countries, and the other is focused on economies in transition. The two frameworks were developed through a decision of parties to the Convention in 2001 (Decisions 2/CP.7 and 3/CP.7). This support can take the form of either financial or technical assistance. Developing countries and economies in transition are required to assess and identify their capacity needs to implement the Convention and Agreement.

There are several provisions and decisions under the Convention and the Paris Agreement that guide and govern support for means of implementation (UNFCCC Article 4, Paris Agreement Articles 9, 10, 11). These provisions call for support for finance, technology transfer, and capacity building to particular countries that are less endowed and more vulnerable. Evaluating progress in provision and mobilization of support for implementation is also part of the global stock taken under the Agreement. Crucially, the Agreement also emphasizes the central role of transparency and enhanced predictability in support for implementation. Support for means of implementation has however been a contentious issue, since critics argue that its scale has not been commensurate to the climate challenge (Weikmans and Roberts 2017). Challenges such as transparency in accounting for climate finance (Weikmans and Roberts 2017), and intellectual property rights on climate technologies (Juma 2003), have further compounded this intervention (Ockwell and Byrne 2016).

### **Types of Climate Actors**

Climate action can also be categorized by actors involved. These include states, non-state, and transnational actors. States have been at the forefront in designing multilateral efforts to address climate change. The UNFCCC has served as the key institution where states have designed norms, rules,



agreements, and work programs for responding to climate change at the international level. The Kyoto Protocol, adopted in 1997 under the UNFCCC, sought to commit the highest GHG emitters to reduce their emissions and support developing and least developed countries to undertake climate action. The Kyoto Protocol proved contentious and ineffective in part due to being too rigid and imposing targets on select parties to the agreement (Prins and Rayner 2007; Prins and Rayner 2007).

The Paris Agreement of 2015, on the other hand, adopted a different, universal approach to climate obligations by welcoming all countries to submit their national contributions (NDCs) and ratcheting up their contributions over time. In other words, the Paris Agreement adopted a universal, catalytic approach (Hale 2016; Falkner 2016). This allowed countries to set their own targets and plans of action according to their priorities, national circumstances, and capacities. Parties, including regional entities such as the European Union (EU), have developed national and regional laws, policies, and programs of action that guide climate action in their respective contexts.

Non-state actors, such as sub-national governments and authorities, private sector, and civil society, among others, are also active in climate action (Hsu et al. 2015). Non-state actor-driven climate action is taking place in both developed and developing country contexts. California in the United States, for instance, has been actively involved in leading efforts to address climate change in the United States for a long time. Measures have included spearheading renewable energy initiatives at the state level and investing in clean technologies. Other sub-national governments in developing countries have also played an active role in climate action. In Kenya, for instance, Makueni County, a sub-national government, has been involved in developing climate change policies and programs of action. These include engaging farmers in climate adaptation programs, mobilizing resources to support climate action through a County Climate Fund, and promoting sustainable drought-resistant agriculture.

Cities have also emerged as crucial actors in addressing climate change, especially given the

rapid global rate of urbanization (Romero-Lankao et al. 2018). Private entities such as multinational corporations have also been active in climate action. This has been mainly through voluntary schemes such as forest certification (van der Ven and Cashore 2018). Multinational Development Banks (MDBs) such as the World Bank, regional development banks, and UN agencies have also emerged as key actors, especially in financing climate action and offering technical and capacity building expertise. Overall, non-state climate actors can significantly contribute to closing the gap between countries' NDC pledges and the action required to meet the Paris Agreement's temperature targets (Chan et al. 2018).

Actors engaged in climate action do not always work in isolation, neither are they restricted within certain jurisdictions. Partnerships among and across various actors have become increasingly common. For instance, MDBs such as the World Bank often fund climate change initiatives in various countries; cities on the other hand collaborate through partnerships such as the Covenant of Mayors; and private companies coordinate their climate actions through the UN Global Compact. The significance of such initiatives was underscored in the lead up to the Paris Agreement on Climate Change, when the Lima Call for Climate Action identified them as a crucial element of addressing climate change. Recent efforts to map such initiatives have led to development of online databases and portals such as the Non-State Zone for Climate Action (NAZCA). This complex landscape of a wide variety of actors and institutions has led to what is often referred to as the "regime complex for climate change" (Keohane and Victor 2011).

## **Key Issues on the Transition to Low-Carbon Economy**

Debates on how to transition to a low-carbon economy have centered on certain old and current key contentious issues. Some of the issues include support for means of implementation, balance between climate action and economic development, removing government support for fossil

fuels, and how to manage the negative impacts of the transition. At the heart of the controversy is the nature and adequacy of the support, transparency, and accountability. While previous international negotiations focused on grant-based sources of climate finance, recent scholarship indicates that loans are dominant (Weikmans and Roberts 2017). That is, what counts as climate finance is highly contested. Transfer of climate-related technologies has also been controversial, focusing on the balance between respecting intellectual property rights (IPR) (Juma 2003) and obligations for support under CBDR&RC in the various international agreements on climate change (Ockwell and Byrne 2016).

Striking a balance between economic development and climate action has been a hotly debated issue (Najam 2005). Developing and emerging economies have often argued that since they have historically contributed less to GHG emissions, hence climate change, they should undertake less action than developed countries. When they have committed to climate action, they have done so conditional on support for means of implementation by industrialized countries. Limited agency of some of the countries in mitigation schemes has also been contentious (e.g., Atela et al. 2017). Developing countries have therefore placed climate action within the broader context of sustainable development (Najam 2005; Makomere and Mbeva 2018). Equitable Access to Sustainable Development (EASD) thus emerged as the preferred concept for these contesting countries (Winkler and Dubash 2016). This debate has been long-standing and is manifest in the Paris Agreement.

While conventional approaches to mitigation have focused on the consumer/demand side, attention has recently turned to “supply-side” efforts. Governments often provide subsidies to fossil fuel companies in the form of tax breaks and other fiscal instruments. Some estimates indicate that the value of annual fossil fuel subsidies is between US\$ 600 billion and US\$ 1 trillion (Coady et al. 2015; OECD 2015). Phasing out fossil fuel subsidies therefore presents a potent climate mitigation policy because it focuses on

the production of fossil fuels (van Asselt 2018; Erickson et al. 2018). Some governments, especially high-income countries, have begun addressing the issue. The G20, for instance, pledged to phase out inefficient fossil fuel subsidies in 2020 and conduct peer review of each other’s progress (G20 2016, p. 6).

Management of the negative effects of the transition to a low-carbon economy has led to a normative debate on how to realize a just transition (Klinsky et al. 2017). That is, how would a just transition to a low-carbon economy look like? The most significant issue at the global level is the allocation of the remaining carbon budget. Since there is more carbon in fossil fuel reserves than can be burned in keeping within global temperature rise limits, a significant amount will have to remain in the ground (McGlade and Ekins 2015). Scholars have come up with several suggestions on how to allocate the scarce carbon budget (Pont et al. 2017; Kartha et al. 2018). These debates revolve around the notion of equity, which tries to adjudicate between historical responsibility, vulnerability, and capability. Related discussions have also explored, for instance, how coal mine workers in the fossil fuel industry can be retrained after closure of the mines (Newell and Mulvaney 2013; Mayer 2018).

Divestment from fossil fuel assets has emerged as an important climate policy to spur the transformation toward low-carbon economies (Ayling and Gunningham 2017). The goal of divestment is to shift financial investments from fossil fuel assets toward supporting transition to an economy based on low emissions. Efforts by investors to divest from fossil fuels have led to concerns over stranded assets, since some of those fossil fuel assets will lose their value (to the tune of US\$ 4 trillion) (Ansar et al. 2013; Mercure et al. 2018). Stranded assets due to climate action are therefore becoming a major component of financial risk assessment. Shareholder activism based on ethical concerns for investing in fossil fuels has become a significant factor influencing major investment decisions (Reid and Toffel 2009; Hunt and Weber 2018).



## Future Directions

There is broad consensus on the need to strengthen climate action toward a low-carbon economy. Several themes, challenges, and opportunities are emerging in efforts to enhance climate action and the transition to a low-carbon economy. Some of these are discussed below.

While multilateral climate governance has been widely studied, some national, regional transnational climate governance and other non-state-led climate action remain less studied. Recent scholarship has begun addressing this gap, but it has mostly focused on the Global North. Transnational and non-state climate action and governance in the Global South however are still underexplored (Hale 2016, p. 20). Addressing this crucial gap will contribute to greater understanding of how such actions and governance arrangements can enhance the transition toward low-carbon development.

Understanding how states and their constituents particularly in less developed and emerging countries are striking a balance between economic development and climate action will also be critical. These countries will be the biggest future source of GHG emissions; hence it is important to understand their climate policy implementation. Issues of equity and fairness are becoming more acute. Examining the global transition to a low-carbon economy from this perspective could require a constant evaluation of the implementation of principles underpinning climate action such as Common but Differentiated Responsibilities and Respective Capabilities (CBDR&RC), in light of the global stock take on responses to the impacts of climate change (Rajamani 2006).

## Cross-References

- ▶ [Climate Change Adaptation](#)
- ▶ [Financial Market Services](#)

## References

- Andonova LB, Hale TN, Roger CB (2017) National policy and transnational governance of climate change: substitutes or complements? *Int Stud Q* 61:253–268. <https://doi.org/10.1093/isq/sqx014>
- Ansar A, Caldecott B, Tilbury J (2013) Stranded assets and the fossil fuel divestment campaign: what does divestment mean for the valuation of fossil fuel assets? Smith School of enterprise and the Environment, University of Oxford, Oxford, UK
- Atela JO, Quinn CH, Arhin AA et al (2017) Exploring the agency of Africa in climate change negotiations: the case of REDD+. *Int Environ Agreements* 17:463–482. <https://doi.org/10.1007/s10784-016-9329-6>
- Ayling J, Gunningham N (2017) Non-state governance and climate policy: the fossil fuel divestment movement. *Clim Pol* 17:131–149. <https://doi.org/10.1080/14693062.2015.1094729>
- Brent K, McGee J, McDonald J, Rohling EJ (2018) International law poses problems for negative emissions research. *Nat Clim Chang* 8:451–453. <https://doi.org/10.1038/s41558-018-0181-2>
- Bulkeley H, Andonova LB, Betsill MM et al (2014) *Transnational climate change governance*. Cambridge University Press, Cambridge
- Carrasco JF (2014) *The Challenge of Changing to a Low-Carbon Economy: A Brief Overview*. Low Carbon Economy 2014. <https://doi.org/10.4236/lce.2014.51001>
- Chan S, Ellinger P, Widerberg O (2018) Exploring national and regional orchestration of non-state action for a < 1.5 °C world. *Int Environ Agreements* 18:135–152. <https://doi.org/10.1007/s10784-018-9384-2>
- Coady D, Parry I, Sears L, Shang B (2015) *How large are global energy subsidies?* International Monetary Fund, Washington, DC
- Dou X (2015) The essence, feature and role of low carbon economy. *Environment, Development and Sustainability: A Multidisciplinary Approach to the Theory and Practice of Sustainable Development* 17:123–136
- du Pont YR, Jeffery ML, Gütschow J et al (2017) Equitable mitigation to achieve the Paris agreement goals. *Nat Clim Change* 7:38–43. <https://doi.org/10.1038/nclimate3186>
- Eckersley R (2012) Moving forward in the climate negotiations: multilateralism or Minilateralism? *Glob Environ Polit* 12:24–42. [https://doi.org/10.1162/GLEP\\_a\\_00107](https://doi.org/10.1162/GLEP_a_00107)
- Erickson P, Lazarus M, Piggot G (2018) Limiting fossil fuel production as the next big step in climate policy. *Nat Clim Chang* 8:1037–1043. <https://doi.org/10.1038/s41558-018-0337-0>
- Falkner R (2016) The Paris agreement and the new logic of international climate politics. *Int Aff* 92:1107–1125. <https://doi.org/10.1111/1468-2346.12708>
- G20 (2016) *G20 Leaders' Communique*. G20, Hangzhou

- Hale T (2016) "All hands on deck": the Paris agreement and nonstate climate action. *Glob Environ Polit* 16:12–22. [https://doi.org/10.1162/GLEP\\_a\\_00362](https://doi.org/10.1162/GLEP_a_00362)
- Hsu A, Moffat AS, Weinfurter AJ, Schwartz JD (2015) Towards a new climate diplomacy. *Nat Clim Chang* 5:501–503. <https://doi.org/10.1038/nclimate2594>
- Hunt C, Weber O (2018) Fossil Fuel Divestment Strategies: Financial and Carbon-Related Consequences. Organization & Environment 1086026618773985. <https://doi.org/10.1177/1086026618773985>
- IPCC (2014) Climate change 2014: synthesis report. Contribution of working groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change, Geneva
- IPCC (2018) Summary for policymakers. In: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. World Meteorological Organization, Geneva
- Jordan A, Huitema D, Schoenefeld J et al (2018) Governing climate change Polycentrically. In: Jordan A, Huitema D, van Asselt H, Forster J (eds) Governing climate change: polycentricity in action. Cambridge University Press, Cambridge, pp 3–26
- Juma C (2003) International trade and environment: towards integrative responsibility. In: Vertovec S, Posey D (eds) Globalization, globalism, environments, and environmentalism. Consciousness of connections. Oxford University Press, Oxford, UK, pp 17–38
- Kartha S, Athanasiou T, Caney S et al (2018) Cascading biases against poorer countries. *Nat Clim Chang* 8:348–349. <https://doi.org/10.1038/s41558-018-0152-7>
- Keohane RO, Victor DG (2011) The regime complex for climate change. *Perspect Polit* 9:7–23. <https://doi.org/10.1017/S1537592710004068>
- Klinsky S, Roberts T, Huq S et al (2017) Why equity is fundamental in climate change policy research. *Glob Environ Chang* 44:170–173. <https://doi.org/10.1016/j.gloenvcha.2016.08.002>
- Lenton TM (2014) The Global Potential for Carbon Dioxide Removal. In: Geoengineering of the Climate System. The Royal Society of Chemistry, pp 52–79
- Makomere R, Mbeva KL (2018) Squaring the circle: development prospects within the Paris agreement. *Carbon Clim Law Rev* 12:31–40. <https://doi.org/10.21552/cclr/2018/1/7>
- Mayer A (2018) A just transition for coal miners? Community identity and support from local policy actors. *Environ Innov Soc Trans* 28:1–13. <https://doi.org/10.1016/j.eist.2018.03.006>
- McGlade C, Ekins P (2015) The geographical distribution of fossil fuels unused when limiting global warming to 2 °C. *Nature* 517:187–190. <https://doi.org/10.1038/nature14016>
- Mercure J-F, Pollitt H, Viñuales JE et al (2018) Macroeconomic impact of stranded fossil fuel assets. *Nat Clim Chang* 8:588–593. <https://doi.org/10.1038/s41558-018-0182-1>
- Najam A (2005) Developing countries and global environmental governance: from contestation to participation to engagement. *Int Environ Agreements* 5:303–321. <https://doi.org/10.1007/s10784-005-3807-6>
- Newell P, Mulvaney D (2013) The political economy of the 'just transition. *Geogr J* 179:132–140. <https://doi.org/10.1111/geoj.12008>
- Ockwell D, Byrne R (2016) Improving technology transfer through national systems of innovation: climate relevant innovation-system builders (CRIBs). *Clim Pol* 16:836–854. <https://doi.org/10.1080/14693062.2015.1052958>
- OECD (2015) Measuring and reforming support for fossil fuels. Organisation for Economic Co-operation and Development, Paris
- Pauw WP, Klein RJT, Mbeva K et al (2018) Beyond headline mitigation numbers: we need more transparent and comparable NDCs to achieve the Paris agreement on climate change. *Clim Chang* 147:23–29. <https://doi.org/10.1007/s10584-017-2122-x>
- Prins G, Rayner S (2007) Time to ditch Kyoto. *Nature* 449:973–975. <https://doi.org/10.1038/449973a>
- Rajamani L (2006) Differential treatment in international environmental law. Oxford University Press, Oxford/New York
- Reid EM, Toffel MW (2009) Responding to public and private politics: corporate disclosure of climate change strategies. *Strateg Manag J* 30:1157–1178. <https://doi.org/10.1002/smj.796>
- Reynolds J (2015) A critical examination of the climate engineering moral hazard and risk compensation concern. *Anthropocene Rev* 2:174–191. <https://doi.org/10.1177/2053019614554304>
- Romero-Lankao P, Bulkeley H, Pelling M et al (2018) Urban transformative potential in a changing climate. *Nat Clim Chang* 8:754–756. <https://doi.org/10.1038/s41558-018-0264-0>
- Royal Society (2009) Geoengineering the climate. Science, governance and uncertainty. The Royal Society, London
- Royal Society (2018) Greenhouse gas removal. The Royal Society, The Royal Academy of Engineering, London
- Talberg A, Christoff P, Thomas S, Karoly D (2018) Geoengineering governance-by-default: an earth system governance perspective. *Int Environ Agreements* 18:229–253. <https://doi.org/10.1007/s10784-017-9374-9>
- UNEP (2011) Towards a green economy: pathways to sustainable development and poverty eradication – a synthesis for policy makers. United Nations Environment Programme, Nairobi
- UNFCCC (1992) United Nations framework convention on climate change. United Nations, New York
- UNFCCC (2015) Paris agreement on climate change. United Nations, New York

- UNFCCC (2016) Aggregate effect of the intended nationally determined contributions: an update. United Nations Framework Convention on Climate Change (UNFCCC), Bonn
- UNFCCC (2018) Yearbook of global climate action 2018. United Nations Framework Convention on Climate Change (UNFCCC); Marakech Partnership, Bonn
- UNGA (2015) Resolution adopted by the General Assembly on 25 September 2015. United Nations General Assembly, New York
- van Asselt H (2018) The politics of fossil fuel subsidies and their reform. Cambridge University Press, Cambridge
- van der Ven H, Cashore B (2018) Forest certification: the challenge of measuring impacts. *Curr Opin Environ Sustain* 32:104–111. <https://doi.org/10.1016/j.cosust.2018.06.001>
- Vaughan NE, Lenton TM (2011) A review of climate geoengineering proposals. *Clim Chang* 109:745–790. <https://doi.org/10.1007/s10584-011-0027-7>
- Weikmans R, Roberts JT (2017) The international climate finance accounting muddle: is there hope on the horizon? *Clim Dev* 1–15. <https://doi.org/10.1080/17565529.2017.1410087>
- Winkler H, Dubash NK (2016) Who determines transformational change in development and climate finance? *Clim Pol* 16:783–791. <https://doi.org/10.1080/14693062.2015.1033674>
- World Bank (2017) The potential of the blue economy: increasing long-term benefits of the sustainable use of marine resources for Small Island developing states and coastal least developed countries. World Bank, Washington, DC