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Integration and Synthesis of Assessments

BOX III Toward an Inclusive and Connected Repertoire of Climate Action

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Integration and Synthesis of Assessments

Changing social dynamics and physical processes increase the pressure to adapt

The current Outlook consists of three distinct chapters that provide in-depth empirical analyses on social dynamics affecting the plausibility of deep decarbonization by 2050 (Chapter 3), physical processes in the context of regional variability and extremes (Chapter 4), and context conditions for the plausibility of sustainable climate change adaptation (Chapter 5). As in previous editions of the Outlook, Chapter 3 assesses the dynamics of 10 selected social drivers as key processes affecting the prospects of social transformations toward deep decarbonization. The update of the social driver assessments emphasizes that deep decarbonization by 2050 remains not plausible under current conditions. This sobering finding emerges despite heightened social driver dynamics, which are observable in quantitative increases and—to a lesser extent—qualitative shifts in climate action. Overall, there is a proliferation of resources and consequently a qualitative change in the global opportunity structure for climate action (Section 3.1). Nevertheless, there are no fundamental changes in the repertoires of action and ultimately in societal agency toward a low-carbon shift. A key implication of our social plausibility assessment of deep decarbonization by 2050 is that societies worldwide will face increased pressure to adapt to climate change as mitigation efforts lag far behind and greenhouse gas emissions continue to increase.

Chapter 4 assesses the interplay of internal climate variability and extreme events through a selection of examples that illustrate some critical challenges to sustainable climate change adaptation. The chapter provides key insights on (1) the capability of climate models to represent extremes, (2) the attribution of extreme events to human influence, and (3) the probability of compounding extreme events. Understanding the uncertainties and limits of climate models is key for evaluating how well they represent extreme events. This in turn is crucial for predicting future extremes and developing adequate strategies for dealing with uncertainties in adaptation responses. Understanding whether extreme events have—at least in part—been caused by human influence is important for planning and developing adaptation strategies. That said, Chapter 4 also points out that an affected community must respond to an extreme event irrespective of whether it was partly caused by human influence or entirely due to natural causes. The assessments of physical processes further highlight that there is a heightened risk when extremes occur as compound events that may result in disruptions to socio-ecological systems, increasing vulnerability and significantly affecting the adaptive capacity of people and communities.

Against this backdrop, Chapter 5 assesses the plausibility of sustainably adapting to climate change through case studies in nine localities across the globe. The case study assessments show that climate change adaptation is a genuinely localized and socialized endeavor that is affected by politico-administrative dynamics and intangible socio-cultural aspects such as social inequality, gender, and diverse ways of knowing. The overall assessment of case studies delivers insights on diverse adaptation responses categorized as coping, incremental, and transformative adaptation. A key finding in this regard is the prevalence of coping and incremental adaptation responses, highlighting the presence of governance, technical path-dependencies, and lock-ins that could bear the danger of maladaptation in future, changing physical conditions. The analysis of implications underscores the importance of narrowing implementation gaps, for example, through climate action strategies with legally binding, accountable goals, as well as participatory governance and other strategies that incorporate diverse ways of knowing and dealing with natural contingencies and hazards into climate action.

While all assessments deliver key insights on dynamics and contexts that are summarized in more depth in the respective chapters, this chapter develops an integrative assessment that reveals the interconnected nature of the findings. As outlined in the methodology chapter (Chapter 2), this integrative approach, which consists of three building blocks, attempts to answer the overall question of the current Outlook: Under which conditions is sustainable climate change adaptation plausible?

Toward an integrated plausibility analysis

The building blocks of the current Outlook contribute to a better understanding of the plausibility of specific climate futures, understood here not only as projections of future greenhouse gas emissions, but rather as future states of the co-evolution of the physical climate system and society. Climate futures, in this sense, encompass the multi-layered

interactions of social and physical processes, which include both mitigation and adaptation scenarios. While the social driver assessments address deep decarbonization by 2050 as a mitigation-specific climate future, the implications of such assessments have important consequences for adaptation responses. That is, the plausibility of deep decarbonization by 2050 affects the plausibility of sustainable climate change adaptation. The adaptive capacity of a region or a community is sometimes constrained and sometimes enabled by context-specific conditions that, in turn, are influenced by current and future global decarbonization pathways and related anthropogenic climate change, especially by regional variability and extremes. The findings of each of the building blocks of the current Outlook edition provide key insights on the interplay of these interlocking elements of plausibility. The overall analysis of the assessments points to two fundamental issues in climate futures research: uncertainty and the relations between global and local scales in physical and social dynamics. In the following, we discuss these important aspects in turn.

Uncertainty in social and physical dynamics

Uncertainty in social and physical dynamics affects the plausibility of sustainable climate change adaptation on three levels. First, in Chapter 3 our sobering conclusion that deep decarbonization by 2050 remains not plausible—even less plausible than in previous assessments—is a finding that narrows down the plausibility range of climate futures scenarios, especially in terms of what we can realistically expect that society will have to adapt to. Whereas in previous Outlook editions our assessment found that two out of 10 social drivers were inhibiting (deep) decarbonization (i.e., corporate responses and consumption trends), the present update adds a third inhibiting social driver, namely fossil-fuel divestment. The dynamics of six other social drivers support decarbonization, but are insufficient for deep decarbonization; one driver is ambivalent (Section 3.12). Uncertainty remains as to how social expectations and anticipatory actions will shape the perceived necessity for future mitigation measures and adaptation strategies to expected effects and impacts of climate change. Furthermore, while achieving a 1.5 °C limit to global warming is currently not plausible, there is a wide range of uncertainties regarding other plausible climate futures beyond that limit that, in turn, hamper anticipatory adaptation responses.

Second, as Chapter 4 highlights, uncertainty is also crucial in assessing regional climate variability and extremes, especially because of the role of chance (or aleatoric uncertainty). Uncertainty is a key element in evaluating the capability of climate models to represent extremes, the attribution of extreme events to human influence, and the probability of compounding extreme events. The attribution of extreme events to anthropogenic climate change or internal climate variability, in particular, raises the question of whether it matters to know what a community is adapting to. Attribution research describes how the likelihood of an extreme event changes with anthropogenic warming, which serves as basic orientation for policy planning and development; conversely, lack of attribution might serve as an excuse for inaction. An additional consideration that goes beyond the scope of our case study assessments is that attribution might become crucial to establish liability and compensation for losses and damages from climate change impacts and risks.

Third, as the case studies in Chapter 5 reveal, climate change adaptation in and of itself is also intrinsically affected by uncertainties in the physical and social worlds, inasmuch as it involves the processes of anticipatory action based on past experiences and future expectations. The overall assessment of the case studies indicates that in addressing or coping with uncertainty, communities often resort to established routines and practices, which can lead to governance and technical path-dependencies. These potential lock-ins constitute limitations to adaptation responses that constrain the plausibility of sustainably adapting to climate change.

Global-local interactions

Global and local dynamics affect the plausibility of sustainable climate change adaptation in two main ways: First, the assessment of social driver dynamics, which focuses on the global opportunity structure for climate action, serves as a backdrop for the case study assessments on sustainable climate change adaptation, which in turn highlight the importance of context-specific conditions and place-based actions. The global dynamics of social drivers point to the dimension of societal agency worldwide that materializes in cumulative greenhouse gas emissions. The plausibility and scenario framework for deep decarbonization, therefore, uses global dynamics as a point of reference for the empirical assessments. The social driver assessments thus focus on trends and dynamics that are observable worldwide and configure a global opportunity structure for climate action. The analysis of the plausibility of sustainable climate change adaptation, in contrast, emphasizes the importance of locality. It manifests itself in regional geohazards and local history, place-based contingencies of everyday life, and more generally the specific conditions of the local physical and social environment. Global dynamics are by no means irrelevant to adaptation; however, an empirically grounded analysis requires a localized approach focusing on the sites where adaptation as a social practice actually takes place. Thus, the question of plausibility adopts a place-based approach that focuses on local manifestations of climate change and different time horizons and therefore requires a local scenario of sustainable climate change adaptation.

As a number of social driver assessments indicate, some decarbonization dynamics reveal an interplay between climate change mitigation and adaptation that is shaped by interactions between global and local scales. UN climate governance sets the framework for international negotiations on adaptation (Section 3.2); transnational cooperation exhibits various initiatives such as city networks on adaptation (Section 3.3); social movements and activism include pre-figurative practices that foster local adaptation (Section 3.5); a number of climate litigation cases worldwide touch on issues of adaptation, although these remain a small portion of climate change cases globally (Section 3.6); corporate responses sometimes include adaptation-related concepts such as organizational risk and organizational resilience (Section 3.7); there is comparatively low media coverage of adaptation issues in selected countries (Section 3.10); and various forms of knowledge production are a core dimension of adaptation responses (Section 3.11). All these prove that the global dynamics of social drivers of decarbonization generate resources and repertoires of climate action that are potentially relevant for local adaptation responses. Further research is needed here to better understand how resources and repertoires of climate change mitigation and adaptation travel across global and local sites of governance. Questions remain, for example, on how global norms and regulations are shaping local adaptive practices—if at all—, or whether financial resources reach localities and enhance the adaptive capacity of communities.

The second way in which global-local dynamics affect the plausibility of sustainable climate change adaptation is in the heightened importance of regional climate information, related to the spatial resolution of global climate models. The assessment of regional climate variability and its impacts on specific localities can be crucial for place-based adaptation responses. The assessments of physical processes in Chapter 4 deliver insights into these dynamics. A key issue that the assessments bring to the fore is that the interplay between anthropogenic climate change and internal climate variability can amplify or attenuate changes in climate extremes on a regional scale. The large-ensemble simulations with increased spatial resolution substantially improve the representation of extreme events; but the required spatial resolution highly depends on the specific location and characteristics of the extreme event. As a result, not all model simulations are suitable for offering high-quality information for adaptation, thus impacting the planning of adaptation strategies to extreme weather events (Section 4.3).

The global and local dimensions of adaption responses (or the lack thereof) are also observable in the potential consequences of compound extreme events that generate impacts on multiple scales or cascades of effects never experienced before. Concurrent extreme heatwaves in the world's crop growing regions, for example, could combine with dry spells to cause crop yield loss, thereby disrupting local food production and posing new challenges to global food security (Section 4.5). Improving our knowledge on the specific global, regional, or local scale(s) on which the consequences and impacts of extreme events will occur is therefore important for the plausibility of sustainable climate change adaptation. These dynamics also empirically highlight the analytical premise of our framework: Social realities and the physical world are inextricably intertwined. While physical processes construct the frames in which social drivers unfold, social dynamics are at the same time shaping the physical environment in countless ways.

Conditions of agency in light of ambition and implementation gaps

In previous assessments, we have identified a growing densification of climate action, for instance in the number of national climate laws and Nationally Determined Contributions, transnational initiatives, attendants to global climate conferences, or climate litigation cases; we also noted an increase in resources within the global opportunity structure for decarbonization and climate justice. At the same time, our assessments of social driver dynamics toward decarbonization and of local case studies on sustainable climate change adaptation also showed persistent gaps in both ambition and implementation. The term *ambition gap* refers to the disparity between given aspirations, such as the goals on mitigation and adaptation set in the Paris Agreement, and the level of commitment, dedication, and planning required to turn these aspirations into reality, which would increase the plausibility of achieving these goals. The term *implementation gap* refers to the difference between the actual realization of mitigation and adaptation measures vis-à-vis proclaimed goals and targets. These goals are, for example, found in projected emissions of different climate scenarios, in Nationally Determined Contributions, and in adaptation plans outlined on different scales of governance.

In our model of change toward achieving the Paris Agreement goals, the building up of social agency and of more (and new) resources for a global opportunity structure is a necessary but not sufficient conditions for closing the existing ambition and implementation gaps. The analysis of social drivers of decarbonization and sustainable climate change adaptation emphasizes that both gaps are the result of various dynamics within and across social drivers and adaptation contexts. Empirical evidence provided in the current Outlook underpin four central and interconnected dimensions that help explain the persistence, or sometimes even widening, of ambition and implementation gaps in the face of increasing levels of climate action: (1) existing power dynamics and inequalities, (2) different

ways of understanding, interpreting, and translating climate change-related norms and practices, (3) a lack of political coherence on different scales of climate governance, and (4) climate change mitigation and adaptation as multifaceted and wicked problems.

Power dynamics and inequalities

The current Outlook provides new empirical evidence highlighting how existing power dynamics and social inequalities shape the capacity of societal agents to effectively engage in climate change mitigation and adaptation. The emblematic matter among the social drivers is that the production of fossil-fuel and the consumption of carbon-intensive goods and services remain unevenly distributed and continue to significantly increase both global emissions and revenues for already dominant actors. The vulnerability to the consequences of climate change and the capacity for sustainable climate change adaptation are also shaped by social inequalities and remain unevenly distributed. These inequalities exist *within* local contexts—whether on a city, regional, or state level—as well as *between* these contexts and unfold in different ways. In general, the nine adaptation case studies highlight the larger issue of fundamental asymmetries of adaptive capacity, given the stark inequalities in access to technical means and financial resources. The lack of access to economic, political, and social resources undermines the plausibility of both deep decarbonization and sustainable climate change adaptation. This lack leaves behind certain actors, namely those without the necessary means and conditions to adapt to the consequences of climate change—as seen in the São Paulo case study, where the combination of a high level of social inequalities, the lack of infrastructure, and the consequent unequal levels of risk exposure and vulnerability have led to climate-related fatalities (Section 5.4). Social inequalities also undermine and inhibit dynamics toward deep decarbonization, for instance in the contexts of UN climate governance, climate activism, and fossil-fuel divestment (Sections 3.2, 3.5, and 3.8). Oil-producing states and firms continue to monetize their political power to limit mitigation efforts and increase their income by increasing fossil-fuel investments, having the power to ignore all pressures to divest. Climate activism and social mobilization, in contrast, face severe opposition all around the world. The implementation and ambition gaps thus intersect with power dynamics and inequalities on a spectrum from actively preventing implementation to eroding the grounds for meaningful mitigation and adaptation.

Divergent understandings and contestation of climate change-related norms and practices

Implementation and ambition gaps are also shaped by different ways of understanding, interpreting, engaging with, and translating particular goals, plans, and policies. Their actual meaning often remains contested, especially in light of political and cultural diversity. This ranges from local cases of adaptation strategies suggested by formal state institutions that are shown to fail when based on assumptions that contradict local norms and values (as in the case of pastoralists in Kunene, Namibia, Section 5.8) to global challenges of developing essential resources for decarbonization. The global resources generated by UN climate governance and transnational cooperation (Sections 3.2 and 3.3), for example, can, when incorporated into stable repertoires of climate action, contribute to align expectations and build trust among state and non-state actors or enhance climate-related standard-setting and certification processes. This continuous densification of climate action is an important development since the previous assessment. It indicates new opportunities and potentials for a global low-carbon transformation, as well as new avenues for research on societal climate futures. Nevertheless, empirical findings also highlight that despite the plethora of resources and an increase in dynamics no qualitative transformative shift toward deep decarbonization can be observed. Hence, the implementation gap is also a result of different social dynamics in which political goals, policies, or targets become contested. For example, the social driver assessments and adaptation case studies highlight that implementation is affected by divergent or even contrasting interpretations of particular goals and policies. Implementation may furthermore be impeded by loss of trust in governments or a lack of convinced self-efficacy at the individual level (see the case of the Maldives, Section 5.10, and that of the Nepalese highlands, Section 5.7).

Lack of political coherence on different scales of climate governance

A larger structural dimension that links the contexts of deep decarbonization and sustainable climate change adaptation is the observed lack of political coherence on different scales of climate governance. The overall dynamics of the 10 social drivers not only remain insufficient to attain deep decarbonization by 2050, but also highlight ambivalent and contradicting dynamics within and across drivers. For example, packaged forms of knowledge such as the IPCC assessment reports strongly support the scenario of deep decarbonization by addressing governance problems and policies. Yet, there are various knowledge resources gaining momentum that counter the plausibility of achieving this scenario, as

different actors spread mis- and disinformation and establish new forms of climate denialism and delayism (Section 3.11). UN climate governance, transnational cooperation, and climate-related regulation, for example, highlight some positive trends in terms of establishing trust and cooperation through the establishment of standards or policy instruments (Sections 3.2, 3.3, and 3.4). However, there is still little effect on existing structural and institutional context conditions of drivers. The lack of qualitative shifts is indicated by the finding that the actual implementation of policy instruments remains limited due to political and social backlashes, and the change from soft to hard law in climate governance is not in reach. Similarly, the nine case studies on local adaptation also report the lack of political coherence as key constraining conditions to climate change adaptation. Adaptation strategies run through different political and administrative scales, from the local to the national, and display unclear roles and responsibilities of the public sector, frequent changes in regulation, and little coherence or even mismatches between goal setting, planning, and implementation. These different and contextualized ways of managing adaptation result in uncertainties, lack of trust in policy, and administration, as seen in the case of Lower Saxony (Section 5.6) and the Maldives (Section 5.10). Fragmented administration and unstable political dynamics worsen the situation as reported in the case studies of São Paulo and Taiwan (Sections 5.4 and 5.11). Further constraining conditions are limited budgets, no adequate funding support, or a lack of financial capacity at all (Sections 5.4, 5.7, 5.8, and 5.11). Also relevant in the case studies of Hamburg, Lower Saxony, and Taiwan are land or land-use conflicts (Sections 5.4, 5.6, and 5.11). These manifest as a perceived antagonism of housing and economic development on the one hand versus environmental and climate protection on the other.

Climate change mitigation and adaptation as multifaceted and wicked problems

A final point highlighted by the empirical analyses in Chapters 3, 4, and 5 is that the discussed implementation and ambition gaps also result from climate change mitigation and adaptation being a multifaceted and wicked problem. Contradictions and structural constraints with regard to building societal agency become visible in many contexts of climate change adaptation cases, where implementation often remains on a conceptual level and stops short of turning plans into actual practices. Adaptation or prevention action is not only a financial but also a socio-cultural challenge (see e.g. Section 5.9 on North Frisia), and a sense of urgency to act is psychologically linked to an experience rather than a (scientific) prediction. Ambition gaps exist in many cases where a coping rationale, which prefers merely reacting to the next climate-related event or disaster, prevails although transformational approaches would deliver more sustainable solutions. Against this background, a major lack consists in local application of adaptation, anticipatory planning, and dealing with plausible climate futures. The mode of action is currently still more oriented toward acute and pressing Disaster Risk Management approaches than on mid- and long-term adaptation measures. In this sense, the rationale remains one of "predict and act" where a "reflect and act" rationale might be needed. In a similar vein, social drivers of deep decarbonization are constrained by the required long-term measures and rationales, which contrast with short-term interests and goals. This not only manifests itself in the ongoing investments in fossil fuel engagements and corporate responses' continued contribution to greenhouse gas emissions. There is, moreover, a lack of long-term vision on how to achieve just climate futures. Although a growing focus on just transition programs have resulted in some positive initiatives, such as the just transition partnerships launched within the wider context of UN climate governance, their reach is still limited and may, in many cases, not even prevent the development of new fossil fuel infrastructures.

Additionally, climate action is always embedded in, and intersects with, other dynamics that inhibit required global efforts for climate protection. For example, political and economic rivalries between the US and China, the two major global emitters, often turns climate change into a minor issue although dynamics of rapprochement in the context of climate change are visible. These examples illustrate that acute political crises often stand in the way of the long-term perspective required for both climate change mitigation and adaptation. This turns dealing with climate change into a wicked environmental problem.

Enabling conditions for sustainable climate change adaptation

In this final section, we outline a set of conditions necessary for sustainable climate change adaptation to become plausible. A fundamental and underlying condition for change, as discussed in the integrated plausibility analysis, relates to the interdependencies between mitigation and adaptation scenarios. The plausibility of achieving deep decarbonization by 2050 substantially affects the plausibility of sustainably adapting to climate change, which entails that increasing social dynamics toward a low-carbon shift would facilitate future adaptation responses. However, the specific question of whether an adaptation response will be sustainable or not depends not only on global emissions and the physical boundary conditions of climate change but also on the context-specific limitations to adaptation, which involve a variety of socio-cultural and politico-administrative aspects. These limitations, as the previous section outlines, translate into societal ambition and implementation gaps (see Chapter 5.12).

The overall analysis of the case study assessments clearly highlights the necessity for policymakers and decision-makers at large to consider localities and socio-cultural dimensions when designing and implementing climate adaptation strategies. In general, the existing political and local administrative structures lack conceptual and practical readiness to effectively address the local and place-based dimensions of social and physical context-conditions that are inherent to climate change adaptation responses (or the lack thereof). For example, knowledge production, dissemination, and participation play key roles here. A recurring approach to climate change adaptation policy involves gathering more data to enhance scientific knowledge, commonly perceived as a solution for enhancing and better aligning sustainable climate change adaptation measures. This evidence-based approach, however, often relies on the rationale of "wait and act" where a "reflect and act" rationale would be more fitting in light of the outcomes delineated in this context. Hence, recognizing diverse ways of knowing and related opportunities for social mobilization in these specific policy contexts is imperative to facilitate the co-production of knowledge and policy in a way that addresses extant power dynamics and inequalities.

The prevalence of coping and incremental adaptation responses often reveals governance and technical path-dependencies that maintain insufficient and in part unsustainable adaptive practices and hinder the development of alternative approaches. The case studies highlight the importance of flexibility and openness in politico-administrative approaches to adaptation policy, for example by integrating the diverse ways of knowing of local frontline communities into participative approaches to knowledge production and policy making. The relevance of these conditions lies not only in their potential to generate alternatives and avoid lock-ins, but also in ensuring that climate justice criteria are respected in the processes of transition to resilient societies. Whereas some medium- and large-scale technical interventions in climate change adaptation could be deemed superior in terms of efficiency, climate justice requires an approach that addresses recognition, processual, and distributive criteria.

Finally, sustainable climate change adaptation can only become plausible in a context of societal support for and political action toward structural transformations. This involves addressing social inequalities and asymmetric power dynamics, both of which constitute structural causes of climate change vulnerability and undermine the adaptive capacity and resilience of communities and marginalized groups in society. These challenges point at once to immensely inadequate international adaptation finance and local power dynamics that prevent affected groups from accessing resources that enhance their adaptive capacity and resilience. Such structural transformations are fundamental not only for overcoming current barriers to sustainable climate change adaptation, but also for increasing ambition and closing implementation gaps in climate mitigation while promoting climate justice at different levels of governance.

In sum, the nine case studies underscore the importance of considering context-specific aspects and diverse ways of knowing and dealing with climate-related risks and impacts when assessing, planning, and implementing climate adaptation strategies. In this context, co-producing knowledge, promoting the inclusion of diverse social actors in decision-making processes, and garnering broad societal support for ambitious climate policies and structural transformations is fundamental for sustainable climate change adaptation to become plausible.

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