The Plausibility of Achieving Deep Decarbonization by 2050

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3.1

The Social Plausibility Assessment Framework

The Social Plausibility Assessment Framework is a central contribution to scenario-driven research on climate futures. It was first developed in the Outlook 2021 (Aykut et al., 2021) and refined in the Outlook 2023 (Wiener et al., 2023) as a robust qualitative approach to assess if a particular climate future appears plausible or not, given what we know about relevant social dynamics. The assessment draws on in-depth analyses of processes that act as social drivers of the climate future in question, with a view to examining past, present, and emergent dynamics of these processes, as well as context conditions that might enable or constrain them in the future. In doing so, we do not adopt a normative approach that focuses on what *should* happen to make a desirable scenario plausible. Instead, we use an analytical approach that aims to systematically explore the social plausibility of a given climate future and understand what processes, institutions, and agencies shape this plausibility.

What do we mean when we say that we assess the *plausibility* of a particular climate future? Indeed, there is a vivid debate on how to conceptualize possible, feasible, probable, and plausible climate futures in the IPCC and elsewhere (Brutschin et al., 2021; Jewell and Cherp, 2023; Glette-Iversen et al., 2022; Pielke Jr. et al., 2022; Riahi et al., 2022; Schipper et al., 2021). There is also a strong call to quantify the probability of climate futures. However, looking at the probability of deep transformational change by 2050 would require prioritizing quantified trend extrapolations over the recognition of deep uncertainties inherent in social dynamics and of complex interrelations between them (Selin and Guimarães Pereira, 2013). While it may be possible to apply probability reasoning to much more narrow dynamics such as demographic change or energy demand, we do not think it is possible to establish a robust quantitative assessment of the probability of deep decarbonization by 2050. Instead, our assessment is based on a much more holistic, but also in many ways more modest, understanding of the complexities of transformational change over a long period of time, in which we acknowledge the importance of history, context, and agency (Aykut et al., 2021; Wiener et al., 2023; Engels and Marotzke, 2023). We define plausibility as a state in which an internally consistent future—or qualitative scenario—and a theory-based model of change are assessed vis-à-vis available empirical evidence on relevant social dynamics that can be held against this model of change. Plausibility in this sense is suitable for assessing processes of deep uncertainty, and it involves an inherently qualitative knowledge judgment (Glette-Iversen et al., 2022). We are therefore not far away from Jewell's and Cherp's (2023, p. 3) definition of plausible as "occurable in exploratory scenarios with internally-consistent assumptions", but go beyond their interest in *feasible* options that can be implemented by specific groups of actors. We also depart from Pielke Jr. et al.'s understanding of plausible emission scenarios, which use growth rates consistent with observations and near-term projections without employing an underlying theory or model of social change (Pielke Jr. et al., 2022).

Finally, our framework differs from research on social tipping points toward decarbonization (Otto et al., 2020; Fesenfeld et al., 2022). Studies in this tradition typically identify social fields or dynamics which can bring about radical transformational change once a critical threshold has occurred (Winkelmann et al., 2022; Lenton et al., 2023). The assumption is that from then on the unfolding dynamic becomes so strong and self-reinforcing that a new normality is firmly locked-in, leading to rapid decarbonization with limited reversibility of the process (Milkoreit, 2023). The typical S-curve

of a technological innovation is the mental model here: It starts with only a few early adopters, but over time the number of adopters rises to a critical point at which the new technology very rapidly, and sometimes even disruptively, replaces an older technology (Kucharavy and Guio, 2011). We depart from this mental model for a number of reasons (Wilkens et al., 2023; Aykut et al., 2021). Mainly, our focus does not lie on identifying invariable social tipping points in social systems, but on understanding context-dependent social processes and the set of relevant context conditions of these processes that would actually have an effect on future shifts in social dynamics. This allows us to get a more realistic understanding of where current social dynamics and constellations of enabling and constraining conditions point to, given the available empirical evidence. Knowing that social dynamics very often follow the shape of recurrent waves or cycles rather than clear-cut S-curves, and knowing that it is often only possible to determine in hindsight whether some threshold has changed the direction of a dynamic permanently, we prefer a realistic assessment over providing optimistic narratives.

The past Outlook editions have applied the Social Plausibility Assessment Framework to assess the plausibility of deep decarbonization by 2050 and of limiting global warming to 1.5°C, relative to pre-industrial levels, based on the analysis of 10 selected social drivers (Stammer et al., 2021; Engels et al., 2023). As we understand it here, deep decarbonization describes a transition to net-zero carbon emissions, leading to a very low carbon intensity in all sectors of the economy, a reduced energy demand (Méjean et al., 2019), and very low demand for carbon-intensive consumer goods. Deep decarbonization can thus be thought of as reducing carbon emissions to as close to zero as possible, with residual emissions compensated by active carbon dioxide removal from the atmosphere (IPCC, 2018; Deep Decarbonization Pathways Project, 2015; Wimbadi and Djalante, 2020; UN Climate Action; IPCC 2021, Annex VII, Glossary). Such a transition also implies a profound social transformation, including changes in norms, regulations, institutions, individual behaviors, and personal values (Shove and Walker, 2010; O'Brien, 2018; Beckert, 2024). The scenario must be clearly distinguished from other, less constrained futures in which decarbonization is only partially achieved by 2050. However, it must also remain generic enough to allow for a broad range of emissions trajectories and technology pathways so as to place the analytical focus on the social transformations that enable deep decarbonization (Held et al., 2021, p. 25; see Figure 3.1).

The Social Plausibility Assessment Framework consists of a series of key concepts—social drivers, context conditions, resources, and the global opportunity structure—that allow us to capture and describe the continuous interplay of historical dynamics and path dependencies, structural and institutional conditions for social change, and the creative work of societal agency (Aykut et al., 2021; Wiener et al., 2023). Social drivers are defined as overarching social processes that generate change toward or away from a given scenario and its characteristics. As social processes, drivers mediate between agency and structure and span micro-, meso-, and macro-scales of global society (Jordan et al., 2018). They reflect societal multiplicity and the agency of a plurality of stakeholders (Wiener, 2022), but also economic and socio-technical dynamics (Geels et al., 2017). Social drivers capture a broad and multifaceted range of political and societal engagement with the climate problem, which facilitates or hinders decarbonization and generates "climatizing" effects by diffusing climate concerns in new policy fields, governance arenas, and societal spheres (Aykut et al., 2017). As in previous Outlooks, we analyze 10 social drivers, which represent relevant existing and emergent social processes that generate change away or toward a scenario of deep decarbonization by 2050. This list (see Table 2.1) represents an analytical choice based on the literature and our own expert elicitation. Given the intrinsic complexity of social systems and foreseeable changes in the dynamics of low-carbon transformations worldwide, this list may be subject to changes in the future (we address some newer developments below).

To assess the plausible contribution of these processes to a global low-carbon shift, we look at their historical trajectory and current dynamics, but also at the specific context conditions that are likely to shape future driver dynamics. This means that enabling and constraining conditions in our framework are not overarching structural features of a global social system, but need to be further specified with regard to specific drivers. They describe "those driver-specific institutional, structural, and material environments which favor or inhibit driver dynamics toward a specific climate future" (Aykut et al., 2021, 34f). Our research hence aims at a better understanding of the social dynamics of global climate politics by targeting social drivers, their historical and current dynamics, and evolutions in driver-specific enabling or constraining context conditions. Moreover, we complement this focus on processes and institutions by a focus on agency. To do so, we borrow the notion of opportunity structure from social movement research. This concept has been introduced in the context of cross-country comparisons to identify *political* resources and institutional arrangements for effective social movement mobilization (Kitschelt, 1986, p. 58). It enabled researchers to take account of nationally contingent relations between historical dynamics and path dependencies, institutional context, and agency. The Social Plausibility Assessment Framework uses the concept analogously but applies it to a global scale in order to reflect the planetary nature of climate change and the globalized politics of deep decarbonization. Against this backdrop, we assume that global opportunities for climate-related societal engagement are

an emergent feature of global society, which forms and evolves through processes of transnational and inter-societal interaction. Accordingly, the global opportunity structure for climate action represents "the repertoire of resources and constraints for global societal agency to move toward a specific climate future" (Aykut et al., 2021, p. 35).

Finally, we use the term resources in a broad sense, which encompasses material, formal, and informal dimensions. Material resources include for example monetary support, financial assets, and built infrastructures; formal resources can refer to rules, procedures, and regulations; and informal resources consist of, among other, ideas, values, and knowledge. This broad understanding of the term builds on the above-mentioned tradition of comparative political science studies of new social movements (Wahlström and Peterson, 2006; McCammon, 2013). Resources that mattered in this context included economic funding, political support, appropriate societal institutions, and power structures. Importantly, resources were not merely conceived as structure-based (i.e., relative to a specific national context) but also as agency-generated (i.e., being generated through social movement politics) (Jenson, 1993). This approach also allowed for identifying a qualitative change of governance and an "increasing institutional density" as part of the evolution of EU institutions (Wiener, 1998, p. 296).

Through the inclusion of climate action resources, our analytical framework contributes to ongoing debates about agency vis-à-vis global climate change. Societal agents construct agency in the face of climate change by developing new discourses, communicative frames (Toivonen, 2022) and "climate imaginaries" (Davoudi and Machen, 2022), by enacting sustainable consumption practices (Yang et al., 2023), by amplifying local sustainability initiatives in the Global North and in the Global South (Lam et al., 2020), by building transnational networks and heterogeneous political coalitions (Heikkurinen et al., 2021), or by using judicial strategies that establish new legal norms and open new legal opportunities (Vanhala, 2020). In all of these cases, we can identify the emergence of patterned forms of social behavior that bridge social and political scales and circulate transnationally (Bhardwaj, 2022). We capture this evolution by using the terminology of climate action scripts and repertoires. Societal agents build agency by creating climate action resources and by using these to build new climate action scripts and repertoires.

The notions of social drivers, enabling and constraining conditions, resources, and the global opportunity structure constitute the conceptual backbone of the Social Plausibility Assessment Framework. As we observe an increasing variety and multiplicity of climate action within national political arenas and state-led governance processes, such as the UN climate change conferences, but also beyond in the form of transnational grassroots mobilizations, epistemic communities and expert networks or private climate initiatives (Wiener and Aykut, 2024), we place a supplementary focus in the current Outlook on understanding the dynamics of a *densification* of climate action and the *relationality* between social drivers. Densification has been introduced in the 2023 edition of the Outlook to capture quantitative increases and qualitative shifts in climate action resources, scripts, and repertoires. Through this notion, we attract attention to the emergence and global circulation of, for example, new discursive frames that constitute resources for political advocacy and social mobilizations, or new climate litigation scripts that enable novel forms of court actions across national jurisdictions. "As resources for decarbonization multiply, gain visibility, and materialize in new climate action repertoires, they provide novel opportunities for societal agency operating across national boundaries and social fields" (Aykut and Wiener, 2023). Analyzing densification therefore entails mapping changes over time in the global opportunity structure for climate action. The current Outlook adds the dimension of relationality to the analysis. This adds a novel conceptual layer that has been devised in order to systematically identify and study interrelations between social drivers and hence detect possible (positive or negative) feedbacks and clusters of change that might affect the plausibility assessment. Over this and the next assessments, we will progressively examine which resources within the global opportunity structure are used by other drivers than those from which they originated. This is the case, for example, when new formulations in international climate treaties or COP decisions are used in climate litigation cases to ground new legal rights or duties, or when scientific articles or expert reports are used by climate activists to build political narratives. Over time, this will allow us to understand which resources are produced regularly and used repeatedly in different social contexts until they become part of new climate action repertoires spanning several drivers. Answering these questions will allow us to further specify changes within the global opportunity structure, that is, the shift from visible climate action resources toward more stable (material) repertoires. We assume that this process of stabilization and materialization of climate action resources occurs through the use of these resources by a variety of climate agents. While so far we have operated on the assumption that this shift is possible and likely to occur, it is only with the help of the novel concepts of densification (mapping resources, agents, scripts, and repertoires within the global opportunity structure) and relationality (identifying relations between drivers, their push and pull dynamics, and the potential for more stable institutionalized links which generates additional climate action repertoires across drivers) that we will be able to identify driver relations and measure their dynamic effects on the plausibility of deep decarbonization with future Outlooks.

The approach and terminology introduced here is not limited to analyzing climate-aligned social dynamics. Over the past few years, similar tactics to those of pro-climate advocates, involving the creation of resources, scripts, and repertoires, have been used by counter-movements to undermine efforts to curb emissions or advance climate justice. This is the case, for example, in aggressive campaigns against sustainable transportation, which re-enact cultural norms of "petro-masculinity" and build mobilization scripts aimed at celebrating car culture and a patriarchal and fossil-fuel-dependent status quo (Daggett, 2018). It can also be observed in legal and judicial strategies to undermine corporate reporting on environmental, social, and governance indicators or intimidate potential climate activists and litigants (Sections 3.5 and 3.6). The question pertaining to the inclusion of these dynamics as separate social drivers or constraining conditions within the individual drivers will have to be addressed in each new Social Plausibility Assessment, to the extent to which the conservative backlash continues to grow and develop a dynamic of its own.

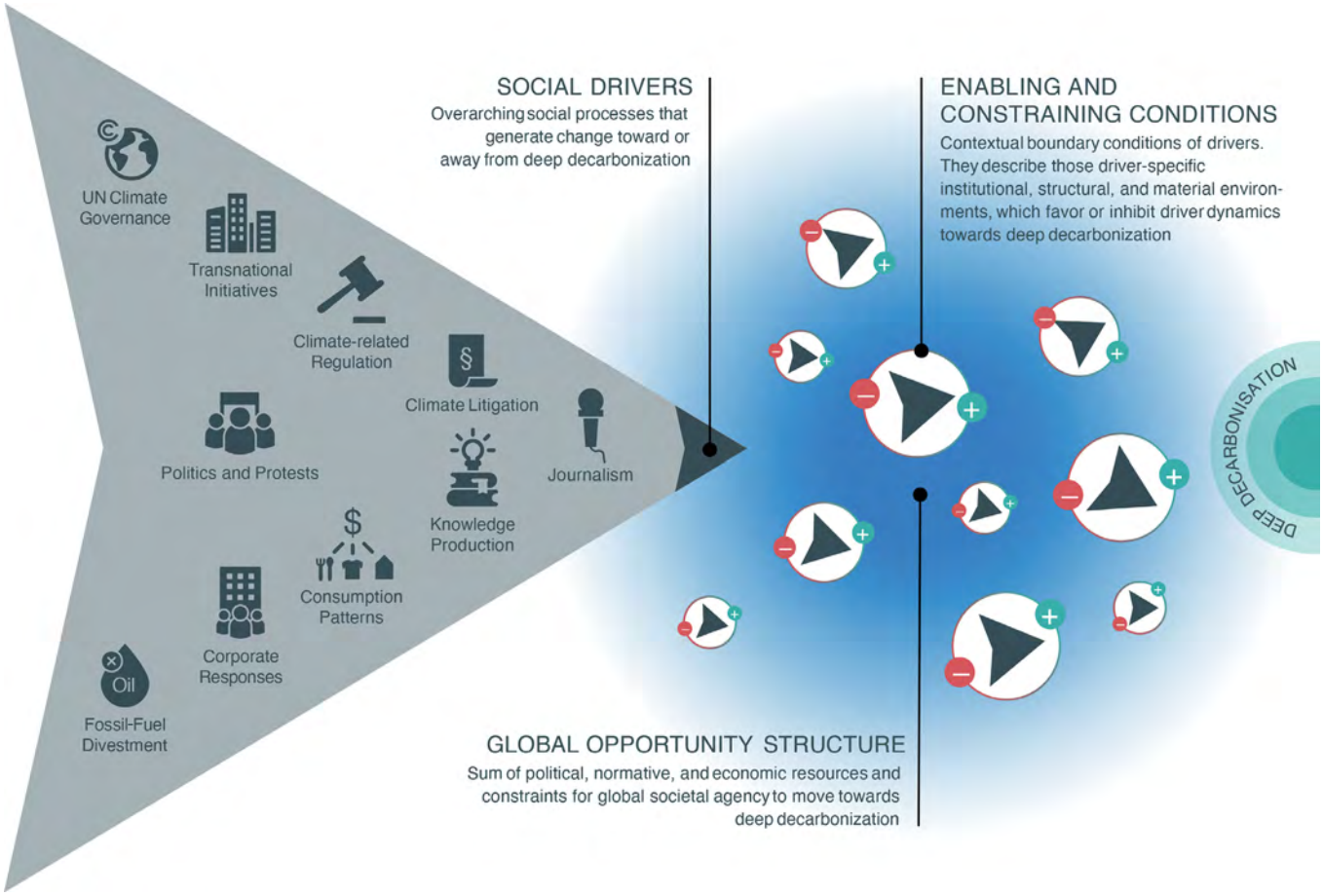

Figure 3.1: Social Plausibility Assessment Framework from the Outlook 2021. The figure shows the chosen climate future scenario, deep decarbonization (right), and the selected key social drivers of deep decarbonization (left). The assessment of the driver dynamics (center), their enabling and constraining conditions, and the global opportunity structure lead to a conjecture about the plausibility of the future scenario.

Guiding questions

To apply the assessment framework and include a stronger focus on relationality between drivers, we structured our work on updating the driver assessments through the following questions:

- Do you identify key events or dynamics since the publication of the Outlook 2023 that have shaped/changed the driver assessment?
- Do you see anything that is strongly enabling or constraining the driver dynamic toward deep decarbonization?
- If you look at the literature, have any new major studies been published on the driver?
- What resources generated by other drivers are being used by this driver?
- Does your driver assessment have any implications for the question of climate change adaptation?

The author teams for each driver started with group discussions to identify key events and publications relevant for their respective driver assessment. Discussions on relationality were conducted across the driver teams. In addition to relevant work produced within CLICCS, the author teams conducted a literature review focusing on new studies that had appeared since 2022 and that have received attention by the scientific community. The teams were specifically encouraged to include epistemic perspectives and studies as well as authors from the Global South. By sending two previous versions of the driver assessments to our team of international reviewers, the assessments underwent the same quality control as other chapters of the Outlook.

3.2

UN Climate Governance

UN climate governance comprises state-led cooperation under the umbrella of the UN Framework Convention on Climate Change (UNFCCC) and the Paris agreement, evolutions within the wider climate change regime complex, and climate-related activities of other international organizations. The wider climate change regime complex comprises other regulatory regimes that have an impact on climate governance and climate-related activities of UN organizations, other international agreements, and multi-lateral processes that have implications for climate change but do not fall under the Conference of the Parties (COP) process of the UNFCCC.

Key social driver dynamics since the previous Outlook

Since the last assessment (Aykut et al., 2023), a series of developments affected the dynamics of global cooperation within and outside the UN climate change regime. Overall, the evidence reviewed here suggests that the driver's contribution to deep decarbonization remains significant, but that it has slightly weakened as a result of these developments.

Despite geopolitical crises and conflicts that threatened to overshadow climate issues, COP27 in Sharm-el-Sheikh, Egypt, and COP28 in Dubai, United Arab Emirates, attracted record numbers of participants—39,000 and 85,000, respectively (Günel 2024)—and high levels of global media attention. The conferences implemented the final phase of the so-called Global Stocktake, a review cycle created by the Paris Agreement that prepares the submission of new country pledges (Nationally Determined Contributions or NDCs) by 2025. The Global Stocktake is important because global greenhouse gas emissions increased by 1.2% from 2021 to 2022 to reach a new record of 57.4 Gt of CO_2 equivalent ($GtCO_2e$), putting the world on track to crossing the Paris Agreement's temperature threshold of 1.5°C within this decade (UNEP, 2023a). Against this backdrop, negotiations made only limited progress on mitigation. At COP27, observers criticized the side-lining of discussions on mitigation ambition, the glacial pace of decarbonization (Masood et al., 2022), and a record number of unresolved agendas (Arora and Arora, 2023). The final decision merely reiterates the COP26 compromise of a "phasedown of unabated coal power and phase-out of inefficient fossil fuels subsidies" (UNFCCC FCCC/CP/2022/10/Add.1, §13). The conclusion of the Global Stocktake process at COP28 was more successful. The final decision contains for the first time a call to "transition away from fossil fuels in energy systems" and encourages parties to accelerate the shift toward renewable energies and energy efficiency (UNFCCC FCCC/PA/CMA/2023/L.17, §28a,d). This is undoubtedly a step forward, even though earlier drafts of the Global Stocktake conclusions contained even more direct language about phasing out fossil fuels. Moreover, the final text's references to carbon

capture, utilization and storage, and low-carbon fuels (which can be read as an allusion to natural gas) could be used to justify further delays and bets on unproven technological solutions (Chandrasekhar et al., 2023). Negotiations did also progress in other areas. For example, the establishment of new funding arrangements for Loss and Damage at COP27 and the creation of a dedicated fund at the first day of COP28 constitute an important breakthrough after a decade of negotiations.

Outside of the negotiations, new climate policy initiatives were launched on a range of issues. Building on the Glasgow Forest and Land Use Declaration, a "forests and climate leaders' partnership" was announced at COP27, and the final declaration included a forest section and a reference to "nature-based solutions" (Arora and Arora, 2023). One week later at the G20 Bali summit, ministers from Indonesia, the Democratic Republic of the Congo, and Brazil announced a South-South rainforest leadership alliance. However, the Three Basin Summit held in October 2023 in Congo Brazzaville fell short of securing significant progress on reducing deforestation and forest degradation. New initiatives announced at COP28 include a pledge by over 130 countries to triple the world's renewable energy capacity by 2030 and double the annual rate of energy efficiency improvements (these objectives were later included in the Global Stoketake), a Joint Statement on the need to phase out fossil fuel subsidies, an Oil and Gas Decarbonisation Charter signed by major oil companies to reduce methane emissions, and a Declaration on Sustainable Agriculture, aimed at creating more resilient and climate-friendly food systems. However, there were also significant setbacks. The G20 meeting in India in July 2023, which brought together countries responsible for 80% of global greenhouse gas emissions—among which China accounts for 30%, the USA for 11%, and the European Union and India for 7% each (UNEP, 2023a)—did not yield any tangible outcome on renewable energies and fossil-fuel phase out. The absence of the Presidents of China, France, and the US at the Climate Ambition Summit convened by the UN Secretary-General in September 2023 and the failure of the US and China in pledging funding to the Green Climate Fund at the replenishment conference in October 2023 indicate an overall decline in climate commitments. Moreover, 12 new or updated country pledges have been submitted before, during or after COP28, bringing the total number of new NDCs since the Paris agreement to 149 as of 20 December 2023 (UNFCCC Nationally Determined Contributions Registry). According to the United Nations Environment Programme (UNEP) Emission Gap report, while more NDCs now contain economy-wide greenhouse gas reduction targets, and although implementation gaps have been reduced in some G20 countries, overall ambition remains insufficient, as current country pledges would lead to an estimated 2.5°C— 2.9°C warming this century (UNEP, 2023a).

More generally, recent studies cast doubts on the effectiveness of the Paris Agreement's ambition and orchestration mechanisms. Instead of rigorous peer monitoring aimed at naming and shaming laggards to raise ambition, existing assessment exercises have often "provided occasions for 'claiming and shining' through selective and punctual reporting" (Aykut et al., 2022b, p. 191). And even when failures are publicly addressed, this appears to be effective only in a limited number of countries with "high quality political institutions, strong internal concern about climate change, and ambitious and credible international climate commitments" (Dannenberg et al., 2023, p. 1). Catalytic impacts of orchestration on nonstate climate action have also not broadly materialized so far (Teunissen and Chan, 2024). The effectiveness of voluntary initiatives even appears to be trending downwards (New Climate Institute et al., 2022). As a result, a growing body of evidence suggests that the "global target-setting approach to solving climate change, driven by competitive national virtue signalling or shame avoidance, is reaching diminishing returns" (Dubash, 2023).

Developments within the wider climate change regime complex have been more encouraging, prefiguring a gradual, albeit still uncertain, reinforcement of international climate finance. First, Just Energy Transition Partnerships (JETPs) gained traction as a climate governance instrument, following a USD 8.5 billion deal with South Africa announced during COP26. The donor pool includes the International Partners Group and the Glasgow Financial Alliance for Net Zero (GFANZ) Working Group. Additional deals have been concluded with Indonesia, Vietnam, and Senegal. However, concerns have been raised that this mechanism may inadvertently finance the development of new fossil fuel infrastructure, including gas projects. Second, there has been a significant push toward mainstreaming climate concerns in global development finance by reforming lending strategies of multilateral banks and international organizations. The final document of COP27 for the first time backed a reform of the International Monetary Fund (IMF) and the World Bank (Masood et al., 2022). Calls for increasing and redirecting the banks' lending capacities toward climate-friendly projects receive increasing international support, including by newly appointed World Bank President Ajaypal Singh Banga. These debates were also at the center of the Summit for a New Global Financing Pact in Paris in June 2023. Initiated by Prime Minister Mia Mottley of Barbados and President Emmanuel Macron of France, its stated aims were to ramp up international climate finance, initiate broader reforms of the Bretton Woods System, and provide debt relief to poor countries.

With regards to other climate-relevant areas of UN governance, new treaties have been adopted concerning high seas and marine biodiversity protection, and discussions have started on the adoption of an international agreement to regulate plastic waste. The Kunming-Montreal Global Biodiversity

Framework adopted in 2022 establishes a common goal of conserving 30% of land, oceans, coastal areas, and inland waters by 2030. Developed countries also committed to investing USD 200 billion annually in biodiversity initiatives, which resulted in the launch of the Global Biodiversity Framework (GBF) Fund in August 2023. These parallel processes have important implications for the preservation of natural carbon sinks (IPCC, 2019a; IPCC, 2019b, p. 20). Furthermore, the Energy Charter Treaty, widely considered a major obstacle to a rapid decarbonization, has been significantly weakened. The European Court of Justice ruled that the treaty is not competent to handle legal disputes among EU member states, and several countries (France, Germany, Luxembourg, Netherlands, Poland, Slovenia, Spain) have decided to withdraw from the treaty. The European Parliament also adopted a resolution, urging the Commission to exit the treaty, in November 2022.

In sum, this driver's dynamics have been marked by growing resistance and even a risk of backsliding in the UN climate change regime as well as increasing doubts over the effectiveness of the Paris Agreements' ambition and orchestration mechanisms. These developments have been partly counterbalanced by the first ever mentioning of a transition away from fossil fuels in a COP decision, positive developments in the climate change regime complex, and wider UN governance on issues such as biodiversity, development finance, and energy investments. The concrete effects of the Global Stocktake and the outcome of debates over global financial reform will be crucial to watch in the upcoming year.

Enabling and constraining conditions affecting driver dynamics

Several of the context conditions for global cooperation have been affected by rising international tensions since the publication of past Outlook editions. Overall, our current assessment indicates little hope that the existing trend of the driver's limited contribution to deep decarbonization will be reversed in the near future.

In terms of world politics, the times for multilateralism are more difficult than ever since the signature of the Paris agreement in 2015. The ongoing war in Ukraine and rising global tensions after Hamas' attack on Israel on 7 October 2023 and Israel's ensuing bombing and invasion of Gaza pose major obstacles to global cooperation. US-China tensions remain important but seem contained for the moment. A meeting between US-President Joe Biden and Chinese General Secretary Xi Jinping took place in November 2023, in the aftermath of which the bilateral working group on climate issues that was paused last year resumed its work.

National policy environments are in constant flux, and a full assessment is outside the remits of this Outlook (see also Section 3.4). Developments that appear particularly significant for UN climate governance include record installations of low-carbon electricity generating capacity in China, particularly wind and solar. Together with a rebound in hydro output, this has observers projecting a drop in Chinese emissions in 2024 and possibly the start of a phase of structural decline of emissions thereafter (Myllyvirta, 2023). In Brazil, the election of President Lula da Silva has nourished hopes for a return of the country to climate ambition and yielded first results in terms of actions against deforestation. In the US, the Inflation Reduction Act (IRA) have produced some strong results while the victory of Republicans in the mid-term elections might well compromise future climate policy initiatives in Congress. The UK government under Prime Minister Rishi Sunak has significantly weakened climate policy ambitions by approving new oil and gas explorations and even a new coal mine in Cumbria. Climate action in a number of European countries (for example Germany, France, and Sweden) has been slowed down, partly due to a rising tide of right-wing and climate-skeptic populism (Boecher et al., 2022; Lockwood and Lockwood, 2022). The EU Green Deal also appears under pressure after the resignation of Vice President and Climate Commissioner Frans Timmermans, and in the wake of a high-risk European election in 2024.

Social movement pressure persists and at times intensifies in some countries, but overall stays very far from pre-pandemic levels of mobilization. In Europe, new and more confrontational tactics gained momentum over the past year with groups such as Just Stop Oil, Last Renovation, and Letzte Generation. However, opinion polls appear to indicate a potential risk of backlash related to these protest forms (see also Section 3.5).

In energy technologies and markets, the consequences of the energy crisis sparked by the Russian invasion of Ukraine are still not fully understood. On the one hand, high energy prices underscore the benefits of energy efficiency measures and prompted behavioral and technological changes to reduce energy use in some countries. International Energy Agency (IEA) data indicates that long-term investments since the Ukraine war might have reinforced renewable energy sources rather than fossil fuels (IEA, 2022). The agency also projects significant effects of the US Inflation Reduction Act on low-carbon investments, as global clean energy investments could see an increase of 50% by 2030, with annual solar and wind capacity additions in the US even growing. Overall, global energy investments in 2023 stand at an estimated USD 2.8 trillion, USD 1.7 trillion of which were directed to low-carbon sources (USD 382 billion to solar alone). On the other hand, a total of USD 1 trillion were still invested into unabated fossil fuels, USD 371 billion of which into oil, and USD 150 billion into coal (IEA, 2023d). While 2022 and 2023 were marked by record additions in renewable energy capacity, they were also record years for oil majors, complete with announcements of high-profile mergers in the sector, new oil and gas

explorations, and major investments in fossil infrastructures. Moreover, short term effects of the global energy crisis include rising poverty and inequalities around the world. This has fueled contestations in the agriculture sector throughout Europe, following national measures aimed at reducing fossil fuel subsidies. The EU's diversification strategy in gas supply has also accentuated the vulnerability of gas importing countries from Asia and the Global South. This creates looming risks of recession, poverty traps, and new conflicts in many regions of the world.

All this has ushered a return of energy security scripts in public debates, which are increasingly used to legitimize the return to fossil fuel extraction and combustion. Despite these concerns, opinion polls around the world show that public support for climate action remains strong. This is particularly true for liberal democracies and countries that do not depend on fossil fuels for their electricity (Kenny, 2023). In many countries, media coverage of recent extreme events, as well as of the publication of the IPCC Synthesis Report of its Sixth Assessment Report in March 2023, have also constituted significant resources for climate-related agenda setting, reporting, and activism (IPCC 2023a).

Major studies published since the previous Outlook edition

Since the compilation of the previous Outlook, a range of studies and research papers have been published on UN governance. Among these, Masood and colleagues (2022) and Arora and Arora (2023) examine the outcomes of COP27. Aykut et al. (2022b), Dannenberg et al. (2023), and Teunissen and Chan (2024) analyze and assess practices of soft coordination and orchestration in the post-Paris regime.

In addition, there have been publications on the impact of the pandemic and some early assessments concerning the impact of the Russia-Ukraine war on global energy politics (IEA, 2022; 2023a). The IPCC Synthesis Report (IPCC, 2023a), the NDCs Synthesis Report (UNFCCC, 2022a), and the Emissions Gap reports (UNEP, 2023a), among others, provide important information of the current state of global climate science and global cooperation as well as crucial inputs for the Global Stocktake.

Generation of climate action resources and uptake from other drivers

NDCs are a product of climate-related regulation and a key ingredient of the Paris process. Positive examples of government action are also used as best practices in COP events. Reports (packaged knowledge) produced by the IPCC (for example the Synthesis Report of its Sixth Assessment Report published in March 2023), by international organizations (for example UNEP's emissions gap report), and global research projects (for example the Global Carbon Project) are used in the Global Stocktake of the Paris Agreement and other UNFCCC processes.

Climate protests, successful climate litigation cases, and media frames of extreme events are used as discursive resources by NGOs, UN and state representatives in negotiations, and plenary sessions at climate COPs (Aykut et al., 2022a). Transnational initiatives and net-zero pledges by companies and subnational actors are used to build momentum during climate COPs (Teunissen and Chan, 2024).

Due to its centrality in the coordination of global responses to climate change, UN Governance also produces a large number of resources for other drivers. Over the past years, the UN has contributed to forging Net Zero Standards for firms, investors, and civil society. An important step has been the establishment, by UN Secretary General António Guterres, of a High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities, which published its final report "Integrity Matters: Net Zero commitments by Businesses, Financial Institutions, Cities and Regions" at COP27.

Much like COP27, COP28 in Dubai provided a networking platform and media opportunities for transnational initiatives, states, cities, and companies. Civil society organizations and climate activists also used the COP to build networking capacities and circulate media frames, although conditions for access and mobilization for critical, activist social movements were more difficult in Dubai than in liberal democracies.

The First Global Stocktake concluded with an important, albeit not unequivocal, signal to transition away from fossil fuels. It also provided an unprecedented amount of data and analyses, from country reports, communications, and voluntary submissions via synthesis reports produced by the UNFCCC secretariat and the COP's subsidiary bodies to a wide range of submissions by non-partisan stakeholders. It also helped place a global media focus on gaps in policy ambition and implementation, both in terms of mitigation and provision of finance. The data and analyses compiled in the Global Stocktake can be used by other drivers, including in climate litigation cases.

Implications of driver dynamics for climate change adaptation

Negotiations are ongoing on the framework for the Global Goal on Adaptation. The Glasgow-Sharm el-Sheikh work program was agreed upon at COP26 in Glasgow in 2021 and includes a two-year work program as well as four workshops per year. Its objective is to provide input for the Global Stocktake. COP27 has also provided some progress on national adaptation plans (NAPs). As of November 2023, 49 countries have submitted such plans in which they articulate their adaptation priorities and needs. Importantly, discussions on Loss and Damage also

address growing preoccupations on adaptation failure, or the impossibility to adapt to some global warming impacts. COP27 made progress on the governance structure of the Santiago Network on Loss and Damage and reached consensus to establishing a dedicated fund. COP28 selected the United Nations Office for Disaster Risk Reduction and the United Nations Office for Project Services as the hosts of the Santiago Network secretariat. Progress was made in discussions on a Global Goal on Adaptation, where a framework with objectives and a new work program to develop indicators was adopted. However, discussions on a new quantified goal for climate finance did not make significant advances. Moreover, new adaptation criteria were included in the Global Climate Action portal to encourage transnational initiatives, businesses, and cities to also report on adaptation.

3.3

Transnational Cooperation

Transnational cooperation encompasses diverse forms of coordination that cut across traditional state-based jurisdictions and operate across public and private divides (Bulkeley, 2014). Transnational cooperation happens, for example, within city networks, business self-regulation initiatives, transnational initiatives of NGOs, and public-private partnerships (Scheffran et al., 2021). It contributes to climate governance mostly through advocacy and policy monitoring to exert pressure on national governments, or through establishing voluntary arrangements, rules and standards for corporate, subnational or financial entities operating transnationally (Bäckstrand et al., 2017; Green, 2017).

Key social driver dynamics since the previous Outlook edition

Since the most recent assessment of this driver (D'Amico et al., 2023), the evolution of many of these initiatives and the ways in which they cooperate toward collective effects to mitigate climate change has been constant rather than defined by singular key events or sudden dynamics changing the strength or direction of the driver. Nevertheless, media attention around the annual UN Climate Change Conferences is used for expanding existing networks or presenting new initiatives. The sheer number and diversity of transnational cooperation complicates a global assessment, but six positive dynamics can be observed: (1) Many initiatives have seen a growth in the numbers of their members or an expansion of their activities (New Climate Institute et al., 2022; UNFCCC, 2023). (2) There is increasing transnational cooperation toward improving ambition, transparency, and accountability, particularly in terms of expanding and standardizing reporting and net-zero target setting (Net Zero Tracker, 2023; Science Based Targets initiative, 2024). For instance, the Say on Climate Initiative supported by the Children's Investment Fund Foundation incentivizes companies to establish robust net-zero transition plans with shareholder feedback in an annual advisory vote. Climate-related corporate and financial reporting rules have substantially strengthened in 2023, particularly in the European Union but also in other parts of the world, potentially driving a more sustainable economy (Task Force on Climate-related Financial Disclosures, 2022; Epstein, 2023). (3) Some initiatives are moving closer toward concrete planning, for example by providing sectoral decarbonization pathways or by promoting transition plans for specific industries or cities (Boehm et al., 2022; Sokolowski et al., 2023). (4) Indigenous activism has become increasingly visible. For example, the new operational work plan of the Local Communities and Indigenous Peoples Platform (LCIPP) adopted in Glasgow aims to facilitate the exchange of Indigenous knowledge and resources and their participation in the UNFCCC regime (UNFCCC, 2022c). (5) Adaptation is becoming a more important part of activities in the field of transnational cooperation pushed by UN climate governance institutions, for example by promoting large campaigns, such as the Race to Resilience campaign (UNFCCC 2022b, 2023). (6) Interrelations between climate change and other environmental topics, such as biodiversity, are receiving more attention (Widerberg et al., 2022). Major empirical developments in this regard are the 2022 UN Biodiversity Conference on biodiversity in Montréal, in which many non-state actors participated, or the updates and emergence of new reporting standards and frameworks, such as the Global Reporting Initiative's standards for biodiversity, the Task Force for Nature-related Financial Disclosure and the European Sustainability Reporting Standards on biodiversity and ecosystems. Despite these positive developments, initiatives for transnational cooperation are mostly framed as the panacea to sustain the dominant paradigm of liberal economies and global markets. Rising conflicts around the world, increasing tensions in world politics, and protectionist policies

(see Section 3.2) are direct challenges to the governance model purported by transnational initiatives.

Enabling and constraining conditions affecting driver dynamics

Past assessments identified several enabling conditions for a movement toward deep decarbonization, including the existence of a business case for sustainability and a strong institutional design. The past years have seen continued attempts to create common rules and principles at organizational levels strengthening the institutional environment supporting decarbonization. This trend continues, as several international guidelines and (voluntary) standards are currently being developed or prepared for implementation. These include the ISO norm 14068, which provides clear definitions for climate neutrality pledges by organizations, companies, cities, and municipalities; the International Sustainability Standards Board's Disclosure Standards (ISSB); and the European Sustainability Reporting Standards (ESRS). Both address the consolidation of information on companies' and financial institutions' governance, strategy, risk management, targets, and metrics related to climate change. As a result, there have been some improvements in accountability and ambition levels in the sense that these new standards are becoming mandatory for operating in some jurisdictions and markets (Task Force on Climate-related Financial Disclosures, 2022). However, the standards differ in their level of stringency. While the European Sustainability Reporting Standards will adopt a so-called double materiality approach that includes the (financial) impact of climate change on companies as well as the companies' impact on climate change, the International Sustainability Standards Board's Disclosure Standards follow a single materiality approach and so are focusing on climate-related financial risks for companies only. Maintaining the double materiality approach can be regarded a success. However, the European Parliament has also considerably reduced the number of disclosure requirements suggested in the first drafts of the European Sustainability Reporting Standards in their final adoption and proposed to postpone some aspects, such as sector-specific disclosures, for two years until 2026 (European Commission, 2023; 2024). In addition, a group of critical watchdogs, such as the New Climate Institute, Camda, or Climate Action Tracker, highlights the poor quality of disclosure and the lack of robust targets, questioning the methodology and results of leading transparency and target setting NGOs such as CDP or the Science Based Targets initiative (Day et al., 2023; Net Zero Tracker, 2023).

Past assessments identified several constraining conditions, which remain relevant. Among them are a lack of resources, funding, and efficiency for non-state commitments. For instance, cities came out of the COVID-19 pandemic with strained financial resources, inflation issues, unemployment, and resource scarcity, which may negatively affect their transnational cooperation. At the same time, rising energy prices and the experience of extreme weather events highlight the need for exchanging practices for climate resilience, especially with a view on critical infrastructure (Global Covenant of Mayors for Climate & Energy, 2022). Furthermore, there is a persistent regional inequality with a strong over-representation of and large influence by organizations from developed countries of the Global North, such as the US and European countries (Kaiser, 2022; NewClimate Institute et al., 2022; Papin and Beauregard, 2023). This poses considerable justice issues, as climate responses continue to be framed by actors of the Global North, who are also the main perpetrators of environmental damages (Callahan and Mankin, 2022). Even though Indigenous voices may receive increasing recognition, for example through facilitating participation in the UNFCCC regime or in meetings around the Belém Declaration, transnational coalitions of Indigenous Peoples and local communities continue to face considerable constraints to influence climate politics. Among them are tokenism, lack of political will, and a lack of effective recognition of their role to maintain large stretches of preserved ecosystems (Belfer et al., 2019; Carmona et al., 2023; Dwyer et al., 2023). Finally, the geopolitical developments around Russia's invasion of Ukraine and the rising global tensions after Hamas' attack on Israel on 7 October 2023 and Israel's ensuing bombing and invasion of Gaza may further complicate transnational cooperation. In sum, the enabling conditions for transnational cooperation contributing to deep decarbonization are becoming slightly more favorable, while the main constraining conditions remain powerful and persistent. In this sense, we do not see any strong change in the overall driver assessment.

Major studies published since the previous Outlook edition

New publications highlight the following topics: Fankhauser et al. (2022) investigate transnational norm-making activities around net-zero and argue that seven attributes are important factors for making net-zero a successful framework for climate action. These attributes relate to the urgency of reducing emissions, the integrity of removals and offsets, and the consistency of climate action with other sustainable development goals (SDGs). Mai and Elsässer's (2022) critical view on the role of data shows that new data, data infrastructures, and actor constellations around the Global Climate Action Portal have changed because of a shift from using data to orchestrate and leverage non-state actor commitments toward tracking and animating implementation activity. Drawing on the analysis of Mexico City and Lima, Leal and Paterson (2023)

argue that the C40 city network promotes particular forms of investment, pursuing the interests of transnational capital and assembling combinations of actors to generate this effect. This coerces cities to prioritize climate mitigation over adaptation, over-riding local preferences and ignoring local expertise. As a result, C40 potentially undermines the capacity for such cities to generate their own solutions. Papin and Beauregard (2023) provide a critical reflection on the influence of billionaire entrepreneurs on global climate governance. Taking the example of Michael Bloomberg, co-founder and former chair of the C40 network, they argue that this influence is centered on depoliticization, outgrouping, and technical solutionism. While these dynamics might generate short-term legitimacy, it risks undermining long-term goals of addressing climate change. A more positive role of city networks is highlighted by Picavet et al. (2023), who argue that these networks have a pivotal role in strengthening the capacity for collaborative governance by capacity building through providing structural arrangements, leadership, knowledge and learning, and resources. Another critique points to the still existing strong North-South imbalances in transnational climate change governance, present not only at the UN level but also among sub-state and non-state actors (Kaiser, 2022; NewClimate Institute et al., 2022). In the case of cities, Leffel et al. (2023) recently questioned the polycentric character of transnational municipal networks. They argue that a small fraction of economically strong cities is powerful in diffusing their agendas and innovations through participating in multiple initiatives.

Generation of climate action resources and uptake from other drivers

Transnational cooperation is interdependent with other drivers. On the one hand, many resources of the global opportunity structure underpin the growth in size of networks and initiatives, as well as the deepening of activities and strengthening of the connection between ideas, goals, and implementation activities. Firstly, whereas transnational cooperation has emerged as a direct response to the absence or the ineffectiveness of binding rules at the UN or national regulation levels, recent improvements in these drivers have provided enhanced resources to the stringency and reach of transnational cooperation. UN summits and orchestration from UN institutions have supported the development of new standards, for example with the Recognition and Accountability Framework for integrity in setting net-zero pledges and policies for accountability (Mai and Elsässer, 2022). In addition, it created more direct and binding opportunities for connecting with bottom-up initiatives (COP27 Presidency, 2022b) and promoted new multi-stakeholder coalitions for sectoral decarbonization pathways (Hermwille et al., 2022). Furthermore, improved access to presidencies and high-level state delegates provides better international and national agenda-setting opportunities to Indigenous Peoples and local communities (Belfer et al., 2019). However, while UNFCCC's focus on themes, mobilization of transnational initiatives, and emphasis on minimal requirements for institutional robustness can positively influence the effectiveness of transnational engagement, an assessment of the effectiveness of these developments is still difficult (Chan et al., 2022). Secondly, regulation provides essential resources for the uptake and development of transnational rules and standards (D'Amico et al., 2023). In the European Union, the recent revision of the Corporate Sustainability Reporting Directive (CSRD) has made sustainability reporting mandatory for large companies, thus considerably strengthening the role of standard transparency schemes as a basis for changes in companies' responses (Epstein, 2023). Thirdly, there is a constant uptake of frames, tools, and indicators from the outputs of the driver of knowledge production, as well as sourcing of best practices from corporate responses and city experimentation. Fourthly, external pressure such as transparency requests from financial investors for pursuing divestment strategies, or climate movements demanding enhanced accountability for emitters, are influencing corporations' and municipalities' adoption of transnational rules and standards (Epstein, 2023). However, these pressures might pursue divergent objectives or have limited reach and thus need further investigation.

Transnational cooperation also generates numerous resources for other drivers. It helps strengthening UN Climate Governance by sending signals of societal mobilization and joining sectoral coalitions to design decarbonization pathways, such as the Marrakesh Partnership or the recent Sustainable Urban Resilience for the Next Generation (SURGe) initiative (COP27 Presidency, 2022a). Even if only voluntary, corporate sustainability standards provide inputs for climate litigation cases, for example Shell Milieudefensie et al. vs. Royal Dutch Shell plc., and are sometimes one source, among others, for strengthening national regulation (Global Climate Change Litigation database, 2022). In addition, private sector initiatives and city networks contribute to disseminating norms (for example net-zero, reporting) which are supposed to be picked up by corporations or cities as a basis for rethinking their operations and services in response to climate change (Leffel, 2022; C40, 2022) or generate knowledge and best practice examples for industry-specific or regional challenges (Revi et al., 2022).

Implications of driver dynamics for climate change adaptation

In the wake of the Sharm-El-Sheikh Adaptation Agenda (COP27 Presidency, 2022b), activities in the field of transnational cooperation have also

embraced adaptation-related issues. City networks have launched a number of initiatives to support local planning and the exchange of experiences on water management, heat stress, early warning system and emergency response plans for extreme climate events, renaturalization of city areas and protection against sea-level rise (i.e., C40 initiatives). Especially nature-based solutions are fostered as promising solutions to address both mitigation and adaptation challenges in urban areas and ensure more resilient and livable cities. The trend toward more disclosure includes vulnerability assessments to physical climate risks and adaptation matters, both for cities and corporations. In 2022, for example, 2021 cities reported their main hazards (Global Covenant of Mayors for Climate & Energy, 2022), while the increasing adoption of the Task Force on Climate-related Financial Disclosure (TCFD) framework promotes the assessment of physical risks and adoption of risk management strategies among companies (Task Force on Climate-Related Financial Disclosures, 2022). Overall, there are some signs that transnational cooperation increasingly understands mitigation and adaptation as complimentary and related actions. However, further integration of transdisciplinary approaches to adaptation that include traditional sustainable practices and Indigenous knowledge are paramount (Baker et al., 2023)

3.4

Climate-Related Regulation

Climate-related regulation refers to legislation and regulations issued by national and supranational government bodies with the intention of limiting or reducing the concentration of greenhouse gases in the atmosphere. It creates the bounds for legal operations and shape the incentive structure for companies, households, and other actors that are the immediate loci of greenhouse gas emissions. The extent to which climate-related regulation is able to induce technological and behavioral change toward low-carbon modes is a key component of the social plausibility of deep decarbonization scenarios (Engels et al., 2023).

Key social driver dynamics since the previous Outlook edition

The implementation gap, that is, the difference between a jurisdiction's emissions-reduction pledges and the actual projected reductions given the current set of regulatory instruments in operation (Perino et al., 2022), which was at the heart of the previous assessment of climate-related regulation, has been independently confirmed both conceptually (Fransen et al., 2023) and empirically (Rogelj et al., 2023; United Nations Environment Programme, 2023a). Marquardt et al. (2023) provide further conceptual insights on the origins of the implementation gap in the Global South. The most recent UNEP Emission Gap Report finds that the global implementation gap has halved from 3 $GtCO_2e$ to 1.5 $GtCO_2e$ since the previous report (UNEP, 2023a, p. XIX). Moreover, the gap does not move along usual default lines such as industrialized countries versus the Global South (Fransen et al., 2023, p. 755) and varies highly from country to country and among sectors (UNEP, 2023a, p. XIX; Climate Action Tracker 2023; Burck et al., 2024).

An important event at the international level is the crisis of the Energy Charter Treaty, which may make a difference for fostering more substantial climate-related regulation. The fear of investor-to-state disputes meant that European climate policy-makers abstained from more radical decarbonization agendas, yet the walk-out of Italy, France, Germany, the Netherlands, Poland, and Spain created momentum for an EU-wide exit (Ekardt et al., 2023). At the same time, the expansion of the treaty to West African countries and to the MENA region means that these countries are at risk to face investor-to-state-disputes and to liberalize their energy economies at a point where this may pose a threat to local small and medium energy enterprises.

In August 2022, the Inflation Reduction Act was adopted in the US, which constitutes a substantial investment in emission reductions. It reduces the implementation gap in the US substantially but is not expected to close it entirely (Bistline et al., 2023).

In early 2023, the EU passed key components of its Fit-for-55 package, implementing the European Green Deal's ambitions of climate neutrality until 2050 and an overall emissions reduction until 2030 of 55% compared to 1990. Specifically, it involved a redesign of the existing Emissions Trading System, with more ambitious reductions targets and a wider scope that now includes shipping. The Carbon Border Adjustment Mechanism was added to the system introducing a carbon price on the import of certain products. A second stand-alone emissions trading system has been legislated for the building and transport sectors, which will become operational in the second-half of the decade. The new emissions trading system is supplemented by the Social Climate Funds

with a budget of EUR 86 billion to protect vulnerable households from adverse distributional effects (EU Commission, 2023). Taken together, the adoption of key components of the Fit-for-55 package constitute a major step toward closing the implementation gap in the EU compared to previous year's assessment.

In the Global South, Chile is an extraordinary case. It has recently adopted a comprehensive framework law on climate change, aiming at Carbon neutrality by 2050 (Government of Chile, 2022). India has updated its nationally determined contributions in 2022, including stronger ambitions on renewable energy production, but the contributions are still considered to be insufficient regarding the Paris Agreement (Climate Action Tracker, 2022). Costa Rica has climate policies in place that are 1.5°C-compatible. The progressive policies for the electrification of its national transport sector are pioneering (Climate Action Tracker, 2023). China is on the brink of reaching its renewable energy capacity objectives for 2030, possibly achieving them as early as five years in advance (Global Energy Monitor, 2023). Nevertheless, as nations discuss whether to gradually reduce or eliminate coal usage, around 2,100 GW of coal-powered plants are currently operational, and approximately 560 GW of new coal-powered plants are in development, primarily in developing nations such as China, India, Indonesia, and Bangladesh (Global Energy Monitor et al., 2023; Boehm et al., 2023, p. 3-12).

The US and the EU have made major steps toward reducing the implementation gap. The overall performance of the EU, however, is a combination of union-wide policies and climate-related regulation by member states. To illustrate, we report on relevant changes in Germany that have occurred since the previous Outlook. In Germany, the movement seems to be sidewards, with process in some areas and drawbacks in others.

The Federal Climate Protection Act sets climate targets and serves to coordinate various sectoral policies. The amendment currently debated in parliament aims at changing the monitoring mechanism. So far, monitoring is based on sector-specific annual emission targets. Exceeding them led to the obligation to draw up an immediate action program for the respective sectors. The proposed amendment introduces projection data as a new basis for monitoring. Only if the projections indicate that aggregate annual emission targets for the years 2021 to 2030 will be exceeded for two consecutive years, the government has to implement additional measures. The government promotes the reform as an increase in flexibility, foresightedness, and hence efficiency. However, the German Advisory Council on the Environment (SRU) criticizes the turn away from sector-specific targets as a dilution of responsibility and the replacement of past emissions by projections as being more susceptible to outcome-driven assumptions (SRU, 2023).

Positive effects are expected from amendments to the Renewable Energy Act that now assigns the status of a privileged status to construction and operation of renewable energy plants. Competing interests are to take precedence only in exceptional cases. In November 2023, a judgment by the Federal Constitutional Court sent shock waves through Germany climate policy by ruling that a law channeling EUR 60 billion into climate mitigation measures was unconstitutional (Bundesverfassungsgericht, 2023). It is too early to fully assess the repercussions of this decision, but it is highly likely to increase the implementation gap in Germany.

Overall, the implementation gap has been reduced but is still sizable.

Enabling and constraining conditions affecting driver dynamics

The prevailing concerns about the social impacts of climate policy continue to constrain implementation of stringent climate policy instruments (Vona, 2023). The debates ahead of passing the German Heating Law and the German intervention on the ban of combustion engines at the EU level serve as examples. There is mounting empirical evidence on the constraining role of right-wing parties (Huber et al., 2021; Kulin et al., 2021; Lockwood and Lockwood, 2022). Climate protests by the Fridays for Future movement have been shown to substantially increase voting shares for the Green Party in Germany between 2019 and 2021 (Waldinger et al., 2022) and the movements' decentralized approach to best accommodate behavioral patterns (Jarke-Neuert et al., 2023). More recently there has been an increasing trend of polarization over climate policy, with climate activists resorting to more disruptive actions such as blocking streets and attacking works of art on the one hand, and the rise of climate-skeptic parties on the other (Zilles and Marg, 2022). Internationally, the recent increase in interest rates has also been flagged as a constraining factor in renewable deployment (Pahle et al., 2022).

While social impacts, right wing populism, and a growing polarization are constraining conditions in some European countries, there are still other factors pointing to continued or even increased domestic extraction of fossil fuel reserves. In particular, the persistence of the production and use of coal despite health risks (Barbhaya et al., 2022) and high local pollution levels (Romana et al., 2022) deserves further scrutiny (Jakob and Steckel, 2022), as it foils decarbonization gains made by the growth of renewable energy production. China, while showing the fastest growth in wind and solar energy, is at the same time both the largest producer and consumer of coal, with India the second largest in terms of total quantities. More generally, there are strong coalitions between governments or political parties and the coal industry (Clark and Zucker, 2023) while local protests are oppressed (Fünfgeld, 2019). The legitimacy of continued coal exploration is often high in countries where large shares of the population

still lack access to electricity and coal reserves are abundant, for example in India and Colombia. It is important to note that the enabling and constraining conditions for the continued production and use of coal in countries of the Global South are regionally diverse (Jakob and Steckel, 2022).

Major studies published since the previous Outlook edition

As stated above, the existence of the implementation gap and the conceptual framework explaining its existence that have been put forward in the previous Outlook and an associated paper (Perino et al., 2022) have been independently confirmed (Fransen et al., 2023; Rogelj et al., 2023). For the Global South, Marquardt et al. (2023) systematize the field of climate mitigation efforts based on an extensive literature review. They analyze how climate change mitigation is institutionalized and suggest a topology of (1) reform-orientation, such as market incentives, (2) transformative institutionalization aiming at fundamental change, and (3) institutional resistance.

For the EU, the introduction of the Carbon Border Adjustment Mechanism into the Emission Trading System has been criticized for replicating neo-colonial structures that will put developing and least-developed countries such as Mozambique at risk as they are not able to quickly decarbonize and will lose out on their aim of entering EU markets (Mbeva et al., 2023). Borghesi et al. (2023) point out shortcomings in the 2023 reform of the Emission Trading System that could undermine the carbon market's effectiveness, which is relevant because it is the cornerstone of EU climate policy in the electricity and industry sectors. Searchinger et al. (2022) draw attention to the conflict between the promotion of bio energy and carbon storage and biodiversity conservation in the EU.

Faccioli et al. (2022) show that a carbon tax on food would reduce emissions more effectively than informational interventions. Perino and Schwickert (2023) highlight that a majority of Germans support a moderate tax on meat, but support is higher if the same tax is introduced to protect animal welfare rather than reducing carbon emissions. Parlasca and Qaim (2022) point out that taxing meat could conflict with other sustainable development goals in the Global South.

China is likely to play an ever-increasing role in shaping climate related regulation. Qi and Dauvergne (2022) conclude that the country makes use of its central position within the Global South to promote a techno-centric strategy toward growth-oriented solutions in mitigation regulation. Research concerning climate governance in Africa, Southeast Asia, and the Andean region emphasizes the importance of coordination, long-term planning, and the institutionalization in local contexts to raise acceptance for climate action (Francis et al., 2022; Aleluia et al., 2022; Carrión et al., 2022).

Generally, net-zero targets have been identified to help highlighting the relevance of climate policies as commitment devices to guide expectations and investments rather than current emissions (Dolphin et al., 2023). However, new computations suggest that the point in time by which net zero has to be reached to meet the Paris Agreement climate goals has to be earlier than expected (Lamboll et al., 2023).

Uptake of climate action resources generated by other drivers

The Paris goals and the pledge-and-review process established as part of the UNFCCC provide an important resource for climate-related regulation as it sets a clear reference point with respect to ambition and creates an international audience scrutinizing efforts by individual countries. Climate protest and social movements ensure that the topic remains an important part of the public discourse and push policy makers toward more stringent policies (Waldinger et al., 2023).Some cases of climate litigation, such as the successful lawsuit against the German Climate Change Act (KSG), force policy-makers to implement more stringent policies. Shifting consumption patterns such as a rising share of vegetarians induced by a change in values reduce the opposition against some mitigation measures such as meat taxes in the Global North.

Implications of driver dynamics for climate change adaptation

Due to the way the driver has been defined, it does not cover regulation related to adaptation measures. Nevertheless, there are links: For one, the more effective climate-related regulation is, the less the need for adaptation measures in the medium to long term. Furthermore, there might be both trade-offs and synergies between specific mitigation and adaptation measures (Pasimeni et al., 2019, Lee et al., 2020).

3.5

Climate Activism and Social Mobilization

In the Outlook 2023, we assessed this driver under the title *climate protests and social movements*. We will move forward renaming the driver *climate activism and social mobilization* in order to capture broader dynamics within climate-related civic engagement (Fisher and Nasrin, 2021). This is necessary because climate activism has undergone significant developments since September 2022. The focus of this update will be on these developments in relation to the trajectory of deep decarbonization, in particular on the pluralization of strategies, the rising radicalization of climate protest activities and its surrounding debates on acceptability and legitimacy, and increasing state repressions. It also highlights the emerging prominence of the concepts of climate reparations and Loss and Damage in international debates following COP27, as well as the crucial role of Global South activist groups in this context.

To illustrate some of the recent dynamics, changes, and challenges, we are going to refer mostly to examples in the US, Germany, and the UK in more detail. This is mainly because these contexts have been at the forefront of the historic mobilizations of 2019. It shows in increased research on these groups, thus providing a rich set of data and literature. However, we are aware of the prevailing Eurocentrism in social science climate (justice) research. There is a substantial gap between the crucial role of Global South activism enabling climate action (Sultana, 2021; 2023; Crawford et al., 2023) and research on Global South activism (Kavya et al., 2023; Thiri et al., 2022).

Key social driver dynamics since the previous Outlook edition

The most recent assessment of climate movements and protests' driving capacity toward deep decarbonization in the Outlook 2023 concluded that it functions as a supporting factor for decarbonization but is not sufficient for deep decarbonization by 2050 (Pagnone et al., 2023). Yet, there were enabling conditions identified, such as the growing relevance of climate justice frames and shifting perceptions in the broader public allowing for more long-term and indirect effects. The interaction of climate movements and protests with other social drivers, such as media, climate governance, climate litigation, and knowledge production provided further supporting effects (Pavenstädt et al., 2023, 102f).

Climate movements in many countries are undergoing a transition phase. The initial surge of public concern has encountered obstacles in sustaining long-term mobilization and movement building, partly due to the COVID-19 pandemic's impact (Buzogany and Scherhaufer, 2023; Della Porta, 2022; Andrews et al., 2023). To adapt to changing circumstances, climate activists are diversifying their strategies. This includes symbolic and disruptive protests to escalate the public discourse and pressure policymakers, as seen in the advent of new groups such as Last Generation as well as a focus on alliance building, grassroots actions, and coalition building between other movements with groups like Fridays for Future and Extinction Rebellion.

In the US, the climate movement, including youth-led organizations like the Sunrise Movement and Fridays for Future, has experienced fluctuations in its momentum. The COVID-19 pandemic disrupted their activities, leading to a period of dis-grouping, reorganization, and strategic recalibration (Haßler et al., 2023; Pavenstädt et al., 2023). A growing radical flank of groups like Extinction Rebellion, Scientist Rebellion, and Declare Emergency! engages in direct action (Fisher and Renaghan, 2023). Groups like Sunrise Movement started to adopt a more decentralized approach with a focus on local initiatives (Bauck, 2022). The passage of the US Inflation Reduction Act has been influenced by many climate and environmental civil society actors, including environmental NGOs and climate movements (Aronoff, 2023). Some observers suggest that the Sunrise Movement played a crucial role in the process (Bordoff, 2022; Stokols, 2023). This landmark legislation represents a significant shift in climate policy, emphasizing stronger government investment and a linkage to job creation and justice. Although the Inflation Reduction Act is seen as an important first step, it has also been criticized as a forced compromise (Kleimann et al., 2023). In Germany, the Fridays for Future movement has encountered its own set of obstacles, and there are internal struggles and uncertainties about strategic direction as frustration over the inertia in current socio-economic systems rises (Marquardt, 2023). Some activists switched to direct-action, organized by Last Generation, and gained high public visibility. Last Generation's actions did not gather extensive mobilization in numbers, but they stood out due to their disruptive and unconventional tactics (Grimm et al., 2023). Last Generation engages in street blockades and blockages of critical

infrastructures like highways, airports, and liquefied natural gas terminals (Rucht, 2023) as well as symbolic actions (Grimmbacher, 2023). Fridays for Future and the German trade union Verdi formed a coalition and engaged in issue-linkage between climate action and fair wages in the public transportation sector (Lucht and Liebig, 2023). In the United Kingdom, movements like Extinction Rebellion and Just Stop Oil also engaged heavily in direct action. They have been met with increasing state repression, primarily through stringent police laws and restrictions on the right to protest (Serhan, 2022). Recently, Extinction Rebellion UK has announced a strategic shift away from illegal actions (De La Garza, 2023), and mobilized 60.000 people for "The Big One" protest on Earth Day in alliance with other established environmental NGOs (Read, 2023).

Mobilization and contention, especially from Global South activists, have been further crucial in pushing for implementing effective steps with regard to adaptation, loss and damage, and climate finance. As a result, the topic of climate finance became more prominent within climate movements and affected the broader public discourse and relevant institutions (Jackson et al., 2023; Schalatek, 2022). The Global South-led and international Debt for Climate movement calls for debt cancellation owed by Global South countries to the Global North (Debt for Climate, 2023; Morgan and Charaby, 2023). The People's Forum on End Fossil Finance, held in June 2023, highlighted the urgency to promote a debt relief in order to enable a self-determined just transition in Global South countries (endfossil.finance, 2023). The International Monetary Fund claims to acknowledge the issue at hand, suggesting so-called debt-for-climate-swaps in August 2022, meaning partial debt cancellation in exchange for investments in climate action (Harvey, 2023). However, Debt for Climate criticized this as undemocratic and as evoking narratives of a charitable Global North (Adrogué and Plant, 2023). This campaign has recently been able to generate more attention, including protests in front of the International Monetary Fund and World Bank headquarters in Washington D.C., and during the G7 summit in Germany (Wilkins, 2022; Köpf and Wehner, 2022). Overall, and despite the recent Paris climate finance summit failing to deliver the urgently needed proposal to transform the global financial system, it is reasonable to say that the combined efforts of civil society and the persistent advocacy of Most Affected People and Areas (MAPA) states and organizations have created momentum for addressing these urgent finance-related issues. The months following COP27, coupled with years of civil society engagement, have contributed to a growing recognition of the need for reforming the global financial system (Morgan and Charaby, 2023). Nevertheless, Global South activists continue to struggle with the ongoing experience of disregard at various sites of climate governance, such as the COPs. In addition to the issue of vulnerabilities, some of the major points of contestation include how various structures of discrimination intersect with climate governance dynamics and how to forward diverse understandings of climate justice. Thus, Global South activists contest the discourse portraying the Global South as mere victims void of agency but highlight their formative role for climate action (Crawford et al., 2023).

Enabling and constraining conditions affecting driver dynamics

Increasing repression against climate activism has become a troubling global trend. First, the strategy of filing strategic lawsuits against public participation (SLAPP) is on the rise, through which large corporations aim to intimidate and ultimately silence activists and protestors (Monforte, 2023; Priyatno et al., 2023). Second, governments and authorities suppress environmental protests and activities with a variety of tactics, violating human rights and even harming the activists' physical integrity, sometimes with fatal consequences (Taylor, 2021; Temper et al., 2020; Weis, 2022). Although this is not unprecedented in the Global South, it is noteworthy that it is now being witnessed in liberal democracies in the Global North as well, which have historically been known for upholding strong principles of freedom of assembly. This may constitute a more general trend toward authoritarian measures (Fearn and Davoudi, 2021), including countries such as Germany, the Netherlands, France, the US, the UK, and Australia (Ataman and Paddison, 2023; Gulliver et al., 2023; Uyeda, 2022; Scheidel et al., 2020). In the US, repression against climate activism has been on the rise ever since Indigenous groups resisted environmentally destructive projects, most notably represented by the Standing Rock protests against the Dakota Access Pipeline (Correia and Wall, 2021; Gilio-Whitaker, 2019). Activists have had to face arrests, raids, and prosecution for decades already; but recently they have also been confronted with domestic terrorism charges. In early 2023, one climate activist has been killed by the police in Atlanta, marking the first police killing of an environmental activist in the US's recent history (Akbar, 2023; Mowatt, 2023). This growing repression is intertwined with framings as climate gluers or climate terrorists, portraying climate activists as obstructive and disruptive, seeking to delegitimize their cause and justify law enforcement actions (Akbarian, 2023; Kubiciel, 2023). While most court rulings imposed only moderate penalties, recent developments saw prison sentences of several months for gluing actions after activists announced that they would continue to commit to direct action (Rucht, 2023). Additionally, Last Generation activists were subject to wiretapping, surveillance, raids, and preventive detention, with investigations conducted to determine whether the grouping qualifies as a criminal organization (Zeit Online, 2023; Langmack and Brandau, 2023).

This was subject to legal debate, noting that these law enforcement practices are questionable and sometimes violate human rights (Rippert, 2022; von Bernstorff, 2023; Rucht, 2023).

Furthermore, the described driver dynamics themselves can have effects for enabling and constraining conditions, but there is still a lack of comprehensive empirical studies on these effects (Özden and Glover, 2023). Possible short-term effects of direct action are described in the literature on radical flanks (Haines, 1984). Possible enabling conditions are political concessions to climate advocates considered moderate by governments as a result of radical forms of protest by other climate movements (see e.g. 350.org's divestment campaign; Schifeling and Hofmann, 2019). Factors that would affect constraining conditions for further activism include the de-legitimization of the whole climate movement as well as increased public polarization. While polls do indeed signal public disapproval of the protest groups committed to direct action and even a general drop in support for climate activism and polarization (More in Common, 2023), there is neither evidence that disruptive protest methods will reduce general approval of stronger climate policies, nor that they yield significant gains (Özden and Glover, 2022; Kountouris and Williams, 2023).

The use of direct action as well as the subsequent criminalization of these practices can lead to so-called chilling effects, causing individuals or groups to self-censor or refrain from exercising in certain behaviors due to a fear of negative consequences (von Bernstorff, 2023). Scholars identified such effects, for instance, in recent waves of climate action in India (Goodman and Morton, 2023). This has significant implications for democratic participation, public discourse, and the mobilization climate (justice) movements. Some contend that transitioning from street protests to direct action could potentially shift the focus of public discourse from simply raising awareness to actively engaging in the cause by putting even stronger emphasis on the issue's immense urgency (Berglund, 2023; Capstick et al., 2022).

Long-term effects may entail deeper cultural and normative change in societies that will facilitate deep decarbonization. Initial studies indicate that parts of the climate movements in Germany, the US, and Belgium have increasingly incorporated critical narratives into their discourse (Crouzé et al., 2023; Pavenstädt and Rödder, 2024). Scholars note that direct action has the potential to contest hegemonic norms and discourses, which could eventually constitute an enabling condition for facilitating deeper cultural and normative change (Andrews et al., 2023, Christou et al., 2023). Yet, some scholars also argue that certain ongoing direct action campaigns focusing on radical tactics rather than making explicit demands, tend to undermine the promotion of critical discussions on existing socio-political and economic systems. (Rucht, 2023). Furthermore, there is growing concern that a focus on urgency and emergency in activism and politics would serve to lock-in current systems and inequalities (Goodman and Morton, 2023; de Moor, 2023). All of this, coupled with a surrounding public discourse that focusses on the legitimacy of direct action, might mean that potential for a deeper contestation of norms as well as current socio-political and economic systems may currently be missed (de Moor and Marquardt, 2023). Recent articles suggest that climate movements ought to address power imbalances and challenge dominant narratives more strongly in order to foster long-term mobilization (Hayes and MacGregor, 2023; Pavenstädt and Rödder, 2024; Buzogany and Scherhaufer, 2023).

Furthermore, there is an increasingly unfavorable discursive environment for climate (justice) activism: As actors in the economy, media, and politics promote discourses that focus on technology and market-centered policies along a green growth paradigm (Leipold, 2021). While discussions about the use and implementation of technologies and other measures are indeed necessary, climate activists will need to react to the frequent co-occurrence of climate delay discourses. These include, for instance, re-directing responsibility to individuals or other states, technological optimism, or framing fossil fuel use as the right to development (Lamb et al., 2020). Ongoing disapproval of protest tactics and repressive reactions by the state will likely have an effect on movements' future strategizing. Global conflicts such as the war in Ukraine and lately, rising global tensions after Hamas' attack on Israel on 7 October 2023 and Israel's ensuing invasion of Gaza, as well as insecurities about inflation and the development of the economy provide a further challenging discursive environment for this driver. Lastly, while some right-wing populist governments were voted out of office, right-wing populists elsewhere in Global North and Global South countries continue to mobilize with the goal of contesting stronger climate action, posing additional constraining conditions toward climate activism (Marquardt et al., 2022).

In sum, climate movements have reacted to increasing constraining conditions in the global opportunity structure, consisting of an increasingly unfavorable discursive environment, state repression, and public disapproval for direct action tactics. We identify a diversification of practices, from issue-enlargement and coalition building, to international demands. Moreover, new direct action protest groups gain relevance achieving comparatively high media attention, sparking internal disputes over tactics and advancing fragmentation within the broader climate movement. Striking a balance between moderate and radical approaches, between issue bridging to engage people long-term and reaching as many people as possible through broad messaging, between internal community strategies, public advocacy, and disruptive actions will be key to re-gaining momentum. Therefore, we conclude that the driver continues to contribute toward decarbonization, but not sufficiently for deep decarbonization by 2050.

Major studies published since the previous Outlook edition

New major studies include a collective volume on Fridays for Future in Germany, encompassing a range of different disciplinary and methodological perspectives (Pollex and Soßdorf, 2023). Buzogány and Scherhaufer summarize key findings about new climate movements in a chapter in the *Routledge Handbook of Environmental Policy* (Buzogány et al., 2023; Jörgens et al., 2023). In addition, there are studies on the global spread of Extinction Rebellion (Gardner et al., 2022) and the connections of Fridays for Future Germany to other societal stakeholder like NGOs and trade unions (Laux, 2023). Scheuch et al. (2024) analyze media reporting connected to different protest tactics in the UK. Survey-based studies look at the influence of climate protest on environmental attitudes (Kountouris and Williams, 2023; Fritz et al., 2023) and the reporting practices by the IPCC on protest behavior (Doran et al., 2023). A number of publications focus on the role of scientific knowledge in the climate movement (Rödder and Pavenstädt, 2023; Soßdorf and Burgi, 2022; Thierry, 2023), their digital discourse, mobilization, and organizing practices (Sorce, 2022; Suitner et al., 2023; Spaiser et al., 2022) as well as the use of post-apocalyptic narratives (de Moor and Marquardt, 2023). Criminalization of protest, however, is primarily discussed in academic and journalistic forums (e.g., in the Verfassungsblog, a popular German blog for national and international legal issues) and has not yet found its way into new major studies (with the exception of Gulliver et al., 2023).

Uptake of climate action resources generated by other drivers

- **Climate litigation:** Climate movements can build on legal frameworks and previous successful cases of climate litigation for subsequent legal (and moral) arguments in both Global South and Global North countries (Kotzé and Knappe, 2023; Donger, 2022; Moreira et al., 2023; Stuart-Smith et al., 2021).
- **Knowledge production:** Climate movements not only draw upon packaged knowledge provided by institutions like the IPCC but also use it as a source of legitimacy. In particular the movments focus on and call for the 1.5°C limit, is shaped by the scientific outputs, such as the IPCC's special report on "Global Warming of 1.5 °C". Notably, the IPCC's Sixth Assessment Report incorporated the concept of degrowth for the first time in 2022 in their technical summary of Working Group III. However, it was not discussed in the Summary for Policymakers. A more systematic exploration of degrowth pathways, for example through changes in modeling or assessment practices, may strengthen future consideration of alternative policy options (Braunreiter et al., 2021; Veland et al., 2018, Beck and Oomen, 2021). However, given concerns about the political feasibility (Keyßer and Lorenzen, 2021), such developments would likely depend on a re-evaluation of the meaning of policy-relevance. Additionally, there is increased interaction between these drivers, prompting a re-evaluation of academic practices at the science-policy interface, the role of social sciences (Glavovic et al., 2022; Cologna and Oreskes, 2022), and the responsibility of scientists to engage in advocacy and activism (Hartz, 2023).
- **Corporate responses:** Among the various effects this driver has on climate activism and social mobilization, the most prominent one surely still is the following: Corporate responses deemed inadequate become targets for negative campaigning against greenwashing, positioning corporations as adversaries within movement narratives (Yilmaz and Baybars, 2022; Alperstein, 2022).
- **UN Governance:** The annual climate summits act as peaks of global attention, serving as focal points for mobilization. This heightened focus attracts increased media and political interest, fostering international exchange and the formation of alliances among activists (Aykut et al., 2022a; de Moor, 2022; Uldam, 2013).
- **Physical drivers:** The attribution of extreme weather events or disasters to climate change plays a dual role for both climate movement narratives and public discourses. However, it also has the potential to divert attention from the socio-political factors underpinning vulnerability (Lahsen and Ribot, 2022). In the long term, the exposure-vulnerability trap (Sobhan, 2014) may hamper the means for mobilization in the most vulnerable regions.

Implications of driver dynamics for climate change adaptation

Since adaptation is a collective effort, successful adaptation also depends on how affected communities engage with climate risks. Social mobilization is therefore central to adaptation, particularly transformational adaptation (Kuhl and Shinn, 2022). This driver may have implications on adaptation through (1) activism and social mobilization for questions of adaptation, or (2) activism and social mobilization as adaptation, that is, through engaging in local community and prefigurative practices that foster adaptation on the ground.

1. On a more general level, the establishment of a climate fund in November 2022 at COP27 to address Loss and Damage, initially put forth by Vanuatu in 1991, marked a critical milestone for global climate justice and for climate movements worldwide (Raffety et al., 2022; Bakhtaoui and Shawoo, 2022; Gewirtzman et al., 2018). Civil society groups, especially from the Global South, played a pivotal role in advocating for the inclusion of climate financing in the official conference agenda. This highlights the urgent

need to address the disproportionate impacts of climate change on vulnerable regions, especially after the rejection of a climate fund proposal at COP26 (Adger, 2023; Niyitegeka and Mukayiranga, 2023; Schalatek, 2021). Despite immense restrictions and human rights violations, civil society engagement remained high throughout COP27 (Charaby, 2022; Raffety et al., 2022).

2. Overshadowed by large-scale social mobilizations demanding adaptive changes are long-standing traditions of grassroots organizing, capacity- and community-building, and prefiguration in and by communities heavily affected by climate crisis implications (Ziervogel et al., 2022). These kinds of local community practices facilitate survival, well-being, and care in times of multiple crises (Yates et al., 2023). They are able to create and maintain collectivities practicing alternative ways of living. Thus, life is constantly re-organized and adapted in light of changing needs and challenges (Dionisio et al., 2023; Fash et al., 2023). In that sense, adaptation does not refer to a conclusive and comprehensive strategy, but rather to the creation of a social network that is able to change and transform (Fash et al., 2023). Furthermore, the concept of climate change adaptation is in itself contested, criticizing that adaptation governance focuses on "tangible, biophysical impacts of climate change in a given geographic area" (Fünfgeld and Schmidt, 2020, p. 437), thereby sidelining social complexities of both the climate crisis and adaptation planning and governance, including issues of racism, colonialism, and extractivism (Parsons, 2023; Yates et al., 2023).

3.6
Climate Litigation

Climate litigation refers to individual and strategic cases aimed at achieving decarbonization and climate justice. It comprises lawsuits against governments, administrations, or companies to strengthen national emissions reduction commitments, prevent carbon-intensive infrastructure projects, or hold firms accountable for global warming impacts. There is no clear distinction between individual and strategic cases. However, strategic litigation is brought with the intention of going beyond the individual enforcement of rights in a single case and achieving or working towards a regulatory change relevant to a wider group of actors (see also Setzer and Higham, 2023).

Key social driver dynamics since the previous Outlook edition

In the 2023 assessment of climate litigation, we found it plausible that it would continue to increase in number and spread geographically and thus have the potential to support social dynamics toward deep decarbonization. However, this trajectory is highly dependent on the dynamics of closely related drivers such as climate-related regulation, climate activism and social mobilization, and knowledge production.

Overall, dynamics in the climate litigation driver have remained relatively stable since the previous assessment. We observe further geographical spreading, a continuing rise in cases at a lower growth rate, an increase in cases against private companies, further diversification in scripts (i.e., legal bases and lines of argument), and enhanced knowledge production in attribution science that can be used in various types of cases to establish responsibilities for the reduction of greenhouse gas emissions or compensation of global warming impacts. According to the Sabin Centre's database on climate cases in 2022, 144 new cases had been filed in the US and 79 cases globally outside the US. With regard to 2023, the database accounts for 61 new climate cases in the US and 22 new cases in other jurisdictions until the middle of July (five of those in the UK and four in France). Compared to the number of cases filed per year in 2019 and 2020 (152 and 164, respectively) the number of new cases submitted in the US slightly declined in 2021 and 2022 (142 and 144, respectively). Globally (excluding the US), the number of annually submitted cases steadily rose each year since 2014, from 27 cases in 2014 to a peak of 111 cases in 2021. 79 new cases have been filed globally in 2022, which was still more than in 2020. From the 61 newly submitted cases in the US in 2023, around 47 were pro-climate cases and about 14 non-climate-aligned. Notably, all new cases submitted outside the US in 2023 were pro-climate cases, and all but one of them were filed by NGOs. Germany saw a stark rise in climate-aligned cases after the landmark Neubauer ruling of the Constitutional Court (from seven in 2020 to 11 in 2021 and 22 in 2022). However, it has to be noted that 13 of the 22 cases filed in 2021 were direct follow-up and parallel cases against 13 German states that were not accepted for decision by the Constitutional Court.

We continue to observe a geographical spreading of cases. Drawing on the Sabin Centre's database,

Setzer and Higham (2023) identified first climate cases in Finland, Romania, Russia, and Thailand between 2022 and May 2023. Overall, the vast majority of climate cases is still documented for the US (over 1,500), followed by Australia (130), the UK (102), the EU (67), Germany (59), Brazil (40), and Canada (35) (Setzer and Higham, 2023). A total of 135 climate cases are accounted for in countries of the Global South with around 20 cases filed each year in 2020, 2021, and 2022.

In terms of outcomes, around 55% of the decided climate cases documented in the Sabin Centre's database had direct judicial outcomes that support decarbonization (Setzer and Higham, 2023, p. 28). However, it is important to bear in mind that an assessment of actual effects is highly complex.

With regard to the plaintiffs, we observe that the vast majority of non-US cases submitted in 2022 and 2023 have been brought to court by NGOs and individuals or both (Setzer and Higham, 2023, p. 3). On the defendant side there is a decline in cases brought against governments and a rise in strategic cases initiated against corporate actors of a growing range of sectors (Setzer and Higham 2023, pp. 3, 21). However, still more than half of the cases submitted in 2022 and 2023 were brought against governments.

Setzer and Higham (2023) identified a set of common strategies in climate-aligned strategic litigation across non-US jurisdictions filed between 2015 and May 2023 that can be understood as new scripts in the analytical framework of the Global Opportunity Structure (Section 3.1). According to this categorization, the most applied script was "integrating climate considerations", identified in 206 cases that aim to include climate-related standards and principles into decision-making, often challenging new fossil fuel projects. The next most applied script consisted of so-called "government framework" cases (81), challenging (lacking) state climate policies. A rather new and increasingly used script is the so-called "climate-washing" litigation (57 cases, 52 of which brought against companies). Also increasing are "turning off the taps" cases (28), which aim to prevent funding of carbon intense projects. Not large in numbers but in scope are five new "global guidance" cases (requests for advisory opinions) filed with the International Tribunal for the Law of the Sea, the Inter-American Court of Human Rights, and the International Court of Justice (Setzer and Higham, 2023, pp. 3, 22, 23).

Enabling and constraining conditions affecting driver dynamics

The key structural and institutional enabling conditions remain access to justice and—for human rights-based cases—fundamental substantive rights, such as the right to a healthy environment or extensions thereof, for example a right to a stable climate or to a life-sustaining climate system. With regard to legal enabling conditions, we observe a rise in climate-related legislation such as the US Inflation Reduction Act, the EU taxonomy, and more and more climate change framework laws that offer statutory bases for new cases, including at sectoral level. However, it has to be stressed that the relationship between legislation and litigation is complex (see also Setzer and Higham, 2023, p. 13). In the US, the discussion about the scope of regulatory competence of the Environmental Protection Agency after Supreme Court rulings is still ongoing. Another recent development is a rise in regulatory and soft law initiatives that work toward more detailed and transparent climate taxonomies. There are plenty of salient examples: the UN Secretary General's High Level Expert Group on Non-State Actor Net Zero Commitments; the OECD Guidelines for Multinational Enterprises on Responsible Business Conduct; the EU Commission adopted a proposal for a Directive on Green Claims, and the European Parliament approved a Corporate Sustainability Due Diligence Directive that imposes responsibility for climate transition planning on company management; the UK Competition and Markets Authority published new code; the US Securities and Exchange Commission launched a Climate and Environmental, Social and Governance (ESG) Task Force to develop initiative to proactively identify ESG-related misconduct and streamline ESG-related disclosure rules for investors; the Glasgow Financial Alliance for Net Zero. Last but not least, the UN Global Stocktake under the Paris regime produces new data (see Section 3.3). All this enables new climate-aligned litigation such as climate washing cases, but also provokes cases by affected companies challenging the new standards.

A key scientific enabling condition that strengthens the plaintiffs' arguments regarding responsibilities and causation in climate litigation are advances in climate science, especially those assembled in the latest IPCC assessment reports, as well as newer developments in attribution science. Attribution science is climate science that analyses and evaluates the relative contributions of various causal factors to a changing climate or to a specific event (Otto et al., 2020; Wentz et al., 2023). Furthermore, a new, not yet peer-reviewed study by Grasso and Heede (2023) argues that 21 leading fossil fuel companies are liable for annual climate reparations amounting to at least USD 209 billion, which is likely to support future damage claims.

With regard to socio-political enabling and constraining conditions, we observe a new wave of activism using civil disobedience tactics as well as courtrooms as a supplementary public arena to voice their claims (Just Stop Oil, Letzte Generation, Dernière rénovation). Related climate activist cases are increasingly heard in court. In very few instances, courts in the US and one German court accepted "climate emergency" as a justification for acts of trespassing and similar civil disobedience actions.

As noted above, for the purposes of this assessment we define climate litigation solely as climate-aligned litigation because we consider the social processes leading to pro-climate cases inherently different from such that fuel anti-climate litigation. This implies that we capture anti-climate litigation as one of the constraining conditions of pro-climate litigation if it is either directly tackling the plaintiffs of pro-climate cases or if it is filed in reaction to certain scripts and repertoires used by climate-aligned litigation. While there has only been one anti-climate case recorded outside the US since 2022, we observe further cases of Strategic Litigation Against Public Participation (SLAPP), aimed at exerting a chilling effect on activists and potential litigants, and anti-ESG litigation to weaken the growing climate taxonomy alliance in the US. Anti-ESG lawsuits emerged in the US in the context of an observable densification of climate action opportunities in the field of climate taxonomies. This densification consists in the confluence of three developments: First, a growing number of global firms participate in climate disclosure alliances and self-report data. Second, a more thorough engagement on part of regulators such as the EU Commission and the US Securities and Exchange Commission with processes to define stricter reporting standards. Third, an increase in climate lawsuits targeting corporations and greenwashing practices that use self-reported data and could, in the future, invoke new regulatory standards. The Anti-ESG lawsuits therefore constitute at least in parts a reaction to pro-climate litigation and aim at minimizing future litigation risks for companies.

Major studies published since the previous Outlook edition

The following larger synthesis and review studies have been published within the past year:

Setzer and Higham (2023) published an update of their yearly observation of global trends in climate litigation based on the two largest databases of climate cases. Among their key findings are the continuous growth of climate cases at a slowing growth rate and a continuing expansion of geographical scope and typologies (i.e., strategies) of cases.

The Global Climate Litigation Report 2023, which is jointly published every three years by UNEP and the Sabin Center for Climate Change Law, underpins these key findings and complements them by looking at the role of women in climate litigation. They do not only see women as victims who suffer disproportionately from the effects of climate change, but more importantly as agents of change who can contribute significantly to climate justice.

Iyengar (2023) examines the social embedding of human rights-based climate litigation using qualitative socio-legal research methods with a special focus on how lawyers and activists bring and think about the cases.

Peel et al (2022) reviewed 280 publications of grey and academic literature addressing the impacts of climate change litigation in the time period of 2000 to 2021. They found that only a few contributions conduct a systematic review of impact and assume that this is due to the complexity of impact assessment and the lack of analytical frameworks (approaches, definitions, and methods).

Uptake of climate action resources generated by other drivers

New climate laws and standards developed by climate-related regulation are arguably the most relevant resources for climate litigation, followed by scientific knowledge on climate risks and causalities developed in attribution science and strategic litigation networks expanding in cooperation with social movements.

Implications of driver dynamics for climate change adaptation

Climate change adaptation litigation has been on the rise recently. Of the more than 1800 ongoing or concluded climate change cases worldwide, Setzer and Higham (2023) find 180 that touch on the issue of adaptation—100 in the US and 61 before Australian courts. The most common form of adaptation litigation and scholarship in this area has focused on land use and urban planning at the city or local government level. Plaintiffs have used environmental and administrative law to challenge individual developments, from the Keystone XL Pipeline Project in the US to residential development projects in Australia. Tort law compensation claims for past failures to adapt are less common so far.

3.7

Corporate Responses

Corporate responses to climate change can be defined as communicated strategies and corresponding actions by organizations to mitigate as well as adapt to a changing climate, which ideally could serve as a social driver for progress toward deep decarbonization by 2050. Carbon management activities such as science-based target setting and increased investments in renewable energy support these deep decarbonization strategies.

Key social driver dynamics since the previous Outlook edition

While most companies have not adequately responded to climate change, recent evidence (e.g., Net Zero Tracker, 2023; Science Based Targets, 2023) demonstrates an increase in corporate actions such as target setting, net-zero targets, and communicated investment plans. Despite the fact that these signals of commitment toward deep decarbonization are reaching more elevated levels of ambition with regard to their emissions reduction (MSCI, 2023), implementation is still weak. Recent assessments have brought forth that although targets are set, proper actions plans and transparency concerning reduction and offsetting practices remain scarce (Hale et al., 2021). Furthermore, a gap between the Global North and the Global South persists: The majority of emissions have been and are being caused by companies that amass wealth in the Global North, while people in the Global South will bear the brunt of climate change (Hickel and Slamersak, 2022).

While public corporate commitments to deep decarbonization are becoming more prevalent, overall corporate responses still restrain deep decarbonization by 2050, as communicated targets and other promises are not translated into effective actions and greenhouse gas emissions continue to rise. This update thus confirms the previous assessments, which concluded that corporate responses are currently insufficient for deep decarbonization and are unlikely to change in the next decade.

Enabling and constraining conditions affecting driver dynamics

Two significant conditions have impacted the corporate landscape concerning climate change mitigation, both of which can be considered both enabling and constraining. Firstly, Russia's invasion of Ukraine led to an immediate rise of global energy prices, particularly in Europe, thereby primarily affecting nations and industries dependent on fossil fuels such as electricity and power generation, heavy industry (e.g., cement, iron and steel, chemicals, etc.), food and beverage processing, and transportation. Overall, the impact of this is rather ambivalent: On the one hand, it appears more constraining in the short term, as nations and corporations are now more concerned with energy security no matter the energy source (e.g., US companies are more and more reliant on state-provided natural gas). On the other hand, it could become more enabling in the long term as nations and large companies in the Global North seek to adopt renewable energy as a means for energy security (Zuk and Zuk, 2022). Since the outbreak of the war, the EU has been pursuing a new strategy, called REPowerEU, to lessen its reliance on Russian fossil fuels and expedite the green transition by way of energy savings, investments in renewable energy sources, and diversification of energy supply (European Council, 2023a,b). Building on this new strategy, the EU adopted the revised Renewable Energy Directive in 2023, an earlier version of which had already been proposed under the Fit-for-55 package in 2021 (European Council, 2023a). The revision includes the introduction of a new binding target concerning the share of renewable energies, increasing to at least 42.5% by 2030 and ultimately aiming for 45% (European Commission, 2023). Furthermore, it includes indicative targets for the following sectors: construction, industry, transport, and district heating and cooling (European Council, 2023a; IEA, 2024). However, if and how these targets will be translated into action is still unclear, as member states are expected to submit their draft action plans only by June 2024 (IEA, 2023a).

Secondly, although there has been an increase in sustainable financing to give companies the necessary capital to invest in low-carbon transformations, global investments imply rather constraining tendencies. Some financial institutions and investors are increasingly incorporating environmental, social, and governance considerations into their investment decisions, allowing more funds to be allocated to climate-friendly projects and organizations. However, a simultaneous increase in spending on new fossil fuel exploration and extraction activities undermines much of the progress accomplished (IEA, 2023d). This is part of extensive cross-sectoral nature-negative funding activities, which exceed current private investments in nature-positive solutions (UNEP, 2023b). Moreover, the inadequacy of voluntary initiatives in addressing climate finance challenges, exemplified by the failure of the

Glasgow Financial Alliance for Net-Zero, where key members left after realizing that others in the alliance continued to fund fossil-fuel industries, has become apparent. In sum, the insufficient compliance with policies restricting financing for new fossil projects underscores the prevailing constraints in this context (see Section 3.8 for details).

These events have highlighted the need for urgent action, more sufficient corporate commitments and their subsequent implementation, and enabling conditions for greater collaboration among governments, businesses, and other stakeholders to address the climate crisis as well as the tolerated unsustainable investment and production practices around the globe. However, as long as global events such as the increased risk of war and expansion of fossil fuel investments persist, major corporations will take advantage of the situation to keep business running as usual.

Major studies published since the previous Outlook edition

Recent studies concentrate on proposing methods for assessments of corporate climate action and applied strategies. Vieira et al. (2023) focus on the European oil majors' strategies in transitioning from carbon dependence to renewable energy sources in the face of climate change. The study reveals four main strategies adopted by these firms: sustained carbon dependence, carbon emissions compensation, carbon emissions mitigation, and carbon independence. The findings highlight varying levels of action among the companies, with only one out of ten surveyed actively transitioning away from fossil fuels.

This is also confirmed in an assessment by Reclaim Finance (2023), which highlights the lack of transparency of and seriousness in the decarbonization efforts exhibited by certain industries, such as the oil and gas industry, where certain key players are attempting to expand production of fossil fuels, thereby withdrawing from earlier decarbonization statements.

Furthermore, Cherepovitsyna et al. (2023) propose a method for assessing progress based on a carbon intensity reduction goal. Their assessment shows similar results as Vieira et al. (2023), according to whom companies are mostly falling below their goals, demonstrating either no movement or a negative trend.

Expanding the scope of analyzed companies, Coen et al. (2022) study companies on the Dow Jones Sustainability Index and the Financial Times Stock Exchange 100, the latter containing 100 companies mostly from the United Kingdom and Europe. The authors provide a more specific focus on operational improvements as a significant predictor of climate performance improvement, highlighting the significance of strategies beyond emissions reductions. Promisingly, we can see an increase in ambition and commitment, particularly in corporate climate target setting (Bendig et al., 2022; Berger-Schmitz et al., 2023); however, it is either too early to detect significant reductions in absolute greenhouse gas emissions or unrealistic to expect massive reductions.

Practice-oriented publications such as the Corporate Climate Responsibility Monitor by the New Climate Institute (2023) and the Net Zero Tracker (2023) by the US finance company MSCI, track the progress of mostly Global North companies in fulfilling greenhouse gas reduction commitments. They confirm our previous assessment on corporate responses, that is, that there is an increase in commitments but that the majority of the assessed pledges lack robustness and are of low integrity. An Allianz Research Report (2023) focuses on investment strategies to decarbonize the industrial sector in Europe, emphasizing the urgency of action. Overall, these practice-oriented publications highlight the importance of genuine commitments and the need for urgent action to address climate change effectively.

Generation of climate action resources and uptake from other drivers

Social drivers such as climate-related regulations, transnational cooperation, climate litigation, consumption patterns, and fossil-fuel divestment play a crucial role in creating tangible and intangible resources for corporate responses to climate change. Climate-related regulations such as the EU Taxonomy influence corporate responses via strict guidelines and mandatory practices. The EU Taxonomy provides a framework for classifying environmentally sustainable economic activities, which guides companies in aligning their operations with sustainable practices. This creates a common understanding and common criteria for investors, facilitating sustainable financing and investor feedback.

Transnational cooperation provides crucial resources to companies that positively affect sustainability practices and climate action, including knowledge and best practices that address industry-specific challenges. Initiatives like the Science Based Target initiative (SBTi) offer guidance, capacity building, knowledge generation, and legitimacy for the companies. Yet, although gaining high traction, such initiatives should not be misconstrued as neutral, apolitical bodies looking out for the greater public interest. While they are definitely an important step toward the mainstreaming of more ambitious and robust targets, the choice of underlying emission scenarios, the neglect of principles of distributive climate justice, and the promotion of a win-win paradigm are important points of criticism of the SBTi (Tilsted et al., 2023). Given these recognized issues, the UN Race to Zero campaign encourages companies to commit to achieving net-zero emissions, fostering collective efforts in addressing climate change. Beyond its direct impact, transnational cooperation provides valuable resources to

other drivers that can also affect corporate responses, such as climate litigation. Climate litigation has the potential to hold companies accountable for their environmental impact and can lead to financial and reputational consequences, pushing companies to adopt more low-carbon practices. One example, which is considered unprecedented, is the Milieu-defensie et al. vs. Royal Dutch Shell plc. case (Tosun, 2022). While this case will surely go through an appeal process, the Court's initial decision that Shell is obliged to reduce its emissions is provisionally enforceable, meaning Shell will be required to meet the reduction obligation even if the settlement was appealed (Climate Change Ligitation Database, 2019). Consumption patterns and fossil-fuel divestment are two further social drivers that influence business behavior. On the one hand, consumption patterns provide social legitimacy and demand for low-carbon products; whilst also tolerating the continuation of products with high carbon footprints, if only for the sake of cost savings. On the other hand, sustainable finance, particularly investments in clean technologies and fossil-fuel divestments, are on the rise. However, we continually observe large investments in fossil-fuel exploration and extraction, which acts as a backlash for the fossil-fuel divestment movement (Reclaim Finance, 2023). These three drivers (corporate responses, consumption patterns, and fossil fuel divestments) are inextricably linked and demonstrate how the willingness or reluctance of key players to engage with these drivers will most likely determine the fate of deep decarbonization.

Moreover, corporate responses generate resources such as innovations, economies of scale, lobbying, legitimacy, and risk mitigation strategies that contribute to the overall progress in addressing climate challenges and can be utilized by other social drivers. Companies that bring low-carbon and climate-neutral innovations to the market contribute to market readiness, making clean technologies more accessible and affordable for other companies and encouraging sustainable consumption patterns. Additionally, the economies of scale achieved through corporate responses make clean technologies more cost-effective, benefiting not only the companies implementing them but also the wider business community and society. Finally, companies often lobby and advocate for climate policies that can align with the Paris Agreement, especially when it is in their own interest to do so (Ketu et al., 2022). However, corporate lobbying activities against more stringent climate policies continue to persist. It is therefore necessary to scrutinize these companies' lobbying and advocacy practices, as these can act against progressive climate laws and regulations (Brulle, 2022; Pulver, 2023).

Implications of driver dynamics for climate change adaptation

In both academic and business settings, corporate responses to climate change are mostly split into mitigation and adaptation strategies, with few overlaps at the moment. Nevertheless, several concepts exist at the intersection of these two concepts: organizational risks, organizational resilience, and nature-based solutions.

Organizational risks deal with how companies respond to climate-related loss and damage, which could encourage both mitigation and adaptation efforts simultaneously (Sun et al., 2022). However, companies still do not pay the real costs of environmental damage, especially in the Global South (Lee et al., 2022). Organizational resilience has emerged as a concept to consider the extent to which companies can absorb loss and damage from severe weather impacts related to worsening climate change, and how they can recover while maintaining their current or future operational functions (Linnenluecke and Griffiths, 2012; Buzzao and Rizzi, 2023). One recent study (Seddon, 2022) examines how both corporate mitigation and adaptation can be addressed through nature-based solutions, such as management of natural and seminatural ecosystems within river catchments or along coastlines to protect against flooding and erosion. Having said that, even the study's author admits that nature-based solutions will not suffice on their own.

As a final observation of this specific research field, it is important to offer insights into the limitations of research on corporate adaption strategies. In light of the known vulnerability of Global South countries to the effects of climate change, corporations operating in these regions will become more equipped with comprehensive adaption strategies. Nevertheless, as mentioned before, the most prominent academic perspectives on corporate responses lack global inclusivity, since most studies and solutions originate from the Global North. Further research with corporate responses in susceptible regions may enable us to elaborate further on the role this driver plays in the context of climate adaption.

3.8

Fossil-Fuel Divestment

We use the term divestment in a broad sense, referring to any form of reduction or cessation of financial flows, from private or public sources, to existing or new upstream or downstream fossil fuel engagements. In this sense, we can observe both the expansion of acts of divestment by large institutional investors and the continued financing of the fossil fuel industries, and even of massive new extractive activities.

Key social driver dynamics since the previous Outlook edition

On the one hand, according to the divestment database (Global Divestment Commitments Database, 2023), more than USD 40 trillion have been divested by 1591 institutions by 2023, which is slightly more than in the previous year (1550 institutions). On the other hand, the upstream investments into oil in 2023 have reached their highest levels since 2015, and oil producers maintain their plans on expanding production capacity (IEA, 2023d). In 2022, the major oil companies achieved record profits (Sharma, 2023). Major banks have increased fossil fuel financing (Rainforest Action Network et al., 2023), and overall banks' financing for low-carbon energy supply is lower than that for fossil fuels (White et al., 2023). In response to the energy crises that followed Russia's invasion of Ukraine, some countries, such as Germany, have invested in new oil and gas agreements, thus prolonging or deepening fossil dependencies. Plans for extraction are still vast: A recent study identified 425 fossil fuel projects with more than 1 $GtCO_2$ of potential emissions globally, which would exceed a 1.5 °C carbon budget by a factor of two (Kühne et al., 2022). The same study, however, emphasizes that 40% of these fossil fuel projects had not started extraction by 2020.

Compared to this driver's assessment in the previous Outlook, in which it pointed toward decarbonization, we see a partially reversed dynamic, as even under divestment pressure oil majors commit more openly to continued and even expanded extraction investments. To the extent that divestment is actually leading finance away from continued or new fossil fuel engagements, it is always pointing toward decarbonization. However, we see half-hearted divestment or even a renewed wave of financing towards extraction. There might be strong enabling conditions for more and more effective divestment in the future, but the current signs point to a change in direction, as companies are almost always able to acquire capital to finance their activities elsewhere, even if hit by divestment activities.

Enabling and constraining conditions affecting driver dynamics

Some constraining conditions became obvious recently. The new and ongoing wars around the world contribute to increased geopolitical tensions and increase the demand for fossil fuels for military operations (see Box 2). Moreover, in some countries the national income from fossil fuel extractivism creates the foundation for social policy programs and is therefore important to maintain democratic structures; or this income serves to maintain the power of corrupt elites and is therefore under their protection (Jakob and Steckel, 2022). Other constraining conditions are failed divestment promises or renewed interests in fossil fuel investments: A recent review article on climate action in the US concludes that colleges and universities have not committed to real divestment (away from fossil fuels), but have instead only increased their investments in renewables (Basseches et al., 2022). The Glasgow Financial Alliance for Net-Zero founded in 2021 in collaboration with the UN Race to Zero campaign (Glasgow Financial Alliance for Net-Zero, 2022), turned quickly into a failure. Only a few members of the Alliance have policies in place that restrict the financing of companies developing new fossil projects, and various members continue to finance the expansion of fossil-fuel based companies and industries (McCully, 2023). For various reasons, many members already left the Alliance (Marsh, 2023; McNally, 2023; Hodgson, 2022; Schwartzkopff and Marsh, 2022). The weakening of the Glasgow Financial Alliance for Net-Zero requirements (Segal, 2022) and the numerous dropouts from the Alliance indicate that voluntary initiatives are not sufficient. In addition, the recent backlash against Environmental Social Governance by the Republicans in the US (Wilkes et al., 2023) and announcements of major oil and gas companies to continue fossil fuel production (Reclaim Finance, 2023) rather point into the opposite direction. Currently, fossil fuel majors display a renewed sense of profitability, and investors show strong interest in the six largest publicly listed fossil fuel extractors Saudi Aramco, Shell, BP, ExxonMobil, Chevron, and Total Energies.

Some recent developments could turn into enabling conditions for divestment: First, researchers on divestment activism in higher education have pointed to the need of combining divestment and reinvestment practices more tightly (Dizon et al., 2022). Second, international treaties can become more supportive, or their hindering effects can be corrected. The Energy Charter Treaty, for example,

started as a systemic hindrance, effectively preventing substantial climate policy-making due to the fear of investor-to-state disputes. But the treaty's ongoing expansion to West Africa and the MENA region will put decarbonization strategies at risk and strengthen discourses of climate delay. The exit of major players, most probably including the entire European Union, might limit this systemic hindrance (Eckes et al., 2023). Third, partnerships and networks can provide support. there is also a growing awareness of the potential distortions that both rapid and stalled decarbonization mean for many countries in the Global South. A related broadening of the Just Energy Transition Partnership and new outcomes of innovative finance tools from the Paris Climate Finance Summit might lead to the improved facilitation of divestment moves in the Global South, especially targeting economies that face a high risk of stranded assets and seem unable to manage a green transition without external support. The Just Energy Transition Partnership model, encompassing the respective domestic government, a Climate Financial Task Team situated at the Partnership's presidency, the International Partner Group, and the Partnership's secretariat may be an innovative model for transition governance, as long as democratic legitimacy and transparency is guaranteed (Hege et al., 2022). Expectations connected to South Africa's Just Energy Transition Partnership include a green economic stimulus package, enhanced energy security, accelerated decarbonization of the heavy industry, and job security for workers (Fakir, 2023; Xaba, 2023). The expansion of the Partnership approach to Senegal, Vietnam, and Indonesia underscores the attractiveness of the model. The macro-economic effects and the contribution to divestment cannot be quantified. Still, as proponents of the Partnership's extension to Vietnam point out, the Partnership may bear the ability to speed up Vietnam's coal exit, streamline the domestic energy transition, and engage in the reskilling of workers. A general hindrance may be a lack of political will on the domestic side, as well as vested interests both by domestic and by transnational actors (Behrens, 2023).

Major studies published since the previous Outlook edition

There have been several new studies of interest since the previous Outlook. The most pertinent ones refer to stranded assets, the quantitative determination of divested funds, the motives and determinants of divestment, and potentially negative effects of divestment, respectively.

Stranded Assets: A systematic review by Firdaus and Mori (2023) provides an overview on how stranded asset risks influence energy companies' decisions and their impact on the sustainable energy transition. Most commonly, the stranding of assets is understood as a devaluation or conversion to liabilities caused by market changes, regulation, or financing conditions in the course of climate change. The authors find that high perceived risk with regards to stranded assets may impede investors to move toward renewable energy sources. Instead, energy incumbents will only adopt clean technologies if the costs of divestment are offset by the investments into renewables (Firdaus and Mori, 2023). This is contested by other studies (e.g., Guo et al., 2022). Semieniuk et al. (2022) calculate the distributive effects of market risk of stranded assets and find that the majority of market risk falls on private investors in the OECD countries. They hence conclude that OECD countries have a major influence in how the transition away from fossil fuels is managed.

Quantitative determination of divested funds: Giuliani et al. (2022) analyze equity portfolios of the 10 largest institutional investors in the US. While these investors build a narrative around their commitment to climate action, they have only marginally divested from fossil fuels. The analysis of the 1000 European largest pension funds revealed that only 13% of the funds have committed to divestment (Egli et al., 2022).

Motives for divestment: Latest research has provided insights on various motives of investors to divest (Nyiwul and Iqbal, 2022). Van Benthem et al. (2022) show that one major motivation for divestment is to reduce one's exposure to climate risks, both physical and regulatory. A study by Egli et al. (2022) shows that large publicly owned funds and private funds competing for clients are more likely to divest.

Potentially negative effects of divestment practices: Hartzmark and Shue (2023) find that increasing cost of capital for firms with continued fossil fuel engagements leads to large negative changes in firm impact. Thus, investors that direct capital away from such "brown" firms and toward "green" firms may even be counterproductive in that this makes brown firms more brown without making green firms more green.

Uptake of climate action resources generated by other drivers

Social movement impact on divestment: Divestment movements employ discursive strategies of stigmatizing the fossil fuel industry, relying either on emotions and affects or on cause-and-effect explanations (Ferns et al., 2022). Becht et al. (2023) observe that stigmatization campaigns directed at the fossil industry on social media influences share prices and hence can lead to stranded assets. This finding is somewhat contested by other studies showing less strong effects or fewer effects (van Benthem et al., 2022; Schwartz et al., 2023).

Climate related regulation: National regulation has a huge potential for creating or reducing financial risks of fossil fuel engagements and for the transition to renewable energy systems (Nyambuu and Semmler, 2023). Regulation on effective climate policy impacts transition risks, which shape investors'

expectations on divestment (van Benthem et al., 2022). Finally, many states directly invest in continued fossil fuel engagements, especially in countries of the Global South, due to structural dependence, internal power relations, and lack of alternative source of finance (Jakob and Steckel, 2022).

Climate litigation: In some cases, climate litigation has increased the costs of continued fossil fuel engagements, as in the successful case against Shell, in which the company was sued to pay EUR 15 million in compensation for petrol-pollution in Nigeria (Müller, 2023). The possibility of future climate litigation might serve as a resource for divestment actors (Sato et al., 2023). Publication like the Greenpeace report "Fossil Fuel Crime File" collect cases of corruption, human rights violations and complicity in war crimes (Greenpeace Nederland, 2023). Some US signatories of the Glasgow Financial Alliance for Net-Zero are increasingly concerned about legal risks, such as the potential breach of antitrust law (Wilkes et al., 2023), but also about consequences in case they fail to reach the proclaimed net zero goals (Schwartzkopff and Marsh, 2022).

Implications of driver dynamics for climate change adaptation

The continued investment in fossil fuel extraction is a key driver of global warming, therefore increasing the risks of adverse climate impacts and the demand for adaptation. From a climate justice perspective (Sardo, 2023), this raises serious concerns about the global distributions of climate change's benefits and burdens: So far, the growing profits gained in continued fossil fuel engagements are not systematically linked to the expected damage that are the consequences of these profitable investments.

3.9

Consumption Trends

Consumption patterns refer to actions aimed at fulfilling needs or wants that lead to expenditure patterns within and across categories of products and services. These patterns are influenced by economic, political, cultural, and other factors and context conditions, and they can be bundled into typical lifestyles, ranging from high- to low-carbon lifestyles (Gresse et al., 2023). Consumption can be a major lever of sustainability transformations (Creutzig et al., 2022; Fuchs et al., 2021). However, our past plausibility assessments of global consumption patterns revealed that the observed dynamics of this social driver significantly hinder the prospects of achieving deep decarbonization by 2050 (Gresse et al., 2021; Gresse et al., 2023). These assessments focused on consumption patterns as a social driver of decarbonization, that is, on particular ways in which consumption—as a social act—is done, is organized, or happens, and thereby influence global decarbonization. This time, the starting point of the analysis is global consumer trends, which relate not only to the conditions but also to the prevailing tendency of consumption around the world. In this vein, this chapter provides an update on the dynamics of global consumption trends that affect the plausibility of reaching deep decarbonization by 2050, including the growing inequality in consumption and its effects on low- and high-carbon lifestyles.

Key social driver dynamics since the previous Outlook edition

Global greenhouse gas emissions continue to increase, driven by worldwide unsustainable patterns of consumption and production (IPCC, 2023b). There are still no observable structural changes in global consumption trends, indicating that the dynamics of this social driver continue to inhibit the pathways toward deep decarbonization. While low-carbon consumption patterns such as electric mobility and renewable energy use increase at insufficient levels to achieve decarbonization (IEA, 2023e; 2023f; IPCC, 2023b), very-high-carbon consumption trends (e.g., fossil fuel-powered Sports Utility Vehicles/SUVs, yachts, space tourism) continue to gain momentum (Markard et al., 2023; Hirth et al., 2023). In general, current consumption trends are strongly associated with increasing emissions and high social inequalities and represent key barriers to sustainability transformations (Gresse et al., 2023; UNEP and International Resource Panel, 2024). Global patterns of consumption and investment drive unequal contributions to climate change (Chancel et al., 2023; Khalfan et al., 2023). The wealthiest 10% of households are responsible for almost half of global consumption-based emissions and are therefore the highest global emitters, while the bottom 50% contribute only 13-15% (IPCC, 2023b, p. 5). The 2023 Climate Inequality Report shows how wealth inequality relates to climate injustice (Chancel et al., 2023). Figure 3.2 highlights the shares of global

population by income and reveal that high emitters (10% of the world population) face only 3% of relative income losses due to climate change, while those contributing the least to global greenhouse gas emissions (the bottom 50%) are exposed to 75% of climate-related income losses (Chancel et al., 2023, p. 85-86). In addition, the figure shows that the wealthy minority of the global population is not only who contributes the most to climate change, but also those who hold much greater finance capacity, indicating that achieving the same emissions reductions would require a significantly lower effort for this group than for low-emitting ones (Chancel et al., 2023; see also Büchs et al., 2023).

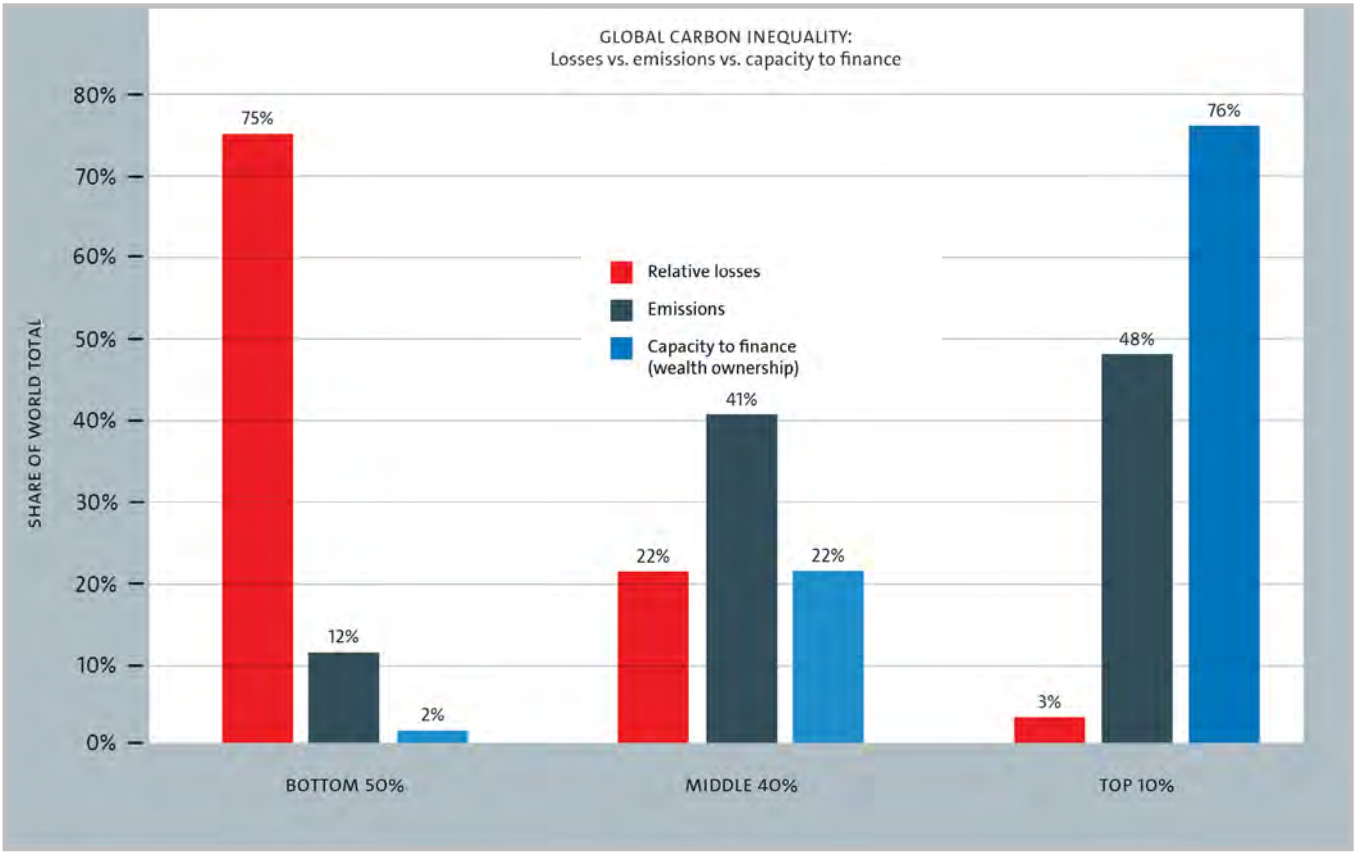

Figure 3.2: Global carbon inequality: relative losses, emissions, and capacity to finance, see next comment. The chart illustrates that the bottom 50% of the global population is responsible for 12% of worldwide emissions but faces 75% of relative income losses attributable to climate change. The emission inequality data is derived from the World Inequality Database for 2019. The total global relative income loss burden, weighted by population, is obtained by summing these loss scores and is distributed across emitter groups. It is crucial to interpret these estimates of global inequality in income losses cautiously, given the simplified approach used to construct them. Nevertheless, they offer a valuable representation of the substantial global inequality in climate change impacts identified in the literature. Source: Chancel et al., 2023.

Furthermore, as Figure 3.3 shows, the disparities in carbon emissions within countries have recently become more significant than the disparities between countries: Carbon emissions inequality within countries currently represents the bulk of global emissions inequality (about two thirds of the total), indicating a complete reversal compared to the year 1990 (Chancel et al., 2023, pp. 9-10). In other words, the gap between emissions from affluent consumers and non- affluent consumers within countries is larger than that between countries, suggesting that the wealthy are the most responsible for high consumption-related emissions, no matter from which country they are. As Khalfan et al. (2023) show, the climate crisis is mostly driven by wealthy individuals (i.e., the richest 1%) through their emissions, investment patterns, and political influence. Governments around the world do not regulate upper limits for the personal carbon footprints of consumption, and so no automatic emissions reduction can be expected from the side of affluent consumers. Unless policies to substantially reduce both poverty and social inequalities are implemented around the world, just low-carbon transitions in consumption trends will remain not plausible (Khalfan et al., 2023).

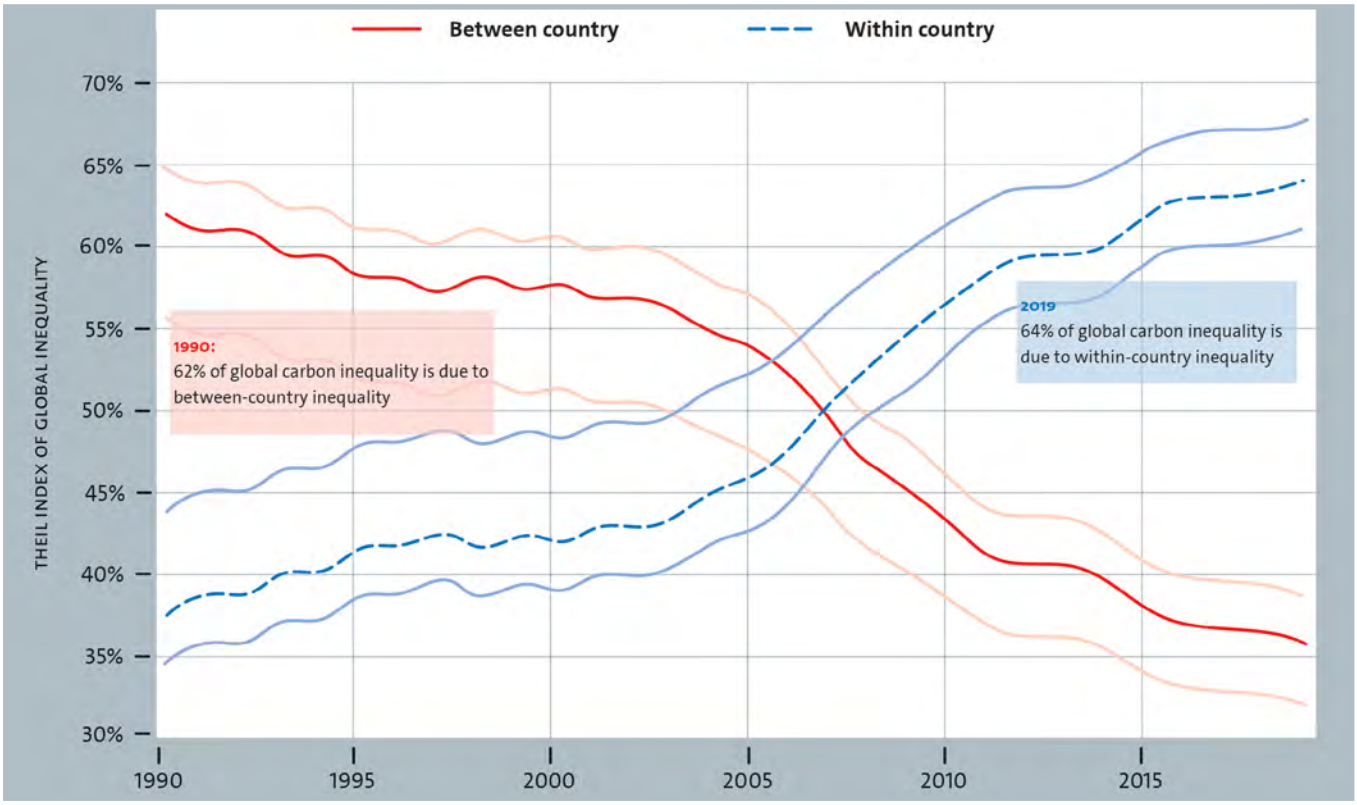

Figure 3.3: Global inequality of individual emissions: between vs. within country inequality, 1990-2019. This figure shows that in 1990, the predominant factor contributing to 62% of worldwide disparities in individual carbon emissions was the variation in average emissions between countries. However, by 2019, this scenario had undergone a significant shift, with 64% of the global inequality in emissions attributed to differences within countries. These findings present a breakdown of global inequality using the Theil index, utilizing modeled estimates derived from the systematic integration of household surveys, tax data, and environmental input-output tables. The emissions considered encompass footprints associated with both consumption and investments, and the values account for the carbon embedded in international trade. Source: Chancel et al., 2023.

Disruptive events such as the COVID-19 pandemic and Russia's invasion of Ukraine provoke sudden changes in consumption trends. For example, during the COVID-19 pandemic, the average consumer in the 28 countries of the Organisation for Economic Co-operation and Development (OECD) reduced consumption in transport and restaurants, but spent more on food and housing (OECD, 2021). Another example is the considerable reduction in gas consumption in Europe in the aftermath of Russia's invasion of Ukraine (IEA, 2023a; Ruhnau et al., 2023). Nevertheless, consumption reductions in response to these crises were facilitated by seasonal factors, and proved temporary or incremental at best (Gresse et al., 2023; Renn et al., 2022; Pang et al. 2022). In terms of overall consumption trends and emissions reductions, these events are associated with increased social inequalities and rebound-effects (Gresse et al., 2023). Noteworthy is also the fact that although global clean energy investment has received a significant surge due to the efforts made in recovering from the COVID-19 pandemic and the energy crisis (IEA, 2023b), subsidies for fossil fuel consumption reached an unprecedented amount of over USD 1 trillion in 2022, marking a substantial increase and setting a new record for the highest annual value observed (IEA, 2023c; see also Section 3.8).

Enabling and constraining conditions affecting driver dynamics

The implementation of policies, technologies, and infrastructure that combine social protection with climate change mitigation and adaptation is key to support important shifts in consumption trends, such as the adoption of low-carbon diets, low-carbon modes of transport, and renewable energy consumption (Chancel et al., 2023; Hirth et al., 2023; IPCC, 2023a). As important as shifts in consumption trends is addressing social inequalities and reducing overall consumption, especially among affluent groups (Wiedmann et al., 2020; Khalfan et al., 2023). In this regard, the IPCC has recognized the need to promote energy and material consumption reduction and sufficiency, which is regarded as a "set of measures and daily practices that avoid demand for energy, materials, land, and water while delivering human well-being for all within planetary

boundaries" (IPCCa, 2023, p. 72). According to the Global Resources Outlook 2024, the effects of material extraction and consumption on climate and biodiversity greatly surpass the goals set by the Paris Agreement, and for this trend to be reversed integrated policies and action on resource efficiency, climate and energy, food, and land are needed (UNEP and International Resource Panel, 2024). These transformations are crucial enabling conditions for this social driver to support deep decarbonization by 2050. However, there are no signs that these enabling conditions are strongly at play.

Currently, there are constraining conditions that strongly inhibit the pathways toward decarbonization, let alone deep decarbonization. The fundamental constraining conditions of this social driver are the growth-based political economy of mass and affluent consumption and the persisting investments in fossil fuels and subsidies for fossil fuel-based consumption (see also Section 3.8; IEA, 2023c). That is, the unchallenged pursuit of continued economic growth and accumulation as a key societal goal, which enables and is pushed by the institutionalization of mass consumption (Blühdorn, 2019; Boström, 2020) and the power structures shaping worldwide consumers' conduct toward high-carbon and highly resource-intensive consumption (Cohen et al., 2022; Dubuisson-Quellier, 2022; Hirth et al., 2023). These constraining conditions inhibit structural transformations in worldwide consumption and production processes, especially as production is still mostly based on fossil fuels (Hirth et al., 2023; see also Section 3.7). Increasing social inequalities also represent key constraining conditions for deep decarbonization, inasmuch as they negatively influence social cohesion and cooperation toward environmental protection and decarbonization efforts (Creutzig et al., 2022). The insistence of powerful social actors on technological progress and the role of markets and individuals' action as solutions to the global ecological crisis also hinder decarbonization and sustainability transformations at large (Fuchs et al., 2021; see also Gresse, 2022). Experts show that innovations in technology and behavior do not necessarily lead to lower levels of total emissions but have the potential to both create new inequalities and reinforce existing ones (Sovacool et al., 2022).

Social inequalities are also reinforced and reproduced by corporate responses to inflation, which elevates the general price level of goods and services and affects the purchase power of most economically vulnerable consumers (Weber and Wasner, 2023). Consumption is thus reduced among those who contribute the least to global emissions, while overall consumption and emissions continue to rise. For instance, the substantial rise in Europe's inflation over the past two years can be largely attributed to the increase in corporate profits, as companies have raised prices to a greater extent than the surge in costs associated with imported energy (Hansen et al., 2023). Finally, disruptive events and military conflicts around the world lead to deep uncertainties, multiple crises, and instability, which considerably hinder global efforts toward decarbonization (see Box 2). For example, the COVID-19 pandemic, the Russian invasion of Ukraine as well as the military conflicts and instability in the Middle East region have an important impact on energy market and prices (IEA, 2023a;f), making it difficult for societies to prioritize transformations toward deep decarbonization over short-term crisis management.

Major studies published since the previous Outlook edition

The latest World Energy Outlook published by the International Energy Agency (IEA) shows that the global transition to clean energy is moving at unprecedented speed, but remains too slow and incompatible to the 1.5°C global warming scenario (IEA, 2023f). In addition, the report reveals that demand for fossil fuels might peak before 2030 since the deployment of low-emission alternatives is accompanied by a slowdown in the incorporation of new assets reliant on fossil fuels into the energy system (IEA, 2023f, p. 18).

A recent study on affluence consumption highlights how innovations may even make societies less sustainable (Markard et al., 2023). By focusing on Sports Utility Vehicles (SUVs) and space tourism, the study shows how the former reproduce unsustainable consumption trends while the latter creates new ones. In other words, it reveals that innovations in socio-technical systems eventually create new barriers or constraining conditions for sustainability transformations such as deep decarbonization. New reports focused on climate justice highlight the enormous disparities in emissions, vulnerabilities and adaptive capacity around the world and advocate for radical reductions in social inequalities, power shifts, and structural transformations toward climate neutrality (Chancel et al., 2023; Khalfan et al., 2023). The latest Global Resources Outlook also shows how unsustainable consumption patterns are linked to unequal impacts on climate and biodiversity. It also highlights that predominant emphasis on supply-side (production) measures must be balanced by a stronger emphasis on demand-side (consumption) measures toward climate neutrality (UNEP and International Resource Panel, 2024).

A systematic review of empirical observations on lifestyles and consumption patterns sheds light on a series of enabling and constraining conditions for sustainable consumption (Hirth et al., 2023). Among them, so-called deep barriers for lifestyles compatible with the 1.5°C global warming scenario are economic business models relying on the fossil fuel industry, which are backed by powerful political actors; the strong institutionalization of the economic growth paradigm in social relations; the belief in neoliberal governance; as well as political priorities and valuations related to satisfying

high and rising energy demand at the expense of sufficiency strategies for energy use (Hirth et al., 2023, p. 5). Conversely, key enabling conditions for sustainable consumption patterns are strong regulation and litigation of supply and demand, climate-friendly infrastructure, corporate responses and subsidies, public access to minimum levels of essential goods and services, sufficiency strategies in combination with climate justice narratives as a basis for increasing societal acceptance of climate mitigation measures, and shifts in societal values toward collective well-being and alternative paradigms focused on sustainable consumption for a "good life" (Hirth et al., 2023, p. 6).

Uptake of climate action resources generated by other drivers

Changing the dynamics of this social driver is extremely difficult and depends on the utilization of resources produced by other social drivers, such as knowledge production and climate-related regulation. Knowledge production generates resources that inform social practices and processes toward decarbonization and can be used by societal agents to promote shifts in consumption trends. Nevertheless, knowledge production with regard to mitigating climate change remains highly contested (see Section 3.11). The resources produced by climate-related regulation to steer consumption toward low-carbon patterns or toward sufficiency are still limited or non-existent (see Section 3.4). Political systems worldwide do not refrain from but actually rely on and often stimulate carbon-intensive consumption behavior. For example, encouraging consumption through fiscal and monetary policy is a very common strategy used in times of economic crisis and also as a tool for overcoming poverty (Arestis et al., 2021; Abdulrahman and Oniyide, 2023). Sustainability standards or ecological labels produced by transnational initiatives, for instance on food, textile, or household appliances, still provide very limited incentives for less carbon-intensive consumption patterns (Plakantonaki, 2023; Yokessa and Marette, 2019; Hameed and Waris, 2018; see also Section 3.3)

Implications of driver dynamics for climate change adaptation

The interplay between social inequalities and consumption trends is also evident in the context of climate change adaptation. Climate-related risks and vulnerabilities (for example water insecurity, poor sanitation, migration in response to climate-related disasters) disproportionately affect those who contribute the least to consumption-based emissions, especially women and girls in developing countries (Chancel et al., 2023; Schipper et al., 2021; Khalfan et al., 2023). Promoting climate justice thus requires the combination of significant reductions in carbon-intensive consumption with social protection programs that promote sustainable development and improve resilience (IPCC, 2023b).

3.10

Media Debates

Media debates as drivers of public debates on climate change can be split into news media (professional journalism), alternative fringe media outlets, and social media networks. Since the most recent publication of the Outlook, structural changes in the digital media environment and political dynamics have impacted the media debates on climate change, with different effects.

Key social driver dynamics since the previous Outlook edition

In the previous Outlook we concluded that this driver is currently at a critical juncture, with media attention toward climate change in constant flux, making its impact difficult to assess. Though there are trends toward transformative journalism and newly established formats and websites which could support social dynamics toward deep decarbonization, the impact of this driver will depend on individual patterns of information use, the overall role journalism will play in society, to what degree social media and alternative media will be regulated, and the general state of world affairs providing distractions from the issue of climate change.

Within the past year, this driver has been strongly shaped by structural changes in the digital media environment such as, first, the broadened accessibility of generative artificial intelligence for the production of texts (e.g., ChatGPT), images, as well as audio and video content; second, changes in ownership (e.g. Twitter/X) and regulation of social media platforms; but also by, third, a rise in novel transformative practices among journalists; and, fourth, the success of climate-related entertaining media content.

The newly available generative artificial intelligence tools can help journalists work more efficiently and make their products more accessible and attractive for a more diverse range of audiences (Caswell, 2023). This could improve journalistic coverage of climate change, for example by providing more personalized and interactive information (Newman, 2023) about the impacts of climate change, climate change mitigation, or adaptation measures to citizens. However, generative artificial intelligence also threatens to destabilize professional journalism itself. It can be used (and is already being used) to replace journalistic staff in some areas—it remains to be seen whether this will also concern the highly qualified and specialized climate (policy) journalism. At the same time, the digital media sphere threatens to be flooded by unverified and potentially false information produced by generative artificial intelligence (which has been shown to "hallucinate" and provide nonexistent facts and sources, see Ji et al., 2023). This increases the already high pressure on professional journalism to verify and counteract climate misinformation (Lelo, 2023; Porter and Wood, 2021; Hassan et al., 2023).

There is also a positive trend of a journalism that is more engaged in covering climate change and motivating a debate about ecological transformations: transformative journalism (Brüggemann et al., 2022). However, climate change is still rather neglected by many media, such as Germany's main TV news broadcast, the Tagesschau (Tschötschel et al., 2022). Having said that, climate journalists have also benefited from the success of popular entertainment media content (for example the movie "Don't Look Up") which succeeded in raising awareness for climate change within the general public (similarly to "An Inconvenient Truth", see Nolan, 2010) and thus creating a greater interest in and demand for journalistic coverage of these topics.

Looking at fringe alternative media or hyper-partisan right-wing media opposing climate policy—and in case of Fox News (US) and GB News (UK) mainstream right-wing media—, the direction is somewhat clearer: For them generative artificial intelligence will greatly facilitate the production and distribution of mis- and disinformation, aiming to push societies away from deep decarbonization.

The final sale of Twitter/X to Elon Musk and the resulting changes to the platform have also re-shaped this driver: While Twitter/X has so far retained its role in connecting scientists, journalists, politicians, and—to a lesser degree—the public, it has become significantly more unpredictable, and the share of unreliable information has increased. But by effectively closing down academic data access, it has deprived the research community of an important tool to monitor public debates about climate change. Reacting to the increasing political polarization in the US, other social media platforms have rolled back some of their measures against the spread of misinformation (Myers and Grant, 2023). Hence, it will be important to see whether the recently adopted EU Digital Services Act regulating digital platforms (Helberger et al., 2021) will succeed in stabilizing the media sector and the quality of available information, including information on climate change.

Enabling and constraining conditions affecting driver dynamics

Political dynamics have both enabled and constrained media debates as drivers toward deep decarbonization. Some countries have seen increased disruptive climate protests such as those organized by the Last Generation in Germany, Austria, and Italy or Just Stop Oil in the UK. New protest forms targeting rush-hour traffic have triggered much public debate, which has been used by conservative actors to de-legitimize or even criminalize the climate movement. So far, however, there is no empirical evidence that disruptive climate protests have lessened support for climate policy or decreased climate engagement (Kenward and Brick, 2023; Özden and Ostarek, 2022).

As climate debates move closer to the implementation of climate policies, they also become more controversial. Climate contrarian think tanks (Almiron et al., 2023) and industry campaigns (Sassan et al., 2023; Holder et al., 2023) continue to push narratives of delay and denial (Meyer et al., 2023c), which are increasingly taken up by more mainstream actors to mobilize political support against governments trying to implement climate policies. At the same time, recent electoral successes of authoritarian right-wing actors and the general trend of democratic backsliding have restricted the freedom of the press in a number of countries, with particular pressure on investigative journalism of environmental or climate-endangering crimes (Medeiros and Badr, 2022). Since many right-wing populist actors also propagate climate denialism (Forchtner, 2019), this is likely to decrease the plausibility of deep decarbonization.

Finally, media debates continue to be affected by Russiás invasion of Ukraine and the rising global tensions after Hamas' attack on Israel on 7th October 2023 and Israel's ensuing bombing and invasion of Gaza, which take away media attention from climate change related issues. At the same time, the overlap of policy measures aiming to reduce Russian influence and curb greenhouse gas emissions has charged the public debate surrounding climate mitigation in rather unforeseeable ways. The policy measures responding to and the general economic impact of the war have triggered substantial protests, likely contributing to a notable increase in support of parties denying the need for these measures. Concurrently, the sanctions against Russia are limiting the activities of some alternative media responsible for climate change misinformation (such as RT, formerly Russia Today)—or at least pushing them into clandestineness.

Major studies published since the previous Outlook edition

New studies in the field of climate communication focus on a whole range of issues, three of which should be mentioned here due to their relevance for the plausibility of climate futures: first, media constructions of climate futures; second, the move from denial to narratives of delay of climate action; and third, the polarizing debates around climate protests.

The first strand of research identifies dominant visions of the future as represented in news media discourse: Overall, climate futures are imagined similarly in leading news outlets in countries from both the Global North and South, as comparative content analyses of media in Germany, India, South Africa, and the US shows. This is due not only to the global nature of climate change risks but also to the strong voice of science institutionalized in one global body (the IPCC). We find that, across countries, climate change is being depicted as far away geographically, far in the future, and not concerning audiences directly. This is captured in the journal article title: "Not here, not now, not me" (Guenther et al., 2023). This finding is relevant, as psychological distance is commonly viewed as an important reason why people do not engage with climate change, even though the evidence for this mechanism is actually weaker than generally assumed, as a recent systematic review shows (van Valkengoed and Brüggemann, 2023). In terms of concrete frames, four can be distinguished. The most important is a distant risks-to-ecosystems frame, followed by risks-to-humanity, a technical solutions frame, and an economic opportunity frame (Guenther et al., 2023; Guenther et al., 2024). What is rather rare is an apocalyptic climate catastrophe framing, and what is almost totally absent is a great transformation frame, which would envision substantial system changes in society. While the need for broad and deep socio-ecological transformations of society have been widely debated in academia for years (e.g. Schneidewind et al., 2016), journalists do not seem to engage with these debates. But there is also evidence that, at least in countries of the Global South, journalists are focusing more on the effects of climate change on humans, thereby encouraging societal change (Hase et al., 2021).

Second, while climate denial still exists on Twitter/X, it has become a minority claim (Meyer et al., 2023c). Even in a context that features elite-sponsored climate denialism like in Australia, denial has become a minority position (Bednarek et al., 2022). Apparently, after years of increasing droughts, wildfires, floods, and record-breaking temperatures, anthropogenic climate change is no longer deniable. Instead, strategies of obstructionism against climate policies have moved on to a variety of "discourses of climate delay" (Lamb et al., 2020, p. 1), which effectively all argue against immediate far-reaching action. Fossil-fuel companies use Facebook to frame their argument for the importance of fossil fuels around catchwords like pragmatism, innovation, patriotism (Holder et al., 2023). A broadly used strategy is greenwashing, that is, pretending to be climate-friendly while effectively sticking to a business-as-usual approach, as a study shows that compares communication with the actual investments of large oil companies (Li et al., 2022).

Third, a hotly debated topic in Europe in 2022 and 2023 were disruptive forms of climate protests. Some studies have explored the media coverage of the more conventional climate movements (such as Fridays for Future) and found a high salience of youth protests in the news, but from an apolitical perspective, not providing a voice to the protesters as actors with political demands (von Zabern and Tulloch, 2021; Poot et al., 2023). Two studies under review compare coverage of the more disruptive climate movements with the more conventional ones and find evidence of polarization around disruptive climate protests in Germany on both Twitter/X and in news outlets: Toxic interactions are fueled by frames that originate among political and media actors from the far right of the political spectrum, in which the frames are set by political actors from the extreme right and their respective media outlets in Germany (Meyer et al., 2023 a, b).

Uptake of climate action resources generated by other drivers

Climate protests and social movements trigger media attention and provide reporting opportunities for climate action, even though, effectively, coverage of protests might focus on the protesters rather than their demands (von Zabern and Tulloch, 2021; Poot and Bauwens, 2023; Meyer et al., 2023b)

Similarly, UN climate governance offers reporting opportunities providing voice to calls for climate action. Particularly the climate conferences have done so (Brüggemann et al., 2017) and continue to be a main driver for media attention to climate change (Hase et al., 2021).

Implications of driver dynamics for climate change adaptation

Our own manual quantitative content analysis of news media from India, South Africa, the US, and Germany (Guenther et al., 2023a) shows that adaptation measures are not often mentioned or advocated for in media coverage related to climate futures. Generally, media coverage is still focused on describing the risks associated with climate change. Political demands raised in media coverage are not highly frequent, but if they occur, the call for mitigation rather than adaptation measures, as shown below in Figure 3.4. Country differences are not displayed as the countries showed fairly similar general pattens of news reporting.

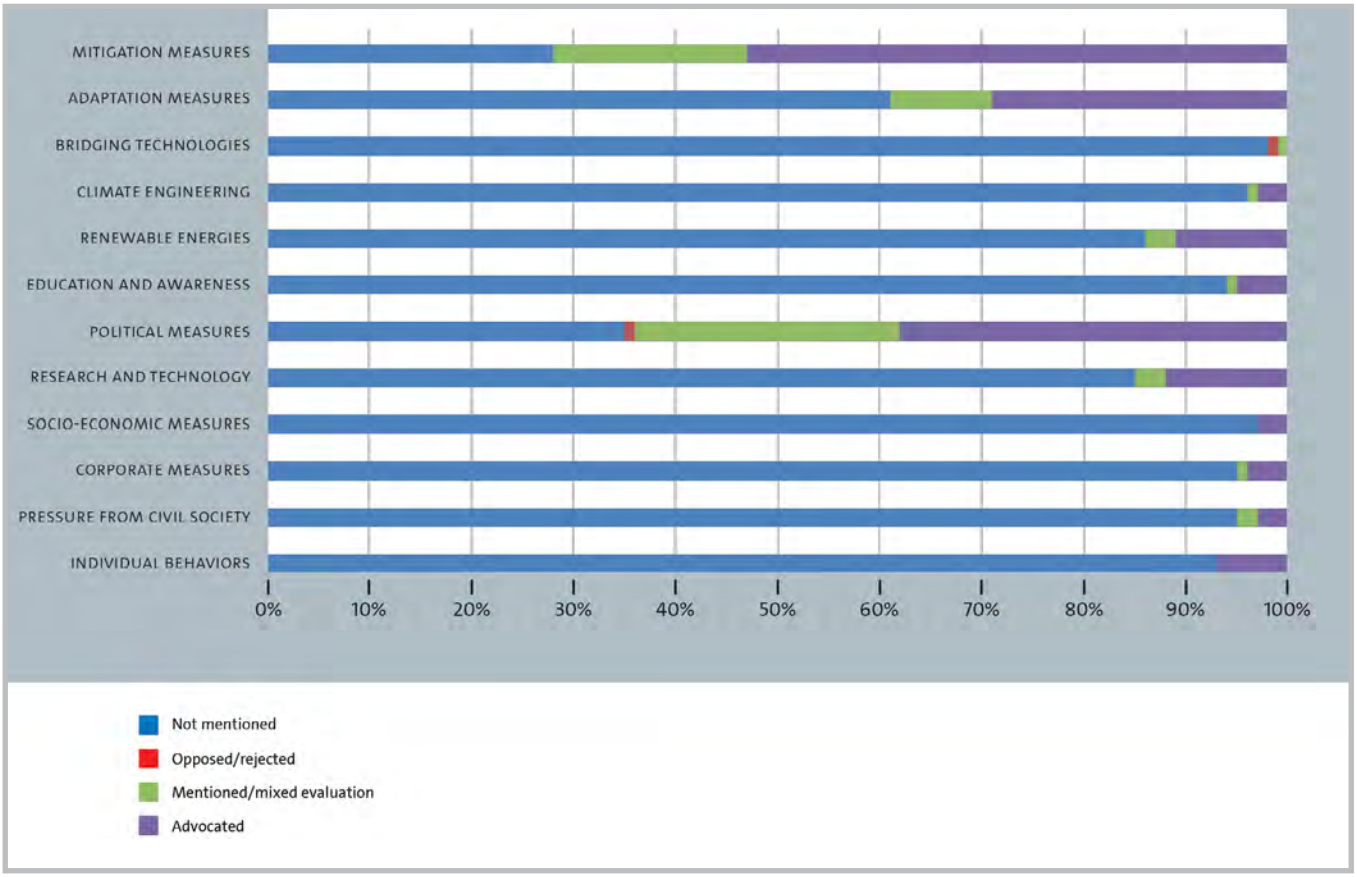

Figure 3.4: Climate actions: mentioned or demanded in media reporting on climate futures across German, Indian, South African, and US media (n=734); data is retrieved from quality print media, regional print media, tabloid media, digital news media, and weekly news magazines.

3.11

Knowledge Production

Knowledge production refers to practices of knowledge generation and validation that provide facilitative capacities for envisioning and enacting transformations toward deep decarbonization.

Key social driver dynamics since the previous Outlook edition

The previous Outlook found that the knowledge production driver continues to support decarbonization as there is a continuous increase in global knowledge resources, including earth observation capacities, that are packaged and tailored to specific governance problems and policy processes. The dynamics of the driver were found to be insufficient for deep decarbonization, however, among other reasons due to the weak integration of diverse ways of knowing to produce socially robust knowledge (Wilkens et al., 2023, p. 138). In the current Outlook, we continue to see an increase in knowledge resources that feed into the global opportunity structure and affect the dynamics of other drivers toward decarbonization by 2050. These include the release of landmark publications such as the Synthesis Report of the IPCC Sixth Assessment Report and the UNEP Emissions Gap Report 2023. At the same time, there is an opposing development that has recently gained momentum: the increasing contestation of consensual and authorized climate knowledge as well as the targeted spreading of disinformation and false news about climate change and its consequences (see Fischer, 2019; Oreskes and Conway, 2022; Shue, 2022). The problem of disinformation and organized climate change denial is not a new phenomenon. However, it has taken on a new significance during

the past year. The reasons are multiple and complex and include the rise of right-wing parties in many Western countries, the amplification of disinformation through social media networks and underlying algorithms (Section 3.10), and global political events such as ongoing implications of the COVID-19 pandemic as well as the war in Ukraine and resulting economic turbulence (Oreskes and Conway, 2022).

Enabling and constraining conditions affecting driver dynamics

On the one hand, the production of packaged climate knowledge continues to serve as enabling condition in the global opportunity structure, most prominently through the production of IPCC and other global assessment reports (see next section for an overview). On the other hand, this development is constrained by three interlocking forms of contestation: rejection of knowledge, unpacking authorized knowledge, and counter-packaging. First, the packaged knowledge resources tailored to the needs of climate governance are often complex and condensed, abstracting from local experience (Wilkens et al., 2023). As Sundqvist et al. (2018) point out, the near certain, consensual nature of authorized climate science, makes it an easy target for denialism and disinformation. In their words: "Political discussions about trust or distrust in science occur when knowledge comes in one single package without alternatives, creating dichotomies between believers and nonbelievers" (2018, p. 460). In the current context of the war in Ukraine and resulting economic instabilities, this dualistic representation has enabled conservative and far-right actors to contest and reject consensual scientific knowledge.

Second, the emergence of particular climate denial discourses could be understood as a form of unpacking authorized climate knowledge. Unpacking can be understood as a distinct epistemic practice directed against authorized scientific organizations like the IPCC and their key publications. Many conservative, right-wing actors in fossil-fuel producing states (such as Saudi Arabia, Russia, or the US) do not outrightly deny the existence of climate change anymore, but question the seriousness of its impacts, the feasibility of mitigation measures, or incite concerns about societal transformation toward decarbonization (Fischer, 2019, p. 147). They have moved from denial to delay (Shue, 2022; see also Section 3.11). In other words, such actors unpack authorized knowledge resources such as the IPCC assessment reports by affirming some of its findings while discrediting and denying others.

Third, the literature on non-knowledge and ignorance shows that climate skeptics and deniers are themselves involved in the packaging of knowledge resources (Stehr, 2012; Wehling, 2022). In this literature, authors have stressed that uncertainty and ignorance should not just be understood as the absence of knowledge, resulting for example from lack of data or methodological limits, but as something that is actively produced and manufactured (Aradau, 2017, p. 330). Non-knowledge, in this sense, becomes a strategic resource that can be mobilized by political actors in public controversies. Large think tanks, such as the Heartland Institute in the US, actively produce resources of ignorance through a range of packaging practices that imitate those of climate science. For example, these organizations host yearly international conferences and produce major reports, maps, and other resources. The main aim of these packaged forms of non-knowledge is to cast doubt and challenge the consensual knowledge of the IPCC. They thus enter the global opportunity structure as counter-resources, in which they act as obstacles to the goal of decarbonization by 2050. The dynamics of the knowledge production driver, therefore, remain insufficient for deep decarbonization.

Considering these forms of contestation, which happen in parallel to the increasing production of packaged climate knowledge, it is crucial to assess the direction of the driver and its impact on the global opportunity structure for deep decarbonization by 2050.

Major studies published since the previous Outlook edition

A key publication during the past year was the Synthesis Report of the IPCC Sixth Assessment Report, which was finalized in March 2023. The Summary for Policymakers of the Synthesis report in particular underlines the growing tension between knowing fundamental problems, such as the ongoing growth of greenhouse gas emissions and the declining carbon budget, and a lack of substantial climate action (IPCC, 2023a; see also Forster et al., 2023). The Emission Gap Report 2023 has synthesized knowledge on emission trends, highlighting not only insufficient mitigation efforts but also underlining the need for knowledge sharing for a successful energy transition on a global scale (UNEP, 2023a). A number of new studies and reports have been published adding empirical details to key challenges, such as climate change and inequality (Chancel et al., 2023) and transboundary climate risks (Anisimov et al., 2023). A good example of how expert knowledge can exert a more direct influence on global climate governance, and hence the plausibility of deep decarbonization by 2050, is the open letter calling for an International Non-Use Agreement on Solar Geoengineering. Initially published in 2022 in WIREs climate change (Biermann et al., 2022), the letter has been signed by more than 490 academics from 61 countries since then. In the letter, the scholars express concern that research into solar geoengineering approaches could diminish the international community's ambitions for decarbonization. This criticism is particularly resonating with vulnerable developing countries, which rejected a proposal by several industrialized countries to establish a

geoengineering expert group at the sixth session of the United Nations Environment Assembly (UNEA-6) in Nairobi in February 2024 (CIEL, 2024).

Other recent publications highlight how non-knowledge has been actively produced and used by the fossil fuel industry and other economic actors to hinder deep decarbonization. In a recent study that confirms the role of the fossil fuel industry, Supran et al. (2023) reveal how ExxonMobil accurately predicted global warming using their own internal models and nevertheless pursued a strategy of climate denial. In a similar way, the report "The Emperor's New Climate Scenarios" (Trust et al., 2023) shows that the climate-scenario models used by financial services underestimate climate risk by minimizing or ignoring large-scale impacts such as potential tipping points, sea-level rise, or climate-related migration.

Generation of climate action resources and uptake from other drivers

Expert (and other) knowledge generated by climate science offers resources for virtually all other social drivers by providing the knowledge base of social practices and processes toward decarbonization and adaptation. Knowledge production, at the same time, uses resources generated by other drivers as it integrates these in packaging practices which assemble different forms of knowledge for a variety of audiences. UN climate governance, for example, works as a global platform for the production and validation of consensual climate knowledge. The IPCC and the UNFCCC work largely as boundary organizations that mediate between science and policy. The IPCC's Summary for Policymakers (2023c) is a clear illustration of the interplay between political and scientific consensus. The UNFCCC, in a similar vein, works as a boundary organization not only for scientific communities but also for a wider diversity of actors, most prominently Indigenous and local knowledge holders, especially via the Local Communities and Indigenous Peoples Platform (López-Rivera, 2023).

As the evolution of the IPCC communication strategy illustrates, the media debates driver is another important one to generate resources for knowledge transfer and science communications. The introduction of communication innovations by the IPCC has led to an increasing outreach and stronger media coverage. This includes live-streamed press conferences, the formulation of headline statements, and a greater use of social media and digital technologies (Lynn and Peeva, 2021). The resources derived from the media driver thus enhance outreach and potentially the diversity of audiences for climate science.

Further resources are being generated by social movements, which constitute sites for the generation, reformulation, and diffusion of knowledge (Casas-Cortéz, 2008; Choudry, 2020). The diverse knowledges of social movements become tangible in experiential and embodied practices of resistance and mobilization for social and climate justice. A number of concepts that originated in social movements have thus been taken up by certain strands of critical climate and environmental research in the social sciences. These concepts include climate justice, the rights of nature, food sovereignty, land grabbing, ecological or climate debt, and extractivism, among others (Martinez-Alier et al., 2014). The repertoires of action of climate movements, at the same time, are being taken up by scientists who engage in climate activism. Prominent examples include Scientists for Future and Scientist Rebellion.

Implications of driver dynamics for climate change adaptation

The driver dynamics of knowledge production not only produce resources for decarbonization but also for adaptation. In the IPCC, in particular, adaptation has become an increasingly important topic, especially since the third assessment report. The knowledge packaging practices of the IPCC have been crucial in framing the concept of adaptation within a specific understanding of science-policy interactions. The IPCC's global and regional perspectives on adaptation, however, require down-scaling to the local contexts where adaptation takes place. IPCC assessment reports increasingly acknowledge the importance of bottom-up approaches through the recognition of the role of community-based adaptation, as well as Indigenous and local knowledge (IPCC, 2022b).

There is extensive evidence regarding the importance of Indigenous and local knowledge in adaptation actions. Local observations have been shown to improve or supplement the absence of weather and climate forecasting (Petzold et al., 2020; Leal Filho et al., 2022). There is case-specific evidence that the use of Indigenous and local knowledge positively correlates with higher levels of implementation of adaptation actions (Zvobgo et al., 2023). The case study assessments in this volume provide additional evidence in this respect. Nepalese rural communities utilize Indigenous and local knowledge in adaptation practices, thus supplementing limited observational data and providing guidance for locally appropriate adaptive responses (see Section 5.7). The case study on Namibian pastoralists highlights the importance of considering the specificities of local understandings of weather and climate (see Section 5.8). The German North Frisian case, for its part, provides a counter-point insofar as local knowledge and place-based identities reflect a historical preference for a technical intervention, namely dikes, to the detriment of alternative approaches (see Section 5.9).

Research in the field of global climate governance has shown how inequalities in knowledge production shape current processes and complicate knowledge co-production especially in light of diverse ways of knowing climate change (Wilkens and Datchoua-Tirvaudey, 2022). While knowledge

co-production in climate change mitigation and adaptation is increasingly seen as a prerequisite for just and successful practices, its implementation remains contested and risks to reproduce inequalities if it degrades into a mere technical point of conducting research (Muhl et al., 2023). The plausibility of adapting to climate change in a sustainable manner is therefore highly dependent on the way in which situated knowledges inform social and cultural responses to climate-related impacts.

3.12

Summary of Social Driver Assessments

Following the Social Plausibility Assessment Framework (see Section 3.1) to assess the climate future scenario of achieving deep decarbonization by 2050, we have updated the social driver assessments based on the analyses of changes in driver dynamics and context conditions, as well as reviews of newly published studies relevant to each driver. We analyzed whether key events have led to significant shifts in driver trajectories and if notable developments occurred in their enabling and constraining environments since the publication of the previous Outlook edition. The social dynamics of a global low-carbon shift continue to highly depend on interactions between drivers and climate action by individuals, groups, and organizations that cut across societal spheres and social processes. We therefore tracked how resources for societal transformation produced by social drivers acquire global visibility, become part of climate action scripts, and materialize into broad repertoires of climate action. The assessments highlight that these resources encompass a broad range beyond material means, such as economic capacity, but also includes discursive, epistemic, normative, and political resources. To evaluate the unfolding of these dynamics over time, we have introduced the concepts of densification and relationality (see Section 3.1). Densification refers to both quantitative increase and qualitative change of resources for climate action (i.e., documented by institution-building, societal interaction, routinised practices, repertoires, and scripts), whereas relationality refers to the dynamics generated through interrelations among social drivers (i.e., interlinkages). It captures observable linkages of increasingly institutionalized relations. As such it offers invaluable data in order to map and evaluate dynamics that support or undermine the plausibility of deep decarbonization. This section synthesizes the main findings of the social driver assessments with regard to the current status of driver dynamics. It is based on the information provided in the respective driver assessments in the Sections 3.2 to 3.11.

Signs of change in social drivers' dynamics

In Stammer et al. (2021) and Engels et al. (2023), we found that deep decarbonization by 2050 is not plausible although most analyzed social drivers support at least a partial transition toward deep decarbonization. The previous assessment concluded that the "current trajectory of seven social drivers (i.e., UN climate governance, transnational initiatives, climate-related regulation, climate protests and social movements, climate litigation, fossil-fuel divestment, and knowledge production) supports decarbonization but not deep decarbonization", while "[t]he dynamics of two other social drivers (i.e., corporate responses and consumption patterns) continue to substantially undermine the pathways to decarbonization [...]" (Pagnone et al., 2023, p. 34). In the current Outlook, we observe that reaching deep decarbonization by 2050 remains not plausible under current circumstances. This emerges from the updated assessments of social drivers, most of which show continuation, while some display considerable changes in their dynamics compared to previous editions. One social driver in specific, fossil-fuel divestment, changed its direction, as it now points away from the deep decarbonization scenario, contrary to previous assessments. As in the 2021 and 2023 Outlook editions, none of the 10 social drivers supports deep decarbonization by 2050, meaning a reduction of carbon dioxide emissions that is fast and strong enough to achieve net-zero carbon emissions by that date is not plausible.

Drivers supporting decarbonization

Six social drivers—one fewer than in the previous Outlooks— are currently supporting decarbonization, but not deep decarbonization. These supporting drivers are UN climate governance, transnational cooperation, climate-related regulation, climate activism and social mobilization, climate litigation, and knowledge production. While none of these exhibits a shift in direction, there are noticeable changes in the dynamics of each driver. The assessment of UN climate governance (Section 3.2) describes how

a series of events affected developments within the United Nations Framework Convention on Climate Change (UNFCCC) as well as in the wider global climate governance space. Although driver dynamics have weakened, there is no decisive change in the driver's direction. Likewise, no shift is observed in the updated assessment on transnational cooperation (Section 3.3) despite a constant increase in initiatives forging cooperation among various actors to mitigate climate change. The assessment of climate-related regulation (Section 3.4) points out three major positive developments: the decision to introduce a Loss and Damage fund at COP27, the adoption of key components of the Fit-for-55 package in the EU, and further steps to reduce the implementation gap in the US and the EU. Overall, however, the ambition gap remains unchanged, and the implementation gap is still sizable despite notable reductions. In the assessment of climate activism and social mobilization (Section 3.5), significant dynamics with ambivalent effects can be observed, though they do not lead to a change in the overall assessment. While in the long term it may support deep decarbonization through deeper cultural and normative change in social contexts, in the short and medium term profound dynamics since the last assessment point to both positive effects, such as maintaining the pressure to keep climate change on the political agenda in light of multiple crisis, and negative effects, such as the polarization with regard to protest repertoires and the increasing criminalization of movements. The climate litigation driver (Section 3.6) shows a continued geographical spreading of cases, the use of new litigation scripts and legal standards, an expansion of hybrid transnational litigation networks, a growing variety of global climate agents, and the broadening of the scientific evidence base for court cases. Despite signs of a growing political and judicial backlash against climate litigation, especially in the US, the driver continues to support decarbonization. Finally, the assessment of the driver knowledge production (Section 3.11) highlights new empirical evidence that both supports and undermines the driver's dynamics toward deep decarbonization. For example, IPCC assessment reports and other packaged forms of knowledge, which are tailored to climate action, strongly support the scenario by addressing governance problems and policies; but at the same time different actors spread mis- and disinformation, new forms of climate denialism, and delayism, all of which undermine the plausibility of the deep decarbonization scenario.

Driver with unclear direction

Unchanged from the most recent Outlook edition, the assessment of the media debates driver (Section 3.10) points to an ambivalent outcome vis-à-vis deep decarbonization. A key development points to structural changes in the digital media environment that entail both positive impacts, such as broadened accessibility to new technologies, and negative ones, such as an expected increase in the production and distribution of mis- and disinformation.

Drivers inhibiting deep decarbonization

While fossil-fuel divestment (Section 3.8) has so far been assessed as pointing toward decarbonization, this is no longer the case. To the contrary, shifts away from decarbonization have been observed since the most recent assessment. The empirical evidence now indicates that divestment announcements are rarely implemented, and even if they are this does not necessarily lead to lower emissions. Moreover, the pressure on investors to divest from fossil-fuel engagement is lessening, while investments in new fossil-fuel engagements are soaring. Therefore, the assessment of this driver now points away from decarbonization. Corporate responses and consumption trends (Sections 3.7 and 3.9) continue to strongly inhibit dynamics toward deep decarbonization. While corporate responses witness some positive dynamics with regard to ambition, for example through an increase of companies subscribing to specific climate goals and target-setting, implementation continues to be weak. This materializes in the corporations' ongoing and substantial contributions to ever-increasing greenhouse gas emissions. In a similar way, current dynamics such as global inflation and increasing social inequality shape the driver consumption trends, but without generating structural changes. Therefore, this social driver also continues to considerably inhibit the pathways toward deep decarbonization.

Social drivers' resources: densification and relationality

The assessment of social drivers' dynamics toward or away from deep decarbonization is supported by information on key changes in social dynamics as well as by the analysis of densification and relationality. One guiding question in the Social Plausibility Assessment Framework for the updated driver assessments points to the generation and use of climate action resources, which lead to patterns of densification in the global opportunity structure for climate action and to increases in the relationality of drivers by institutionalizing exchanges and strengthening interactions among them. All social driver assessments find a proliferation of resources for climate action, which are generated by the driver and used in other contexts, or used by the driver and generated elsewhere. These resources include net-zero standards, networking platforms, legal precedents from successful climate litigation cases, a multiplicity of forms of protest, new tools for media communication, and innovative knowledge-policy platforms, among others. The global resources generated by UN climate governance

or transnational cooperation, for example, when incorporated into stable repertoires of climate action, can 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 and increase in relationality among drivers is an important development since the previous assessment. It indicates new opportunities and potentials for a global low-carbon shift as well as new avenues for research on societal climate futures.

The findings of the updated social driver assessments regarding resources, relationality, and signs of change lead to two general observations, especially notable in those social drivers which show a continuation compared to previous Outlook editions. First, all drivers provide empirical evidence for an increase in dynamics and activities within the driver, which often creates new resources for other drivers. Second, despite the plethora of resources and an increase in dynamics, no *qualitative transformative shift* toward deep decarbonization can be observed. These seemingly contradictory observations indicate that beyond the quantitative increase in resources and interlinkages, there is ostensibly less change affecting key structural and institutional context conditions of the drivers. Furthermore, patterns of densification rarely entail decisive qualitative shifts, such as a shift from soft law to hard law in UN climate governance. There is only little case-specific evidence about positive trends in this regard, especially in transnational cooperation, where voluntary corporate sustainability standards feed into specific climate litigation cases or become a source for national climate-related regulation (Section 3.3). In climate litigation, we see the use of specifically produced attribution knowledge strengthening litigation cases, as well as a new type of cases using private standards and state regulations to denounce corporate climate-washing (Section 3.6). At the same time, climate mobilization highlights the crucial role of climate movements in translating claim-making into implementing steps with regard to adaptation and loss and damage. Nevertheless, in other contexts, such as social movement campaigns addressing corporate responses, resources appear to have a less direct impact, yet shape the discursive context in which corporations operate (Section 3.5). An additional issue that is observable in the dynamics of some drivers is a form of spurious use of resources, which counteracts or undermines climate action. The knowledge production driver, for instance, mentions the use of misleading climate scenarios by financial actors to make the risk of climate change appear smaller than it is (Section 3.11). The media driver assessment, for its part, observes that the use of new technologies such as Generative Artificial Intelligence in the climate field will facilitate the spread of mis- and disinformation by fringe alternative media (Section 3.10).

In summary, the updated social plausibility assessments highlight a seemingly contradictory trend: Despite an observable densification of resources and increasing relationality among social drivers, little development toward the scenario of deep decarbonization by 2050 is observed; rather, individual drivers are showing changes pointing away from deep decarbonization. This indicates that a mere increase in resources and interlinkages is not sufficient to usher in significant changes in driver dynamics toward deep decarbonization. For example, the emissions gap remains high despite new net-zero standards and updated national pledges in the framework of UN climate governance; the wide mobilization by climate activists, including disruptive actions, are ensuring continuous media attention, but at the same time there is an ongoing social and political backlash in the form of repression or even criminalization of protests. Resources are not being sufficiently used to support deep decarbonization, or are even being used to undermine the goal as in the case of climate denialism in technology debates. The existing enabling conditions for climate action, therefore, are not leading to system-wide societal transformations. A concrete manifestation of this is the widening implementation gap in climate action. These uneven and contradictory developments indicate that, without any major shift in global decarbonization dynamics, a low-carbon shift will not follow a linear upward pattern but will rather continue to be shaped by a non-linear trajectory with uncertain unfoldings over time. The unsettling issue that highlights the urgency of in-time climate action is that even if the current momentum of social drivers remains the same in the near future, the plausibility space for deep decarbonization will continue to shrink as the time horizon for societal transformations draws nearer. This, in turn, has several implications for the plausibility of sustainable climate change adaptation: the less mitigation there is, the more climate-related risks and impacts are expected, and thus more challenges for adaptation, let alone sustainable climate change adaptation, are posed.

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