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# Lost in transformation: The Paris Agreement, the IPCC and the quest for national transformative change

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The IPCC stated in its special report on global warming of 1.5°C (SR15) that meeting the temperature target of the Paris Agreement requires rapid and far-reaching changes across all aspects of society. This is called a need for *transformative change*. However, what is meant by transformative change? What should be changed, and how should it be changed? These questions are explored in this paper, which is structured in three steps. First, it develops a conceptual meaning of transformative change that is centered on society. Then, it analyses how the IPCC in SR15 understands transformative change. The analysis finds that the proposed pathways to reach the targets of 1.5 and 2°C have a strong technical focus on energy supply, which makes broader and deeper transformative change almost unnecessary. This finding is related to the recently published IPCC report on mitigation. Even if institutional and socio-cultural dimensions of transformative change are better covered in this report, they are insufficiently integrated into the overall assessment of necessary transformative changes. Finally, it turns to the national level, analyzing Sweden's ambition to become the first fossil-free welfare society in the world. The analysis shows, in line with SR15, that Sweden has a restricted focus on changes in energy supply, making transformative change, such as restructuring the economic system and questioning consumption patterns, unnecessary. Based on this analysis of international (the IPCC) and national (Sweden) levels, this paper identifies a need for an elaborated, consistent and deeper understanding of transformative change. It concludes that to be relevant to countries' work to achieve ambitious climate targets, the IPCC should develop a more qualified understanding of transformative change, which requires a better integration of social science research.

## KEYWORDS

climate policy, Intergovernmental Panel on Climate Change (IPCC), the Paris Agreement, science-policy interaction, Sweden, transformative change

## Introduction

There has been an increasing accumulation of scientific data on human-caused climate change. These data have been assessed, packaged, and communicated worldwide, not least to decision-makers. Those urging the message of a climate crisis have succeeded in including this message in environmental discourses and environmental policy. Media are reporting on climate issues in greater detail, there has been a (partial) greening of public discourses, and climate issues have climbed higher on international as well as national political agendas. Today, 23 countries, as well as the European Union, have declared a climate emergency. This means that more than 1 billion citizens are covered by a jurisdiction that has declared such a state of emergency.<sup>1</sup> There have also been promising agreements concerning global policy developments, such as Agenda 2030 and its 17 Sustainable Development Goals (all of which, more or less, relate to climate policies) and the 2015 Paris Agreement on limiting global warming.

However, examining what has been achieved thus far in relation to the demands of global targets tells another story. Since the first assessment report of the IPCC, published in 1990, CO<sub>2</sub> emissions have increased by 60% (Stoddard et al., 2021). To date, world politics, businesses and civil society organizations have been slow to respond, and for many environmental issues, of which climate change is one of the most urgent, there is a broad understanding that actions taken thus far are clearly insufficient. The gap between what has been achieved and what needs to be done to achieve the targets continues to grow. In this situation, “transformative change” has been put forward by international expert bodies as a means of dealing with the gaps and limit global warming to well below 2° (IPCC, 2018) as well as halting biodiversity loss (IPBES, 2019). Unless the underlying causes are addressed, the political targets will not be achieved, and a climate disaster will be unavoidable.

However, intentionally transforming society, and at great speed, is anything but unproblematic. All social changes create winners and losers. For example, fossil fuels were an extremely sensitive topic during the climate negotiations at the COP-26 meeting in Glasgow in November 2021. For the first time, coal and fossil fuel subsidies were addressed in a COP agreement. However, extremely late in the negotiations, the proposed phrase “phase-out” in reference to coal was replaced by the phrase “phasedown”, and the agreement stated only that efforts to ensure the “phase-out of *inefficient* fossil fuel subsidies” (italics added) should be accelerated. Thus, concerning climate change, there is not only an “emission gap” but also an “implementation gap” and a “formulation gap”— too little has been accomplished,

not only in practice but also on paper. Even if a policy is implemented, it will not be sufficient because it is either not far-reaching enough or based on unrealistic assumptions.

A particular problem of the goal to transform society is that transformation is a polysemic concept with diverse meanings and different uses (Feola, 2015; Winkler and Dubash, 2016; Salomaa and Juhola, 2020; Hysing and Lidskog, 2021). It can be framed differently, leading to various proposals on what should be transformed and through which measures. Thus, different actors can frame and strategically use the quest for transformation to support their activities (existing or planned), including those that will increase global warming. Therefore, it is crucial to clearly define what is meant by transformation, including what must be transformed and how this transformation should be initiated and governed.

Since the notion of transformative change has come into focus as a necessary and crucial way to address the gap between emissions and targets, there is an urgent need to reflect on the current discourses and meanings of transformative change. What activities does this conceptual usage suggest, and to what extent do these activities imply a restructuring of society? In this paper, we aim to contribute to this discussion by exploring how the IPCC frames and understands transformative change in initiating and governing efforts to limit global warming.

Our effort is performed in four steps. First, we develop the meaning of transformative change. Here, we refer to recent uses of the concept and try to improve its conceptual meaning. Second, based on our initial and tentative definition of the concept, we turn to the IPCC’s special report on keeping global warming to well below 2°C while “pursuing efforts” to limit the temperature increase to 1.5° (hereafter SR15). This report states that transformative change is needed to reach the temperature targets, and we analyze how transformative change is conceptualized and what actions are suggested for limiting global warming. We find that the IPCC has a shallow and fragmented view of transformative change. We then relate these findings to the recently published assessment report from the IPCC Working Group III (IPCC, 2022), which builds on the SR15 view on transformative change and further elaborates on it. Third, we focus on Sweden, the country with one of the most ambitious national climate objectives in the world. Sweden intends to become the world’s first fossil-free welfare state, and it aims to reach net-zero emissions of greenhouse gases no later than 2045. Our analysis shows that the Swedish government, like the IPCC, frames transformative change in a highly restricted way and has no clear vision of how it should be performed. In the fourth and concluding step, we summarize our findings and conclude that there is a need to critically evaluate how transformative change is framed by the IPCC and qualify its meaning to promote necessary policies and measures for reaching the ambitious targets agreed upon globally as well as nationally.

<sup>1</sup> <https://climateemergencydeclaration.org/climate-emergency-declarations-cover-15-million-citizens/>

## Transformative change: An embraced but unclear concept

Transformation has become a buzzword within scientific and political discourses in which “transformative change” is stated to be the solution to many severe environmental challenges. Expert organizations such as the IPCC and IPBES have stressed that transformative change is necessary to meet environmental challenges (IPCC, 2018; IPBES, 2019). Environmental researchers have claimed a need for transformative change to reorient society toward more sustainable pathways (Linnér and Wibeck, 2019). Political bodies see it as a way to meet environmental as well as social and economic challenges; for example, the European Union understands climate change as not only the greatest challenge of our time but also an opportunity to build a new economic model and states that “the European Green Deal sets the blueprint for this transformational change” (EC, 2019). Thus, there is an emergent call from both political bodies and scientific communities to transform society to meet global environmental challenges and a quest for expert guidance on what should be transformed and how (Díaz et al., 2018; Beck et al., 2021; Stoddard et al., 2021; Lidskog et al., 2022).

While transformative change is seen as the way forward and as an uncontroversial ambition—it is difficult to find anyone who is critical of it—its meaning is nevertheless unclear. It seems to function as a “boundary object”, a concept flexible and vague enough to connect different social worlds and the interests of different actors (Star and Griesemer, 1989). Therefore, transformative change can be shared by communities even as each simultaneously holds its own understanding of what it means. However, investigating the function and strategic use of a concept is one matter, while developing its analytical meaning is another. What kind of change should qualify as transformative? What is to be transformed, by whom and how?

The unclear understanding is not least visible in contemporary discussion of how the climate issue can and should be resolved. For example, there is an extreme gap between Bill Gates (2021) belief that technological innovations (along with innovation policy) can solve the climate challenge, Rockström and Gaffney (2021) emphasis on the need for economic restructuring and global justice, and Scranton (2015) civilization critique, which questions the carbon-fueled society that has made everyone dependent upon its energy flows. These very different remedies result from the different ways of framing the climate issue. As Paterson (2021a) shows, there are several competing frames of climate change at work, such as framing the problem as one of emissions, of market failure, of decarbonization, of individual consumption, of global cooperation, or of fossil fuels. These different frames open up and close down particular options, that is, the kind of transformation that is deemed relevant and justifiable. They

also depoliticize or politicize the climate issue, depending on to what extent these frames question power relations and the social order. Some frames imply no need for deeper changes in society, whereas other frames imply a need for restructuring society, thereby challenging prevailing economic and political power structures.

Similarly, in the scholarly discussion, there is diversity in the conceptual meaning of transformative change. The scientific literature discusses “transformation” or “social/societal transformation” rather than “transformative change” (Pelling et al., 2015; Brand, 2016; O’Brien, 2016; Kinley, 2017; Fazey et al., 2018; Linnér and Wibeck, 2019; see, e.g., Blühdorn et al., 2022). An overview of the concept shows that it is very broad, often contrasted with incremental change and defined as “profound and enduring non-linear systematic changes, typically involving social, cultural, technological, political, economic, and/or environmental processes” (Linnér and Wibeck, 2019, p. 4). This meaning is very broad, and the review includes transformations such as the abolishment of slavery and digitalization of society. Transformation can refer to entire epochs (such as modernity), more discrete and restricted changes (such as automobilization); it can also refer to very rapid processes (e.g., the fourth industrial revolution) or slow processes (e.g., the neolithic revolution) (Linnér and Wibeck, 2019, p. 57). Other studies have adopted a more specified focus on social aspects, such as institutional arrangements, norms and practices (Buch-Hansen, 2018; Stoddard et al., 2021).

Another conceptual ambiguity is that transformation is often discussed alongside transition. Sometimes these concepts are used interchangeably, and sometimes they are contrasted, providing a crucial distinction between incremental change (transition) and fundamental change (transformation) (Roggema et al., 2012; Hjerpe et al., 2017). Additionally, there are great overlaps between these two concepts and others, such as resilience and adaptation, and many times, prefixes are added to qualify the concepts, such as “critical transition”, “societal transition”, “deliberate transformation”, “social transformation” and “sustainability transformation” (Feola, 2015; Salomaa and Juhola, 2020).<sup>2</sup>

<sup>2</sup> This conceptual ambiguity can also be found in the reports published by the IPCC. In the glossary of the SR15, *transformation* is defined as “a change in the fundamental attributes of natural and human systems”: *societal (social) transformation* as “a profound and often deliberate shift initiated by communities toward sustainability, facilitated by changes in individual and collective values and behaviours, and a fairer balance of political, cultural, and institutional power in society”, and *transition* as “the process of changing from one state or condition to another in a given period of time. Transition can be in individuals, firms, cities, regions and nations, and can be based on incremental or transformative change.” (IPCC, 2018, p. 559). However, in its latest assessment report (IPCC, 2022, Ch. 1, p. 49), *transition* is defined as a process, while *transformation* is defined as the outcome (of large-scale shifts in sociotechnical systems).

From an analytical perspective, transformative change is a way to position a problem in a broader context. To claim that there is a need for transformative change to address the climate crisis means that what has been accomplished hitherto is insufficient, inefficient and too restricted. “More of the same” is not a relevant cure. The call for transformative change signals the need for a deeper and more fundamental change.

To create conceptual clarity about transformative change, a reasonable starting point is to examine whether the concept is based on a *qualified understanding of society*. The reason is that the problem of climate change, similar to most environmental issues, is caused by society and can be solved only by and through society. This point is of crucial importance because environmental problems are often framed by questionable and simplistic models of society (Wynne, 2005; Jasanoff, 2014). A suitable starting point is that when striving for transformative change, any relevant and efficient proposal must be based on an elaborated and consistent view of how society is organized and how it changes. There is a need for qualified analyses of the social causes of environmental problems: why a particular environmental problem has developed, why it persists and how it can be changed. If no social analysis is performed, suggested solutions may work on paper but not in practice.

A particular problem is that qualified understandings of society can be of very different kinds because the landscape of theories that explain society is complex and varied. In environmental sociology, for example, it is possible to find several general theories—such as the treadmill of production (Schnaiberg, 1980), risk society (Beck, 1992, 2009), and ecological modernization (Buttel, 2000; Mol et al., 2009)—that present different understandings of the social causes of environmental destruction and what action should be taken to make society more sustainable. Rather than prescribing a particular theory, there is a need for an open and pluralistic view in which different theories and approaches can legitimately be used. This means that instead of advocating a particular theory for how society changes, we advocate a minimalistic understanding that consists of three crucial ingredients.

First, a qualified understanding of society must include a developed theory of *social change*, which is a theory that is recognized and embraced by social scientists. Many theories, such as transition theory (Grin et al., 2010; Köhler et al., 2019), social practice theory (Shove et al., 2012) and socioecological transition theory (Fischer-Kowalski and Haberl, 2007; González de Molina and Toledo, 2014) meet this demand (for an overview, see Feola, 2015). A theory of transformative change can also be composed of different theories because different theories and approaches shed light on different aspects of society and may all be of importance in understanding transformative change. What is important is that the adopted view of transformative

change is not an incoherent mosaic of different thoughts and theories but is consistently and consciously elaborated. If not, the suggested way to transform society runs the risk of delaying or hindering transformative change because it proposes a way forward that is unviable (for technical, social and/or political reasons).

Second, no social sector is separate from the general society. This means that all decisions, measures, and *solutions are socially embedded*. When they are introduced, things will happen, including unintended consequences (Shapin and Schaffer, 1985; Jasanoff, 2004). This point is important to highlight since solutions are often understood, or at least presented, as technological fixes, i.e., purely technical innovations that make social change unnecessary. In fact, the definition of a technological fix is that attitudes and behaviors do not need to change (Heberlein, 2012, p. 3–10; Barthe et al., 2020). A proposed technoscientific solution avoids political conflicts—it requires no change in behavior, rather only improved conditions for technical innovations, their commercialization and use. However, empirical studies have shown that society is always involved when technical solutions are developed and implemented. Moreover, some solutions may not be publicly legitimate and politically viable, irrespective of the strength of the technical support. Other solutions may engender social support and be implemented smoothly but may imply radical social change, despite being framed as a purely technical solution (e.g., the mobile phone as a communication technology is framed as a technical device but has resulted in profound social change). Thus, it is important to critically investigate the wider context and the social implications for solutions to be implemented as part of transformative change. This situation has been called the co-production of technology (broadly defined) and social order (Jasanoff, 2004). This approach stresses that scientific ideas and technological artifacts always evolve together with ideas on how to organize and control society. Technology both embeds and is embedded in social identities, institutions, representations and discourses; “pure” technical solutions have broad and unanticipated effects (Stirling, 2015, p. 54). Transformation is thereby always complex and “unruly”.

Third, a qualified understanding of society must acknowledge *power relations*. As stressed by several social scientists, the gap between what is needed and what is done is deeply connected to existing institutional structures and power relations (Newell et al., 2021a; Paterson, 2021a; Stoddard et al., 2021). To explore why needed changes have not yet been achieved despite growing consciousness of and intensified negotiations on climate change, it is important to examine the social causes of environmental problems and explore how ingrained, unsustainable social and institutional structures continue to be reproduced (Hausknost, 2020; Paterson, 2021b; Blühdorn et al., 2022). Social transformations will affect the distribution of power, and it is therefore naïve to



believe that transformative change will take place without power struggles. Transformative change means that dominant rationales, norms and institutions are challenged and need to be changed; therefore, it generates conflict (Boström et al., 2018; Newell et al., 2021b). Technical innovation is a crucial part of transformative change, but this fact does not mean that it makes it possible to continue expanding production and consumption. Thus, transformative change needs to be combined with a critical outlook that challenges dominant ways of framing and understanding an issue and contests institutional arrangements, power differentials and authority claims (Pellizzoni et al., 2022). Transformative change needs to make conflicts and resistance to change understandable because a fundamental change in society creates winners and losers and challenges current power relations. Any effort toward transformative change requires a focus on leadership, governance, and inclusion as well as on power asymmetries (Bäckstrand et al., 2010).

Thus, our claim for a qualified understanding of society is a *minimalistic claim*, which means that social science will provide different explorations of and advice on transformative change. Within a qualified—social science-based—understanding of society, it is possible to have different views of transformative change (Brand, 2016; Paterson, 2021b). Such an understanding should not be equated with a shallow understanding of transformative change, in which most changes are labeled transformative and not grounded in social scientific knowledge. As stressed above, transformative change signals that there is a need for deeper and more encompassing change, which requires not only scientific and technological advances but also profound and enduring social and cultural changes (Görg et al., 2017). When transformative change is conceptualized and explored, it must include an elaborated social analysis because it is not nature but society that requires transformation.

When the IPCC calls for transformative change and suggests measures on how to transform society to limit warming to well below 2°C, how is transformative change understood in this context? Starting with a brief description of the new context of the IPCC after the Paris Agreement, the next section investigates how the IPCC special report on limiting global warming (SR15) conceptualizes and understands transformative change and to what extent this understanding is valid for achieving the goal of limiting global warming to well below 2 degrees. Thereafter, we investigate to what extent this view is supported in the most recent IPCC report (IPCC, 2022). The section that follows analyses how the Swedish government understands *change*, *solutions* and *power* in its efforts to become the first fossil-free welfare society in the world. What transformative change is needed to realize this extremely high ambition?

## The Paris Agreement, the IPCC and transformative change

After years of conflict over global distribution principles and which countries should reduce their emissions by how much and by what year, the 2015 Paris Agreement implied a radical change: it is now up to individual states to set their own climate targets and ensure that these are met. Complicated international negotiations can no longer serve as an excuse for countries not taking action. The Agreement has therefore been called a national turn in global climate politics (Hermansen et al., 2021). However, the design is partly national—the countries' own voluntary decisions to reduce greenhouse gas emissions [nationally determined contributions (NDCs)]—and partly global—summarized national contributions should keep the global average temperature increase to well below 2°C and preferably limit it to 1.5 degrees. Every fifth year (starting in 2023), the NDCs will be globally reviewed in a process called the Global Stocktake of the Paris Agreement.

The IPCC is the authoritative scientific voice in climate negotiations as well as in public discourse, and its assessments are extensively referenced. The scientific assessments produced by the IPCC have increased in complexity, which means that more issues and more experts are included in the work (Edenhofer and Kowarsch, 2015; Jabbour and Flachsland, 2017). Additionally, there has been an increased quest not only to assess knowledge but also to become more solution oriented, which has made the assessments more political (Haas, 2017; Castree et al., 2021).

As part of the Paris Agreement, the IPCC was invited to provide a special report (SR15) comparing the effects of temperature increases of 1.5 and 2°C and describing possible ways to achieve these temperature targets. However, there was little research to compile, as few studies had been conducted on possible ways to reach the 1.5° target (Hulme, 2016; Livingston and Rummukainen, 2020). The report was not a convenient task for the IPCC to perform: a hallmark of the IPCC is that it demonstrates the scientific necessity of climate policy and climate action but without giving firm political advice. SR15 implies that the IPCC needs to describe policy options and possible ways forward (pathways) to provide decision-makers with relevant knowledge on how to reach the temperature targets. In part, this means that more social scientific studies should be included in the assessment work. It should also mean, in line with the Paris Agreement and the national turn, that the IPCC should give more thought to how to support and inspire ongoing work at the national and regional levels (Carraro et al., 2015; Livingston et al., 2018; Hermansen et al., 2021).

An important reason why the UNFCCC invited the IPCC to produce SR15 in the first place was to “inform the preparation

of nationally determined contributions” (UNFCCC, 2015, §20), and SR15 is accordingly expected to support policy formation at the national level, in line with post-Paris global climate policy. Thus, we find that there is a strong link between the Paris Agreement’s national turn and SR15.<sup>3</sup>

Concerning transformative societal change, it has been argued that the IPCC plays an instrumental role in producing the visions of societal change used by those arguing for its necessity (Beck et al., 2021). SR15 explicitly claims that “limiting global warming to 1.5°C would require substantial societal and technological transformations” in terms of energy production, land use (agriculture and food production), urban infrastructure (transport and buildings) and industrial systems (IPCC, 2018, p. 56). It also states that the work of achieving a resilient future is fraught with complex moral, practical, and political difficulties and inevitable trade-offs.

SR15 presents manifold pathways to reach the 1.5°C target, four of which are selected as illustrative model pathways (IPCC, 2018, ch. 2). These involve different portfolios of mitigation measures combined with different implementation challenges, including potential synergies and trade-offs with sustainable development. At the same time, they all presuppose a decoupling of economic growth from energy demand and CO<sub>2</sub> emissions and the implementation of new low-carbon, zero-carbon or even carbon-negative technologies. The differences between the pathways are presented with the help of global indicators, such as final energy demand, renewable share in electricity, primary energy source, and carbon capture and storage. Thus, SR15 strongly stresses the need and opportunity to make changes in energy supply.

In regard to necessary changes in the social and economic order, which are stressed on a general level, the pathways do not propose any radical changes. Societal conditions are taken into consideration only insofar as they enable or obstruct technological development. This is the case for all the pathways that rely heavily on bioenergy with carbon capture and storage (BECCS), whether they are based on reduced energy demand, include a broad focus on sustainability, or imply intensive use of resources and energy. SR15 states that to implement the pathways, it is crucial to strengthen policy instruments, enhance multilevel governance and institutional capacities, and enable technological innovations, climate finance, and lifestyle and behavioral change (IPCC, 2018, ch. 4.4). However, apart from these sweeping statements, there is no further elaboration on how to create these conditions in relation to different pathways.

SR15 thus exhibits a paradoxical view of transformative change, stressing its necessity but in practice, placing great hope in technological fixes—technical solutions that do not require structural changes. The economic and social order is reduced to a resource for facilitating technological innovation. This view

is reinforced in the report’s discussion of the risks and trade-offs—for the environment, people, regions and sectors—that are associated with the pathways. For example, the novel technology of BECCS is recognized to be unproven and to pose substantial risks for environmental and social sustainability (IPCC, 2018, p. 121), but it is considered manageable; it is only *if* BECCS and other options of negative emissions technologies are poorly implemented that trade-offs will be required (IPCC, 2018, p. 448). Similarly, risks associated with nuclear power (IPCC, 2018, p. 461) are mentioned, but nothing is said about whether these should have any bearing on which pathways to choose. Thus, despite the report’s overall stress on trade-offs, there seems to be a strong belief that they will be manageable and will not constitute substantial obstacles to implementing the pathways. This makes it possible to present and acknowledge risks and the need for trade-offs while at the same time not allowing them to have any implications for the suggested pathways and thereby not politicizing them.

The recommendations presented in SR15—i.e., the pathways—are radical in their view of technology owing to their great faith in future technological innovations but conservative in their view of societal change, as they do not propose any transformation in the economic and social order. It is remarkable that no connections are made between technological and social change. For decades, research in the social sciences has stressed the need for *societal* changes and *social* or *socioecological* transformation (Diaz et al., 2018) in the sense of fundamentally redirecting social organization and human activities, including technology. In contrast, SR15, when presenting possible pathways for limiting global warming, puts its hope in technological innovations isolated from social change. If the IPCC wants to be policy-relevant, it must adopt a wider and more nuanced understanding of transformative change when developing pathways and conceptualize society as more than just a set of conditions that enable or restrict technological innovation.

We find that the IPCC in the influential and important SR15 understands *change* as a shift in energy supply (from fossil fuels to renewable energy resources), nuclear power and negative emission technologies (such as BECCS). This technology shift is, however, *not embedded* in a societal understanding of the wider conditions for and consequences of this shift. On the contrary, the IPCC seems to understand this shift as entailing technological fixes. The *power* issues are also poorly developed in the descriptions of the pathways and the technological shift needed to achieve the temperature targets. It is completely unclear who should do what and how and with what consequences. To be fair, and as already mentioned, there are parts of SR15 that discuss change and power more profoundly, but these views are not integrated into a societal understanding of the pathways. Instead, they are presented mainly in footnotes, comments and cases and function largely to show that the IPCC is aware of (some)

<sup>3</sup> The following analysis of the SR15 is based on Lidskog and Sundqvist (2022).

social science discussions. Hence, the IPCC implicitly shows that it has little ambition and competence to integrate social science research into a coherent view when presenting and discussing the pathways and the transformative change needed to realize them. However, since the publication of the special report in 2018, the IPCC has published a new assessment report. We will now analyze if the IPCC has changed and deepened its view on transformative change or if transformative change is still assessed mainly in terms of technical innovation and energy supply.

In April 2022, the IPCC Working Group III (WGIII) published its report on the mitigation of climate change, which is a part of the Sixth Assessment Report (AR6).<sup>4</sup> This report follows in the footsteps of SR15 when elaborating on five *illustrative mitigation pathways* (IMPs). As described above, SR15 introduced four illustrative pathways with specific characteristics as a resource for representing assessments of different strategies and options to achieve the objectives of the Paris Agreement.

The five illustrative pathways are selected from a database with more than 3,000 scenarios and include broader characteristics than the pathways presented in SR15. The report states that while the pathways discussed in previous ARs focus on technological potentials, the pathways in this report adopt a broader view, stressing the multidimensional character of mitigation challenges and use six dimensions of assessing feasibility (feasibility criteria) (IPCC, 2022, chs. 1 and 3). Of the six dimensions, two concern the physical environment, and four concern societal systems. Among the latter, we find the well-established “economic” and “technological” dimensions along with what are referred to as “socio-cultural” and “institutional and political” dimensions. The socio-cultural dimension is further elaborated in a full chapter of the report (chapter 5), and for the first time in the history of the IPCC, there is a chapter on the social aspects of mitigation (IPCC, 2022, ch. 5).

Of particular importance is that the socio-cultural dimension focuses on the demand side, which also names one of the five IMPs, the “low demand” pathway (IMP-LD), which includes changes in consumption patterns. This feature is a substantial improvement over SR15. In the more descriptive and qualitative assessments of social science research on mitigation, including examples of studies of national and subnational policies and institutions, case studies are presented to inspire further improvements of nationally determined contributions (NDCs) (IPCC, 2022, ch. 13).

<sup>4</sup> The report was finalized and presented on April 4, 2022. When writing this paper, the report existed only as a final draft. It was approved and accepted but may be subject to revision following SPM approval, corrigenda, copy editing, and layout. Therefore, we refer to chapters only and not to pages.

However, when the five pathways are presented in summary form, little has changed compared to SR15. Namely, the pathways still center on technology, the energy system and emissions (IPCC, 2022, ch. 3, Figures 3.7 and 3.8). The pathways are basically technology scenarios on energy supply and demand and prioritize the dimensions of economy and technology. Two scenarios are also headlined by technologies (IMP-Ren for renewable technologies and IMP-Neg for negative emissions technologies). The report explicitly states that all pathways can be assessed in relation to all six feasibility criteria (IPCC, 2022: chapter 1), including the socio-cultural and institutional-political dimensions. However, this point is neither developed nor made in an integrated way.

To conclude, the recent WGIII report is a step forward from SR15. Social science research—focusing on “the socio-cultural” and “the institutional and political” dimensions—is summarized in a way that can inspire and support improvements in national contributions (“real world sectoral transitions”) (IPCC, 2022, ch. 13). However, similarly to the SR15, these dimensions are discussed in terms of enabling conditions and not integrated in an overall assessment or included in the summarized illustrative mitigation pathways. Thus, improvements have been made, social science is given more attention, but is still not sufficiently integrated in the overall assessment; rather, it is seen only as a complement to the core activity of scenario assessment. The IPCC frames mitigation in terms of emissions that should be addressed by technological solutions. This framing is far from a “minimalistic” understanding of transformative change, which concerns a social embedding of proposed solutions with clear ideas on change and power relations.

## Transforming Sweden to a fossil-free society

The Paris Agreement makes individual nation-states central in the policy for limiting global warming, which makes Sweden’s work to contribute to this policy a research subject of great interest. Sweden has a long history of being considered a forerunner in environmental policy (Lundqvist, 2004). It is one of the most ecologically modernized countries in the world (Lidskog and Elander, 2012), and the first country that has decided to set political goals for its consumption-based greenhouse gas emissions and aims to become the first fossil-free welfare country in the world. Sweden has the self-imposed task of taking the lead and showing how a “long-term and controlled system change” can be achieved that avoids “the very high societal costs that are associated with rapidly changing conditions for citizens and companies” (Governmental Bill, 2019/20, No. 65, p. 8, our translation). In the following, we will analyze how this transformation is envisioned to take place. What *changes* are presented, what *solutions* are used and planned

to be used, and how are *power*, leadership and responsibilities distributed and discussed?

Sweden's national contribution under the Paris Agreement is formulated under its EU membership. This fact means a binding target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990 (EU, 2015). In the Swedish *climate policy framework*, which was broadly adopted by the national parliament, Sweden's long-term target is formulated as an ambition to become "the world's first fossil-free welfare country" by 2045 (Governmental Bill, 2019/20, No. 65, p. 7–9, our translation). The framework came into force in 2018 and can be considered the Swedish national response to the global Paris Agreement.

The framework also includes a *Climate Act* that binds current and future governments to the targets through the requirement to submit to the parliament an *annual report* on decided and planned measures, to state what effects these have on emissions and to assess whether further measures are needed. Every 4 years, the government must also present an *action plan* that more ambitiously describes measures and outcomes and how these are expected to achieve the targets. The plan must include forecasts of emission reductions (Governmental Bill, 2016/17, No. 146, p. 5). Furthermore, the framework includes a *review and follow-up procedure*. The government's annual reports and action plans are reviewed by the *Climate Policy Council*, which evaluates how the government's work is progressing based on the requirements set out by the framework. The Council's view will be considered by the government in the following year's report. The Council is an independent expert body with eight members of high scientific competence in climate, economics, and social science who are selected by the government (Swedish Climate Policy Council, 2022). The framework assigns the government a clear and unavoidable task. It is the government's responsibility to achieve the transformation needed to achieve the adopted targets.

To show that a fossil-free welfare society is possible means showing how "the transition to a fossil-free society can go hand in hand with economic development and welfare". A proposed reason for Sweden to take the lead is that Swedish companies are at the forefront in terms of "offering innovative solutions". These solutions will therefore "be exported to contribute to change in other countries. . . Sweden must show that it is possible to change and become a fossil-free country while maintaining competitiveness and welfare" (Governmental Bill, 2019/20, No. 65, p. 9, our translation).

The first climate policy action plan was submitted to the national parliament in December 2019. This plan can be considered the first Swedish climate transformation plan. As a clear sign, the word transformation ("omställning" in Swedish) is mentioned 195 times.<sup>5</sup>

<sup>5</sup> The government uses the Swedish word "omställning", which means re-direction, conversion, change and transformation. The Climate Policy

The climate policy framework requires the government to present how decided and planned measures can contribute to achieving climate targets and what further measures are needed. This presentation is accomplished in the action plan through the use of scenarios. The basic scenario is called the "indicative emission pathway". This pathway is intended to facilitate the review of whether the climate targets have been achieved and is presented as a linear reduction from 2015 *via* the milestone targets of 2030 and 2040 to the goal of net-zero emissions by 2045 (Governmental Bill, 2019/20, No. 65, ch. 8). However, in contrast to the pathways developed by the IPCC, the Swedish pathway is simply a straight line on paper from one year (2015) to another (2045). Nothing is said about what changes are to be made and what solutions are to be used to reach net-zero emissions by 2045.

Regarding the actions needed to achieve climate transformation in Sweden, the action plan states the following. First, to achieve the target, climate transformation must be integrated into all political areas. This means reviewing all relevant laws and targets for other sectors in order to identify possible conflicts with the climate target (Governmental Bill, 2019/20, No. 65, p. 49). Under the heading "conditions for transition", the plan mentions areas of special importance. These areas are "(1) electrification, (2) a growing bioeconomy within a sustainability framework, (3) accessible fossil-free solutions, (4) an investment climate and a financial market that facilitates transformation, (5) increased circularity and resource efficiency, (6) an innovation policy for tomorrow's solutions and (7) an inclusive transformation" (Governmental Bill, 2019/20, No. 65, p. 43, our translation).

However, nothing is mentioned about how these "conditions" work and should work in relation to the envisioned transformation; nothing is mentioned regarding their importance or how they could be managed and combined. For instance, in relation to "an inclusive transformation", the plan states that "an effective climate policy needs to be based on legitimacy, trust, justice and acceptance" (Governmental Bill, 2019/20, No. 65, p. 48, our translation) but nothing is mentioned regarding how to create this needed "effective climate policy".

Then, the government identifies the following societal sectors as key to transformation: transport; buildings and construction; industry; electricity, district heating and waste; forestry and other land uses; agriculture; work machines; and supplementary measures (such as negative emission

Council, however, translates it as "transition". As we stressed above (Section Transformative change: An embraced but unclear concept), transition can either be synonymous with transformation or be seen as a more restricted and incremental change. We therefore choose to translate "omställning" as "transformation". However, when we quote English texts by the government or the Climate Policy Council, we follow their conceptual usage.



technologies). Decisions (decided and planned) made by the government are presented in accordance with these sectors.

The transport sector is assessed as being of special importance. It is the only social sector that has a clear intermediate target of reducing emissions (excluding domestic flights) by 70% by 2030 compared with 2010. This can be interpreted as a signal that the transformation of transportation should occur first and lead the way for other sectors.

The action plan includes 132 measures that the government aims to implement during its term in office. However, these measures are rarely well-described and evaluated in relation to their possible contribution to the climate targets (the outcome) or with clear time plans; such evaluations, however, are needed to meet the requirements of the climate policy framework.

In relation to what decisions already made can deliver for the future, the action plan states that by the year 2045, emissions will be “34–41% lower compared with 1990” (Governmental Bill, 2019/20, No 65, p. 36, our translation), which is significantly <85% required for reaching net-zero emissions. The government is clear about the existence of a large gap but has no clear and coherent idea on how to close the gap and accelerate the needed transformation.

The government argues that the remaining emissions that need to be addressed come mainly from the agricultural sector, industry (especially steel and cement production) and the incineration of waste. Industry is considered able to develop carbon-neutral processes over the next 25 years, while agriculture is considered more difficult to address. Against this background, it is particularly important that “all electricity production, all heating and cooling as well as the entire transport sector and all emissions from work machines achieve zero emissions by 2045” (Governmental Bill, 2019/20, No. 65, p. 37, our translation).

Based on what is clearly visible in the action plan, we conclude that the government assesses the plan to transform the Swedish society as *the sum of government decisions*: that is, measures stacked on top of each other. These individual decisions are of very different kinds, such as setting up a new government investigation, increasing the level of biofuel blending with petrol and diesel, creating a green car premium for those who purchase climate-efficient vehicles and presenting a strategy for a national circular economy. However, these individual actions are not summarized. They are not organized, categorized, weighed against each other or discussed in relation to levels, actors and responsibilities in a way that could shape a more coherent view of what could be called an ongoing climate transformation and how this transformation should be implemented and governed. In short, there is no focus on *societal change*.

Nowhere in the action plan is a clear view of the needed transformation presented. Nothing is specified concerning the drivers and the obstacles, the important actors and their respective responsibilities, or how different regulatory

measures work and are intended to work in relation to each other (e.g., the roles of and dynamic relations between legal mechanisms, economic incentives, and pedagogical and informative instruments). No general understanding is provided, for example, of taxes in relation to public attitudes and the operation of the economy or how lifestyles, consumption patterns and technological innovation will relate to achieving the targets and transforming society. In summary, there is no general discussion on how individual actions will affect society, what they will change and how. No discussion of society and how it should be changed to reach a fossil-free country is presented. Thus, the government believes that it is possible to achieve a fossil-free society without requiring any fundamental transformative change.

The many activities and decisions are presented as discrete and separate activities without any connections to each other and to the wider society. They are *not embedded* in society, and discussions of resistance, support, (differentiated) consequences and coordination/leadership are poorly developed. Therefore, the notion of *power is invisible*. The intended transformation is presented largely as a win–win solution, which means that there is no recognition of actors whose activities may be threatened by a policy for a fossil-free society and who therefore may mobilize against efforts to achieve such a society.

Thus, for the Swedish government, transformation means, according to the first action plan presented in 2019, *the sum of individual government decisions*. Nothing is mentioned in relation to how this transformation should be guided and achieved. Clear emission targets are set, but there are no targets for what society should achieve, when and how.

In March 2020, the Climate Policy Council presented its evaluation of the first climate policy action plan and whether it is compatible with the climate targets. The Council was highly critical of the plan and identified several serious deficiencies. The most serious one is the lack of a *vision* of the overall goal of becoming the world’s first fossil-free welfare society. What should this society look like? Another deficiency identified is that decided measures and planned initiatives are vaguely described, and the government does not show how these measures will lead to the achievement of climate targets. There is no timetable and no assessments of the effects of the decisions on greenhouse gas emissions. Thus, the plan does not comply with the requirements of the Climate Act (Swedish Climate Policy Council, 2020, p. 25–26).

The Council stated that questions about governance and leadership are underdeveloped and therefore proposed that a steering committee should be established to support and clarify responsibilities regarding implementation, with the prime minister as chair (Swedish Climate Policy Council, 2020, p. 9–10). The Council commented that the question of “achieving policy goals does not receive any attention at all”, which it found noteworthy (Swedish Climate Policy Council, 2020, p. 38). The Council also concluded that targets beyond 2020 would not be

achieved and estimated that the long-term impact of the action plan would be an emission reduction of nearly one-third by 2045, which is far from the target of an 85% reduction (Swedish Climate Policy Council, 2020, p. 67).

The Council argued that a transformation from fossil fuel dependence to a fossil-free society implies “a profound change of society”. “This transition must take place through parallel, interconnected changes in technologies, business models, behaviors, regulations, knowledge, culture and values. The changes involve different stakeholders at all levels of society—local, regional, national and global—in interdependent relationships”. According to the Council, this understanding has not yet been established by the government (Swedish Climate Policy Council, 2020, p. 30).

In summary, the Council considered the government’s understanding of the climate transformation to be shallow. The plan lacks an integrated framework, a vision, and leadership. What is also lacking, but is of great importance for climate transformation, is encouraging engagement by all stakeholders, including citizens. This could be done by offering platforms for collaboration in relation to actions and initiatives (Swedish Climate Policy Council, 2020, p. 78–79). This approach could be a way to support what the government envisions but has no idea how to achieve, as discussed above, i.e., “an inclusive transition” built on legitimacy, trust, justice and acceptance.

We agree with the Council that the Swedish government has no clear idea of what transformative change means and what needs to be achieved to become a fossil-free society. The Council, however, restricts itself to evaluating the government’s plans and offers no alternative view or more elaborate discussions of what transformation and change are and how they should be developed in the work of the government.

In this section, we presented and discussed the Swedish government’s plans for transformation toward becoming a fossil-free welfare society and how they have been evaluated by the Council. We conclude that the idea of this transformation—the understanding of what transformation is and how it should be accomplished—is greatly underdeveloped. The idea is no more than individual measures put together, and the pathway to the target is no more than a straight line on paper. The target is the most ambitious in the world, but the idea of what a transformation is and should be, including what a fossil-free society means and implies, is seriously unclear. In short, what transformative change means is not answered by the Swedish case.

## Conclusions: Lost in transformation

The Paris Agreement is an ambitious step toward limiting global warming. To meet its goals, transformative change is

needed. The IPCC has emphasized the need for rapid and far-reaching changes in all aspects of society, and this emphasis has been reinforced in its most recent report (IPCC, 2022). As our analysis shows, a fundamental problem is that at the same time that SR15 claims the need for transformative change, its proposed measures and pathways are not based on a scientific understanding of how society works and how it can change. Instead, SR15 puts together different measures to reach the 1.5°C goal, but without any deeper reflection on the social implications and political viability of the presented pathways. Even if the latest report is a step forward in that it includes more social science research relevant to the presented mitigation pathways, this knowledge is not well-integrated in the overall assessment and thus, the IPCC still frames the mitigation challenge to be addressed mainly with technological solutions. In this sense, the IPCC is “lost in transformation”—i.e., it heavily emphasizes the need of transformation and proposes a variety of measures but offers no general presentation and assessment of what transformation means and how it can be achieved.

This problem—a fragmented understanding of the climate issue as a societal challenge and what kind of transformations it entails—is also very clear at the national level. Our analysis of climate policy in Sweden, a country that aims to take the global lead in becoming a fossil-free welfare society, shows that the policy that it has developed to achieve this ambition is not based on a qualified understanding of society and how it can change. Thus, we have not only an implementation gap but also a formulation gap: the problem is not only that a policy is not implemented but also that the formulated policy is far from sufficient to lead to a climate-neutral society. To reach this goal, there is a need for not only technical development but also social transformation.

This raises the question of what should and can be done to change this situation. Why is it that its special report on limiting global warming (SR15) as well as in its recent report on mitigating climate change (IPCC, 2022), the IPCC takes a radical view of technology, putting great belief in technological innovations, but a conservative view of societal change, not proposing any transformative change in the economic and social order? It is remarkable that while research stresses the need for *social* transformation (see, e.g., Díaz et al., 2018; Stoddard et al., 2021), both the IPCC and the Swedish government put their faith in technological innovation while sidelining social transformation when presenting scenarios, pathways and action plans.

This question is difficult to answer, but one reason may be the epistemic infrastructure: the IPCC’s current way to collect and evaluate scientific knowledge implies that much relevant social scientific research is either not recognized (as in SR15) or, if it is included in the assessment, not done justice to (as in IPCC, 2022). In short, it is difficult for the IPCC to evaluate more qualitatively oriented research given its current epistemic

infrastructure and practices. Thus, the question that the IPCC asks is framed and formulated in a way that social science cannot answer. As the political scientist David Victor finds based on his experience of being involved in AR5, “If the panel looks to the social-sciences literature on climate change, it will find little. But if it engages the fields on their own terms, it will find a wealth of relevant knowledge” (Victor, 2015, p. 29). There may be not only epistemic but also normative reasons for this situation; as we have stressed above, transformative change involves politics and power, and the IPCC’s credo of “being policy-relevant and policy neutral, but never policy-prescriptive” may lead it to avoid stressing power relations, controversies, and conflicts. Transformative change is inherently political in nature because it challenges power relations, not least powerful actors that drive unsustainable practices (Scoones et al., 2015). This was clearly revealed in the sensitiveness of mentioning fossil fuel at COP-26. Therefore, transformative change is fraught with enormous governance challenges at different levels of society. In contrast to abstract pathways, transformative change always takes place in spatial, social, and temporal contexts, which have great impacts on proposed measures and ways forward.

The implication is that providing policy-relevant knowledge for transformative change requires not only that the social sciences are allotted more space but also that they are placed on equal footing with the natural sciences in the IPCC’s knowledge assessments. If not, there will be no science-based guidance on how to initiate, facilitate and (partly) govern social transformation. There is now an urgent need to pay greater attention to the sociopolitical aspects of transformative change and to assess research on how society works. Otherwise, the IPCC will develop only pathways that work on paper but never in practice because they are developed without social and political realism. This also means that issues of power and conflicts of interest, justice, and values cannot be avoided but must be explicitly dealt with in knowledge assessments and when developing policies. A prerequisite is that policy advice, as well as formulated policies, should be based on an elaborated and consistent understanding of transformative change that does not avoid its conflictual and political nature. If not, there is a great risk of both expert organizations providing advice and actors developing policies becoming lost in transformation.

The way forward to achieve an improved and realistic understanding of transformative change is not straightforward, but a possible first step could be to further develop the work on presenting ongoing examples of transformative change (IPCC, 2022, ch. 13) and use these as illustrative examples in relation to pathway selection. This approach can substantiate the pathways by better connecting them to social science research, re-embedding technological solutions in society by relating

these solutions to the socio-cultural and institutional-political dimensions that are now presented in the IPCC report but not used in practice. Another step is to let the assessed social science knowledge better influence the overall assessment, for example, by focusing not simply on abstract drivers and enabling conditions but including more broadly and deeply investigating the social causes of climate change. A step further and the most important step is to reveal and question the overly restricted and depoliticized framings of the climate challenge, revealing the actual situation as a societal crisis whose solutions require that society, and not merely technical systems, be transformed.

## Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: The analysis is based on published and accessible work by the IPCC, the Swedish Government and Swedish public agencies. Full references to these documents (including links to them) are given in the list of references.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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