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Who are the green transition experts? Towards a new research agenda on climate change knowledge

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Abstract

Experts play a significant role in shaping global and local norms on how societies should respond to the climate crisis. However, current scholarship on the relationship between expertise and climate change has not fully addressed recent transformations in the field, specifically the emergence and increasingly influential role of what we term "green transition expertise." We define green transition expertise as a more applied, normative, and contextual form of climate change knowledge that is contrasted with the formalized, pure science of "climate expertise." If climate experts assess the deteriorating state of the global climate, then transition experts tell states and corporations what they should do about it. We argue that if the social science of climate change knowledge is to further deepen its grasp of the politics of the green transition analytically and normatively, it must embrace a "post-IPCC" research agenda that turns increasingly toward studying the power of transition experts in directing state and corporate climate action. Based on a review of the literature, we contrast the extant IPCC agenda with an emerging post-IPCC agenda along three dimensions: expert cast (who are the experts?), expert content (what do they know?) and expert context (where are they located?). By marking a shift in each of these dimensions, the post-IPCC agenda sensitizes the social science of climate change knowledge to overlooked and increasingly powerful forms of experts and expertise. To facilitate their study, we define six specific areas that require detailed attention as the post-IPCC agenda develops.

This article is categorized under:

The Social Status of Climate Change Knowledge > Sociology/Anthropology of Climate Knowledge
Policy and Governance > National Climate Change Policy
Climate, History, Society, Culture > Ideas and Knowledge

KEYWORDS

climate expertise, decarbonization, green state, sociology of expertise, sustainability transitions

1 | INTRODUCTION

Who are the experts shaping action on climate change? Since its formation in 1988, social scientists have studied the Intergovernmental Panel on Climate Change (IPCC) as the primary location of expertise on climate change. Over the following decades, a rich scholarship emerged on climate expertise, covering all aspects of how knowledge claims about the global climate are constructed, communicated, and with what effects (Asayama et al., 2023; De Pryck & Hulme, 2022). However, as the nature of climate politics changes, new locations of climate change knowledge are emerging. These locations exist outside the purview of the IPCC. A key feature of contemporary climate politics is that expert claims and climate change knowledges are pluralizing and diffusing into nearly all forms of organized social life. Anita Engels (2019) has urged social scientists of climate expertise to ask pressing questions about the "social status of climate change knowledge," which, among other things, includes considering new forms of climate change knowledge, where such forms are generated in society, who has access, and to what ends. These concerns are starkly illuminated when considering a new category of climate change experts, which we propose to call "green transition experts," who are coming to the forefront of societal responses to climate change. In short, if *climate experts* make claims about the worsening state of the global climate, *transition experts* tell states and corporations what to do about it. We contest that transition experts, although they are a heterogeneous and dispersed group of experts, can and should be studied as a distinct category of climate experts that draw on a different kind of expertise about climate change. Scholarly attention to this group of experts and their specific form of expertise has so far been limited. In this review, we propose a research agenda on the role of green transition experts and expertise in climate change.

The shifting landscape of global climate politics requires a research agenda on transition expertise. The 2015 Paris Agreement at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) was instrumental in strengthening the role of domestic politics and expertise in global climate mitigation for at least two reasons. First, it positioned the nation state as the focal actor for the implementation of climate mitigation and adaption efforts through the instrument of "nationally determined contributions" (NDCs) (Falkner, 2016). States are consequently taking greater steps towards establishing themselves as influential agents of societal transitions towards sustainability (Eckersley, 2021). For example, nation states are increasingly subsidizing the development of green technologies and infrastructure through "green industrial policy" (Allan et al., 2021). Recent high-profile examples of this include the Inflation Reduction Act in the United States or the European Green Deal in the European Union. Furthermore, states are making important investment and divestment decisions as owners of around half of the world's carbon assets (Babić & Dixon, 2023). To be sure, states have been engaged in climate governance for decades (Dubash et al., 2022). However, since Paris, their importance to global climate politics has only increased (Zetzer & Nachmany, 2018). But who is providing the expertise when states formulate and implement policies that effectuate the NDCs?

While a literature on national climate advisory bodies is emerging (Abraham-Dukuma et al., 2020; Averchenkova et al., 2021), little continues to be known about the domestic expertise that is provided to states and the experts providing it (Dudley et al., 2022). Recent examples from Australia suggest that governments require intermediaries or translators that can turn global, decontextualized climate science into local, contextual decarbonization initiatives: professional service firms such as KPMG or McKinsey & Co. have both recently provided the Australian government with consulting services for national climate modeling and climate strategies (Belot, 2023; Joshi, 2021). In both cases, we can observe a government turning to a form of "privatized climate science" and "climate services" rather than the model "public science for the public interest" championed by the IPCC (Keele, 2019). In 2022, the global climate consulting market was valued at $7.5 billion. By 2028, this number is expected to rise to $35 billion (Johnson & Skinner, 2023). Yet, the characteristics of these new expert actors and their expertise are largely unaccounted for in our existing models of climate change knowledge.

Second, the Paris Agreement also positioned non-state and subnational actors as core actors in the pursuit of more extensive action on climate over time (Hale, 2016; Hsu et al., 2019). Partly, this shift reflects the lacking confidence in multilateral collective action to deliver decisive greenhouse gas reductions. But it also reflects the growing power of especially non-state and subnational actors in climate politics. For example, many corporations emit more greenhouse gases than entire countries (Greenstone et al., 2023), and so the corporate license to operate is coming to depend more and more on (at least rhetorical) commitments to climate responsibility. Recent years have seen actors such as businesses, local governments, cities, and civil society organizations formulate and pledge "net zero" targets and strategies to signal their climate conscience to their environments (Allen et al., 2022). These decarbonization activities are happening largely outside the purview of any global governance institutions or expert bodies (Oberthür et al., 2021). If "net

zero" is indeed becoming "a new organizing principle in multilateral climate policy," (Green & Reyes, 2023, p. 909), then again, we may ask where the expertise is coming from when actors formulate and implement net zero strategies?

Scholarship on climate expertise has extensively covered the social organization and operation of climate change knowledge at the international level, but we are still largely in the dark regarding too many urgent questions about climate change knowledge at the national level, where states, non-state, and subnational actors are starting to take matters into their own hands, eschewing multilateral collective action. Recent work on polycentric climate governance stresses how new forms of governing is appearing around, below and to the side of the UNFCCC (Jordan et al., 2018) as state-, non-state, and sub-national actors are engaging and interacting in new forms of climate action. While patterns of polycentric governance were visible before Paris, the agreement acknowledged and amplified their existence (Jordan et al., 2018). However, expertise rarely features in analyses of polycentric systems. As such, new theoretical lenses are required to address the role of expertise in the increasingly complicated landscape of climate governance. The theories and concepts that are commonly used to study climate expertise (such as: epistemic communities, boundary work/organizations, and the science-policy interface) are especially apt when analyzing climate change knowledge at the international level where a separation between scientists and policymakers (whether real or imagined) is a standard assumption. However, these concepts and assumptions are inadequate when faced with the heterogeneity and informality of expertise at the national level. The private consultancies providing expert advice to the Australian government, for example, are not an epistemic community and they do not draw their expertise from formal science.

Taken together, these developments provide a firm grounding to launch a new research agenda on "green transition expertise" and contrast it to the existing agenda on "climate expertise." We view these agendas as complementary and nested one within the other. Indeed, transition expertise can be understood as a particular form of climate change knowledge, but it is an underappreciated form currently, even while it gains in political and corporate influence. To take the first steps towards sketching this agenda, we proceed as follows. In the next section we offer a literature review of social scientific research on climate change knowledge, especially as it has tended to relate to three core questions: who are the climate experts, what do they know, and where are they organized? We refer to these questions as matters of expert cast, expert content, and expert context. Having established our understanding of the literature on international climate expertise, which we label the IPCC agenda, we next turn to the emerging agenda on green transition expertise in section 3, which we label the post-IPCC agenda. We begin by introducing how the post-IPCC research agenda rests on theoretical developments within the sociology of expertise—a recent strand of research that lets us theorize the salient differences between climate expertise and transition expertise. Then we compare the IPCC and post-IPCC agendas on the questions of expert cast, content, and context. Section 4 takes the next steps by identifying key research questions and topics for studies of transition expertise to consider. Section 5 concludes the article.

2 | THE IPCC AGENDA: CLIMATE EXPERTISE

Debates on the nature and whereabouts of expertise in climate change have gained traction since the late 1980s. Experts are called upon to assess the state of the climate ("how bad is it?"), the risks associated with its changes ("what can happen?"), its origins ("is it really anthropogenic?"), and its possible solutions ("what can we do about it?"). The relative importance of these questions has shifted over time. During the 1990s, debates revolved around the question of whether global warming was happening, its fossil fuel underpinnings, and whether a changing climate was so bad after all (Oreskes & Conway, 2010). In the last decade, scholars generally agree that the focus has moved away from the causes of climate change toward the ideas and solutions needed to guide the decarbonization of our societies (Hajer & Pelzer, 2018). This has changed the political demands for climate expertise and the levels at which such knowledge is produced and requested. At the international level, global expert institutions such as the IPCC are increasingly being asked to contribute to the implementation and monitoring of policy actions (Beck & Mahony, 2018). For instance, scholars have studied how the IPCC's use of modeling, and particularly integrated assessment models, have led them to produce mitigation pathways that project how to achieve specific long-term climate goals (Beck & Oomen, 2021). These have, among others, been key in introducing carbon dioxide removal technologies as feasible mitigation options (Carton et al., 2020).

Yet, concerns over how global expert institutions such as the IPCC can stay relevant in a post-Paris era have also been raised (Hermansen et al., 2021; Livingston et al., 2018). As the focus on NDCs has shifted the loci of governance from the international to the national level, global expert institutions have found it difficult to identify target audiences

and gain policy relevance due to their traditional aversion to country-level solutions and cultures (Hermansen et al., 2023). Despite this shift, the study of climate change knowledge at the national level remains marginal. This is partly, we argue, a result of how the study of expertise in climate change has historically and continually been shaped by a specific research agenda which we term the "IPCC agenda." This agenda has created a certain sensibility in terms of (a) the *cast* of actors considered important expert actors, (b) the *contexts* regarded as significant sites in the study of expertise, and (c) the forms of knowledge that constitute climate change knowledge, that is, the *content* of expertise. This agenda has been powerful in bringing certain aspects of expertise to light, particularly at the international level, but it has also left other forms of knowledges and expert actors unaddressed.

While the IPCC agenda has been a highly influential agenda, it has not been all-encompassing. As already noted, a literature on national climate expertise is emerging (Abraham-Dukuma et al., 2020; Averchenkova et al., 2021; Dudley et al., 2022). Although their insights are important to the post-IPCC agenda, this literature still displays numerous overlaps with how climate change knowledge has been studied previously in terms of its focus on science, science-policy interfaces, and formalized boundary organizations such as advisory bodies. Scholarship exploring other, and less formalized, facets of the relationship between expertise and climate change has developed, focusing on, to name a few, climate consultants (Keele, 2017, 2019), citizen climate assemblies (Boswell et al., 2023; Willis et al., 2022) and lay climate knowledge (Lidskog & Berg, 2022). As we argue in later sections, these latter approaches should be considered central to the post-IPCC agenda.

In the following, we briefly flesh out the main parts of the IPCC agenda in terms of its expert cast, context, and content. Our argument builds on a reading of social scientific scholarship on the role of expertise in climate change. Specifically, we searched, selected, and read papers based on a search in the Scopus database for "expert*" and "climate*" or "transition*" in the period 1980–2022. To narrow down the scope of the literature, our initial reading is based on articles from 14 prominent journals.[1] We conducted an initial round of screening on these articles and excluded book reviews, methods articles, and articles that had been selected because they used expert panels, interviews, or expert judgment as a method. We also excluded articles that discuss expertise only in passing, focusing instead on those that use the term to develop analysis, measures, theories, and contributions. We combined the database search with a snowballing approach, using the reference list and citations of selected papers to identify additional papers. Identified papers were included based on the same criteria employed in the database search.

2.1 | Expert cast

Researchers following the IPCC agenda have positioned scientists as the most important actors for understanding the dynamics of climate expertise. In the literature, climate expertise tends to be associated with formal, scientific knowledge. This is visible in two important strands of research on climate expertise: research on IPCC authorship and climate science communities. First, researchers have addressed the cast of climate expert actors by analyzing the patterns of authorships found in the reports published by the IPCC's working groups. A continuous focus has been on identifying the various forms of biases within the organization and its assessment reports. Studies have found disparities in participation between Northern countries and the global South (Biermann, 2006; Green, 2014; Ho-Lem et al., 2011; Lidskog & Sundqvist, 2022; Paterson et al., 2014), epistemic hierarchies with disciplines such as engineering and economics enjoying high degrees of influence in the IPCC's assessment of mitigation (Bjurström & Polk, 2011; Corbera et al., 2016), underrepresentation of indigenous voices in assessment reports (Ford et al., 2012, 2016), and the role and influence of small but powerful networks of scientific actors in the production of knowledge represented in the assessment reports (Hughes & Paterson, 2017).

Second, the other strand of research has favored in-depth studies of scientific communities of climate change researchers (Demeritt, 2001; Edwards, 2010; Shackley et al., 1998; Shackley & Wynne, 1995). Expert statements on the changing climate are reliant on a growing network of complex scientific computer simulations (Blok, 2010) making the shared techno-scientific knowledge infrastructure of scientific communities an important priority for research on climate expertise (Edwards, 2010). For instance, Shackley et al. (1998) and Demeritt (2001) have studied the diffusion and institutionalization of Global Circulation Models. More recently, studies have critically scrutinized the assumptions and theoretical principles shaping how integrated assessment models—models that allow policymakers to envision different mitigation scenarios—influence the design of climate policy (Carton, 2020; Rubiano Rivadeneira & Carton, 2022). Whether looking at IPCC authorship or climate science communities, the IPCC agenda studies climate scientists as the premier climate experts.

2.2 | Expert context

The most studied location in climate expertise is the IPCC (Agrawala, 1998; Beck & Mahony, 2018; Bolin, 2007; De Pryck & Hulme, 2022; Hulme & Mahony, 2010). This is unsurprising given the IPCC's critical role in transforming climate change from a scientific object to a much broader set of social and political concerns.

The IPCC agenda has either favored looking into the organization of this global expert institution or studied its role in the regime complex of climate change (Hughes, 2015; Morin et al., 2017). Intra-organizational studies investigate how changing political contexts and demands influence the organization, design, and strategies of the IPCC (Beck, 2011; Beck & Mahony, 2018; Edwards & Schneider, 2001). Here, a particular focus has been on how the IPCC has sought to maintain and reconcile both political relevance and scientific authority when faced with new political demands (Mahony, 2015), changing rules of procedure and formalization (Skodvin, 2000; Sundqvist et al., 2015), as well as public controversies such as Climategate (Beck, 2012a; Grundmann, 2012). Recently, such intra-organizational perspectives have led to a fruitful research agenda on the changing role of the IPCC and climate science in general in the post-Paris climate policy regime, where climate science is more actively contributing to policy formulation and implementation (Beck & Mahony, 2017; Livingston et al., 2018). Inter-organizational studies, in contrast, have shed light on how boundary organizations can reduce tensions within regime complexes by generating credible, legitimate, and salient knowledge (Morin et al., 2017). The symbolic power of transnational expert institutions such as the IPCC makes them central objects of struggle in global climate politics (Hughes, 2015). Whether looking inside or outside the boundaries of these global expert institutions, both strands of research strongly situate the study of climate expertise in a transnational context.

2.3 | Expert content

How has the study of climate expertise investigated the character of what climate experts know? When researchers following the IPCC Agenda have turned to this question, they have tended to emphasize how climate experts must produce knowledge within a strongly institutionalized context on the intersection of science and politics (Demeritt, 2001; Hughes, 2023). Three theoretical concepts have been influential for making sense of these circumstances: epistemic communities, boundary organization, and co-production.

Research on epistemic communities explains how collectives of scientists shape political action and coordination between states on environmental issues such as climate change (Haas, 1992; Lövbrand, 2014). The epistemic communities framework has provided a popular approach for exploring how changes to the norms, behaviors, and collective responses to environmental issues are associated with the emergence of scientific professional communities (Demortain, 2017). In this sense, it has been influential in establishing the notion that experts and expertise matter *at all* in the study of environmental governance. A further interest has been to establish the influence of epistemic communities on policy processes (Gough & Shackley, 2001). While this perspective is nearly ubiquitous in studies of expertise in global environmental politics, it has also been the object of repeated criticism. It has been criticized for its inability to link the production of knowledge to political activity (Vanhala et al., 2021), its strong assumption about homogeneity and consensus in opinion and principled beliefs within the communities (Allan, 2017) as well as for its limited focus on explaining how the authority of specific epistemic communities comes about in the first place (Sending, 2015). Although the employment of the epistemic communities framework has declined over time (Hughes, 2023), the idea that certain communities of scientists shape the formation of shared interests continues to be widely shared due to the technical and uncertain nature of climate change.

The concept of boundary organization has been used to examine how expert institutions situated at the interface between science and policy navigate their scientific and political tasks while maintaining both scientific authority and political relevance (Edwards & Schneider, 2001; Guston, 2001). A particular interest has been on how these institutions engage in boundary work or anti-boundary work (De Pryck & Wanneau, 2017) to avoid the pitfalls of over-politicization and over-scientization (Hoppe et al., 2013). This has led to a focus on the specific activities that these organizations undertake to manage their conflictual role between scientific and political demands and norms. Miller (2001), for instance, has analyzed how boundary organizations such as the UNFCCC's Subsidiary Body for Scientific and Technological Advice maintains a productive tension between science and politics through practices of "hybrid management," in which different parts of political and scientific life are brought together, taken apart, orchestrated, and bounded.

Lastly, the notion of co-production has been a highly influential part of the IPCC agenda. Incorporated from the field of science and technology studies, and particularly the work of Jasanoff (2004), co-production has been used to study how the production of scientific knowledge about climate change shapes political action on the issue. While the notion of boundary organizations focuses more on how organizations situated at the science-policy interface straddle the twin demands of scientific autonomy and policy relevance, co-production has been used to examine how epistemic objects such as climate change emerge from the dynamic interaction of scientific and political imperatives (Allan, 2017). Using this lens, scholars have, for instance, shown how the premises of climate models frame their conclusions and the political activities taken in their name (Beck & Forsyth, 2015) or the emergence of the climate as a "global issue" (Miller, 2004). This also highlights the "performativity" of climate expertise (Beck & Mahony, 2018).

3 | TOWARD A POST-IPCC AGENDA: GREEN TRANSITION EXPERTISE

The emergence of green transition expertise requires the development of new theoretical perspectives able to grasp recent transformations in the politics of climate change knowledge. Our point of departure is the claim that the IPCC agenda, even in its broadest rendition, is too narrowly focused to deal with the nature of the actors currently making claims to expert status on climate change and the sites in which they are doing so. While scientists continue to inform the climate actions of both states and corporations across the world, their status as the sole climate experts is being challenged by the advent of a new cast of actors with a different knowledge base. We term these actors "green transition experts" and the nature of their knowledge "green transition expertise."[2] The advent of transition experts requires theoretical perspectives that enable us to analyze the increasingly plural and heterogeneous nature of climate change knowledge, in terms of shifts to its cast, contexts, and content. To facilitate this shift, we argue that social studies of climate change knowledge need to increasingly engage with the key insights and perspectives of the sociology of expertise (Eyal, 2013, 2019; Eyal & Buchholz, 2010; Stampnitzky, 2023). We outline the key tenets of the sociology of expertise, showing how it allows us to notice and shed light on green transition experts and their unique form of expertise.

3.1 | The sociology of expertise

The emerging "sociology of expertise" provides apt tools for addressing the relative transformation away from climate expertise and towards green transition expertise. While no more than a decade old,[3] the sociology of expertise has enriched our understanding of conflicts over expertise in a manner that takes seriously the increasing heterogeneity of the actors making claims to expert status in multiple contexts (Eyal, 2013, 2019; Eyal & Buchholz, 2010). It has highlighted the role and capacity of non-professionalized groups such as laypersons to develop specific "lay expertise" in matters of concern to them, and their struggle for recognition (e.g., Epstein, 1995). The study of the relationship between climate change and expertise stands to gain much from the sociology of expertise for three reasons.

First, it urges us to study the increasing *heterogeneity* of actors making claims to expert status by inviting us to explore the dynamics of expertise in a manner where expert status does not automatically flow from the sciences nor the professions (Evetts, 2011). This does not mean that scientists and professionals are not recognized as experts (often they are), but we cannot take their expert status for granted a priori. According to this way of thinking, expertise should not be regarded as something singular but rather as something that can take multiple forms and is earned through relational attribution and recognition (Stampnitzky, 2023). This shift in understanding also provides a clear opening to better position lay people within theoretical models of climate expertise.

Second, it provides an inherently *relational* understanding of expertise. Expertise is usually conceptualized as a substance that resides either in specific individuals, groups, or bodies of knowledge (Collins & Evans, 2008). In contrast, the sociology of expertise regards expertise as an outcome or accomplishment generated by relations and networks: "Knowledge only becomes 'expertise' when it is made applicable to a particular set of problems, and expertise is therefore always the product of socially and historically specific relations. As these networks form and dissolve, so do various forms of 'expertise'" (Stampnitzky, 2023, p. 1098). Expertise should therefore be regarded as a product of social and historical efforts to form alliances or connections between producers of knowledge, the problems they target, and the material infrastructure and devices that underpin or enable expert statements (Allan, 2017). Tracing such networks of expertise means transgressing organizational boundaries that normally collect groups of formally recognized and homogeneous experts, following the formation of expert alliances as connections are forged between various heterogeneous domains and people.

Third, the sociology of expertise provides a different set of tools for thinking about the *power of experts*. This is especially important in a period where scholars have lately declared either the "death" or various crises of expertise as experts have been regarded as losing authority in policy circles, notably also in climate politics. Once power is analyzed from the point of view of relations, alliances, or networks rather than individuals, communities, and organizations, it shifts the focus from the power to exclude to the power to enroll and include. That is, certain forms of expertise become more powerful due to their capacity to extend their way of seeing and doing onto what others are doing, thus enrolling them to the network and eliciting their cooperation (Eyal, 2013). Green transition expertise is strengthened not by restricting the supply of expertise but by extending it. The demand for transition expertise increases when states, corporations, and other clients take part in decisions about the direction of climate efforts and the aims of decarbonization. Forms of expertise and experts that are better able to interface with such clients will be more effective in shaping the green transition.

3.2 | Comparing green transition experts with climate experts

In bringing attention to the increasingly important role played by green transition experts, the sociology of expertise compels us to make three analytical moves: from the study of climate scientists to the more elusive group of green transition experts; from the study of the production of scientific knowledge about climate change to the making of heterogeneous knowledges around how to transition sustainably (and define the meaning of it); and from studying transnational expert institutions and arenas to national expert networks and alliances. The differences between these two agendas are summarized in Table 1. In the following, we move through the differences between the IPCC agenda and the post-IPCC agenda we are suggesting here by attending to shifts in expert cast, content, and context.

3.2.1 | Shifting expert cast: green transition experts

The most obvious change brought on by moving towards the post-IPCC agenda is a change in the actors considered important for the study of expertise and climate change. Where the IPCC agenda has cast light on the important role played by scientists in the scientific construction and assessment of climate change, the post-IPCC agenda takes as its

TABLE 1 Comparing the IPCC agenda and the post-IPCC agenda.

	IPCC agenda: climate expertise	Post-IPCC agenda: green transition expertise
Expert cast		
Educational training	Natural and technical science	Diverse, but often trained in finance, economics, or administration
Careers	Classical scientific progression through the higher education and research sector	Elite career trajectories, public-private revolving doors and switching between sectors
Organizational affiliation	University, research-based institutes	Heterogeneous, simultaneous connections to multiple types of organizations
Expert context		
Institutional environment	Transnational, polycentric governance, regime complexity	National, centralized power and governance
Clients	International and multilateral organizations, nation states	Corporations, governments, and state bureaucracies
Expert content		
Knowledge form	Episteme (pure science)	Techne (applied knowledge), phronesis (practical knowhow), "stretchable"
Knowledge production	Scientific esteem, normal science, scientific assessments ('climate information')	Experience, lay expertise, implementation and action plans ('climate services')
Knowledge organization	Epistemic communities, boundary organizations, autonomy	Networks of expertise, alliances, generosity

object of study any actor that can make a viable claim to expertise on the matter of how to carry through a green transition. This insight is supported by research on the increasing pluralization of the kinds of actors that regard themselves as authoritative on governing climate change (Hoffmann, 2011). Not only do these actors demand inclusion in political negotiations, they also demand to be recognized as experts.

Green transition experts differ from climate scientists in a number of ways, most notably in terms of their educational background, career trajectory, and organizational affiliations. The climate experts who have so far received most of the scholarly attention are usually trained in the natural or technical sciences. Their careers are marked by clear upward progression (e.g., from doctoral student to full professor) within university and research organizations. Green transition experts, in contrast, are much more diverse in terms of training, career progression, and organizational affiliation. They often hold university degrees, but they tend not to pursue careers in research. While they may have a background in the natural or technical sciences, they can also hold degrees within finance, management, administration, and economics (Frandsen, 2023). Their career trajectories differ significantly from those of climate scientists. A key characteristic of their career trajectories is the phenomenon of "revolving doors" (Seabrooke & Tsingou, 2021), which refers to the movement of people (and their skills and knowledge) between public, private, and academic sectors. This characteristic of their careers allows green transition experts access to important networks where they can convince others of their relevance or affirm their predispositions (Seabrooke & Tsingou, 2021) as well as exploit differences in knowledge (Seabrooke, 2014). As such, they are similar to what Wedel (2009, pp. 13–21) refers to as "flexians": actors able to move seamlessly among different roles in government, business, nongovernmental organizations, think tanks, and universities, blurring the boundaries between the academic, public, and private spheres in turn. As a result, green transition experts are affiliated with many different organizations.

3.2.2 | Shifting expert context: from transnational institutions to national networks

The second distinction we draw is between the different contexts the two agendas take as their object of study. The IPCC agenda has historically focused on studying the role of climate expertise in transnational environments, often characterized by polycentric governance and regime complexity. As noted in Section 2, it has favored studying the dynamics of expertise either inside global expert institutions such as the IPCC or the role of such organizations in regime complexes. The post-IPCC agenda, in contrast, must take a much more domestic focus. It must focus on how networks of experts shape domestic political and organizational determinants of climate governance. This is both related to the role that domestic climate expertise plays in shaping the climate actions of states (Dubash, 2021) as well as their influence on domestic corporations and organizations navigating the heightened political, legal, and social demands of decarbonization (Lidskog & Sundqvist, 2022). This also counts for multinational corporations, which may span across multiple borders but whose headquarters and ultimate influence are embedded in domestic environments under the jurisdiction of states (Farrell & Newman, 2019).

The turn to the domestic has consequences for the study of the clients of expertise—those demanding expert services and knowledge. While the clients considered relevant in the IPCC agenda are states as well as international and multilateral organizations, the study of green transition expertise emphasizes the important role played by corporations, governments, and state bureaucracies as clients. It is also important to mention that the consequence of the "revolving doors" and "flexians" phenomena mentioned in the previous section is that the traditional roles and separation of experts and clients breaks down. This further underscores the necessity of treating expertise not as residing in an epistemic community but as produced through network relations, which connect and intersect different kinds of actors in society. We emphasize state bureaucracies and industrial networks, but equally important are other kinds of actors such as think tanks, nongovernmental organizations, social movements, and so on.

3.2.3 | Shifting expert content: green transition expertise

In terms of expert content, the IPCC agenda has primarily been concerned with studying how scientific knowledge on climate change is produced in a politically saturated environment. The study of green transition expertise, on the other hand, begins from the recognition that the forms of knowledge currently informing how actors are carrying out their transition activities are much less associated with the communities, values, and knowledge forms of the sciences. Green transition expertise is characterized by knowledge that is more applied and closer to practical knowhow than the ideals of pure science—closer to

Aristotle's concepts of *techne* (craft or skill) and *phronesis* (practical wisdom) than *episteme* (pure science). As Grundmann (2024) argues, the IPCC's remit and epistemic core is strongly focused on the physical science of climate change, and providing policy advice is not part of its mandate. However, he also argues that the IPCC still influences policy through its role as a commentator, tacitly reflecting climate policy developments through updated assessments and wording.

Transition expertise, in contrast, goes much further than merely commenting on climate policy. It is explicitly normative and policy-prescriptive, formulating and recommending specific paths of action. As such, transition expertise is closer to the notion of "climate services" than the "climate information" associated with the IPCC agenda (Vaughan & Dessai, 2014), and very far removed from the Mertonian norms of academic science (Merton, 1979). Transition expertise is used to conduct various tasks and activities related to strategy and planning, analysis, evaluation and reporting, facilitation, training and education as well as information and data tools used in decision-making processes (Christensen & Collington, 2024). Rather than academic articles and scientific assessments, the knowledge products of transition experts look more like white papers, strategies, action plans, cost–benefit analyses, reports, scenarios, PowerPoint presentations and policy briefs. They are forms of knowledge that are actively framed as usable, targeted to specific clients, sensitive to context, realistic, practical, and more responsive to the needs of decision-makers in terms of both timeliness and resource constraints (Keele, 2019). In many cases, this constitutes more privatized or commercialized forms of climate change knowledge (Keele, 2017; Webber & Donner, 2017). It is also important to point out that transition expertise, in contrast to climate expertise, is characterized by a much stronger role for lay experts. While some forms of transition expertise will be produced in professional communities (think tanks or consultants), other forms rely much more on experts being able to claim experience with the day-to-day details of whatever activity is being targeted for decarbonization.

Transition expertise is thus highly "stretchable" (Hénaut et al., 2023), which lets it move into areas and sectors in which it has no prior experience. This has elsewhere been referred to as "stretchwork" (O'Mahony & Bechky, 2006). It is what allows green transition experts to "flex in and out" of different contexts, organizations, and demands. The strength of transition expertise is thus fueled by *generosity* rather than *autonomy* (Eyal, 2013, p. 875). Conventional accounts hold that experts become more powerful when they hold a professional monopoly on the production of knowledge—when experts can autonomously restrict the supply of expertise to define what counts as legitimate knowledge. In contrast, Eyal (2013) demonstrates that expertise can also be strengthened by extending the supply of expertise through processes of inclusion, for example by involving clients in the production of knowledge.

We can use Eyal's distinction between expertise as strengthened by generosity as opposed to autonomy to draw an ideal-typical line between transition expertise and climate expertise. Climate expertise is concerned with protecting the purity of the scientific process in climate science. This takes the form of restricting access to climate expertise through occupational credentials, processes such as peer-review and epistemic ideals of objectivity and disinterestedness. It takes many years of work to be considered a climate expert as you pass through established institutions of knowledge production. In contrast, transition expertise is strengthened by inclusion rather than exclusion. Transition expertise is more effective when its concepts, discourses, modes of seeing, doing, and judging are easily available to others, especially policymakers. Rather than protect the purity of the knowledge products (such as the IPCC's assessment reports), transition expertise is more concerned with transacting with multiple parties to shape the aims and development of expert knowledge. The purpose of this is to make its knowledge products impactful and practically useful for a wide variety of clients. This stands in contrast to the strength of climate expert epistemic communities, which rely on their capacity to have their claims verified by the scientific community.[4] As a result, transition expertise lacks clear organizational centers of gravity such as the IPCC or established research organizations, which can coordinate activities across contexts, ensure accountability, and establish quality control. Lacking the formal organization of the sciences, the organization of green transition expertise is more like that of a network: sets of relations based on personal connections without a formal center.

Table 1 summarizes the set of contrasts we drew in this section between the ideal typical IPCC agenda and post-IPCC agenda. In the following section, we clarify what the post-IPCC agenda means for how we ought to study green transition expertise and its decisive influence on the transition trajectories of states and corporations.

4 | RESEARCH AGENDA: THE FUTURE STUDY OF GREEN TRANSITION EXPERTISE

The previous section compared two research agendas for social studies of climate change knowledge: the IPCC agenda and the post-IPCC agenda. Each research agenda is associated with a different form of expert actor and climate change knowledge, which we have labeled climate experts/expertise in contrast to green transition experts/expertise. We currently know a lot

about climate experts and expertise, but very little about green transition experts and expertise. In this final part of the review, we reflect on different research routes forward for studying green transition experts and their increasing importance in steering the transition trajectories of states, corporations, and other actors in the future. As we clarify throughout the section, we view these agendas not in direct competition with each other, but each complementing the shortcomings of the other.

It is helpful to pose a couple of over-arching research questions that help better frame the future direction and necessity of the post-IPCC agenda. First, how do different forms of expert alliances shape green transitions? Alliances of green transition experts are bound to vary widely in terms of their composition (educational and professional backgrounds, organizational affiliations, network positions of members) and their access and relationship to power brokers in domestic politics. Second, how does such variation influence the imagined, proposed, and enacted transition pathways of different sociotechnical systems? As networks of transition experts encounter power brokers in societies, be they state or corporate representatives, questions of legitimation and recognition come to the fore. Some forms of expertise may be recognized as green transition expertise more readily than others. For example, life cycle assessments (LCAs) are becoming increasingly pervasive devices for governing sustainability transitions in all manner of sectors (Freidberg, 2014). In contrast, it has been difficult to make expertise on biodiversity more amenable to directing governance interventions (White & Lidskog, 2023). Third, how do transition experts and expertise emerge in relation to the needs and demands of specific clients or audiences? Interdisciplinary networks of transition experts do not come together naturally but require active assembling by certain agents for specific purposes. The way experts are enrolled into these alliances and "become" transition experts matters for their political effects. A network of transition experts assembled by an environmental nongovernmental organization, for instance, will likely have a very different composition and mandate than one assembled by a food industry and farming lobby. But to public and citizen observers, it can be difficult to distinguish between nuances in transition expertise, even though such nuances can have important ramifications in terms of how decarbonization or other sustainability gains are defined, realized, and funded.

Having posed these overarching questions, we now turn to six specific areas that require careful and immediate attention to advance our understanding of green transition experts and expertise. Three of the areas are associated with internal development of the agenda, and three with external engagements or overlaps with adjacent debates.

4.1 | Area 1: methodology

We need better methodological tools for empirically capturing green transition experts and expertise. Transition experts are not as formally organized or easy to identify as the climate experts that populate the different working groups of the IPCC, constituting a more heterogeneous and fluid group than academic scientists. Furthermore, their knowledge outputs are not communicated as formally as IPCC reports or research articles but tend to take forms more closely related to the policy process, such as white papers, briefings, strategies, and presentations. The many different forms that these knowledge outputs may take makes it even more important to develop methodologies that can better capture the effect or influence of transition expertise. One option could be social network analysis (SNA). SNA has been used already to study IPCC authorship patterns (Corbera et al., 2016; Hughes & Paterson, 2017), but it can readily be adapted to capture networks of importance to the post-IPCC agenda. Where transition experts are located in networks of power in different societies is key to revealing their influence. SNA is a potent technique for revealing patterns of power and the influence of experts and elites in societies, for example through studies of board and advisory body interlocks (Larsen & Ellersgaard, 2018). Sequence analysis of expert careers should also be employed to categorize experts into different types. This can be used in conjunction with SNA to deduce the importance and power of different groups of experts, for example in sustainable finance (Seabrooke & Stenström, 2023). SNA can also be used together with qualitative or quantitative text analysis to illustrate networks of discourse in climate politics (Kukkonen & Ylä-Anttila, 2020; Suitner et al., 2023). In sum, relational methodologies are key to the methodological advancements we envision for the post-IPCC agenda to better capture transition expertise. Relational methods can easily be combined with other kinds of quantitative or qualitative analysis to answer detailed questions about the nature of transition expertise and especially the important question of its power.

4.2 | Area 2: theoretical development

Theory development is required to bridge the gap between existing concepts and assumptions guiding the study of climate expertise and the shift in analytical lenses required for the study of transition expertise. We have taken the first steps to that end

already in the present review, but unsettled theoretical matters should be explored more fully. We have argued that developments within the sociology of expertise (Eyal, 2013, 2019; Eyal & Medvetz, 2023) especially hold great promise for advancing the study of climate expertise and transition expertise, and that this relational turn within studies of expertise has not yet been completely appreciated within existing scholarship on climate change knowledge. Such theoretical development makes it possible to consider the interfaces between transition experts and climate experts. While it could be argued that the IPCC's Working Group 3 delivers transition expertise, their outputs tend to take highly abstracted forms (Integrated Assessment Modeling or anticipatory governance at the global or regional level). This leaves others to deliver the more locally situated, context-specific expertise that is required at the domestic level. The IPCC sets the overall framework or requirements, but they do not tell countries exactly how to meet those requirements (Lidskog & Sundqvist, 2022). Transition expertise clearly rests on climate expertise, but it is not merely a matter of translating climate expertise in specific contexts. We often see that something is lost in the translation from climate to transition expertise, while other things are gained, which may go some way toward explaining the persistence of implementation gaps in climate policy (Fransen et al., 2023). Where does climate expertise and transition expertise meet and how do they interact with each other? What is the nature of their "trading zones" (Galison 1997, pp. 781–784)? How are boundaries established and dissolved between the two? Boundaries and interactions between lay and professional experts in transition expertise networks are equally important to consider. Open questions also remain around transition experts acting as either consultants advising behind closed doors or commentators shaping public opinion (Grundmann, 2024). We have focused our article mainly on the role of professional transition experts acting behind the scenes in advice networks, but other forms of more publicfacing, lay transition experts also exist. This is a distinction that requires both theoretical and empirical refinement, which would provide a fuller picture of the social status of climate change knowledge (Engels, 2019).

4.3 | Area 3: empirical studies

We need empirical studies of transition expertise at play in states and corporations. There are already several examples of these studies in the literature, for example on the role of national climate experts and expert bodies in guiding domestic transition pathways (Averchenkova et al., 2021; Beck, 2012b; Lidskog & Sundqvist, 2022). However, lessons from such studies have not been brought together into a coherent research program on *expertise* in sustainability transitions. As a result, social scientists have yet to provide a clear answer to the question of how expertise (and different forms of expertise) influences national and corporate decarbonization trajectories (Scoones et al., 2015, pp. 4, 10–12). There is an obvious and urgent need to analyze the power of experts in steering the decarbonization trajectories of states and corporations. We emphasize states and corporations as the primary targets for empirical analysis due to their large emissions profiles coupled with their power and agency to enforce decarbonization activities, but empirical studies on transition expertise could be equally revealing at the level of cities, municipalities, or noncorporate organizational actors such as foundations, universities, and so on. Our comments above on the need for theoretical development also underscore the possibility of more varieties of transition expertise, in particular the distinction between a more "closed," technocratic form of transition expertise and an "open," democratic, opinion-shaping form. Empirical studies on varieties of transition expertise can help illuminate the breadth of the phenomenon and the differences in the composition of expert networks and their influence. We imagine closed forms of transition expertise are more closely associated with consultants and "quiet politics," while open forms are more associated with nongovernmental organizations and social movements and "loud politics" (Culpepper, 2010). As a stronger understanding of transition expertise emerges, it must also be translated into policy recommendations and advice so that the pitfalls of regulatory capture of decarbonization strategies are avoided (Lamb et al., 2020; Low & Boettcher, 2020; Mah, 2021). A post-IPCC agenda on transition expertise should thus contribute to broader debates around the roles and responsibilities of social science in contributing to sustainability transformations (Lidskog et al., 2022).

While the first three areas of future research are related to the internal development of the post-IPCC research agenda, the following three areas touch on debates in adjacent fields. Here, the concept of transition expertise can prove helpful in advancing the state of knowledge.

4.4 | Area 4: the role of the state

There is a vibrant debate in environmental politics on the notion of "the green state" or "the environmental state" (Duit et al., 2016; Eckersley, 2021; Hausknost & Hammond, 2020). The green state literature broadly analyzes the role

of the state in sustainability transformations, including questions around how to build state capacity and the role of democratic politics. With the growing attention to green industrial policy in recent years (Allan et al., 2021), the state has arguably never been more important for environmental governance. Transition experts are crucial to lifting state capacity in sustainability transformations, and how such experts populate or interact with the bureaucracies of the green state is an important question. Equally important are questions around the ability of lay expertise to influence state decarbonization, especially as it confronts professionalized or academic expertise either already residing within or interfacing with public bureaucracies or policymakers.

4.5 | Area 5: climate justice

As transition experts grow in their ambition and influence over the coming decades, what are the consequences for social and environmental justice? With more powerful experts governing societal transition trajectories come the problem of technocratic capture. How can equity and justice be assured as states and corporations become increasingly reliant on transition experts? Transition expertise touches directly on academic debates about "just transitions" and "planetary justice" (Kashwan et al., 2020; Newell & Mulvaney, 2013; Wang & Lo, 2021). Beyond questions of how to assure social justice, it is also important to consider the influence of expert voices in even defining what is meant by justice in societal transitions and what justice looks like. These considerations mean that a research agenda on transition expertise must be more sensitive to the interaction between expertise and democracy (Eyal, 2019).

4.6 | Area 6: political economy

Concerns over the power of experts brings us into contact with scholarship in comparative and international political economy, which has developed a keen appreciation for the role of experts and expertise in steering the global economy through transnational governance networks (Kauppi & Madsen, 2013; Seabrooke & Henriksen, 2017), or from the heights of influential international organizations (Broome & Seabrooke, 2012; Kranke, 2022) or central banks (Quorning, 2023). Global economic governance is drastically more responsive to such forms of expertise than it is to the IPCC's scientists. But which forms of transition expertise are emerging in the transnational governance networks and international organizations that rule the global economy? Or within the consultancies and multinational corporations that are increasingly privatizing climate science and building their own transition expertise (Keele, 2019; Leffel, 2022)? How domestic transition experts interact with international and transnational sources of climate governance is a crucial question for the post-IPCC agenda. Sustainability transitions are constrained by domestic political economy, and they happen in interplay with the global economy. These constraints on transition pathways are mediated through expert knowledge, which often takes the form of "quiet politics" (Culpepper, 2010), understood as state-industry deliberation outside the public eye.

5 | CONCLUSION

In this review, we have outlined a new research agenda on the relationship between expertise and climate change, suggesting a novel approach that focuses on understanding the unique expert characteristics associated with green transition expertise. Moving beyond the IPCC agenda and towards a post-IPCC agenda centered around green transition expertise helps us to see not only the heterogeneous landscape, which currently characterizes climate change knowledge, but also the broader effects of these transformations for the politics and governance of climate change. We have argued that this shift in studying climate expertise is necessary in light of the changing reality of global climate politics, which can be summarized as a move from the transnational and international toward a heightened role for domestic politics and the actions of corporations. The operation of transition expertise in guiding national and corporate decarbonization strategies is therefore paramount to consider in this new reality, and it is comparatively under-researched in contrast to scholarship in the IPCC agenda. As climate politics is increasingly concerned with decarbonizing complex systems rather than signing multilateral treaties, the study of climate change knowledge must make a similar move. Furthermore, we have argued that developments within the emerging "sociology of expertise" (Eyal, 2013, 2019; Eyal & Medvetz, 2023) are uniquely well-suited to capture the more elusive and heterogeneous networks of expertise that characterize transition experts in contrast to the more formally organized and homogeneous climate experts.

To define the post-IPCC agenda for social studies of climate change knowledge, we contrast this agenda with an ideal-typical representation of the IPCC agenda. We associate the IPCC agenda with the study of climate experts and climate expertise. In comparison, the post-IPCC agenda is associated with the study of green transition experts and expertise. The study of climate expertise and transition expertise differs on matters of expert cast (who are the experts?), expert content (what do they know?), and expert context (where are they located?). The post-IPCC agenda's focus on transition expertise moves our analytical focus increasingly away from formal, international expert bodies towards informal, domestic expert networks and their alliances with state and corporate interests. As long as the IPCC calls for systemic transformative change in all sectors and spheres of society, without qualitatively specifying in detail what such change entails or looks like (Lidskog & Sundqvist, 2022), it is left to transition experts to provide the knowledge and direction for guiding societal decarbonization trajectories. There are considerable risks to leaving transition experts comparatively understudied: corporate and technocratic capture of decarbonization pathways in order to delay or block sustainability transformations is a well-understood concern (Lamb et al., 2020; Low & Boettcher, 2020; Mah, 2021). A dedicated research agenda on transition expertise can help allay such concerns by providing insights into varieties of transition expertise and how it is organized and institutionalized for greater societal benefit in the coming decades of sustainability transformation.

AUTHOR CONTRIBUTIONS

Søren Lund Frandsen: Conceptualization (equal); data curation (equal); formal analysis (equal); investigation (equal); methodology (equal); project administration (equal); validation (equal); visualization (equal); writing – original draft (equal). **Jacob A. Hasselbalch:** Conceptualization (equal); formal analysis (equal); investigation (equal); methodology (equal); project administration (equal); validation (equal); visualization (equal); writing – original draft (equal).

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ENDNOTES

[1] *Global Environmental Change, Wiley Interdisciplinary Reviews: Climate Change, Environmental Science and Policy, Environmental Politics, Energy Research and Social Science, Climate Policy, Climatic Change, Nature Climate Change, Nature Sustainability, Global Environmental Politics, Journal of Environmental Policy & Planning, Annual Review of Environment and Resources, Global Sustainability*, and *Earth System Governance*.

[2] We use "green transition" and "transition" interchangeably in the review.

[3] Like many other strands of sociological theory, the boundaries of the sociology of expertise are not well established. While some associate it primarily with the work of the sociologist Gil Eyal (2013), we conceive of it as a broader strand of the literature, counting scholars working in the sociology of professions, international relations, STS, IPE, and political science (Eyal & Medvetz, 2023; Seabrooke, 2014; Stampnitzky, 2023). What unites them is the aim to theorize expertise relationally in a manner that is less profession- and science-centric and more open to a heterogeneity of both human and nonhuman actors regardless of their scientific or professional credentials.

[4] This should be read as an ideal-typical distinction, which may break down under nuanced, empirical analysis, but which is a helpful construct for understanding the difference between transition expertise and climate expertise.

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