Scientism: A problem at the heart of formal public engagement with climate change

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Abstract

One response to political contestation over climate change is to promote formal public engagement to address diverse social values, encourage behavioral change, foster support for regulatory initiatives and bridge gaps among experts, policy makers and citizens. Scientism, a normative stance that grants implicit authority to scientific and technical experts to define the meaning of public issues, limits the democratic potential of such efforts. Current manifestations of scientism result in a disproportionate emphasis on fixing public knowledge and attitude deficits and a concomitant lack of scrutiny of the values and assumptions at play in the framing of public policy issues. Confronting scientism involves approaching climate policy as necessarily informed by science but not necessarily reducible to quantitative and statistical frames of reference. Critical geographers and scholars are well positioned to challenge scientism by opening the value commitments obscured or denied by technical approaches to climate change to scrutiny and debate. Such critical interventions are increasingly necessary in an era in which policy discussions are polarized and consensus-based action-oriented approaches advocated. More work is needed to bridge the gap between critical research and the professionals and citizens who orchestrate public engagement with climate change.

Keywords

Public engagement; climate policy; scientism

> What policy advisers anoint as 'science' for intended public authority always embodies unstated policy-related commitments, including presumptions over the defining questions. Such social questions in public science should be recognized and debated openly. Scientific knowledge should inform public issues, not define them.
>
> <div align="right">Brian Wynne (2011, 305)</div>

Introduction

One institutional response to contestation over climate change is to promote formal public engagement to address diverse social values, encourage behavioural change, foster support for regulation and bridge gaps among experts, policy makers and citizens. Scientism is a significant but under-acknowledged problem at the heart of such efforts. For the purposes of this paper, scientism refers to a phenomenon whereby authority is implicitly granted to scientific and technical experts to define the meaning, scope and by extension solution for public policy concerns (Welsh and Wynne, 2014). With respect to formal public engagement, current manifestations of scientism are expressed in the tendency to disproportionately position the public as a problem in need of a remedy and, in turn, to shield from scrutiny the values and assumptions embedded within dominant frames of public policy. Scientism is at play when certain normative commitments and foundational assumptions are obscured by presenting them as if they are objectively determined by science. This contributes to the continuation of status quo practices and provides an enabling condition for polarized conflicts over environmental policy and regulation.

Critical geographers and those in cognate disciplines have long recognized the problems associated with scientism particularly in contexts in which technical expertise plays a substantial role in setting agendas for public debate (Demeritt, 2006; Eden, 1996; Forsyth, 2002; Hulme, 2009, 2013; Swyngedouw, 2010, 2013; see also Goeminne, 2010; Sarewitz, 2004, 2011; Scott, 1998; Wynne, 2006). Debates over environmental policy are situated in contexts in which politics are increasingly discussed in scientific terms - the scientization of politics - and an attendant situation in which scientific claims are challenged on political grounds - the politicization of science (Goeminne, 2010). As Gert Goeminne observes:

> Environmental problems, which are more often than not generated by the products of science and technology—let us not neglect this— are indifferently framed in scientific terms (CO_2 concentrations, Sv dose equivalents, and so on), which inevitably gives rise to a quest for scientific solutions (carbon tax, dose limits, and so on). Whether the issue is climate change or nuclear energy, the resolution is sought in ever more science. This not only leads to the raging

environmental controversies between believers and non-believers we are experiencing today regarding the validity of the answers science provides. More fundamental, this one-dimensional discussion leaves the scientific questions (i.e. the way science frames environmental problems and solutions) unquestioned (2010: 208).

As science and technology studies (STS) scholars have long recognized, scientific knowledge, although typically presented in public debates as value-free and apolitical, is structured by social relations of power before and after it enters policy arenas (Jasanoff, 1999; Wynne, 2016). In turn, scientists wield considerable influence over policy processes by setting the tone, direction and agenda for others to follow (Ingram et al. 1992). While politicians and lay-publics may not implement the specific recommendations put forth by scientists, the boundaries of debate for environmental issues are typically framed in scientific and increasingly risk and economistic based terms. While this is true of environmental science in general, it is particularly true of regulatory science, research compiled and distributed with the explicit intent of informing public policy (Jasanoff, 1990).

Although the argument that scientism presents a barrier to efforts to democratize environmental policy is not entirely novel, scientism takes on significant dimensions in the context of formal public engagement with climate change and, as such, warrants renewed scrutiny. Climate change is a socio-ecological terrain around which social struggle and political imaginaries are organizing locally, nationally and globally (Hulme, 2009). With roots in statistical modelling, dominant techno-scientific representations of climate change facilitate technical solutions that can displace important social, cultural and ethical considerations. Although critical approaches to climate science and policy are prevalent in human geography and elsewhere, these insights are not typically reflected in mainstream public engagement practice. This lack of consideration of critical approaches to the climate science-policy interface echoes a broader political dynamic in which the biophysical sciences and the positivist social sciences frame environmental policy issues and where the critical interpretive social sciences and humanities are consistently glossed over, ignored or misrepresented as 'anti-science' - even in instances in which interdisciplinary approaches are openly called for (Castree, 2016).

A deeply held assumption among scientists and climate communications professionals is that organized climate denial and public misunderstanding of science are the central problems facing public engagement with climate change. Drawing on STS traditions in geography and sociology, I position scientism as an equally significant problem with public engagement with climate change. This does not imply ignoring scientific evidence nor dismissing the importance of regulatory action in the face of climate change. Naming an issue has material effects in that it directs attention to under-acknowledged problems and articulates alternative solutions. By positioning scientism as a problem at the heart of formal public

engagement with climate change, communication and engagement efforts can be directed *in part* towards a productive examination of the tacit normative assumptions that inform the framing of climate policy. Critical geographers are well positioned to challenge scientism in formal public engagement initiatives by opening to public scrutiny and debate the value commitments obscured or denied by technical approaches to climate change. Such critical interventions are increasingly necessary in an era in which policy discussions are polarized and consensus-based action-oriented approaches advocated. More work is needed to bridge the gap between critical accounts of climate change and the professionals and citizens who participate in formal public engagement with climate change.

Scientism and the participatory turn in the governance of science and technology

Scientism is best understood as a political doctrine and normative stance that holds that science is the most authoritative and legitimate knowledge for collective decision-making. Philosopher Bertrand Russell captured succinctly the sentiment underpinning scientism: "Whatever knowledge is attainable, must be attained by scientific methods; and what science cannot discover, mankind cannot know." (1997: 242) The spectre of scientism has a long history in Euro-western contexts as ideas and norms from the natural sciences shaped shared assumptions about society, agency and politics (Bannister, 1991; Blackburn, 2005; Olson, 2008; Williams and Robinson, 2014). In the 17th century Europe, influential intellectuals such as Francis Bacon and Rene Descartes promoted scientific reason by denigrating other ways of knowing that involve creativity and imagination. By the 19th century, scientism was expressed as positivism, exemplified in the social sciences by Auguste Comte's claim that the human societies become realized only when they transcend theological, metaphorical and abstract reasoning and become scientific in orientation (Olson, 2008). Well into the twentieth century in Europe and North America, scientism informed the institutionalization and professionalization of the natural and social sciences, directed by the conception of science put forth by the logical positivism movement in Vienna in the 1930s (Bannister, 1991). By the mid twentieth century, views of science as a largely value-free pursuit became taken for granted in the academe and beyond although this development was uneven across national and regional contexts.

Yet, the guiding assumptions of scientism have also come under scrutiny and revision by scholars from diverse intellectual backgrounds and political persuasions (for instance, Bannister, 1991; Haack, 2003; Hayek, 1942; Lessl, 1996; Sorell, 1994; Waddell, 1977). Key scientistic claims, such as the assumption that policy-relevant knowledge should be reducible to entities that are measurable and comparable, are no longer tenable across academic communities. Indeed, the term scientism is increasingly used pejoratively by non-scientists and scientists alike, and professional organizations such as the American Association for the Advancement of Science warn of its limitations (Burnett, 2016). Although

scientism is the object of much critique, it has an enduring presence in certain contexts particularly in public facing representations that position science as a value-free, decontextual and apolitical pursuit (Bucchi, 2008).

Some scholars argue that a new form of scientism is taking shape in the face of institutional efforts to democratize policy through public engagement (Aitken, 2012; Welsh and Wynne, 2013; Wynne, 2016). For instance, Ian Welsh and Brian Wynne observe a notable and persistent asymmetry in the responses of institutional elites to public controversies that involve science and technology (Welsh and Wynne, 2013: 549 - 556). Although the following description refers to developments in the UK, it is also instructive for other liberal democratic contexts. During the period 1950–1990, lay-publics were primarily considered a "passive non-entity" from the perspective of institutional elites (Welsh and Wynne, 2013: 550). In other words, lay-publics were positioned as politically irrelevant, and as recipients rather than shapers of public issues that involve science and technology. The dominant assumption during this time, informed by a linear view of science and policy, was that technical experts should play a neutral advisory role to otherwise value-driven policy discussions by speaking truth to power and offering certainty and objectivity to policy makers and publics. Welsh and Wynne define a second phase (circa 1970 – 2000) in which political and scientific elites recognized that lay-publics were viable political actors worthy of consideration, although lay-publics were still widely regarded as lacking in requisite knowledge to guide public policy. This period coincides with movements to measure and promote public understanding of science which were guided by the assumption that lay-publics lack proper knowledge of or attitudes toward science; as such, improved education and communication of scientific facts to various constituencies was positioned as a key solution. In current public engagement practices (post 2000), Welsh and Wynne identify two contradictory trends: increasing government support for formal public engagement initiatives, on the one hand, and state efforts to control dissenting publics, on the other. Tactics used to control recalcitrant publics are broad ranging, and include increasing the surveillance of civil society actors, weakening procedural and distributional justice in public engagement frameworks, and positioning lay-publics as a problem that warrants redress. The authors conclude that although policy cultures are increasingly open to experimenting with public engagement, lay perspectives are included in decision-making about science, technology and the environment only to the extent that they fit within dominant initiatives and directions. In short, deficit models of science – public interactions are reinvented rather than transcended in the turn towards formal public engagement with science and technology.

Ample empirical research supports the claim that formal participatory engagement with policy issues that involve science and technology reinforce rather than challenge the hegemony of technical policy frames and their underlying normative assumptions (Elam and Bertilsson, 2013; Irwin, 2006; Macnaghten and Chilvers, 2014; Wynne, 2016) and particularly in the realm of climate change

(Blue, 2015, 2017; Pallett and Chilvers, 2013; Phillips, 2012). While formal public engagement might provide an opportunity for institutions and experts to rethink practices, norms and assumptions, all too often these initiatives normalize extant power structures, institutional assumptions and social practices.

Scientism in public engagement with climate change

One of the most pressing policy issues of our time, climate change raises questions about the directions we need to take across numerous scales to address, contain and mitigate greenhouse gas emissions. Formal public engagement is increasingly proposed as a viable avenue for developing support for robust policy interventions (Brulle, 2010; Niemeyer, 2013; Shaw, 2015). Most efforts in this regard are motivated by a recognition that the scientific consensus on climate change has not resulted in concerted political action and concern on the scale many argue is needed to prevent dangerous climate change by the end of the 21st century (e.g. Hansen et. al, 2008). A recurrent argument is that science needs to play a more prominent and powerful role in the development, framing and implementation of climate policy and that the social sciences should play a decision-support role to bridge the gap between scientific recommendations, public awareness and policy implementation (Weaver et al. 2014). Common responses include compiling consensus statements about scientific acknowledgement of anthropogenic causes of climate change (Cook et al. 2013; Cook et al. 2016; Oreskes, 2004), calling into question the legitimacy of those who disagree with the scientific consensus on climate change (Anderegg et al. 2010; Oreskes and Conway, 2010), and communicating science in a more straightforward, unambiguous and entertaining fashion (Corner et al, 2015). Increasingly, dialogue and engagement rather than one way, top-down flows of information are positioned as an avenue for bridging the gap between scientific evidence and societal action (Moser and Dilling, 2010: 169). The stated goal of engagement is to develop a better understanding of the perceptions, cultural lens and worldviews that inform how people - particularly those who refuse to make behavioral changes or support proposed regulatory action - make sense of climate change with the view to find ways to bridge ideological differences.

Underpinning many current formal engagement approaches is a key insight from behavioral psychology: an individual's views on climate change align with deeply rooted political sensibilities and track in similar ways to other polarizing policy issues such as gun control, abortion and immigration (Featherstone et al, 2009; Lertzman, 2015; Marshall, 2014; van der Linden et al, 2015). According to this line of reasoning, people process information in a manner consistent with preexisting mental models. Most nonscientists' mental models of nature are flawed due to the ways human brains are "wired", preventing people from developing a more fulsome understanding of the causes and consequences of climate change (Marshall 2014; van der Linden et al, 2015). The vast social change and social mobilization literature also share a common goal of narrowing the gap between

scientists and public policy by fostering attitudinal and behavioral change among lay-publics and decision-makers. Suggested actions for social mobilization include framing messages strategically by tailoring the engagement process to the audience, mobilizing trusted messengers to deliver audience-appropriate messages to mobilize political action, using meaningful imagery to communicate scientifically credible information, connecting with emotions through active social involvement and emphasizing the local significance of climate change through place and community (see Sheppard et al. 2015 for overview).

Taken together, these communications and engagement strategies position lay-publics as a problem that requires fixing and, in turn, situate dominant policy frames of climate change as unproblematic and unworthy of scrutiny. Consider, for instance, the Climate Outreach program's use of narrative as a method for public engagement to demonstrate that "an otherwise largely disinterested and uninformed public can engage in meaningful deliberation about this complex subject" (Shaw & Corner, 2017: 274) or the positioning of public deliberation as a way of building public support for emissions reductions (Shaw, 2014). These engagement initiatives, while worthy in their own right, risk reinforcing status quo practices and depoliticizing collective action on climate change because they stop short of questioning dominant institutional framings of environmental change. Shove (2010) has documented how the predominance of the positivist social sciences in public engagement efforts reflects and reinforces a paradigm of social change that focuses on individual behaviour, values and beliefs while deflecting attention from structural issues such as the influence of institutions in promoting unsustainable economies, practices and ideas. In turn, missing from view are ways in which formal public engagement with climate change might feasibly serve other ends, namely, to facilitate learning and reflection among various stakeholders including citizens, decision-makers and technical experts about the assumptions and normative commitments in dominant institutional policy framings in order to open consideration of other viable policy frames and possible responses (Pallett and Chilvers, 2013; Wynne 2006, 2016).

Scientism in public engagement with climate change warrants critical attention due primarily to the dominant policy framework put in place by the global climate regime. Commencing with the establishment of the IPCC in 1988 and the signing of the UN Framework Convention on Climate Change (UNFCCC) at the Earth Summit in Rio in 1992, the global climate regime positioned anthropogenic climate change as a central public policy concern and positioned its mission as stabilizing atmospheric greenhouse gas concentrations to prevent dangerous human interference with the climate system (Bodansky, 2001). The global climate regime fostered a singular representation of climate change as a statistical phenomenon that is amenable to quantification, measurement and control while displacing from consideration other understandings of climatic variability and environmental change (Weart, 2008). Dan Sarewitz refers to this policy approach as "the plan" whereby "science shapes our understanding not only of reality but of appropriate

action." (2011, 475) This dominant frame supports reductionist approaches to human-environment interactions in which climate change is positioned as a determining factor of social change and where political authority is implicitly granted to technical experts whose normative judgements play a powerful role in shaping political imaginaries and policy frameworks (Hulme, 2013). The assumptions and value commitments embedded within the global climate policy regime have not been the focus of formal public engagement initiatives, in part due to the specialized and technically-complex ways in which climate policy has been framed and implemented (Demeritt, 2006; Swynegouw 2010, 2013).

Two examples illustrate what is at stake when a statistical, technical and universal definition of climate change informs and shapes the contours of public policy and public engagement: the foregrounding of consensus as a desirable political outcome and the centrality of neoliberal environmentalism as guiding political imaginary. As outlined above, public engagement efforts are often directed towards finding ways to communicate the scientific consensus on anthropogenic climate change to broader audiences with the view to reach political consensus on policy directions. Underpinning this approach are efforts by scientific organizations to endorse consensus statements and academic research that demonstrates the majority (> 97%) of published scientific studies confirm the significance of anthropogenic influence on climate system (e.g. Cook et al. 2016). For instance, Naomi Oreskes argues that, although disputes over epistemological and methodological issues are an integral part of science, these disputes take on a different significance when they spill over into the public domain:

> Lack of consensus becomes a public issue when there is a public stake, which means a moral, political or economic stake. In such cases, natural sciences can play an important role by providing informed opinions about the plausible consequences of our actions (or inactions) and by monitoring the effects of our choices. (2004: 381)

In a commentary in *Nature*, Oreskes advocates for a more central role for scientific consensus in public engagement with climate change. She argues that in the face of well-orchestrated climate denial movements, lay publics should trust climate science because the collaborative nature of scientific knowledge production ensures that verifiable and accurate knowledge informs collective decision making. Scientists can play a key role in establishing this trust by developing better public communication strategies:

> Improving communication is a step that can make a difference. In addition, if the public is to learn that science is 'messy' and full of uncertainty — which can help to improve public trust in the system — they should also learn that sensible decision-making involves acting on the best information available. Peer-reviewed literature

and the agreed opinions of expert bodies can and should be granted reasonable trust. (Oreskes and Conway, 2010: 687)

For Oreskes, the "best information available" for collective decision-making purposes refers to quantitative, statistical and by extension reductionist approaches to climate change as opposed to other more politically and culturally explicit formulations. In response, Wynne questions the processes that render climate science so fragile in public arenas and argues that the amplification of doubt and uncertainty by climate denier groups relies on the "ingrained assumption that scientific evidence is the only authority that can justify policy action." (2010a: 441) In other words, the very success of climate denier movements lies precisely with frames of public policy in which quantitative science is placed at the center. The dynamics of denialism are most pronounced when "science attains its greatest political influence, when it goes beyond supplying the facts to defining the public meaning of problems." (ibid: 441) In a similar vein, Pearce et al (2017) argue that efforts to bring publics on side with policy initiatives through appeals to scientific consensus, particularly those based on simple claims such as "humans cause climate change", serve as unnecessary distractions from more important conversations about the orchestration of knowledge, values and assumptions in policy debates. Communications campaigns that use scientific consensus to correct public views and behaviours can stymie rather than advance discussions over climate policy by glossing over dissent, obscuring competing values, neglecting important tradeoffs and encouraging political polarization. The authors present a different role for scientific expertise in public policy discussions in which judgement, context and dissenting perspectives play a more central role.

The dominance of neoliberal environmentalism as the guiding institutional framework for the global climate regime provides another example of why scientism in public engagement with climate change warrants scrutiny. As numerous critical scholars have demonstrated, the global climate regime is complicit with and supportive of neoliberal systems and styles of governing (Featherstone, 2013; Heynen et al. 2007; McCarthy and Prudham, 2004; Swyngedouw, 2010). Neoliberalism refers to a complicated set of ideas, practices and policies that are organized differently across multiple geographical scales. A common aim and purpose of neoliberal approaches lies with the expansion of market principles into increasing realms of life, facilitated by a reconfiguration of state policies and regulatory frameworks. Neoliberal approaches reign large in global climate policy, ranging from voluntaristic non-binding standards and codes to the foregrounding of markets as the best response to mitigate rising GHG emissions. Neoliberal commitments in climate policy are often shielded from scrutiny by a veneer of technical, mathematical and scientific representations and calculations (O'Lear, 2016; Roscoe, 2016; Victor, 2015).

The IPCC and the UNFCCC regulatory process facilitated and supported the uptake of neoliberal ideas in global climate policy. The IPCC is a hybrid institution that compiles scientific facts under significant political constraints: state

governments influence what information is contained within the summaries for policy makers, who is selected to serve on the panel, and who ultimately is authorized to speak in the name of climate change (O'Lear, 2016). In turn, the consensus approach of the IPCC creates incentives on the part of natural and social scientists to err on the side of conservatism and to avoid controversial policy relevant questions (Victor, 2015). With respect to governing human-environment interactions, the IPCC tends to favor market-based approaches, in part because economics "operates from a mathematical foundation and produces quantifiable results that are readily dovetailed with natural science models of the climate and the preferences of policy makers." (Roscoe, 2016: 657) Overall, the IPCC tends to represent climate change as manageable within current institutional arrangements where neoliberal market principles reign large. This approach reinforces the assumption that current political-economic arrangements are unproblematic and stifles dissenting opinions that suggest otherwise (Machin, 2013; Swyngedoux, 2013). The Kyoto Protocol further enabled the development of carbon markets which in turn relied on the discursive transformation of atmospheric chemicals into interchangeable carbon dioxide equivalents (C02e) that can be traded as commodities (Liverman, 2009). The marketization of GHG emissions is the result of a series of factors including broader attempts to reconcile environmental protection and economic growth, dominant representations of nature as a resource and the use of quantitative climate science as the preferred framing device for global policy (Heynen et al. 2007; McCarthy and Prudham, 2004).

As these two examples illustrate, the tendency to shield from scrutiny the normative commitments in technically-oriented environmental policy regimes risks reinforcing rather than challenging status quo practices. As Swyngedouw (2010, 2013) has long argued, national and international climate policy are significant arenas in, by and through which technical, managerial and instrumental approaches to environmental and social matters are promoted, centering public debate around a general agreement about the naturalness and inevitability of existing neoliberal policies. Policy efforts framed in language of numerical targets and statistical averages facilitate the uptake of market-based mechanisms, the commodification of nature and neoliberal political imaginaries. Critical geographers and those in cognate disciplines provide the necessary intellectual resources to help expose and explain these tacit value commitments and assumptions with the view to open science-based policy to alternative framings and perspectives. In some quarters, this critical engagement is taking shape, such as the Science, Society and Sustainability research group at the University of East Anglia and their innovations in deliberative mapping and other forms of engagement (Bellamy, et al. 2016; Macnaughen and Chilvers, 2014). Such critically informed initiatives are rare in the broader formal public engagement landscape, however.

A key question remains as to why the critical literature on climate change has yet to inform most formal public engagement practices. I offer two possible explanations. One is an enduring assumption about the desirability of value-free

science by those who are concerned about climate change. Challenges to this assumption can easily be cast as anti-scientific and rejected out of hand. As illustrated by the science wars in the 1990s, some scientists have proven themselves to be uncivil, uncordial and abusive when taken-for-granted foundational ideas about value-free knowledge are called into question in public venues (Mercer, 1999). In turn, critical scholars who challenge idealized notions of value-free science can all too easily be characterized as suspicious or frivolous and their claims rendered illegitimate (Jasanoff, 1999). In light of the uneven epistemic power between the positivist sciences and their constructivist counterparts, it may take considerable effort on the part of critical scholars to productively intervene and reconfigure scientism in public discussions of climate change even though simplistic ideas about value-free science and information-deficit publics have repeatedly failed to provide the intellectual and political resources necessary to productively engage the broader public in policy debates (Castree, 2016).

Another explanation lies with concerns that public acknowledgement of the limitations of scientific framings of climate policy can provide ammunition for denial movements. Most popular references to scientism in relation to climate change come from commentators who seek to undermine environmental regulation (e.g. Ford, 2011). As Oreskes points out in response to her critics, the reliance on consensus as a communications strategy is motivated precisely by the persistent efforts of climate denial groups who cast doubt on the veracity and trustworthiness of climate science: "In a political environment where contrarians have repeatedly misrepresented scientific consensus in a deliberate attempt to influence public policy, it is both reasonable and necessary for scholars to participate in attempting to clarify what scientists believe that they have established." (2017: 2) What Oreskes stops short of acknowledging, however, is that appealing to scientific consensus, regardless of the motivation, does not resolve the political problems associated with framing environmental policy exclusively through a scientific, technical and quantitative lens. Indeed, a recognition of scientism and its limitations can support arguments to strengthen and expand regulatory frameworks as it is entirely possible that statistical representations of climate change and the policy frameworks they support under-estimate rather than exaggerate the harms associated with current socio-economic practices (Wynne, 2010b).

Conclusion

Whereas public misunderstanding of science is typically positioned as a central problem in public engagement with climate change, scientism is an equally pressing issue. Scientism refers to the premise that the problem facing the development and implementation of climate policy lies *entirely* with the views and attitudes of the lay-public and not *in part* with the foundational assumptions and framing strategies that underpin public policy. A disproportionate emphasis on fixing public views leaves unaddressed the possibility that institutional norms and related technical framings of climate policy might also warrant scrutiny, revision

and reform. Calling for a recognition of the problem of scientism in public engagement with climate change is not an appeal to populism or anti-intellectualism, nor is it intended to disparage the efforts of climate scientists, social researchers or communications and engagement professionals. Rather, challenging scientism in public engagement with climate change simply means that technical frames of reference should not be given automatic and uncontested power to dictate what constitutes an appropriate policy response.

This is not a trivial matter. History has repeatedly shown the danger of allocating too much power to technical experts to establish social norms and meanings in the absence of public debate (e.g. Scott, 1998). Inclusive participatory approaches to environmental policy are not simply about persuading citizens and policy makers to implement the recommendations of technical experts. These initiatives should also expand the values and perspectives that inform how policy is framed in the first place. Rather than proceeding from the assumption that science is separate from politics and values, a more robust starting point for public engagement with climate change lies with the claim that "the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we chose to live in it." (Jasanoff, 2004: 2) In short, how we frame climate change matters for the ways in which we collectively act on it. While the challenges of bringing the insights of critical geographers and STS scholars to bear on formal public engagement are many, so too are the potential rewards by fostering more diverse political expressions and imaginaries to guide possible socio-ecological futures.

Acknowledgements

References

Aitken M (2012) Changing climate, changing democracy: A cautionary tale. *Environmental Politics* 21 (2): 211 – 229

Anderegg W, Prall J, Harold J, Schneider S (2010) Expert credibility in climate change. *PNAS* 107 (27): 12107 - 12109

Bannister R (1991) *Sociology and Scientism: The American Quest for Objectivity, 1880–1940*. Chapel Hill: The University of North Carolina Press.

Bellamy R, Chilvers, J and Vaughn, N. (2016). Deliberative mapping of options for tackling climate change: Citizens and specialists 'open up' appraisal of geoengineering. *Public Understanding of Science*, 1 - 18

Blackburn S (2005). Scientism. *The Oxford Dictionary of Philosophy*. pp. 331–32. New York: Oxford University Press.

Blue G (2015) Framing climate change for public deliberation: What role for the interpretive social sciences and humanities? *Journal of Environmental Policy and Planning* 18 (1): 67 - 84

Blue G (2017) Reasoning together about climate change: Coproducing science and public reason in a global citizen panel. *Global Society* 31 (1): 83-100

Bodansky D (2001) The history of the global climate regime. In U. Luterbacher and D. Sprinz (eds) *International Relations and Global Climate Change*. pp. 23 – 40. Boston: MIT Press.

Bucchi M (2008) Of deficits, deviations and dialogues. Theories of public communication of science. M. Bucchi and B. Trench (eds) *Handbook of Public Communication of Science and Technology*. pp. 57 – 76. London and New York: Routledge.

Brulle R (2010) From environmental campaigns to advancing the public dialog: Environmental communication for civic engagement. *Environmental Communication* 4 (1): 82–98

Burnett T (2016) What is scientism? *American Association of the Advancement of Science: Dialogue on Science, Ethics and Religion*. Available online at: https://www.aaas.org/page/what-scientism. Accessed Jan. 3. 2017.

Castree N (2016) Broaden research on the human dimensions of climate change. *Nature Climate Change 6:* 731

Cook J, Nuccitelli D, Green S, Richardson M, Winkler B, Painting R, Way R, Jacobs P, Skuce A (2013) Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters* 8 : 024024

Cook J, Oreskes N, Doran P, Anderegg W, Verheggen B, Maibach E, Carlton J, Lewandowsky S, Skuce A, Green S. 2016. Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters* 11: 048002

Corner A, Lewandowsky S, Phillips M, Roberts O. (2015) *The uncertainty handbook: A practical guide for climate change communicators*. Bristol: University of Bristol.

Demeritt D (2006) Science studies, climate change and the prospects for constructive critique. *Economy and Society* 35 (3): 453 – 479

Eden S (1996) Public participation in environmental policy: Considering scientific, counter-scientific and non-scientific contributions. *Public Understanding of Science* 5 (3): 183 – 204

Elam M and Bertilsson M (2013) Consuming engaging and confronting science: The emerging dimensions of scientific citizens. *European Journal of Social Theory* 6 (2): 233–251

Featherstone D (2013) The contested politics of climate change and the crisis of neo-liberalism. *ACME* 12(1): 44-64

Featherstone H, Weitkamp E, Ling K, Burnet F (2009) Defining issue-based publics for public engagement: Climate change as a case study. *Public Understanding of Science* 18 (2): 214 – 28

Ford C (2011) Climate change and the politics of scientism. *The New Atlantis: A journal of technology and society.* Published online at: http://www.thenewatlantis.com/publications/climate-change-and-the-politics-of-scientism. Last accessed March 17, 2017.

Forsyth T (2002) *Critical political ecology: The politics of environmental science*. London and New York: Routledge.

Goeminne G (2010) Climate policy is dead, long live climate politics! *Ethics, Place and Environment* 13 (2): 207 – 214.

Haack S (2003) *Defending Science Within Reason: Between Scientism and Cynicism*. Amherst, NY: Prometheus Books

Hansen J, Makiko S, Karecha P, Beerling D, Berner R, Masson-Delmotte V, Pagani M, Raymo M, Royer D, Zachos J. (2008) Target atmospheric CO_2: Where should humanity aim? *Open Atmospheric Sciences Journal* 2: 217 - 231.

Hayek F (1942) Scientism and the study of society. *Economica* 9 (35): 267-291

Heynen N, McCarthy J, Prudham S, Robbins, P (eds.) 2007. *Neoliberal environments, false promises and unnatural consequences*. Routledge, New York.

Hutchinson I (2011) *Monopolizing knowledge: A scientist refutes religion-denying, reason-destroying scientism*. Belmont, MA: Fias Publishing.

Hulme M (2009) *Why we disagree about climate change*. Cambridge: Cambridge University Press.

Hulme M (2013) How climate models gain and exercise authority. In K. Halstrup and M. Skrydskrup (eds) *The social life of climate change models: Anticipating nature*. pp. 30 – 44. London and New York: Routledge.

Ingram H, Milward H, and Laird W (1992) Scientists and agenda setting: Advocacy and global warming. In M. Waterstone (ed) *Risk and society: The Interaction of Science, Technology and Public Policy*. pp. 33–53. Netherlands: Kluwer Academic Publishing.

Irwin A (2006) The politics of talk: Coming to terms with the 'new' scientific governance. *Social Studies of Science* 36: 299 – 320.

Jasanoff S (1990) *The Fifth Branch: Science advisors as policy makers*. Boston: Harvard University Press.

Jasanoff S (1999) STS and public policy: Getting beyond deconstruction. *Science, Technology and Society* 4 (1): 59 – 72.

Jasanoff S (2004) *States of knowledge: The coproduction of science and social order*. London and New York: Routledge.

Lertzman R (2015*) Environmental melancholia: Psychoanalytic dimensions of engagement*. London and New York: Routledge.

Lessl T (1996) Naturalizing science: Two episodes in the evolution of a rhetoric of scientism. *Western Journal of Communication* 60 (4): 379 – 396.

Liverman D (2009) Conventions of climate change: Constructions of danger and the dispossession of the atmosphere. *Journal of Historical Geography 35*: 279–296.

Machin A (2013) *Negotiating climate change: Radical democracy and the illusion of consensus*. New York and London: Zed Books.s

Macnaghten P, Chilvers J (2014) The future of science governance: Publics, policies, practices. *Environment and Planning C: Government and Policy.* 32(3): 530-548

Marshall G. (2014) *Don't even think about it: Why our brains are wired to ignore climate change*. New York: Bloomsbury.

McCarthy J, Prudham S (2004) Neoliberal nature and the nature of neoliberalism. *Geoforum* 35: 275–283

Mercer D (1999) The higher moral panic: Academic scientism and its quarrels with science and technology studies. *Prometheus* 17 (1): 77 – 85.

Moser S and Dilling L (2010) Communicating climate change: Closing the science – action gap. In J. Dryzek, R. B. Norgaard, and D. Schlosberg (eds) *The Oxford Handbook of Climate Change and Society*. New York: Oxford University Press.

Niemeyer S (2013). Democracy and climate change: What can deliberative democracy contribute? *Australian Journal of Politics and History, 59*(3): 429-448.

O'Lear S (2016) Geopolitics and climate science: The case of the missing embedded carbon. In S. O'Lear and S. Dalby *Reframing climate change: Constructing ecological geopolitics*. pp. 100 – 115. London and New York: Routledge.

Olson R (2008) *Science and Scientism in Nineteenth-Century Europe*. Urbana, University of Illinois Press.

Oreskes N (2004) Science and public policy: What's proof got to do with it? *Environmental Science and Policy* 7: 369 – 383.

Oreskes N (2017) Response by Oreskes to "Beyond counting consensus*." Environmental Communication* 1-2. DOI: http://dx.doi.org/10.1080/17524032.2017.1377094

Oreskes N and Conway T (2010) Defeating the merchants of doubt. *Nature* 465: 686–687

Pallett H and Chilvers J (2013) A decade of learning about publics, participation, and climate change: Institutionalising reflexivity? *Environment and Planning A* 45 (5): 1162 – 1183.

Pearce W, Grundmann R, Hulme M, Raman S, Kershaw E, Tsouvalis J. (2017) Beyond counting climate consensus**.** *Environmental Communication*, 1- 8. DOI: 10.1080/17524032.2017.1333965

Phillips L (2012). Communicating about climate change in a citizen consultation: Dynamics of exclusion and inclusion. In L. Phillips, A. Carvalho, & J. Doyle (Eds.), *Performing Public Participation in Science and Environment Communication*. Chicago: University of Chicago Press.

Roscoe P (2016) Method, measurement and management in IPCC climate modelling. *Human Ecology* 44 (6): 655–664.

Russell B (1997) *Religion and science*. Cambridge: Oxford University Press.

Sarewitz D (2004) How science makes environmental controversies worse. *Environmental Science and Policy* 7: 385 – 403.

Sarewitz D (2011) Does climate change knowledge really matter? *WIRES Climate Change* 2 (4): 475–481

Scott J (1998) *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press.

Shaw C (2014) Reframing climate risk to build public support for radical emission reductions: the role of deliberative democracy. *Carbon Management* 5 (4): 349 – 360

Shaw C, Corner A (2017) Using narrative workshops to socialise the climate debate: Lessons from two case studies – centre-right audiences and the Scottish public. *Energy Research and Social Science* 13: 273 – 283.

Sheppard S, Iype D, Cote S, Salter J (2015) A synthesis of PICS-funded social mobilization research: What works – and what doesn't – for engaging people on climate change. Collaborative for Advanced Landscape Planning. Vancouver: University of British Columbia. Available online at: http://pics.uvic.ca/sites/default/files/Soc.%20Mob.%20Report%20_0.pdf

Shove E (2010) Beyond the ABC: Climate policy and theories of social change. *Environment and Planning A* 42 (6): 1273 - 1285

Sorell T (1994) *Scientism: Philosophy and the Infactuation with Science*. New York: Routledge.

Swyngedouw E (2010). Apocalypse forever? Post-political populism and the spectre of climate change. *Theory, Culture and Society 27*: 213 – 232.

Swyngedouw E (2013) The non-political politics of climate change. *ACME: An International E-Journal for Critical Geographies* 12: 1–8.

Van der Linden S, Maibach E, Leiserowitz A (2015) Improving public engagement with climate change: Five 'best practice' insights from psychological science. *Perspectives on Psychological Science* 10 (6): 758–763

Victor D (2015). Embed the social sciences in climate policy. *Nature* 520: 27–29.

Waddell E (1977) The hazards of scientism: A review article. *Human Ecology* 5 (1): 69 – 76.

Weart S (2008) *The discovery of global warming*. Cambridge, MA: Harvard University Press.

Weaver C, Mooney S, Allen D, Beller-Simms N, Fish T, Grambsch E, Hohenstein W, Jacobs K, Kenney M, Lane M, Langner L, Larson D, McGinnis R, Moss L, Nichols C, Nierenberg C, Seyller E, Stern P, Winthrop R (2014) From global change science to action with social sciences. *Nature Climate Change* 4: 656 – 659.

Welsh I and Wynne B (2013) Science, scientism and imaginaries of publics in the UK: Passive objects, incipient threats. *Science as Culture* 22 (4): 540-566

Williams R and Robinson D (2014) *Scientism: The new orthodoxy*. London and New York: Bloomsbury.

Wynne B (2006) Public engagement as a means of restoring public trust in science – Hitting the notes, but missing the music. *Community Genetics* 9(3): 211-220

Wynne B (2010a) When doubt becomes a weapon. *Nature* 466: 441–442

Wynne B (2010b) Climate science as political art. *Theory, Culture and Society* 27(2–3): 289–305

Wynne B (2011) Intolerance: Science informs, not defines. *Nature* 471: 305.

Wynne B (2016) Ghosts of the machine: Publics, meanings and social science in a time of expert dogma and denial. In J. Chilvers and M. Kearns (eds) *Remaking participation: Science, environment and emergent publics*. pp. 177 – 183. Abington and New York: Routledge.