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Energy research and the contributions of the social sciences: A contemporary examination

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ABSTRACT

This article reports on changes in climate science, social science, public administration, and policymaking over the past twenty-five years. It responds to Gene I. Rochlin's "retrospective examination" of energy research and the social sciences. In 2014, we find that social scientists are still disadvantaged by policy-maker biases and inaccessible deliberative systems, but also better poised to conduct original humanistic energy research and produce targeted social change interventions. We review promising social scientific advancements, particularly in the realm of citizen action research. We conclude with the case study of evidence-based practice, a model from the health field that illustrates how climate change and energy research, practice, and policymaking could benefit from the inclusion of social science perspectives and methods.

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Today, can social science "contribute to a greater understanding of the dimensions and impacts of global climate change?" [1] Can social scientists calibrate scientific recommendations to complex social realities? Can they gird policymaking with social scientific theory, empirical observations, and experimental results? Can they broker bonds among scientists, policymakers, and the public? What, exactly, is possible in 2014?

In engaging Gene I. Rochlin's "a retrospective examination," we are called to deliberate the essay both as it stood in 1989 and in light of a quarter-century's unfolding. In doing so, we are struck by how little and how much seems to have changed. Climatological models are more complex than ever, and yet their predictive power is difficult to channel into concrete policies and government regulations [2,3]. Academic fields interact with even greater ease than in 1989—a time of great cross-specialty conversation—and yet disciplines such as economics still dominate social scientific energy policy [2], and interdisciplinary environmental problem-solving centers are rare [2,4]. Public administration schools in the U.S. are a model of interdisciplinary education [5–8]. Graduates of these programs are increasingly adept at economic risk analysis, program evaluation, and human resource management. And yet, few traverse the practitioner-academic gulf to publish in their field's journals [5,6], including energy regulators. Having weathered decades of criticism and mandatory reforms, most public administrators are reluctant to embark on radical new projects [9]. Further, as the Montreal Protocol negotiations illustrated, they are often sidelined in the policymaking discussions that determine the scope of their work; social scientific debate is limited in these forums too [10].

In 2014, we have greater social scientific knowledge, tools, and capacities than we did in 1989, and yet we are stymied by many of the same obstacles detailed in "a retrospective examination." Given a quarter-century of advances in the sciences, social sciences, and our public sectors, it is possible that we might harness the resources of our present age to better respond to international climate change (politics). Akin to our companion essay, this "contemporary examination" is animated by the belief that the social sciences can meaningfully contribute to energy research now, and throughout the next twenty-five years. Our "contemporary examination" is organized around six questions:

1. What does the reader need to know to fully appreciate "a retrospective examination?"
2. Did "a retrospective examination" sufficiently defend the utility of the social sciences?

3. Has climate change science advanced since 1989?
4. What has social science contributed to public administration and policymaking since 1989?
5. What has social science taught us about climate change and citizenship?
6. Today, what role can social scientists play in solving looming energy and climate calamities?

1. What does the reader need to know to fully appreciate "a retrospective examination?"

To properly understand "a retrospective examination," one must consider the remarkable advancements that preceded and comingled with the original essay. Behaviorism had permeated the policy sciences via Herbert Simon's theories of "bounded rationality" [11,12], Charles Lindblom's evolving insights into incremental public management [13,14], and a host of complementary works [15]. Simon's scholarship suggested that rational choice making preceded not from a reduction of all available alternatives to a few promising options [11] and [15], but from the constrained deliberations of "choosing organism[s] of limited knowledge and ability" [16]. Lindblom's research explored the interactions among policymaking and public management, and illustrated the tendencies of a broad range of public decision makers to conflate means and ends, systematically simplify the range of potential alternatives, skew toward the status quo, and view interpersonal agreement as a signal of successful decision making [13,14]. An economist by training, Lindblom posited that social scientists could assist public administrators and policymakers in designing just and effective institutions [17,18]. His essays in public management coincided with the professionalization of a number of social scientific and professional fields, including Public Administration, and a move toward interdisciplinary social science.

In the United States and elsewhere, the twentieth century witnessed the formalization of fields of practice and disciplines such as Anthropology [19], Economics [20,21], Engineering [22,23], Finance [24], and Sociology [25,26]. Prompted by new discoveries in mathematics, improvements in communication and transportation infrastructure, cosmopolitan competition, and professional lucubration, most scientific and social scientific fields metamorphosed from vocational collectives to abstracted intellectual communities [20,27,28], including Public Administration. Following the industrialization and urbanization of the late 19th century, diverse social movements catalyzed widespread municipal government reforms [29]. From these reforms, a class of professional public managers emerged [29]. In the 1920s and 30s, the first American public administration graduate program was launched [30]; the first issue of Public Administration Review (PAR) appeared in 1940. Shortly after PAR's debut and for decades, leading scholars debated whether the field should or could develop into a formal profession and/or discipline [30]. Among the varied arguments against professionalization, one is concordant with concern over climate change mismanagement: that professions and disciplines are insular and privilege self-preservation over service to the polity and posterity [30–32]. Though these concerns have been realized across the disciplines, the professionalization of fields such as Public Administration has also improved the quality of empirical research and public service delivery, as we describe in following sections of this article. These fields benefited from another mid-century trend: interdisciplinary research.

The work of Herbert Simon, Charles Lindblom, and others mustered broad appeal amidst a diuturnal trend toward cross-disciplinary research. In the 1950s, Simon's *Models of man* [12] arrived on the shelves with Quincy Wright's now-classic text on international relations [33], also cited in "a retrospective examination." *The study of international relations* described retreating disciplinary divisions among the human sciences:

> There has. . . been a tendency to distinguish the *social sciences* (sociology, economics, political science) from the *behavioral sciences* (. . .cultural anthropology), the *policy sciences* (politics, administration, communication. . .), and the *demographic sciences*. . ., but most of the social disciplines actually utilize more than one of these points of view. [34]

A few years later, Lindblom's seminal essay on "muddling through" public management connected Communications, Economics, Operations, Policy, and Public Administration studies [13]. Perhaps the best evidence of the growing regard for interdisciplinary research was when Simon, a political scientist, won the Nobel Prize in Economic Sciences in 1978. The feat was not repeated until 2002, when psychologist Daniel Kahneman captured the prize.

Simon's Nobel Prize win underscores a key point of this introductory section: the decades leading up to "a retrospective examination" were marked by great change and cross-disciplinary fertilization. But the distance between Simon and Kahneman's Nobel prizes hints that the advancements informing "a retrospective examination" were not uniformly developed in the intervening decades. Further, disciplines such as Anthropology and Communication Studies were often relegated to the sidelines, particularly in energy and climate research [2]. We observe a similar bias in our companion essay.

2. Did "a retrospective examination" sufficiently defend the utility of the social sciences?

A litany of disciplines pepper the text of "a retrospective examination"—Cultural Anthropology, History, Psychology, Sociology—but the essay focuses on Political Science, and to a lesser extent, Public Administration. The author acknowledges the limits of this epistemic vantage. Still, his essay reflects a dominant perspective within social scientific writing on energy [2]. The Political Science focus fails to push the bounds of the proposition that the social sciences *generally* might be useful to policymakers, public administrators, or natural scientists. Contemporary Anthropology, arguably the broadest of the academic disciplines, serves as a superior heuristic of the utility of the social sciences—and humanities—in energy policymaking.

In the decades after World War II, anthropologists began to realize how profoundly their discipline had been involved in colonialism, subjugation, and war [19]. This realization led to a period of reflection about how anthropological knowledge is made, represented, and used. Today, anthropologists resist answering "only limited questions, formulated by other people with other interests, largely having to do with how to manipulate beliefs and behavior" [35]. Anthropologists conceive of themselves as actors, *internal* to the problem under investigation, rather than as external critics. Such a perspective encourages them to "not only define problems from the perspective of their own discipline, but also to look at who else is defining problems, and from what other perspectives" [35]. The discipline strives to be: (a) integrative, drawing on multiple subfields as well as historical, ethnographic, and critical methods; (b) holistic, examining problems from multiple perspectives; and (c) inclusive, providing a broader framework for addressing public issues.

Anthropology, among the most generalist *and* specialist of the academic disciplines, is composed of four fields, which are meant to be combined. The origin of this composition of American

Anthropology was the lone scholar in a faraway community who needed to assemble a holistic picture of a people—their language, culture and sociology, archeology, and biology. Today, the discipline traverses traditional boundaries between the social and natural sciences, and humanities. The discipline's subfields yield different types of evidence (biological/cultural, quantitative/qualitative, particular/general, written/artifactual, etc.), and its diverse methods permit it to assess social and environmental questions from multiple viewpoints (e.g., past/present, insider/outsider, powerful/powerless, etc.):

1. *Archeological and historical* methodologies allow researchers to examine and compare phenomena over long time periods—sometimes tens of thousands of years—and avoid "presentist" [36] conclusions [37,38].
2. *Ethnographic fieldwork*, rooted in the methods of participant-observation and semi-structured interviewing [39], allows researchers to observe, describe, and compare peoples' ideas and behaviors, while attempting to avoid ethnocentric conclusions.
3. *Critical* methodologies, rooted in ethnographic social theory, allow researchers to reflect on how control operates and how particular peoples' biographies relate to general trends [40]. Critical methods compel researchers to take power and control into account.
4. Triangulating evidence from multiple subfields and methods then provides the basis for integrative and holistic arguments. Not hidebound to any particular approach, anthropologists adapt their methods to their particular research questions [41]. Methodological eclecticism allows anthropologists to be flexible and adjust to changing circumstances and paradigms.

Anthropology is a holistic discipline in that it addresses questions from multiple perspectives. Environmental anthropologists, for example, not only study environmental science, they also study environmental scientists [42]. Anthropologists study marginalized populations such as indigenous people [43], street children [44], and climate refugees [45]. They also connect the experiences of those people to the beliefs and behaviors of powerful classes and institutions. There are comparative studies of science institutions [46], as well as ethnographies of national laboratories [47], environmental agencies [48], physicists [49], engineers [50], lawyers [51], doctors [52], economists [53], state planners [54], and policymakers [55,56]. There are studies of mining companies [57], nuclear industries [58], advertising agencies [59], corporate public relations firms [60], Wall Street bankers [61,62], international financiers [63,64], and international courts [65]. Anthropologists explain phenomena from both inside and outside their paradigms. This multi-perspectival type of knowledge is especially relevant for public administrators and other specialists who often conceive of problems only from inside their institutions.

As the above suggests, anthropologists are concerned with human life writ-large and thus they can provide a more inclusive framework for thinking about public policy. Both specialist and generalist, Anthropology is already an essential source of knowledge for policymakers interested in effectively addressing pressing social and environmental problems. Anthropologists can be found in positions such as: President of the World Bank (Jim Yong Kim) [66], 2014 Afghani Presidential candidate (Ashraf Ghani) [67], governmental advisor for poverty reduction initiatives (David Harvey) [68], and as participants in major reports such as the US National Climate Assessment [69] and the IPCC [70,71]. Anthropologists have also been hired to work covertly for the US military's Human Terrain System [72]. This latter example reminds us that some public officials still view social science as primarily useful as a tool of prediction and manipulation.

Often, Anthropology and other social sciences are most useful for addressing the questions that public administrators are *not* asking. Too few, for example, were asking "How can we reduce inequality in the U.S." until Occupy Wall Street was sparked by anthropologist David Graeber [73]. In that vein, the social sciences are able to expand the scope of questions and the types of issues that policymakers pursue. Integrative thinking helps transcend entrenched intellectual boundaries, and it can promote institutional power shifts [74]. In this sense, Anthropology provides a superior heuristic of the general utility of social science because it calls our attention to how public administration and policymaking can be enhanced by interrogating narrowly conceived questions, by insisting that those questions be broadened, and by mobilizing external, concerned parties who can put pressure on unresponsive administrations.

General, holistic, integrative, social science is more relevant than ever for public administration and policymaking because so many of the narrow, dominant approaches to complex social issues in the last twenty-five years have produced weak results. Social issues, such as energy and climate problems, are not simple and amenable to one-dimensional fixes [2]. They require a broader, multi-dimensional lens that administrators can find in social science perspectives on ecological conflict [75], long-term human eco-dynamics [37,38], and comparative histories of social collapse [76,77]. Most important, anthropologists and other social scientists remind us that the last externality to be internalized is often the behavior of experts and professionals themselves. A wide-angled scope on social life helps policymakers see that their institutionalized ideas and behaviors are not external to, but are indeed part of, the climate problem. Some of the most noteworthy advancements in climate change science have emerged from just such a realization.

3. Has climate change science advanced since 1989?

Although a nascent field in 1989, climate change science has emerged as a strongly organized community under the Intergovernmental Panel on Climate Change (IPCC). Via collaborative projects such as the periodic assessment reports on the scientific, technical and socio-economic aspects of climate change, the IPCC has formed what Peter Haas describes as an epistemic community: "a network of professionals with recognized expertise" with an "authoritative claim to policy relevant knowledge within that domain" [78]. The Panel's assessment reports, in conjunction with improved climate models, enable scientists and policymakers to better understand the causes and potential impacts of climate change.

A history of the IPCC assessment reports illustrates this development. In the first assessment report, scientists discerned little observational evidence of human influence on the climate [79]. In the most recent assessment report, the IPCC found that more than half of the observed increase in global average surface temperature since 1951 was extremely likely (>95% chance) to have been caused by human influence [80]. Strides in climate science, in turn, were made possible by improvements in climate models. In 1990, the IPCC relied on approximately two climate models, which ran at a low spatial resolution and focused predominantly on atmospheric components [80]. Today, the IPCC compares over forty models, running at higher spatial resolution and focused on more complex components of the Earth's processes [80]. In his recent book, *A vast machine: Computer models, climate data, and the politics of global warming*, historian Paul N. Edwards describes how climate models have emerged through a "global knowledge infrastructure" for understanding weather and climate. According to Edwards, this infrastructure is "constantly opening itself up" so that "over time,

countless iterations of that process have brought us shimmering data, an ever-expanding collection of global data images that will keep on growing, but never resolve into a single definitive record" [81]. Thus, neither climate models nor the weather observations upon which they are built are simple or unified, but climate models have improved dramatically in the past twenty years, as seen by the new era of earth system simulations in the IPCC.

3.1. Climate models

Model comparisons in the Fifth Assessment Report now also include Earth System Models—the state of the art in climate simulation—and more advanced regional simulations. Earth System Models capture feedback effects between system components and include more relevant processes within the carbon cycle, atmospheric chemistry, and aerosol-cloud interactions [82]. Regionally downscaled climate models, by contrast, give policymakers greater insight into the localized impacts of climate change and regional vulnerabilities (which many see as a precondition for effective adaptation policy). Collectively, these improvements in climate models allow for a more complete rendering of the climate system, giving policymakers more data than ever before upon which to base their responses. Yet, improvements in the climate models are confounded by the spread of uncertainty in recent model projections.

Despite tremendous gains in the sophistication and scope of models, recent simulations in the Fifth Assessment Report have not reduced the spread of uncertainty since earlier assessment reports. Conceptually, this uncertainty can be easily explained: more variables are interacting with more complex processes and generating a larger model spread [83]. Although models in the Fifth Assessment Report trade off more certainty for completeness, this has prompted a confused response about the role of climate models for informing climate policy. Should policymakers hold out for greater model certainty, or move forward with imperfect predictions? Some scientists have called for an international effort to improve, and even "revolutionize," the computational capabilities of climate models, especially on a regional scale [84]. Others have responded with a slightly different, yet not incongruous, message: the models are strong and provide enough data for sensible policy. To this end, Reto Knutti and Jan Sedláček explain that a certain amount of uncertainty is inherent to any natural science and that some of the model spread is "irreducible owing to internal variability in the climate system" [85]. Mark Maslin and Paul Austin recommend reframing model uncertainty on "the date by which things will happen, rather than onto whether they will happen at all" [86]. Such advice could help policymakers realize that future generations of models, at least in the near term, might not be able to significantly reduce the range of projected uncertainties, but that bold policy is still warranted.

Rather than framing uncertainty as a surmountable problem, Edwards has convincingly argued that uncertainty is an inherent feature of the complicated social process of constructing "global data" [81]. Global weather data has been processed by meteorologists for over 150 years from a vast, varied, and complicated socio-technical infrastructure. In a process known as "infrastructural inversion," climate scientists have become keen on making visible these issues of inconsistency as part of their attempts to collect more refined and certain weather data for climate models. Climate change skeptics have also taken to infrastructural inversion, making visible the infrastructure for data collecting and its uncertainties. Yet Edwards notes that being aware of the inconsistencies, or "inhomogeneities," in this complex infrastructure need not obligate us to discard important climate change findings about which there is strong agreement among scientists. The endless accumulation of more climate data is not what is needed to deal

with such controversies, but rather, we need social engagement and communication—a prime arena for social science.

3.2. Terminological development

Just as climate models have transformed since 1989, so too has the language used by policymakers to understand and describe climate change. Gene I. Rochlin's discussion of impact mitigation, social coping, and prevention remind us that the now ubiquitous terminology for mitigation and adaptation were underdefined twenty years ago. For example, Rochlin's description of impact mitigation—"strategies for mitigating the effects of climate change"—provides a prescient account of what the IPCC now refers to as adaptation, first introduced into the title of Working Group II in 1995. A well-cabined terminology for adaptation was developed to address the now unavoidable impacts of climate change. Absent a scenario of large-scale carbon capture and storage, the climb of carbon dioxide levels in the atmosphere is now irreversible, and generates a corresponding risk of exceeding climatic thresholds or tipping points, most notably the melting of Arctic sea-ice and the Greenland ice sheet [87]. It is in this context that perhaps the most surprising development has been made within the IPCC: a new engagement with the social and ethical dimension of climate policy.

Unlike previous IPCC assessment reports, the final draft Report of the Working Group III contribution to the Fifth Assessment Report distinguished itself by asking, for the first time in such detail, how ethics and justice should factor into climate change policymaking. In a chapter on Sustainable Development and Equity, the IPCC acknowledged the evident disparities in consumption patterns and distributional implications of climate response strategies [88]. Moreover, in its chapter on Social, Economic, and Ethical Concepts and Methods, the IPCC contemplated the limits to the methods of economic analysis, representing a movement away from a purely positive analysis of climate change toward one that is also informed by philosophy and ethics [89]. Today, the IPCC serves as an authoritative "policy map maker," describing policy options available for a given mitigation scenario and their associated benefits and tradeoffs. To remain relevant, the IPCC must further imbricate ethical considerations into its own social science research.

Thus, we are helpfully reminded that as much as climate science has advanced since 1989, the underlying ethics of climate change remain underdeveloped as a field of inquiry [90]. Positive analyses of climate policy will be further developed under the IPCC, but those efforts cannot replace the work of social scientists in recommending appropriate policy options that are aware of and informed by social values. Of course, those recommendations will reflect imperfect information and insufficient control over complex resources and processes; further, social scientific recommendations cannot substitute for the morality and insight of individuals and communities [91] and [92].

4. What has social science contributed to public administration and policymaking since 1989?

> What social science… might best contribute is to make clear what it is we have learned with regard to social dynamics, and with regard to the parameters and boundary conditions that determine how humans, social organizations, and societies cope with and mitigate the social impacts of large-scale, externally caused social dislocations" – Gene I. Rochlin, 2014. [1]

When our companion essay was written, social scientists were reporting important discoveries about the macro-operations of public bureaucracies and civil organizations. But they lacked sufficient experimental data on individual and community decision

making, and democratic institution-building, particularly in environmental conservation and energy contexts [93,94]. From the 1980s to today, superlative inter-disciplinary studies have reported observational and experimental findings about how decisions are made, and provided tools that social scientists and policymakers can harness to increase the rigor of public sector decision making. Amos Tversky and Daniel Kahneman's work serves as a prime example [95,96].

Tversky and Kahneman's experimental studies added contour to the incrementalist behaviors Lindblom described [11,12]. One set of early experiments, reported in a 1981 *Science* article, revealed enduring decision maker biases ranging from risk aversion when assessing gainful policies to risk taking when assuming losses to fixation on perceived but nonexistent inter-relations among wins, losses, and decisions in complicated scenarios. To subvert (or exploit) these biases, they recommended the strategic framing of competing options. They explained the rationale for this strategy:

> Individuals who face a decision problem and have a definite preference (i) might have a different preference in a different framing of the same problem, (ii) are normally unaware of alternative frames and of their potential effects on the relative attractiveness of options, (iii) would wish their preferences to be independent of frame, but (iv) are often uncertain how to resolve detected inconsistencies. [97]

In other words, to minimize or alter decision maker biases, social scientists or decision makers could purposefully recast alternatives to highlight certain contextual elements and minimize others. Framing is particularly useful when problems are so complex that they beg the sort of simplistic incremental reactions Lindblom described; this idea is further explored in Kahneman's recent book, *Thinking, fast and slow* [98]. Coincident with many of Tversky and Kahneman's works, Paul C. Stern explored the micro-practices of environmental problem-solving and policymaking.

Beginning in the mid-1970s, Stern explored how perceptions, attitudes, and incentives guide individual and institutional decision making about natural resource use and conservation [99,100]. Since then, his work has illuminated interactions among personal preference, political advocacy, public policy, and public administration. Stern's research revealed cognitive heuristics that were impeding solutions to global environmental change. A 1991 study suggested that calculations for carcinogenic potency, nuclear meltdown, and other highly uncertain risks were often underestimated by policymakers, who privileged the simplicity and clarity of single point estimates to more accurate but varied ranges of possibility [101]. Stern, Dietz, and Ostrom suggested system-level solutions to this problem in a *Science* article that advocated for adaptive, nested (i.e., complex, redundant, layered), varied, and deliberative governance institutions [102]. The authors suggested that such public systems would thrive on trust and debate, and would surface alterative readings of risk probabilities and policies for protecting the commons [102]. At the intrapersonal and interpersonal levels, Dietz, Stern, and Dan experimentally tested how certain frames impacted citizens' "contingent valuations" of alternatives (e.g., how much money they will pay to fix a problem). The researchers discovered that group deliberation activated public values frames, whereas isolated consideration (e.g., completing a survey alone) foregrounded individualistic concerns [103]. The discovery of deliberative forum effects meshes with contemporary psychological choice research by Sheena Iyengar and others demonstrating that limiting the quantity of choices available to decision making groups (or individuals) increases personal satisfaction with the choice-making process and the outcomes [104].

Over the past quarter-century, social scientists have arrived at a better understanding of how humans, social organizations, and societies understand climatological risks and craft policy responses. First, Tversky, Kahneman, Stern and others uncovered specific cognitive biases preventing decision-makers from assessing risk and crafting effective solutions. Then, they empirically validated strategies for overcoming those impediments, including controlling information, forum type, and policy frames [2,100,103]. Second, scholars further explored the layers that comprise policymaking and public administration systems, from (intra)personal motivations to competing governance structures. Again, they suggested specific interventions aimed at increasing critical thinking and democratic decision making [102,103]. Third, they broadened this research to encompass citizen inputs and agency, and developed mechanisms for priming citizen actors toward long-term, communitarian thinking [103]. Many of these developments speak directly to the concerns of public administrators. Paradoxically, these gains in social scientific discovery coincided with a tumultuous era in public administration and policymaking.

In 1989, the public sectors of most OECD countries were in crisis [105]. In the U.S., public confidence in government institutions had been waning for decades [105,106] and the Volcker Commission Report had validated widespread concerns about cronyism and cumulative capacity gaps in the government workforce [107]. Across Europe, similar concerns about nepotism and unchecked growth within the public sector fueled widespread antagonism toward government workers [105]. In response, a series of reforms in the U.S. and Europe sought to reduce and improve the civil sector ranks; they were united under the amorphous doctrine of New Public Management (NPM) [105]. Though diverse, NPM initiatives typically involved:

> (i) attempts to *slow down or reverse government growth* in terms of overt public spending and staffing... (ii) the shift toward *privatization and quasi-privitization* and away from core government institutions... (iii) the development of *automation*, particularly in information technology...; and (iv) the development of a more *international* agenda... [108]

Though birthed by criticism, the reforms that flowed from NPM empowered many highly skilled administrators to hire, manage, and fire support staff more easily, and to implement more refined programmatic assessments [105]. Still, as NPM advanced, its focus on measurable outcomes increasingly constrained public managers' abilities to implement creative solutions [109].

While post-World War II government reform efforts had focused on increasing scientific management (i.e., from a base of largely intuitive decision making), the NPM era fostered a combustible mix of increased managerial authority and responsibility, perpetual (re)training, quantitative performance measurement, a focus on outputs rather than processes, competition among public agencies, surveillance of public workers, disciplining of under-performers, and transparency regarding waste [7,105,109]. Concomitantly, public administration schools and leading policy textbooks posited market solutions as the default paradigm, and government initiatives as correctives to limited market failures [7–9,109]. Immersed in these perspectives, public sector leaders were increasingly adept at quantitative analysis and data-driven decision making [109]. Their programs were benchmarked to performance indicators and efficiency measures [109].

Adjunct to those efforts, government agencies were both stretched and defunded. Services were increasingly delivered via multiple communication channels and formats, a costly upstart aimed at increasing efficiency [110,111]. Simultaneously, budgets were slashed [109]. Administrators were expected to achieve better results by leveraging e-governance and waste-reduction savings [109]. Some agencies were urged to chase self-sustainability, often

via increased revenue streams such as license fees and fines. As Paul C. Light observed, this backfired in the case of the U.S. Internal Revenue Service, where a confluence of NPM-style performance measures resulted in "increasingly aggressive collection tactics" and property seizures that outraged the public [112].

More broadly, the competing pressures to produce more and better services with fewer resources began to stifle experimentation and promote conformity, insularity, and the sort of self preservation early critics of professionalized Public Administration had feared [113]. Competition also pitted municipalities against each other, even during environmental disasters, as the Hurricane Sandy Rebuilding Task Force recently noted [114]. In the past twenty-five years, transgovernmental resource sharing and planning—particularly for environmental protection or disaster recovery—has rarely succeeded [114–116]. Perennial refinements to public management models and best practices have fueled a growing malaise in the public sectors of OECD nations and have led scholars such as Light to conclude that late-stage NPM could be salvaged only via a moratorium on new reform [9]. This is one reason that public agencies have failed to seamlessly meld the advances of the sciences, social sciences, and public administration to address climate change. Policymakers have suffered some of the same constraints as administrators.

Public frustrations with public sector performance were redirected at policymakers following the oil shocks of the early 1970s and inflation in the late 1970s [117]. The sentiments underlying NPM drove the elections of conservative leaders such as Margaret Thatcher and Ronald Reagan, who furthered energy deregulation in Western Europe and the U.S. [117]. As a result, policymakers deferred authority to national and transnational energy industries, particularly oil conglomerates [118]. Since then, those industries have produced innovations in consumer goods, delivery systems, and new fuels [119]; they has also contributed to national and regional conflicts and undermined democratic resource decision-making [118,120,121]. Societies have responded to growing energy industry power in myriad ways, some of which signal opportunities for a resurgence of democratic energy policymaking.

The balance of industry and government policymaking power has varied widely, even across petrostates [118]. Over the past quarter-century, Western Europe and U.S. policymakers mostly levied weak challenges to industry via incremental taxes, perfunctory funding for alternative energy R&D, and lax command-and-control regulations [2,122]. According to Solomon and Krishna, the U.S. Department of Energy "has had little ability to control energy markets or even policy, with the main exception being efficiency standards for appliances or motor vehicles" [123]. By contrast, Chinese policymakers have exercised robust supply and demand-side policies that have begun to chip away at the nation's monumental energy challenges [124,125]. Concomitantly, China moved from an emerging economy to a leader of "Southern" energy initiatives to a major player in global energy policymaking [124]. Perhaps in response to growing Chinese energy hegemony or longer-term regulatory successes in Denmark and Norway [89], U.S. policymakers are considering tougher mandates on fossil fuel emissions, some of which might strengthen renewable fuel policies [122]. Both competition and the benign export of energy policy instruments from one country to another—when culturally and politically possible [126]—hold great promise. So too do citizen energy initiatives.

5. What has social science taught us about climate change and citizenship?

The world's citizens will solve climate change; or they won't. Regardless of the efficacy of modern public administrators or policymakers, our sustainable future will be won or lost at the level of the citizenry for two reasons. First, climate change is the result of the aggregated actions of billions of citizens. Whether acting alone or as members of corporations, legislatures, houses of worship, or other social collectives, citizens degraded the environment. They hold the knowledge of "how it happened" and bear the responsibility to fix it. Second, citizens must implement the social and technological solutions to climate change, from the level of the household to community, regional, nation-state and globe [92]. While we are currently experiencing a "chicken-and-egg situation" in which "politicians. . . wait for stronger demands from citizens, just as citizens are waiting for stronger action from politicians" [127], the deadlock will be resolved when enough ordinary citizens insist upon change.

The role of the citizenry is a prominent theme in energy research [128]. Moezzi and Janda suggest that past studies fall roughly into three camps: "(1) 'If only they knew. . .', (2) 'If only they could be made to care. . .' [and] (3) 'If only they stayed home." [129]. These themes correspond with the knowledge-attitude-practice (KAP) gap literature emerging from Diffusions of Innovations research, particularly offshoots of Everett Rogers' work [130]. In keeping with Moezzi and Janda's work, prominent KAP studies have illustrated slippage among the gap categories and have undercut the presumed gap-filling hierarchy [131]. Though social scientists and policymakers long presumed that knowledge preceded attitudes and behaviors, Valente, Paredes, and Poppe's Peruvian contraception research revealed a host of empirical KAP pathways [131]. For instance, people sometimes commence new practices (e.g., using condoms) before they fully understand how those practices work or feel strongly about the changes they are making [131]. As a result, interventions must not presume a hierarchy of learned behavior beginning with information reception and concluding with optimal choicemaking. Policies that "nudge" pro-social behaviors without requiring complete knowledge or pro-social attitudes exemplify this finding [132]. Regardless of the empirical shortcomings of the KAP model, it remains a useful heuristic for organizing the research on citizens and climate change [128].

5.1. Knowledge

Determining what citizens know about the causes, impacts, and solutions of climate change is no mean feat. Individual knowledge about energy use, environmental pollution, and climate change policy is multifaceted [133]; it ranges from understanding the charges on a utility bill to evaluating whether public officials have fully disclosed the short and long-term benefits and risks of a nuclear power plant [133,134]. Citizens derive their information from an increasing number of sources, not always according to their preference. In Theodori, Lulogg, Willits, and Burnett's recent survey about fracking in the Marcellus Shale region of Pennsylvania, citizens reported learning more from newspapers, industry, environmental groups, and landowner coalitions than university professors, regulatory agencies, or a renowned documentary on fracking (*Gasland*) [135]. Residents felt under-informed about a number of key issues, such as methods for disposing or treating frack flowback water, and seemed to want more information from trusted sources [135].

That study and a host of others have illustrated the breadth of claims offered by competing information sources [134–136] and how citizens have responded to information density by developing hierarchies of trust. Greenberg reported that engineers and other actors central to the energy industry are often highly regarded by laypeople; Theodori et al. found that university professors are widely trusted to "deliver unbiased, factual knowledge on hydraulic fracking" [137]. Beyond source credibility, information

must be intelligible, straight-forward, and related to a citizen's current situation or imminent decision [99,134]. Even when information is effectively shared, citizens interpret it via their situated understandings (e.g., via their genders) [138], and attitudes.

5.2. Attitudes

Attitudes toward the causes of climate change and its solutions are mediated by a host of demographic, cultural, political, and temporal factors. The diversity within single countries is remarkable. In the aftermath of the Fukushima Daiichi Nuclear Disaster, Arikawa, Cao, and Matsumoto discovered that pro-nuclear power attitudes varied little between genders and generations, but significantly between among those who used electrical appliances minimally or intensively [139]. Also in Japan, Ida, Murakami, and Tanaka found that willingness-to-pay for smart equipment (e.g., hourly electric consumption meters, photovoltaic generators) varied little between owners and renters, but significantly based upon marital status and income level [140]. Within country differences evolve over time and in response to local and distant cultural attitudes, particularly with regard to comfort.

Human comfort, though not the most significant driver of energy use or climate change, nonetheless illustrates how community attitudes influence individual environmental decision making. Humans could exist on less non-organic energy, but not at the standards that many cultures have cultivated [133,141–143]. Energy provides comfort in the form of heating, cooling, cooking, transportation, information dissemination, etc. As Wallenborn and Wilhite explain, increasing demands for material comfort in Europe and beyond—particularly throughout the past twenty-five years—have altered citizens' attitudes about household energy needs:

> [I]n the course of one generation, bodily cleaning in Europe has been transformed from weekly bathing to daily showering. Shower gels, hair treatments and deodorants have been added to eliminate smells and add sheen, both of which have become essential elements of the presentation of the clean body. The standardization of comfort and cleanliness norms in the latter 20th century has fixed the achievement of both at high levels of energy intensity. [144]

Even when citizens recognize the price of their comforts or the need for more efficient energy sources, broad acceptance of new energy initiatives rarely equates to local support for specific energy-saving technologies [145]. In part, local community and individual attitudes remain inflexible, because many energy solutions require considerable cultural change [145,146]. As Otte illustrated via case studies from Burkina Faso and India, adopting instruments as technologically simple as solar cookers can require monumental shifts in attitudes about social organization, such as whether a family earns its livelihood independently or in cooperation with other families [146]. Beyond these case studies, monumental attitudinal adjustments often attend even small shifts in daily practices.

5.3. Practices

Small and large practices at the individual, household, industry, and community levels contribute to climate change [147]. While much energy research has focused on the big decisions propelling consumption and pollution, fewer studies have examined the billions of micropractices that comprise the majority of daily energy transactions [142]. Closely connected are the microdemographic shifts that affect household composition and consumption. As Fu recently noted, while energy research has tracked broad patterns of practice to large-scale demographic and cultural shifts (e.g.,

urbanization in China), sparse social science studies have explored how increasing intergenerational cohabitation, delayed fertility, and the like have affected resource use in diverse communities. Stern has long noted that individual and household energy practices contribute significantly to national energy consumption directly and via the subtle formation of frames of reference for energy policy options [102,134]. In fact, citizen engagement in climate change debates often stems from personal experiences with energy shortages and pollution [135].

Citizen engagement, or energy citizenship, is frequently activated following sudden disasters (e.g., Chernobyl, Fukushima) [136,139,148], and to a lesser extent, by incremental calamities such as the polluting of ground water following fracking or the diffuse effects of climate change [135]. Unfortunately, reactive organizing by the victims of energy extraction or production externalities rarely results in revolutionary changes to industry or consumer practice [135]. As Theodori et al. observed in the case of fracking:

> Despite increased opposition from environmental organizations, concerned citizen groups, and anti-industry activists, as well as intensified scrutiny and possible oversight from federal, state, regional, and local governments, we do not envision a nationwide moratorium on the use of these technologies to develop shale gas resources in the foreseeable future. [149]

Even absent responses to local exigencies, pockets of the global citizenry are engaged in solving climate change. Social science research has documented the roadblocks facing citizen advocates and suggested interventions that might improve activist efficacy, increase participant satisfaction, and foster more sustainable energy democracy.

Citizens are often frustrated by what they perceive as narrow technical solutions, particularly in the realm of energy efficiency, that entail sacrifice and yield vague results [134,147]. Their frustration reflects a well-documented truth: consumer purchasing of smarter light bulbs, washing machines, or vehicles is insufficient to reverse or halt climate change [86,147]. But as Goulden et al. discovered in focus group research on smart grids, citizens possess complicated understandings of how their behaviors contribute to pro-social and pro-climate change. When pushed to reflect on their daily choice-making, participants' "energy citizen persona[s]" emerged [150]. Though still defensive of their less environmentally conscious choices, study participants were thoughtful and flexible about how they might contribute to sustainability at home and beyond [148]. An important finding of the research is the need for citizens to own parts of the technical design, decision-making, and implementation processes, even though ownership introduces a new set of challenges [148].

Cooperative businesses have enabled citizens to seize a greater ownership role. In Europe, there are over 2400 renewable energy cooperatives that operate on the key principle of one member one vote. Denmark, for example, is the world leader in wind turbine manufacturing and per capita renewable energy consumption [151]. It also has more than 600 energy cooperatives that have been leaders in the country's energy transition now for decades. In 2005, for example, 88% of Danish onshore wind projects were owned by farmers and local citizens organized in cooperatives while only 12% were owned by utilities [152]. Among the cooperatives' most important advances has been a national law mandating that 20% of the ownership of any new wind energy project be opened up to everyone within 4.5 kilometers of the project site, thus enabling them to become part of the co-op [153]. The Danish experience has shown that Not In My Backyard is often a veritably social problem. Local control over design, planning, and implementation has produced a growing and decentralized energy system better

characterized as Please in Our Backyard, since member-owners not only participate in projects but also receive direct economic benefit from them.

Even at its best, democratic ownership is still complicated. Sage-biel, Müller, and Rommel recently demonstrated via a German case study that when energy is produced locally and cooperatively, citizens understandably remain concerned about price and the transparency of decision-making. They judge future cooperative projects against past successes and failures, such that a poorly managed first effort at local energy production and/or decision-making can hinder future community projects [154]. Just as citizens are skeptical of the capacities and ethics of their elected officials, many doubt the skills and intents of their neighbors [154]. So, how will this German and Danish research hold across diverse contexts? Given the under-representation of energy research from African, Asian, and Latin American authors and contexts, we can only guess at how energy citizenship translates globally [2,155,156]. Beyond what a narrow group of the world's citizens already know, believe, and do lies a land of great promise for social science energy research [128].

6. Today, what role can social scientists play in solving looming energy and climate calamities?

Twenty-five years after Gene I. Rochlin advocated the value of social scientific research for preventing and mitigating climate change in "a retrospective examination," we have passed critical environmental thresholds and begun to witness the effects of climate calamities across the globe [86]. Simultaneously, we have developed more sophisticated methods for observing human behavior, collecting social data, and designing robust interventions and policymaking tools. In a nutshell, we are both worse off and more advanced than we were in 1989. And therein lies the hope for responding to human-made environmental disasters. In 2014, can social scientists contribute to a greater understanding of the dimensions and impacts of global climate change? Yes; we already have. Will social scientists actively influence the next generation of policy recommendations, and engage the world's citizens in their deployment? A range of answers is possible, as the case studies of the Montreal Protocol negotiations and evidence-based practice (EBP) in health science research, care and policymaking suggest.

6.1. There's no real role for social scientists: the case of the Montreal Protocol negotiations

The Montreal Protocol on substances that deplete the ozone layer, which entered into force the year "a retrospective examination" was drafted, evinces the star-crossed affair between social scientists and contemporary policymakers. The international agreement to phase out chlorofluorocarbons (CFCs) and other ozone-depleting substances, mitigated a looming environmental calamity in relatively short order [10]. As Karen T. Litfin observed, the protocol negotiations appeared to many observers, at least superficially, to reflect "a rigorous process of risk analysis and adroit diplomacy" [157]. Given the outcomes of the negotiations, it was easy to believe that "the ozone regime grew out of efforts by an epistemic community to forge a political consensus on the basis of science" [157]. Even if the science "did not speak for itself," it seemed that policymakers believed the risk assessments offered by experts [158]. Whether science was heeded or exploited to advance particular agendas [10,159,160], scientists and social scientists seemed to occupy a central role in solving an environmental calamity.

But as Litfin and others discovered, a narrow group of power brokers, neither leading scientists nor social scientists, controlled most of the process and forged the final agreement. "[K]nowledge brokers" from the United Nations Environment Programme and the U.S. Environmental Protection Agency (EPA) set the stage for the negotiations [161], but were soon outmaneuvered by European and U.S. policymakers [10] and [159]. As pre-negotiation meetings progressed, economists and other social scientists were offered increasingly limited time to present and debate their findings and conclusions [159]. United States institutions such as the National Resource Defense Council and DuPont chemical company wielded as much or more influence on the specific reductions contained in the final document as academic scientists and social scientists [10] and [159]. Diverse countries committed to the protocol *not* because of epistemic consensus on the risks of non-compliance, but mostly due to complicated behind-the-scenes deal-making [10] and [159].

The Montreal Protocol is one of the only examples of a multilateral environmental agreement that *actually worked*. In that sense, it is an important guide for future agreements. But to the extent that climate change problems and solutions are becoming more complex, the Montreal template might be insufficient. Today, the Protocol also stands as a cautionary tail for how international negotiations—even those reliant on scientific and social scientific evidence—can relegate non-power brokers to the margins. The lasting take-away is that there is no *real* role for social scientists in environmental policymaking beyond "being called in at the end of a project, to coerce behavior to gain compliance..." [1]. But at odds with that dismal conclusion, a broader case study suggests that social scientists can advance research and practice in scientific, technical, and policy domains.

6.2. Social scientists can help transform scholarship and action: the case of EBP in health science research, care and policymaking

The lasting lesson of the Montreal Protocol negotiations might be that social scientists—and even scientists—rarely penetrate the inner sanctums of policymaking [162,163]. The negotiations seemed to ramp up just as the "epistemic community" contracted, when transdisciplinary dialog was at its lowest. While recent IPCC activities cut against these fears, we find more compelling reasons to remain optimistic in the case of evidence-based health science research, care, and policymaking.

Few fields have changed more radically than the health sciences over the past twenty-five years. Since 1989, health researchers, practitioners, and policymakers have sought the advice and council of economists, psychologists, communication scholars, and anthropologists, not just on matters tangential to the field, but on how to solve the field's most pressing problems and move it forward. Today, EBP represents the sea change possible when a field plagued by incrementalism and insularity embraces social science.

Though contemporary evidence-based medicine observes its origins in an early nineteenth century Parisian movement known as Médecine d'Observation, its recent incarnation is often traced to a 1992 article in the Journal of the American Medical Association [164,165]. Additional seminal essays emerged separately from the medical, nursing, and allied health fields throughout the early 1990s [166]. Despite the diverse ontologies among the health sciences, EBP consistently requires consideration of the "best external evidence" [167]. Evidence-based practice draws upon natural and social scientific research, "[c]ritically appraise[s] validity... and usefulness (clinical applicability)," and integrates research results into clinical practice and policymaking [168]. Recent EBP chapters in the *Annual Review of Public Health* (*ARPH*) suggest a virtuous cycle that: (1) begins with observed public health, service delivery, and/or policy challenges, (2) fosters robust clinical trials and/or observational research, and (3) produces interventions, assessments, and/or better questions about remaining health disparities [169,170]. The keywords prefacing two recent ARPH chapters illustrate key elements of EBP: "research methods, public health

Table 1
Six questions central to a contemporary examination of energy research and the contributions of the social sciences.

What does the reader need to know to fully appreciate "a retrospective examination?"	-Behaviorism had permeated the policy sciences -Most social science disciplines and related fields had professionalized in prior decades -Inter-disciplinary research increased mid-century
Did "a retrospective examination" sufficiently defend the utility of the social sciences?	-The article's political science focus reflected a dominant discipline in energy and climate research -Political science does not well-illustrate the general utility of the diverse social sciences Anthropology better illustrates the evidentiary, methodological, and epistemological reaches of the social sciences
Has climate change science advanced since 1989?	-The nascent field evolved into a community of practice under the IPCC -Climate models increased and improved -Uncertainty remains in climate simulations -New climate terminology reflects scientific discovery and irreversible climate changes -The ethics of climate change and adaptation is a growing field of inquiry and policymaking
What has social science contributed to public administration and policymaking since 1989?	-Human biases in risk evaluation and choice-making have been identified -Strategic reframing and nested public system design can influence individual decision-making and policy outcomes -Social science research methods have enhanced public sector decision-making -The public sectors of OECD countries are not fully incorporating social science discoveries and interventions
What has social science taught us about climate change and citizenship?	-The relationship among knowledge, attitudes, and practices is not always linear or hierarchical -Citizens gain information from diverse sources, but not always the sources they prefer -Attitudes toward material comfort, communal responsibility, and individual/familial livelihoods influence daily practices -Micropractices and microdemographic shifts remain understudied in energy and climate research -Energy citizenship can be activated by exigency, framing, or community need -Energy citizenship can be activated by exigency, framing, or community need -Community climate change management is complicated and understudied
Today, what role can social scientists play in solving looming energy and climate calamities?	-Policymaking power brokers often minimize the role of social scientists and practitioners -IPCC activities suggest a role for social scientists in the climate science community -Evidence-based health practice illustrates how social scientific methods, evidentiary standards, and concerns can permeate a field

impact, validity, dissemination" [171], and "disease prevention, evidence-based medicine, intervention, population-based" [172]. Increasingly, EBP is incorporating socio-ecological approaches to understand how culture, physical environment, and daily practice influence health outcomes [169]. A highly cited Lancet article from 2001 advised the EBP community to invest in qualitative research "useful for the study of human and social experience, communication, thoughts, expectations, meaning, attitudes, and processes, especially related to interaction, relations, development, interpretation, movement, and activity—all core components of clinical knowledge" [173]. Since then, evidence-based health policymaking has become routine [170,174]. In summary, the health sciences are now saturated with the principles, principals, methods—and even critiques (e.g., of positivism) [174]—of the broader sciences and social sciences. The case of EBP health research, care, and policymaking hints at what is possible in climate change practice and policymaking.

Karen T. Litfin likely anticipated such dynamic interaction among scientists, social scientists, practitioners, and policymakers involved in the Montreal Protocol negotiations [10]. We found it operating a few years later, in the health field. We witnessed it recently in the appointment of physician-anthropologist and co-founder of Partners in Health, Jim Yong Kim, as president of a pre-eminent global financial institution. Given the public health (and financial) implications of environmental calamities [175], the culture of EBP might soon seep into climate change policymaking. If public administrators and policy makers could make the same leaps that doctors, nurses, and other health professionals made in the early 1990s, we would be well on our way to a robust community of research and practice. We have done it before; there is hope.

7. Conclusion

In this article, we reported on more than twenty-five years of developments in climate science, social science, public administration, and policymaking. Since 1989, a community of practice, united under the IPCC, issued increasingly complex climate models and nuanced recommendations. Still, environmental degradation advanced. Laggardly efforts to prevent environmental calamities were due in part to the narrow heuristics employed by policymakers and citizens, as behavioristic research across the social sciences illustrated repeatedly.

Social scientists such as Elinor Ostrom and Paul C. Stern translated laboratory and empirical findings about human choice making into behavioristic interventions, some of which informed policymaking, public administration, and the engagement of citizens. Unfortunately, fiscal conservatism across Europe and the United States stymied broader reform efforts; the millennial dawn was not a time of unfettered creativity in the public sectors of OECD countries. Despite the chilling climate for reform, citizens and academic activists won victories, such as the Montreal Protocol. Simultaneously, tens of thousands of public administrators were trained by social scientists to better evaluate risk and manage change. While exhausted by the fight to survive conservative cuts, many remain committed to a broad vision of the greater good. They are perhaps waiting for their field to transform again.

When the time comes for that transformation, social scientists will have a great deal to offer climate change and energy regulators and policymakers, as reported throughout this article and as responses to our six guiding questions in Table 1.

We hope that these questions and answers will spur new debates about the intellectual history of social scientific energy research, the disciplinary balance of the field, social scientific interpretations of emerging climate science, social scientists' participation in the IPCC and other climate change research communities, human risk analysis and decision-making, citizen engagement led by social scientists, and broader thinking about *ethical* collective decision-making at the nexus of cultural, political, economic, and environmental concerns. Today, there are great possibilities for such debates to contribute broadly.

In 1989, Gene I. Rochlin pondered whether social scientists might gain wide influence beyond their own disciplines and narrow research topics. Could or would they be heard by policymakers, public administrators, and the polity, particularly on issues as important as mediating (or now, adapting to) climate change? Perhaps, he answered, if the utility of the social sciences could be made apparent and expectations among all parties could be matched. Our combined essays make the case for the value of the social sciences in energy research. They describe the unique insights that Anthropologists, Political Scientists, and other social scientists glean using tools forged by their disciplines and refined via inter-disciplinary work. These include discoveries into why humans stall change, even when it seems in the best interests of their long-term survival, and how we can design instruments and institutions that nudge decision makers toward the choices that their best selves—their energy citizen selves—want to make. The two essays concur on the promise of social scientific contributions; they diverge at their conclusions. The 1989 essay offers hope but no template for diffusion of the social sciences into energy and climate research; our "contemporary examination" proffers a prototype: evidence based practice in health science research, care and policymaking.

The social scientific revolution in the health sciences illustrates how far a field can move in just a quarter-century. Today, health science researchers and clinicians utilize social scientific research methods and heed behavioristic research. The health fields leverage interdisciplinary science and social science to improve patient and population outcomes. Social scientists occupy central roles in health science departments, major hospitals, and international health organizations. They were invited into these circles by insiders, such as medical doctors, who witnessed disease in their professional practices and sought amelioration from the social sciences. Therein lies the hope that the social sciences could contribute meaningfully to a broad array of fields, including energy and climate change research, by 2039. Of course, for this hope to be realized, we must better understand how to translate wins in health research, practice, and policy to climate research, practice, and policy. We need to learn this quickly.

In 2014, we face more complex climate challenges than at any time in human history. If we are to solve the worst of them, we must involve a broad range of ideas, methods, and people. Ideally, we need to transform entire fields of practice. Absent radical change, social scientists could engage citizen groups in discussions about assessing risk, and budgeting for uncertainty and human fallibility. Such discussions are particularly important in light of the complexity of climate change models, and of the climate system itself. More radically, social scientists could organize citizens to subvert the entrenched interests of oligarchs and policymakers and take bold action on climate change. Recent studies suggest that the public trusts university experts on environmental issues [135]; those of us in academia should better exercise that social capital. In between moderating town halls and taking to the streets, there are ample opportunities for social scientists to use their tools to inform research, practice, and policy in the energy field. While we cannot predict the extent of social scientific observations, experiments, and interventions, we have great hope that the combined force of our disciplines can make a positive contribution to energy research. Never have we been more informed or well-equipped; never have we been more needed.

Acknowledgements

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