Just transitions: A humble approach to global energy futures

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1. Introduction: Whose problem?

A haze hangs over some of the world's great cities [1]. It is 2017, some fifty years after air pollution became a primary target of environ mental legislation throughout the industrial world. Yet in Beijing blue skies are a rarity and visitors cut short their stays to avoid getting sick. In New Delhi, the air grows at times so toxic that schools are shut, flights delayed, and traffic gets snarled through lack of visibility [2]. These palpable signs are only the tip of the iceberg of smog's evil effects on health and the environment. What a growing human population spews into the air through its varied patterns of energy use contributes mightily to the global burden of disease. A study conducted by the Health Effects Institute, an independent research organization based in Cambridge, Massachusetts, concluded that some half of the pollution-related deaths worldwide, or about 2.2 million, occur in China and India [3]. Who is to blame, and how do the answers relate to the future of energy on the planet?

Energy use is seen today as a problem of global proportions, especially when refracted through the lens of climate change, which afflicts all of Earth's living systems. Yet, when it comes to the more visible aspects of environmental degradation, such as smog, the finger of blame often points downward—toward the deficient practices of poor, local communities and the lack of political will among state and substate actors. Writing in November 2017, the editorial board of the prestigious *New York Times* framed the causes of New Delhi's air pollution crisis as follows: The main culprit that turns New Delhi, already one of the 20 most polluted cities in the world, into what Delhi State's chief Minister, Arvind Kejriwal, called "a gas chamber," is the annual burning of crop stubble by farmers in nearby states who are too poor to clear their fields for replanting by less polluting means. But rather than help farmers afford the equipment they need to clear stubble without burning it, turn it into compost or use it to generate biogas, state governments simply issue bans that nobody pays much attention to [4].

Rising middle-class car use, well recognized as a major source of air pollution and a target of emergency measures during this particular crisis, is set aside as less significant than the incapacity of the poor. The *Times* editors conclude, "But it is crop burning that has pushed the area's already high pollution level off the charts."

Crop burning may be partly responsible for acute events, such as Delhi's great smog of 2017, but inefficient cook stoves, another faithful companion of poverty, have been held responsible for chronic environmental and health effects over many more decades. A brown cloud looming over South Asia, visible from space in satellite images, contains masses of soot from inefficiently burning stoves used for cooking and heating in the homes of the poor [5]. Although engineers and environmentalists have made cleaner, cheaper alternatives for domestic energy use a priority for many years, the problem persists for reasons that have not been fully grasped by technocrats from wealthy, innovating societies.

These persistent mismatches between problems, policy framings, and solutions point to a set of unsettled ethical conundrums in the ways that the energy transition is being imagined at the centers of global power. First, in line with the conventional, linear narrative of progress, development is seen as a straight arrow directed toward more sustainable futures, even though experience points to more complex and uncertain relationships between prosperity and sustainability [6] Second, while technological change is seen as essential to the transition, little attention has been paid to the fact that disparities within societies demand differentiated solutions, with no silver bullet of "green technology" to alleviate a problem framed as universal. Third, in a world where environmental policy still remains largely reactive—as the confused policy responses to New Delhi's 2017 air pollution crisis illustrate—there seem to be no principles in place for how to think about our common energy future, especially if the objective is not merely to effect a transition, but to do so with attention to social justice. This brief reflection addresses these points in turn.

2. Second enlightenment—or interrogating progress

Historians and philosophers have taught us to regard the rise of scientific thinking and reasoning in the 17th and 18th centuries as the Enlightenment. Enlightened societies refused to accept tradition and convention as good enough bases for describing what the world is like, or how we should act in it. We moderns learned the virtues of experimenting, modeling, simulating, and scenario-building before taking pointless or too costly actions. Buoyed by successes in managing nature's roughest edges, we looked to science and technology for solutions to all our predicaments. Just as science can take credit for putting climate change on the agenda of global action, so science and the technologies it enables have come to be seen as integral to climate change solutions, including humankind's energy futures. This gravest challenge for humanity, many agree, requires every bit of scientific insight and technological inventiveness at our collective disposal. But are our uses of science and technology properly enlightened? This is where we run up against a set of difficulties. Transformative solutions to the world's energy needs will not be achieved without also transforming the ways we look at the problem. For this purpose, it is essential that we take account not only of what science knows but also how science knows it, what it does not know, and how to compensate for our ignorance. For all our growing sophistication, the complexity of attaining a zero-carbon future overwhelms our knowledge of what we need in order to attain such a goal. There are faults in our instruments, weaknesses in our models, and untested, unverified assumptions that affect our attempts to draw good conclusions from insufficient data and to translate among divergent scientific disciplines. Without asking hard, scientific questions about the sources and limits of what we know, we cannot become truly enlightened in our efforts transform our entrenched patterns of energy use.

The questions demanding answers should not be posed from a position of scientific exceptionalism. It would be a mistake to think that science alone can stand apart from the commitments, biases, and imperfections that mark all other human enterprises. The national and international institutions that guide global energy policy, including even the highly respected Intergovernmental Panel on Climate Change (IPCC), would do well to recognize how their findings are marked by particular histories of knowledge production that brightly illuminate some puzzles while leaving others shadowed [7]. Under these circumstances the choice of how to characterize the world is never divorced from values. Values are inextricably woven into the production of facts, not only in the topics we choose to study but in the means with which we do so. Making those values explicit is an essential step toward producing transformative solutions for a global society. Acknowledging the uncertainties that lie beyond the frontiers of present knowledge would not be an admission of weakness. Nor would it signal defeatism. The late German sociologist Ulrich Beck, and his colleagues saw the open admission of uncertainty in science as part of a process of

growing social awareness that they called reflexive modernization [8]. That reflexivity could become the doorway to a Second Enlightenment, a stage of self-awareness in which we deploy both our knowledge and our doubts more wisely.

Reflexivity demands a dismantling of artificial walls between science, technology and public policy. The IPCC, for example, has performed extraordinary services to humanity, deservedly winning the Nobel Peace Prize in 2007. And yet the IPCC unwittingly misrepresents itself when it imagines that it can provide policy-neutral and policy-relevant advice without being policy-prescriptive. The sociology and politics of science, themselves domains of robust scientific inquiry, tell us otherwise. Built into the very processes of knowledge-making are disparate social and cultural judgments that inevitably shape policy: judgments about what is worth knowing (and what is not); whose knowledge counts (and whose does not); which facts deserve contestation (and which ones do not); whose questions should be taken seriously (and whose should not). In the Second Enlightenment, those invisible presumptions will have to be opened to public view, dusted off, reexamined and critiqued, and rearticulated in order to build a more robust base of knowledge and technologies for transformative action.

3. A more inclusive politics

Political agreement at high governmental levels will not solve the problem of the global energy transition—not unless the solutions nations find speak convincingly to the hugely disparate needs and aspirations of more than 7 billion people living on this bounded planet. In a world of staggering, and increasing, inequality, the very words “our common future” can serve as cover for evading responsibility, through business as usual, and by failing to address the maldistribution of wealth and power that got us to the mess we are in.

The axes of inequality remain inscribed in the fundamental structures of global governance. Expert knowledge, coupled to state regulatory authority, produces abstract problem framings at the transnational level that lay subjects within nations rarely have the opportunity to question or protest. Paternalistic assumptions guide the choice of solutions that seem plausible to higher echelons of authority, even when disconnected from the ways people actually live and behave. The *New York Times* editorial board rightly draws attention to the futility of imposing bans on crop burning when Indian farmers must remove the stubble of the last growing season and have no alternative means for doing so. But that very paper’s call for the Indian state to supply farmers with equipment to turn their stubble into compost or biogas gives no apparent thought to the economic, social, and political infrastructures that are needed to sustain any wide-ranging technological transformation. The history of development efforts is littered with the relics of technological solutions implemented without heeding issues of local capacity, whether in the form of social institutions, technical know-how or more material supports [9].

The Donald Trump administration’s proposed repeal of the Obama-era Clean Power Plan [10], adopted to meet US obligations under the Paris climate accord, is a chastening reminder that even in rich countries local politics can acquire the power to override international norms. In this case, the most enlightened and forward-looking efforts to use existing law to meet international green energy standards lost momentum because regional oil and gas interests that had never acquiesced in that program captured a presidency and won control of national environmental policy. The turnaround offered dramatic evidence that the transnational politics of the energy transition had become so decoupled from America’s local politics that a policy aimed at benefiting humanity at home and abroad could not survive a change in the US presidency.

4. A search for principles

New ways of thinking are all the more urgently needed because the search for a more sustainable global future disrupts the scales of human experience at multiple levels: most notably, community, politics, space and time [11]. These variables constrain not only our forms of life but our ways of knowing and, to some degree, acting collectively. They shape the disciplinary imaginations with which we study the world. Discount rates in economics, for example, zero out those distant futures that the ideal of sustainable development tells us to care about. The choice of a scientific method therefore becomes a philosophical decision about the right way to account for the unknowns before us [12].

Coping effectively with the future of energy will require every human on the planet—scientists and lay people—to operate at new scales: accepting relationships with persons from very different cultures; putting up with political decisions reached outside the processes of our nation states; adapting to changes originating beyond our local control; and thinking in extended time spans that dwarf human imagination and experience. Stonehenge, after all, was built less than 5000 years ago. But how little its builders imagined of the world of today; and how little we now know what was in the builders' minds when they set up those huge, mysterious pillars of stone! Yet, the imaginary of a zero-carbon future calls on us to plan now for a world thousands of years distant from our own.

Science can tell us with high certainty that human activities are raising the earth's mean surface temperature, that extreme weather events are more likely to occur, and that melting ice caps may cause abrupt changes in ocean-atmosphere interactions. But for each door of doubt that science provisionally closes, others relevant to policy elude closure by science alone. Climate science cannot tell us, for example, where and when disaster will strike, how to allocate resources between prevention and mitigation, which activities to target first in reducing greenhouse gases or increasing the use of renewable energy, or whom to hold responsible for protecting the poorest of the poor.

I live in Cambridge, Massachusetts, in one of the most densely knowledgeable few square kilometers on Earth. But neither I nor my colleagues could have predicted that the winter of 2015 would set records for amounts of snow deposited over 4 days, 30 days, and a single meteorological winter; nor could we have predicted that the Paris climate science meeting of that same year would begin during a record-breaking heat wave across much of Europe.

What can we say about a collective action problem that so disrupts humanity's most basic experiences of living and acting together? How should policymakers deal with all the layers of uncertainty and ignorance?

The short answer is with humility: about the reach of science and about when to stop relying on science or technology because the problems we face are as much ethical and political. Science fixes our attention on the knowable, leading at times to an over-dependence on fact-finding. Even when scientists recognize the limits of their own inquiries, as they routinely do, the policy world, often encouraged by scientists, asks for more research. Policymakers need to understand, as Pope Francis suggested in his climate encyclical of 2015, that looking to science is not equivalent to finding ethical solutions. Science and technology advisers, too, should welcome the diverse forms of knowledge that should ideally inform political decisions.

For complex problems such as the energy transition, building the capacity for collective action has to be a multifaceted exercise, engaging both knowledge and politics. It should be multidisciplinary in the best sense, drawing on history, moral philosophy, political theory, and

social studies of science and technology, in addition to the basic and applied sciences as conventionally understood. The reason is not simply to aggregate facts from many sources but rather to allow divergent positions and viewpoints to illuminate each other's limitations.

These efforts, moreover, need not be random or unsystematic. There are disciplined methods of compensating for the partiality of scientific knowledge when acting under irreducible uncertainty. I call these methods technologies of humility [13].

The human and social sciences of previous centuries made visible the social problems of modernity—poverty, unemployment, crime, illness, violence, and technological risk. Over time, these sciences became our "technologies of hubris," reassuring us that all futures are measurable, and hence calculable and manageable. Today, there is a need for technologies of humility to complement those older approaches: to make apparent the possibility of unforeseen consequences; to make explicit the normative judgments that lurk within technical calculations; and to acknowledge the need for plural viewpoints and collective learning. How can these aims be achieved?

From the abundant literature on technological disasters and failures, as well as from studies of risk and policy-relevant science, we can extract four focal points around which the social and human sciences of the energy transition can develop new technologies of humility. They are framing, vulnerability, distribution, and learning. Together, these provide a scaffolding for the ethical questions we should be asking about the global energy future: What alternative ways can our questions be posed? Who is most likely to be hurt? Who loses and who wins? How can we know better? On all of these dimensions, the more inclusive politics proposed above will improve our capacity for analysis and reflection.

Framing comes first: It is an article of faith in public policy that the quality of solutions to perceived social problems depends on the adequacy of the questions. If a problem is framed too narrowly, too broadly, or simply in the wrong terms, then the solution will suffer from the same defects. To take some simple examples, a chemical testing policy focused on a single chemical cannot produce knowledge about the environmental health consequences of multiple exposures. A belief that violence is genetic may discourage the search for controllable social influences on behavior. A focus on the biology of reproduction may delay or impede effective social policies for curbing population growth. Similarly, too great a focus on the physical properties of energy systems may keep us from finding solutions that improve lives already disrupted by the very processes of global change.

Vulnerability is next. What matters here is not just that we study it but how we do so. Human populations are often classified into groups of varying vulnerability for policy purposes (for example, most susceptible, maximally exposed, children, the elderly, women of childbearing age, or those with preexisting disease conditions). It is right that we should take most care of those least able to care for themselves. However, classifications based on physical and biological indicators alone tend to overlook the multiple social foundations of vulnerability. These approaches not only disregard differences within groups but tend to reduce individuals to statistical data points. Such characterizations often leave out of the calculus of vulnerability factors like history, place, class, and social connectedness, all of which play crucial roles in determining a society's overall resilience.

Distribution is key. To get meaningful agreements on energy futures, we will have to address head-on the distributive concerns that still divide countries, regions, and people. Will the "solutions" of the rich only keep the poor in their places, leading hardscrabble lives while others prosper? For how long? Will policies that seem rational when applied to entire nations or to the

world as a whole do justice—and indeed be seen as doing justice—to the needs of those who are most disadvantaged by the energy transition? Will the historically marginalized peoples of the Earth continue to have less voice in formal, expert-dominated negotiations than those with greater access to knowledge and power?

And what of *learning*? For scientists and technological experts engaged in the study of natural or social systems, the question "what is to be learned" is seldom a problem. The presumption is that a correct answer, or at least a better answer, exists out there, waiting to be discovered. The only issue is whether political actors are prepared to listen when experts speak truth to power and to incorporate the right answers into their decisions. In the world of the energy transition, however, learning is more complicated. Our capacity to learn is constrained by the frames within which institutions have long thought and acted. Even scientific disciplines see only what their theories and practices allow them to see. Historical experience, moreover, is subject to many interpretations [14]. Even when we acknowledge that a disaster is in the making, its causes may be open to different explanations, each pointing to a different solution. In the context of planning humanity's future energy uses, we need more avenues through which societies can collectively reflect on the ambiguity of their experiences, and to assess the strengths and weaknesses of alternative pathways into the future. Learning, in this modest sense, should become a prime objective of political deliberation, at local, national, and supranational levels.

There are some fairly straightforward steps we can take to incorporate the technologies of humility into science and policy. Four are worth singling out for future work on energy futures:

- Be attentive to systematically neglected issues, such as the role of communal practices and norms in causing as well as mitigating harmful energy uses.
- Study the influences of history and culture, especially as they affect experiences of vulnerability and resilience.
- Restore normative concerns to energy policy deliberations, especially issues of distribution, fairness, and justice.
- Design new participatory strategies to offer publics greater access to scientific resources and official political institutions at all levels of policymaking.

What we lack most in current energy policy debates are methods for connecting the is and the ought. For too long, we have delegated the tasks of observation and analysis to expert communities without challenging their framing assumptions and even the values that guide their methodological choices. The challenge for tomorrow is to reintegrate the sciences of the state we're in with a more inclusive debate on where we should be going as a global community. This is not a task for science alone, and certainly not for inventors alone, but for politics, ethics, and activism—animated by a more enlightened view of the limits of what we know, and a more humble approach to what is possible, given those gaps and omissions in knowledge.

I am hopeful that the wealth of ideas generated in this special issue will spill out of this journal's pages into the wide world beyond, creating genuinely open opportunities for reflection and debate. Let us hope, too, that by elevating the languages of value to equal status with the languages of fact we will give ordinary people confidence that this Earth is their Earth, its future their future, and that we are here embarked on a common quest to improve and safeguard our common future.

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