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Mobilizing Hope for Climate Justice, Activism, and Technology Development

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Abstract

Transforming the global economy's energy basis from its longstanding dependence on fossil fuels to a system based on renewable sources is an immense and urgent undertaking. In 2024, world GDP exceeded $111 trillion, and according to the International Energy Agency, more than 80 percent of this economic activity is still powered by fossil fuels. This dependence must be reduced rapidly to limit the rise in global mean temperature to 1.5°C or, at most, 2°C. Meeting the 1.5°C target requires achieving net-zero carbon emissions by 2050, while a 2°C pathway allows only a few additional decades. By way of comparison, during the 19th and early 20th centuries, it took roughly a century for coal to surpass traditional biomass as the favored mode of energy consumption. Today, however, the pace of transition to renewable energy remains far slower than climate targets demand. This paper draws on the arguments I make in *Mobilizing Hope* to discuss how philosophers should theorize climate justice in the present context, why activism is especially important in the effort to achieve net-zero emissions, why forms of technology that could supplement mitigation should be researched, and some of the moral considerations such technology raises.

Keywords: Mobilizing Hope; UNFCCC norms; climate justice; climate activism; geoengineering.

Summary: Introduction; I. Decarbonization; II. Interpreting and Defending Climate Justice; III. Climate Activism; IV. Technology Promotion; Conclusion; References.

Introduction

Nunzio Alì, Diana Piroli, and Luigi Caranti have addressed important matters related to my recent book *Mobilizing Hope: Climate Change and Global Poverty* (Moellendorf 2022). Alì argues on behalf of applying proportional justice, a particular theory of distributive justice, to guide climate policies. Piroli's

arguments concern the response to activism that opposes forms of climate action. Caranti discusses policies other than reducing emissions, such as negative emissions technologies, to combat climate change. In what follows, I discuss their papers with the aim of considering whether the claims of the book should be revised or amended in light of their arguments. I am grateful both for their contributions and for the opportunity to reconsider what I have argued in light of their arguments.

I. Decarbonization

Transforming the energy basis of the global economy from its dependence on fossil fuels to one based on renewable energy is a huge undertaking. The enormity of the project can be appreciated in several ways. The first is the size of the economy itself, which, according to the metric of GDP, was over $111 trillion in 2024 (World Bank 2014). In 2023, over 80 percent of this massive amount of activity is propelled by fossil fuels (IEA 2014, 24). And the pace of technology change must be breathtaking. To limit the mean global temperature increase to 1.5°C, net zero must be reached around 2050, for 2°C around 2070 (IPCC 2023, 20). By way of comparison to another global energy transition, it took over 100 years, over the course of the 19th and early 20th centuries, for coal to overtake traditional biomass as the favored mode of energy consumption for a much smaller economy (Our World in Data 2025).

Insofar as climate policy is the province of states, effecting such an ambitious undertaking requires unprecedented global cooperation. The *United Nations Framework Convention on Climate Change* (UNFCCC) was founded in 1994 to facilitate this purpose. The aim of cooperation, as stated in Article 2 of the UNFCCC founding document, is to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC 1994). Moral and political philosophers have largely ignored the rich source of plausible norms for guiding international cooperation that are contained in the UNFCCC document. Nonetheless, engaging with these norms, through activities of interpretation and critical examination, would be useful to philosophers who see themselves as members of a broad public discussion about how to respond to climate change (Moellendorf 2009a, Moellendorf 2016). Doing so has the considerable advantage of working with publicly acknowledged concepts and claims.

It would be hard to find anyone anymore who thought the solutions to contemporary problems required that philosophers should become kings, or kings

become philosophers, as Plato once had Socrates muse (Plato 1888, 170). But in writing about urgent public matters, philosophers frequently seem to assume that their audience should be limited only to those who understand theoretical disputes that animate the discipline. In contrast, there is considerable merit to directing one's arguments to a broader public. By doing so philosophers can function as members of the broad concerned public rather than only as members of their discipline. Adopting this approach makes salient some considerations that might otherwise be relegated to secondary considerations. In debates that accept the terms of the UNFCCC framework, not only must proposals be morally plausible, they are credible in the forum of deliberations only if they cohere with the norms of the framework, appropriately interpreted and compellingly justified.

II. Interpreting and Defending Climate Justice

Parties pursuing any particular joint aim do not necessarily cooperate on fair terms, even if all parties benefit from the joint pursuit. The fact that parties benefit from their arrangement is no guarantee that it is free from exploitation. The idea that exploitation can be mutually beneficial was nicely expressed by Joan Robinson in relation to exploitation within capitalism: "[T]he misery of being exploited by capitalists is nothing compared to the misery of not being exploited at all" (Robinson 1962, 46).

Cooperation on the basis of fair terms is necessary for international justice in climate change mitigation. Stipulating the fair terms of a joint pursuit such that it constitutes cooperation for mutual advantage is the domain of an account of justice. UNFCCC Article 3, paragraph 4, states the terms of joint pursuit:

> The Parties have a right to, and should, promote sustainable development. Policies and measures to protect the climate system against human-induced change should be appropriate for the specific conditions of each Party and should be integrated with national development programmes, taking into account that economic development is essential for adopting measures to address climate change. UNFCCC 3 (4)

In *Mobilizing Hope,* I argue that the right stated here seems plainly to be a liberty right of states (Moellendorf 2022, 82). Within the scope of the cooperative effort of preventing dangerous climate change, states may continue to pursue human development programs, presumably to eradicate poverty and to promote human development (Moellendorf 2022).

There are three arguments in justification of the right to promote sustainable development. One argument is that states have a compelling reason to honor the right in virtue of the commitment that they make in ratifying the UNFCCC treaty, which entails agreeing to uphold its terms, including Article 3(4). It is reasonable to expect states to honor the commitment that they have made in setting the terms of a common project. This is based on a commonplace understanding of what is reasonable, namely the *pro tanto* obligation to honor previous agreements (Moellendorf 2011a, 441). Such a justification of the right to promote sustainable development has the virtue of being superficial; it is based on a widely accepted norm of abiding by previous agreements, not on a complex philosophical theory of justice (Moellendorf 2014, 140). Indeed, states that have ratified the treaty arguably have a promissory duty to respect Article 3(4) (Moellendorf 2022, 84-5). Thus, one reason that states that have ratified the UNFCCC treaty have for honoring the right to promote sustainable development is internal in the sense that it is implied by commitments the states have taken on.

A second argument in support of the right to promote sustainable development is based on the morally mandatory project of poverty eradication (Moellendorf 2022, 83). Insofar as human development is necessary to, or constitutive of, poverty eradication, preserving the conditions in which states can promote human development is morally mandatory. States may not find a reason to take poverty eradication seriously among those that led them to ratify the UNFCCC, but it is noteworthy that Article 25 of the Universal Declaration of Human Rights asserts a right to a standard of living adequate to health and wellbeing (UDHR). And the International Covenant on Economic, Social, and Cultural Rights affirms a right to an adequate standard of living and a right to continuous improvements in living conditions (ICESCR). A commitment to these human rights standards entails a reason to honor Article 3(4).

Finally, a justification of the right to promote sustainable development is based on the demands of fairness in a cooperative project for mutual advantage. Joint pursuit is fair cooperation only insofar as the terms of the effort secure the fundamental reasons for the pursuit by the parties. One of the most important reasons for states to participate in the effort to avoid dangerous climate change is that such change will reliably result in massive loss of human life and destruction of the infrastructure and croplands that humans depend on. There might be many additional terms that could be applied to the joint effort to prevent dangerous climate change, but the liberty to promote sustainable development must be secure in order for the joint effort to prevent dangerous climate change not to undermine one of the most important reasons states have to

participate (Moellendorf 2022, 84). This argument to abide by the right to promote sustainable development, like the previous two, has the virtue of being superficial. It is not based on claims justified by a complex theory of justice, but on an intuitive understanding of fairness in cooperative endeavors.

The three arguments surveyed above are unusual in philosophical discussions of climate justice. More typical are external approaches that employ a principle of justice that is applied to the case of climate change, and the climate politics are freighted not only with preventing dangerous climate change in a fair manner, but with serving some broader account of the demands of justice. Nunzio Ali seems to take this approach. Although he endorses the methodological claim friendly to my approach that "different types of goods require different distributive principles, and domestic justice may rightfully differ from global or intergenerational justice," (Alì 2025, 5) he nonetheless takes the view that the central question of climate justice is the familiar question of a fair distribution among individuals: "How should the socioeconomic costs of climate policies aimed at the Green Transition be fairly distributed among individuals alive today?" (Alì 2025, 3) This leads him then to adjudicate between competing accounts of distributive justice, including sufficientarianism, prioritarianism, moderate egalitarianism, and Rawlsian egalitarianism, and what he and Luigi Caranti call "proportional justice" (Alì and Caranti 2021). Proportional justice constrains the net income and wealth of the highest earners and the wealthiest to a multiple of the average income of the lowest earners and the least wealthy (Alì 2025, 12).

Alì contrasts his account of proportional justice with the anti-poverty principle, which I defend (Alì 2025, 11-2). Although the anti-poverty principle is a normative principle, it is not developed as a principle of distributive justice. Rather, I defend it as a principle for identifying dangerous climate change (Moellendorf 2014, 22-3, Moellendorf 2022, 28-9). According to the arguments I make, identifying when climate change is dangerous involves normative judgment; any attempt at such identification that is purely empirical, involving only a risk-benefit analysis, is insufficient (Moellendorf 2011b).

The central principle of international justice that I defend with regard to the burden of responding to climate change is the right to promote sustainable development. Furthermore, I argue that the account of responsibility that best serves that account of justice is an ability-to-pay principle in which ability is measured in terms of human development level (Moellendorf 2022, 86).

If one thinks that the truth about social justice is that it always requires limiting inequalities between individuals, then the claim that justice requires that international relations respect the right to promote sustainable development looks both insufficiently egalitarian and applicable to the wrong domain of

agents. However, I think there are grave problems with all approaches that seek to develop an account of principles for the moral evaluation of policies and proposals to guide the international effort to prevent dangerous climate change that disregard, without consideration, the norms of the UNFCCC's founding document. The problems are compounded for those approaches that load the tasks of dangerous climate change prevention with the additional task of promoting global egalitarianism. This, however, is not because I disagree with global egalitarianism, indeed I have defended it at length (Moellendorf 2009b, Moellendorf 2018). I see two problems for all such approaches.

First, any account of how the costs of climate change and climate action should be shared that is based on a complex theory of justice that is foreign to the commitments that reasonably constrain climate negotiations is at a serious disadvantage in comparison with the right to promote sustainable development. State leaders are not philosophers, and the public discussions about dangerous climate change by policymakers, activists, and citizens are not forums for assessing complex theories of justice. This suggests that there is little hope of generating timely widespread agreement about the theories of justice and their implications. Suppose the argument about what to do requires winning debates with an array of philosophical opponents, including defenders of sufficientarianism, prioritarianism, moderate egalitarianism, Rawlsian egalitarianism, and limitarianism. This is not the path to rapid climate action. Whereas the problems of climate change are urgent, broad agreement about philosophical matters comes slowly, if at all.

Second, any approach to climate justice that requires egalitarianism or limitarianism of some sort turns an immensely challenging problem into an even harder one. The scope and complexity of transforming the energy basis of the global economy, and the powerful vested interests that stand in the way, make the political project of avoiding dangerous climate change extremely demanding. I summarize some of these problems as the problems of political economy. I suggest four categories of problems: International structural problems, the need for policy trial and error, coordinating domestic regulators, and competing domestic interests (Moellendorf 2022, 125-7). The existence of distributive conflicts about climate policy, in particular the powerful lobby of the fossil fuel industry, has considerably slowed progress. I characterize that lobby as an instance of a plutocratic tendency in democratic processes (Moellendorf 2022, 124). Confronting the vested interests of one sector, albeit a very powerful one, of the capitalist class has proved very difficult. Egalitarian or limitarian politics, whether reformist or revolutionary, threaten the interests of capital on a much wider scale. Even if there are good reasons of justice to take on this task, assigning it to the climate movement invites even greater resistance.

In short, superficial justifications based on widely agreed upon norms of reasonableness or arguments for reasons that are internal with respect to existing commitments have a greater capacity to convince in a timely fashion than do those based on complex philosophical accounts of justice. And a climate movement that must only take on the interests of the fossil fuel industry has a powerful enemy, but one less powerful than the entire capitalist class.

III. Climate Activism

I defend the importance of mass movements for climate action on strategic grounds. I argue that they provide counter power to the power of the fossil fuel industry, and this political perspective is embodied in the activism on behalf of a Green New Deal, which promises renewable energy, growth, technological innovation, more union jobs, and improved social welfare (Moellendorf 2022, 128-33). Insofar as these are popular outcomes, Green New Deal policies hold out the promise of mobilizing a broad segment of the public. It is precisely that capacity for broad popular mobilization that makes Green New Deal politics capable of generating counterpower to the plutocratic power of the fossil fuel industry. In other words, if one accepts that plutocratic power is a significant problem for decarbonization, Green New Deal policies hold significant promise for defeating that power. There are certainly arguments from justice to support planks of a Green New Deal program, but my primary interest in the Green New Deal is that it could serve as a plausible object of hope to a great many people and therefore be a catalyst for popular mobilization.

Diana Piroli notes that the protests by farmers in several European countries and the *gilets jaunes* in France are an indication that the public is divided about climate change policies. These movements indicate that there is also opposition to climate policies that can be mobilized. Protests such as these raise important questions for the development of hopeful green politics. The energy transition is unlikely to garner the popular support that it needs to counter the entrenched interests of the fossil fuel industry, if the political program is based on hope deferred: It will cost you your livelihood or your well-being, but your children will be better off. On the contrary, it is of fundamental importance to a strategically intelligent political program of decarbonization that it aligns the incentives of the transition in such a way that the overwhelming majority of the electorate benefits relatively directly from the transition. This is precisely the promise of Green New Deal programs (Moellendorf 2022, 130-1).

I introduce the idea of mobilizing hope with regard to the development of

mass movements on behalf of climate justice. The idea is that the rationality of the attitude of hope depends on what I call "hope-makers," which are reasons to think that the hoped-for object or outcome is possible. There are many kinds of hope-makers, including facts about the world, social processes, theories of change, and plausible visions of the future. And importantly, insofar as an outcome depends on the actions of people, social and political movements can be hope-makers (Moellendorf 2022, 34). As people take action to confront the interests of the fossil fuel industry, the possibility of achieving climate justice becomes more likely. Hence, through one's activism, one can be a hope-maker to others. This is strategically important. There can be a positive contagion effect to activism. What seems unlikely can become likely if enough people take up the cause.

The contagion-effect can also serve those who resist taking climate action. If movements arise challenging how the costs of climate action are assigned, these can inspire others to protest these policies. Piroli urges the importance of learning from the existence of protests against policies to mitigate climate change. She notes that top-down decision-making has resulted in communities feeling alienated from policy measures to mitigate climate change, turning people who might otherwise have been allies into opponents. This is surely correct. Additionally, the fossil fuel industry has promoted skepticism about climate science (Oreskes and Conway 2010); this has been taken up by far-right political parties that seek to gain political advantage from political protests.

The ambitions of the politics of the Green New Deal are to mobilize hope in favor of a transition by developing a program that is in the interests of most citizens through raising the standard of living, increasing employment in unionized jobs, cleaning up the air that we breathe**,** and removing dependence on foreign sources of energy. The economist Robert Pollin estimates that worldwide such a program calls for investments of between 1.5 and 2 percent of global GDP annually (Pollin 2018, 10). The transition would be effected through industrial policy that pushes technological development in renewable energy generation, smart grids, and non-polluting forms of transportation (Mazzucato 2015, 121-78). Democracies contain powerful lobbies with vested interests that would be threatened by the transition to renewable energy. And so the need to mobilize hope is considerable. Distributive conflicts of this sort, I argue, in *Mobilizing Hope*, are among the most important of the problems of political economy (Moellendorf 2022, 127-8).

Piroli employs Habermas's idea of the public sphere to explain the importance of responding to those who protest climate change mitigation policies. As an ideal, the public sphere is a medium in which ideas are freely exchanged,

disputed, and accepted or rejected on the basis of discourse. Habermas maintains that, "the unity of the collectivity [of the secular state] can be established and maintained only as the unity of a communication community, that is to say, only by way of a consensus arrived at communicatively in the public sphere" (Habermas 1987, 82). If this is taken as a normative claim rather than a dubious empirical one, then responding adequately to those who protest climate change mitigation policies is a requirement of democratic public life engaged in communicative action.

Piroli argues that protests against climate change mitigation constitute forms of counterpublics that both reveal how inequalities shape the public sphere and contest what climate justice requires. She maintains that the voices of such counter-publics should be included in a conception of climate justice to ensure that it is publicly justifiable and legitimate. Expressed in terms of my emphasis on mobilizing hope, one might think of the existence of such protests as a failure to produce a hopeful politics of the transition to a net-zero carbon society. Insofar as politicians seek to avoid the kind of confrontations that redistributive policies create and are reticent to build the mobilized support on behalf of such policies, their only alternative is to pass the costs of the transition on to ordinary people through taxes without redistribution, regulation changes that require expensive home upgrades without adequate subsidies, and job losses without retraining. To the extent that policies such as this give rise to protest, it is an indication of a strategic failure of the politics of the transition to a net-zero carbon society to mobilize the hope needed to overcome the interests of the fossil fuel lobby. I have discussed this primarily as a strategic problem of achieving a net-zero carbon society**.** Piroli's argument, as I understand it, is that it is also a failure of communicative action.

IV. Technology Promotion

In *Mobilizing Hope*, I argue that what is feasible in terms of a transition to a net-zero carbon society is at least partially technology dependent (Moellendorf 2022, 137-40). To take an obvious example, if the only energy technologies available to humanity presently were those that emit CO_2, then the possibility of arresting climate change and maintaining current levels of income would be nil. In other words, a *Pareto* superior transition to net zero would not even in principle be possible. As mentioned above, any transition to net zero will have to use industrial policy to promote the development of renewable energy. The success of the climate activism that I discussed above would have as among its

effects much greater government support for improvements in renewable energy technology and new forms of technology to supplement aggressive emissions reductions. I argued above that the Green New Deal is an attractive political vision because it could serve to mobilize hope; it is also attractive because there is a strong correlation between economic growth, which the Green New Deal promotes, and technology development (Moellendorf 2022, 149-51).

The Intergovernmental Panel on Climate Change forecasts that "limiting global warming to 1.5°C, compared with 2°C, could reduce the number of people both exposed to climate-related risks and susceptible to poverty by up to several hundred million by 2050" (IPCC 2018, 9). However, I argue in *Mobilizing Hope* that mitigation alone is highly unlikely to be enough to stabilize the concentration of CO_2 in the atmosphere at a level that would make it likely that internationally established warming limits of 1.5˚C or 2˚C can be met (Moellendorf 2022, 152-4). If the argument is convincing, then relying only on mitigation to limit global warming would be an exceedingly risky strategy.

There are two factors working against halting planetary warming in the 1.5˚C to 2˚C range by means of emissions reductions alone. The first factor is the rapidly-approaching geo-physical limit: There is an upper limit on greenhouse gases in the atmosphere consistent with a likelihood of limiting warming in that range. As I write this, the concentration of CO_2 in the atmosphere is 422.4 ppm (Daily CO2 2025). The geophysical limit is thought to be somewhere around 440ppm. Although the limit has not yet been reached, the annual increases of CO_2 in the atmosphere have been rising in the 2020s at the fastest rate ever. On average, the increase is 2.58ppm per year. Moreover, the increase from 2023 to 2024 was 3.58ppm (Carbon Brief 2025). Barring a drastic change of policy, the limit will be exceeded in about five years.

The second factor is the impact of the problems of political economy. Reaching an agreement on robust mitigation domestically is hampered by the influence of the fossil fuel industry's lobby, which is also present at international negotiations. But coordination problems abound both internationally and domestically as well. And there is the problem that policy efforts will necessarily need to be revised as their effectiveness is monitored. These problems make it doubtful that progress in reducing CO_2 emissions will be rapid and that increases in the concentration of CO_2 will come to an end before the geophysical limit is reached.

Given the grave risks that hundreds of millions more people will be thrown into poverty if warming is limited to 2˚C rather than 1.5˚C, there is a compelling reason—indeed, there are hundreds of millions of reasons—to consider the possibilities for supplementing the emissions reduction effort by means of new

forms of technology. *Mobilizing Hope* discusses two kinds: negative emissions technologies and solar radiation management (Moellendorf 2022, 155-69).

Whether to research a form of technology to supplement emissions reductions depends on several factors. What are the prospects that it can be developed to scale within a time frame that would help to limit warming? How effective would its use be? How well are the effects of its use understood? Would using it create moral problems, e.g., impede sustainable development efforts, violate human rights, etc.? There is a complicated risk-benefit analysis that must be performed in order to compare the use of new technologies to the grave risks of relying only on emissions reductions. Typically, performing such a risk-benefit analysis requires close attention to the relevant policy studies.

In order to appreciate the complexity of detail involved in drawing a morally defensible judgment regarding technologies to supplement mitigation, consider two examples. First, with respect to Bio-Energy with Carbon Capture and Storage (BECCS), I discuss a concern raised by Henry Shue that its land and water use would raise their costs and therefore prove detrimental to sustainable development (Shue 2017, 214). This is a plausible concern, but one for which there is not yet compelling evidence to substantiate. There is some modelling that gives reason to believe that, in fact, the costs of development would be higher without BECCS, because it would slow the phase out of fossil fuels and therefore reduce the price increases that are expected from the substitution of other forms of fuel (Muratori *et al*. 2016, 7). Second, with respect to Stratospheric Aerosol Injection (SAI), there has been considerable concern that it would diminish much-needed precipitation in certain regions (Sontag *et al.* 2018). Some people contend that drought-prone regions of Africa could be especially affected by this (Robock 2008). One response to this is the proposal that any use of SAI would have to be adjusted not only for its cooling effect but also for its influence on precipitation; the optimal cooling effect might have to be forgone to moderate adverse precipitation results (Keith *et al.* 2015). I argue that neither of these concerns is sufficient to warrant giving up research into the development of each of the forms of technology. Both of them suggest that further knowledge is required. If there is compelling reason to think that the negative effects cannot be significantly mitigated, then deployment would seem to be morally prohibited.

The argument in favor of continued research into, and further reflection on, these technologies that might be able to supplement mitigation proceeds by several steps. It begins as follows:

(a) Taking effective means to avoid the impoverishment of hundreds of millions of people is morally obligatory.

(b) Credible projections hold that limiting warming to 1.5˚C rather than 2˚C would avoid the impoverishment of hundreds of millions of people.

(c) Therefore, to the extent possible, limiting warming to 1.5˚C is morally obligatory.

With the moral credibility of the end established, the means to achieving it require defense.

(a) There are compelling reasons (e.g., the geophysical limit and the problems of political economy) for thinking that mitigating climate change solely by means of deep emissions reductions will not be sufficient to secure the goal of limiting warming to 1.5˚C.

(b) Forms of new technology, including negative emissions technology and solar radiation management, might be able to supplement deep emissions reductions and avoid some or all of the impoverishment of millions of people from climate change.

(c) If there are forms of technology that might aid in attaining morally obligatory goals, these should be researched to establish whether they would be both effective and observe moral constraints.

(d) Therefore, forms of technology, including negative emissions technology and solar radiation, should be researched to establish whether they would be both effective and observe moral constraints.

Furthermore, I have attempted to show that the moral discussion and reflection on these technologies requires a highly detailed consideration of the possible and likely effects. This is the kind of reflection that many philosophers and political theorists do not usually undertake.

There is greater concern regarding the unknown effects of solar radiation management than about negative emissions technologies. Introducing a compound into the atmosphere that is intended to have planet-wide effects on the climate raises worries about what other effects the compound might have. There is no similar concern about negative emissions technologies, which extract substances from the atmosphere rather than introduce new ones. This concern for the unknown effects of solar radiation management might be thought to justify a prohibition on research on precautionary grounds. I argue against such a view (Moellendorf 2022, 167-8). The issue here turns on what a reasonable precautionary principle prohibits.

Statements of principles of precaution vary in at least two ways. One is whether they require actions (e.g., to take special care) or prohibit certain kinds of action (e.g., deployment of technology); the other is whether their triggering

conditions are broad (e.g., lack of knowledge of the risks of negative outcomes) or narrow (e.g., knowledge of specific risks) (Moellendorf 2022, 47-8). I defend a principle that requires special care under a narrow set of conditions, namely the real possibility of uncertain but especially bad outcomes (Moellendorf 2022, 46). This principle is neither prohibitory nor broadly triggered. The reason for this is that there are considerable opportunity costs associated with any precautionary principle, since some forms of action—for example, research or deployment—are ruled out or made more difficult to pursue due to worries about possible negative effects. But ruling out these actions closes off an avenue for pursuing something that might be beneficial.

The idea of a precautionary principle is to balance the concern about negative outcomes with allowing the pursuit of possible benefits. To prohibit research simply on the basis of the possibility of negative outcomes of an unknown probability would rule out far too much scientific research, indeed, most of it. It is more reasonable to require special care in cases where there is a real possibility of an uncertain but bad outcome. If it is reasonable to allow research, while requiring special care when the real possibility of negative outcomes exists, then the general worry that research into stratospheric aerosol injection might enable deployment of something that turns out to be harmful is insufficient to prohibit it.

Luigi Caranti also favors research into new forms of technology to aid the response to climate change. He argues that technological innovation should be a key element of climate policy. He does not seem to disagree with me about the importance of such research in general. Although I am perhaps more cautious than he is in considering the details of the application of such technologies. I will simply elucidate and briefly comment on his view.

Caranti offers an analysis of five structural failures of politics to respond effectively to the problems of climate change. His account corresponds to a considerable degree with what I develop as the problems of political economy. Caranti argues for a global fund for the development of technology. This is worth serious consideration. There are two fundamental aspects to the design of any such fund: its financing and its criteria for disbursements. Caranti advocates funding by levies on countries in proportion to their historical emissions. His is, of course, just a first proposal, but much needs to be developed in order to assess it.

Whether the fund would serve its purpose depends crucially on the criteria for, and mechanisms of, distributing funds to promote emissions reductions supplementing technology. Not only does Caranti's proposal require an account of the criteria for, and mechanisms of, fund disbursement, it also requires an account of how moral oversight would be effectively instituted. As I have discussed above, deciding whether to develop any particular proposal of emissions

reductions supplementing technology requires a close examination of the likely social, economic, and physical consequences of deploying the required technology. In his defense of technology promotion, Caranti does not discuss these matters. However, no proposal for a global fund for new forms of technology would be complete without a convincing account of how it would institutionalize adequate moral oversight over the technology developed.

To consider the possibilities for a technology-promoting fund, consider a similar idea that has been developed in detail by Thomas Pogge (2023). Pogge's proposal is funded by a share of the proceeds from a uniform global carbon tax. The fund is used to incentivize low- and zero-emissions energy-producing technologies, not technologies that supplement emissions reductions. The low- and zero-emissions energy technologies are supported on the basis of their effectiveness in reducing emissions per unit of cost. Pogge limits rewards from the fund to the development of technologies for the lowest-income countries on the grounds that these are the countries where green technologies have seen the least uptake due to patent-monopoly pricing. Participating private firms developing forms of low- and zero-emissions energy technologies are rewarded by the fund rather than by market sales in order to incentivize development for the poor, where effective market demand is weak. Pogge's account does not include mechanisms of moral oversight, nor is the need for them here as compelling as it is for Caranti's fund, since reducing emissions does not raise the kind of concern about unintended effects that supplementing emissions does.

Unlike me, Caranti seems to think that degrowth is a serious contender, although an inferior one, to technology promotion. Indeed, he takes it to be the only serious contender. I'll briefly summarize why I do not think degrowth is a serious contender. In terms of effectiveness at reducing emissions, slowing economic growth has been astoundingly poor. As I point out in *Mobilizing Hope*, we have two experiences that verify this: "The Great Recession of 2008 was the largest slowdown of the global economy since the Great Depression. Between 2007 and 2008, average growth rates fell by about 6 percent globally and by about 7 percent in low- and medium-income countries. That immense decline produced only a minor drop in emissions; global CO2 emissions declined by only 2.5 percent that year. Similar conclusions can be drawn from the economic contraction caused by the COVID-19 pandemic in 2020" (Moellendorf 2022, 144). If temperature increase is to be halted without the use of either negative emissions technology or solar radiation management, then immediate and drastic emissions reductions, leading within two decades to zero emissions, are required. The recent experiences of economic decline are evidence that degrowing the economy cannot achieve that short of a rapid and complete shutdown of

all economic activity. Indeed, this illustrates why, on the contrary, absolutely decoupling economic activity from carbon emissions is necessary. Moreover, if absolute decoupling were achieved, reducing growth for the sake of climate change would be unnecessary. As I argue, degrowth is neither sufficient nor necessary for zero emissions (Moellendorf 2022, 145).

Conclusion

The comments by Nunzio Alì, Diana Piroli, and Luigi Caranti have prompted me to reconsider the issues that I grappled with in *Mobilizing Hope.* I am grateful that they took the time to develop their thoughts regarding the concerns of the book. One of the great delights of being in this profession is the opportunity it affords for careful discussion about things one has put a great deal of time into investigating. I am deeply thankful to them for this exchange, which I hope will spur conversations and debates among this journal's readers.

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