

## PICKING OUR POISON: A CONDITIONAL DEFENSE OF GEOENGINEERING

BY CHRISTOPHER FREIMAN\*

*Abstract: Geoengineering involves intentionally modifying the environment on a massive scale and is typically proposed as a last resort to prevent catastrophic harms caused by climate change. Critics argue that there are powerful moral reasons against researching, let alone undertaking, geoengineering. Perhaps most notably, Stephen Gardiner argues that even if we are forced to choose between allowing a climate catastrophe or geoengineering—and geoengineering is the less harmful option—it could still be the case that we ought not to geoengineer. This essay argues for a conditional: if we are indeed forced to choose between catastrophic environmental harm and the less harmful option of geoengineering, then we ought to geoengineer.*

KEY WORDS: environmental ethics, climate change, geoengineering

Few, if any, threats to humanity's future compare to climate change. Depending on the extent of global warming by the end of the century, heat-related deaths in America alone could rise to over 9,000 per year with annual economic costs totaling around \$100 billion due to lost labor hours, property damage, and more.<sup>1</sup> The World Health Organization expects climate change to result in roughly 250,000 additional deaths per year between 2030 and 2050.<sup>2</sup>

Many believe that technology is not only the cause of our climate problem, but also our best hope for a solution. Over the long term, the world can decarbonize through increasingly accessible renewable energy sources, energy storage, carbon capture, and other technological advances. Yet more drastic measures may be needed to prevent a disaster in the short term. In particular, some propose geoengineering, which involves intentionally modifying the environment on a massive scale.<sup>3</sup> We might, for instance,

\* Department of Philosophy, College of William and Mary, [cafreiman@wm.edu](mailto:cafreiman@wm.edu). Competing Interests: The author declares none. For their helpful feedback, I owe thanks to David Schmidtz, an anonymous referee, and the other contributors to this volume.

<sup>1</sup> Dana Nuccitelli, "Climate Change Could Cost the U.S. Economy Hundreds of Billions a Year by 2090," *Yale Climate Connections*. 4.29.19. Accessed 2.3.20. Available at: <https://www.yaleclimateconnections.org/2019/04/climate-change-could-cost-u-s-economy-billions/>

<sup>2</sup> World Health Organization, "Climate Change and Health," 2.1.18. Accessed 2.3.20. Available at: <https://www.who.int/en/news-room/fact-sheets/detail/climate-change-and-health>

<sup>3</sup> This is roughly the definition found in David Keith, "Geoengineering the Climate: History and Prospect," *Annual Review of Energy and the Environment* 25, no. 18 (2000): 245–84. For philosophical discussions of geoengineering, see, e.g., Dale Jamieson, "Ethics and Intentional Climate Change," *Climate Change* 33, no. 3 (1996): 323–36; Stephen Gardiner, *A Perfect Moral Storm* (New York: Oxford University Press, 2011), chap. 10; Christopher Preston, "Re-Thinking the Unthinkable: Environmental Ethics and the Presumptive Argument Against

inject sulfur into the stratosphere to reflect sunlight and thus cool the planet, or pursue ocean fertilization to increase carbon dioxide uptake.<sup>4</sup> Geoengineering's most zealous defenders argue that it can be a cheap and effective means of mitigating climate change; others make the more modest claim that we should consider geoengineering as a last resort should a catastrophe become inevitable otherwise.<sup>5</sup>

Yet there are those who argue that it is reckless to double down on technology to solve the problems technology created. Indeed, it's hard to imagine something more hubristic than an attempt to regulate an entire planet. Even if geoengineering could work, then, making such an attempt might in itself be a sign of moral failure inasmuch as it is an act of supreme hubris.

This essay argues that the hubris objection to geoengineering and related criticisms are unsuccessful. Hubris may well motivate some demands for geoengineering; however, a refusal to seriously consider geoengineering is hubristic as well. There is risk, after all, in relying on climate solutions that depend on our ability to bring about dramatic and widespread changes in people's economic and political behavior: as things stand, the world is not cutting emissions quickly enough and voters have shown little willingness to hold public officials accountable for their inaction. Since alternative approaches may not succeed, humility demands that we remain open to the possibility that geoengineering will be required to stave off a disaster. Given that there is no escape from calculated risk, I will argue that we should move forward with the calculating and, if needed, geoengineering.

More specifically, this essay argues for a conditional: *if* we are indeed forced to choose between catastrophic environmental harm, and the less harmful option of geoengineering, then we ought to geoengineer. Some of the critics of geoengineering are skeptical that we should geoengineer, even if it turns out to be the lesser evil. Most notably, Stephen Gardiner argues that if we are forced to choose "between allowing catastrophic impacts to occur, or engaging in geoengineering" and geoengineering is the less harmful option, it could still be the case that we ought not to geoengineer.<sup>6</sup> While

---

Geoengineering," *Environmental Values* 20, no. 4 (2011): 457-79; Holmes Rolston III, "The Anthropocene! Beyond the Natural," in *The Oxford Handbook of Environmental Ethics*, ed. Stephen Gardiner and Allen Thompson (New York: Oxford University Press, 2017), 62-74.

<sup>4</sup> See, e.g., Peter Irvine, Kerry Emanuel, Jie He, Larry Horwitz, Gabriel Vecchi, and David Keith, "Halving Warming with Idealized Solar Geoengineering Moderates Key Climate Hazards," *Nature Climate Change* 9, no. 4 (2019): 295-99; Phillip Williamson, Douglas W. R. Wallace, Cliff S. Law, Philip W. Boyd, Yves Collos, Peter Croot, Ken Denman, Ulf Riebesell, Shigenobu Takeda, Chris Vivian, "Ocean Fertilization for Geoengineering: A Review of Effectiveness, Environmental Impacts and Emerging Governance," *Process Safety and Environmental Protection* 90, no. 6 (2012): 475-88.

<sup>5</sup> This latter line of thought is explored in David Victor, M. Granger Morgan, Jay Apt, John Steinbruner, and Katharine Ricke, "The Geoengineering Option: A Last Resort Against Global Warming?" *Foreign Affairs* 88, no. 2(2009): 64-76.

<sup>6</sup> Gardiner, *A Perfect Moral Storm*, 353.

critics rarely claim that the case for geoengineering has been decisively defeated, they raise objections meant to shift the burden of justification to its defenders. In what follows, I aim to meet that burden.

I start by exploring the adverse welfare effects of climate change and how geoengineering could serve to mitigate them. Our duty to prevent grave harms implies that we would have a weighty *prima facie* reason to geoengineer if it were needed to prevent such harms (Section I). Then I consider various arguments against researching the feasibility, safety, and effectiveness of geoengineering (Section II). From here I address moral objections to the use of geoengineering as a measure to prevent a climate catastrophe (Section III). Because the proposed defeaters for geoengineering are themselves defeated, the case for researching—and, in certain circumstances, performing—geoengineering stands.

### I. THE DUTY TO PREVENT A CLIMATE CATASTROPHE

The positive case for geoengineering is straightforward: we have a weighty moral duty to prevent grave harms such as those brought on by climate change. As noted, heat-related deaths in the United State could eventually exceed 9,000 per year, and the WHO estimates an additional 250,000 annual deaths worldwide between 2030 and 2050.<sup>7</sup> If geoengineering becomes the only viable option for preventing these and other harms, then we'd have a strong reason to geoengineer.

For argument's sake, let us suppose that geoengineering measures will be the only feasible, last resort option to avoid the catastrophic harms of climate change in the short term as the world decarbonizes over the long term. I'll stress up front that there are good reasons for thinking that geoengineering is *not* our least harmful alternative for avoiding climate catastrophe. But I'll set this issue to the side to consider whether we should research, and ultimately perform, geoengineering *if* it turns out to be the lesser evil. (There's a question of how, exactly, to specify the notion of the lesser evil. Here I'll understand it as the least harmful option, while acknowledging that values other than welfare are morally relevant. I'll return to this point below.) Moreover, no one suggests that geoengineering is an exhaustive policy response to climate change. High-emission nations are no doubt obligated to do more—not only in terms of long-term emissions reductions but perhaps also the payment of compensation to particular communities harmed by climate change.<sup>8</sup>

<sup>7</sup> See Nuccitelli, "Climate Change Could Cost the U.S. Economy Hundreds of Billions a Year by 2090," and *World Health Organization*, "Climate Change and Health," respectively.

<sup>8</sup> On compensation, see, e.g., Peter Singer, "Ethics and Climate Change: A Commentary on MacCracken, Toman, and Gardiner," *Environmental Values* 15, no. 3 (2006): 415–22. See also Gardiner, *A Perfect Moral Storm*, 366.

The strongest case for geoengineering defends it as a temporary emergency measure designed to avert an imminent disaster.<sup>9</sup> Any plausible moral theory will include a principle that at least temporarily suspends our normal moral obligations when doing so is needed to avoid a catastrophe.<sup>10</sup> For example, government-mandated quarantines are impermissible under normal conditions because they violate citizens' rights of free movement. Yet they may be permissible as short-term measures implemented to save millions of lives that are threatened by the outbreak of a deadly contagious disease. Similarly, geoengineering is impermissible under normal conditions because it violates a duty to preserve natural environments (for example). Yet it may be permissible as a short-term measure to prevent millions of deaths from a climate catastrophe.

I take it to be uncontroversial, even among the critics of geoengineering, that we'd have a strong reason to geoengineer to avoid catastrophe. The controversy concerns whether geoengineering would be justified all things considered. Below I'll explain why none of the moral reservations harbored by geoengineering's critics are powerful enough to override our duty to prevent catastrophic environmental impacts. I'll start by considering objections to undertaking serious research into the safety, cost, and effectiveness of geoengineering. Then I'll address arguments against performing geoengineering even if research suggests it's needed to avoid a climate catastrophe.

## II. SHOULD WE RESEARCH GEOENGINEERING?

Before we examine the conditions under which we ought to deploy geoengineering measures, we need to ask whether it is morally permissible to research geoengineering in the first place. Critics have their doubts; in particular, they worry that such research may induce political inertia and inappropriately divert resources away from catastrophe prevention toward catastrophe preparation.

### A. *Political inertia*

One reason to refrain from even undertaking geoengineering research is that such research may induce complacency about climate change. The American Meteorological Society fears that "the possibility of quick and seemingly inexpensive geoengineering fixes could distract the public and

<sup>9</sup> See, e.g., Victor et al., "The Geoengineering Option." The Royal Society notes, "Solar Radiation Management methods may provide a potentially useful short-term backup to mitigation in case rapid reductions in global temperatures are needed," in The Royal Society, "Geoengineering the Climate: Science, Governance, and Uncertainty" (London: Royal Society, 2009): xi.

<sup>10</sup> See, e.g., Richard Brandt, *Morality, Utilitarianism, and Rights* (New York: Cambridge University Press, 1992), 151; Brad Hooker, *Ideal Code, Real World* (Oxford: Oxford University Press, 2000), 98-99; Robert Nozick, *Anarchy, State, and Utopia* (New York: Basic Books, 1974), 30.

policy makers from critically needed efforts to reduce greenhouse gas emissions and build society's capacity to deal with unavoidable climate impacts."<sup>11</sup> Gardiner says that "many people worry that substantial research on geoengineering will itself encourage political inertia on mitigation and bring on the nightmare scenario and deployment. If this is so, we might have strong reason to limit or resist such research at this stage. We do not want to create a self-fulfilling prophecy."<sup>12</sup> Others have voiced the same concern.<sup>13</sup>

Should we expect research on geoengineering to significantly worsen climate change inaction? After all, the United States, among others, is *already* locked in a state of political inertia: despite knowing about climate change for decades, governments have failed to take large-scale and effective corrective measures.<sup>14</sup> The United States has not come close to cutting carbon emissions to a sufficient extent.<sup>15</sup> Congress has an extensive history of failing to take meaningful action on climate change.<sup>16</sup> Worldwide, few countries are on pace to hit the relevant climate targets.<sup>17</sup> Inertia is precisely the reason why geoengineering is under consideration at all.

Moreover, political inertia will likely persist with or without geoengineering research because large-scale political efforts to mitigate climate change are plagued by a stubborn collective action problem. Indeed, political solutions to climate change face the same sort of collective action problem that gives rise to climate change in the first place.<sup>18</sup> Because any individual's contribution to such political solutions will be inconsequential, no individual has an incentive to contribute wisely—for instance, by figuring out the

<sup>11</sup> American Meteorological Society, "Geoengineering the Climate System," 1.6.13. Accessed 2.10.20. Available online at: <https://www.ametsoc.org/index.cfm/ams/about-ams/ams-statements/statements-of-the-ams-in-force/geoengineering-the-climate-system/>

<sup>12</sup> Gardiner, *A Perfect Moral Storm*, 356.

<sup>13</sup> Edward Parson, "Reflections on Air Capture: The Political Economy of Active Intervention in the Global Environment," *Climatic Change* 74, no. 1 (2006): 5–15; Natural Environment Research Council, *Experiment Earth? Public Dialogue on Geoengineering* (Swindon, UK: Natural Environment Research Council, 2010); Albert Lin, "Does Geoengineering Present a Moral Hazard?" *Ecology Law Quarterly* 40, no. 3 (2013): 673–712.

<sup>14</sup> Gardiner raises this point as well; see Stephen Gardiner, "Some Early Ethics of Geoengineering the Climate: A Commentary on the Values of the Royal Society Report," *Environmental Values* 20, no. 2 (2011): 163–88, 167. I discuss the issue of political inertia and climate change in greater detail in Christopher Freiman, *Why It's OK to Ignore Politics* (New York: Routledge, 2020), chap. 4.

<sup>15</sup> Brad Plumer, "U.S. Carbon Emissions Surged in 2018 Even As Coal Plants Closed," *The New York Times* 1.8.19. Accessed 6.25.19. Available online at: <https://www.nytimes.com/2019/01/08/climate/greenhouse-gas-emissions-increase.html>

<sup>16</sup> Amber Philips, "Congress's Long History of Inaction on Climate Change, in 6 Acts," *Washington Post*. 12.1.15. Accessed 6.25.19. Available online at: [https://www.washingtonpost.com/news/the-fix/wp/2015/12/01/congresss-long-history-of-inaction-on-climate-change-in-6-parts/?utm\\_term=.66aaa8c8b1ed](https://www.washingtonpost.com/news/the-fix/wp/2015/12/01/congresss-long-history-of-inaction-on-climate-change-in-6-parts/?utm_term=.66aaa8c8b1ed)

<sup>17</sup> Intergovernmental Panel on Climate Change, "Strengthening and Implementing the Global Response." Accessed 9.24.20. Available online at: <https://www.ipcc.ch/sr15/chapter/chapter-4/>

<sup>18</sup> I explore this point in further detail in Christopher Freiman, *Unequivocal Justice* (New York: Routledge, 2017), 7–10.

most effective methods of decarbonization and agitating for the policies most likely to realize them.

Geoffrey Brennan argues that the rational ignorance of voters incentivizes governments to take largely cosmetic steps to address climate change.<sup>19</sup> It is typically not rational for citizens to vote to change the outcome of the election because their vote has an insignificant chance of being decisive. However, it could be rational for them to vote to express their allegiance to certain moral values like environmental preservation in the same way it is rational for sports fans to express their allegiance to the home team with a banner at the game.<sup>20</sup> As Brennan writes,

The possibility of global catastrophe is a highly salient and ethically charged issue. It is the kind of issue on which citizen voters expect their candidates to “have views” and on the basis of which candidates’ moral qualities are assessed. No one who is entirely indifferent to the “big issues of the day” deserves to take up space in high places—and on any reckoning, global warming and climate change are “big issues.”<sup>21</sup>

However, because it is not rational for voters to spend significant time inspecting the details of a policy, governments have a strong incentive to push for small, low-cost emissions reductions done for show, which function as signals to the public that they take climate change seriously.

Empirical evidence supports the notion that the typical citizen will be rationally ignorant of environmental issues. By way of example, consider that only about one quarter of Americans know that a cap-and-trade scheme concerns environmental policy—more believe it addresses Wall Street regulation than the environment.<sup>22</sup> American adults are significantly less likely than scientific experts to support nuclear energy as a response to climate change.<sup>23</sup> Political inertia is the expected result of the (in)action of political participants who have little incentive to push legislators to effectively combat climate change.

Gardiner objects that “severe political obstacles must be assumed if geoengineering is to seem like a serious option at all. But then there is a real worry that these obstacles will be so severe that ‘modest research only’ really is the only (politically) viable geoengineering policy.”<sup>24</sup> This point

<sup>19</sup> Geoffrey Brennan, “Climate Change: A Rational Choice Politics View,” *The Australian Journal of Agricultural and Resource Economics* 53, no. 3 (2009): 309–326.

<sup>20</sup> See Geoffrey Brennan and Loren Lomasky, *Democracy and Decision: The Pure Theory of Electoral Preference* (Cambridge: Cambridge University Press, 1993).

<sup>21</sup> *Ibid.*, 323.

<sup>22</sup> Rasmussen Reports, “Toplines – Cap and Trade I – May 7-8, 2009.” 5.7-8.2009. Accessed 6.6.19. Available online at: [http://www.rasmussenreports.com/public\\_content/politics/questions/pt\\_survey\\_questions/may\\_2009/toplines\\_cap\\_trade\\_i\\_may\\_7\\_8\\_2009](http://www.rasmussenreports.com/public_content/politics/questions/pt_survey_questions/may_2009/toplines_cap_trade_i_may_7_8_2009)

<sup>23</sup> Pew Research Center, “Elaborating on the Views of AAAS Scientists, Issue by Issue,” 7.23.15. Accessed 6.25.19. Available online at: <https://www.pewresearch.org/science/2015/07/23/elaborating-on-the-views-of-aaas-scientists-issue-by-issue/>

<sup>24</sup> Gardiner, *A Perfect Moral Storm*, 366.

is well taken; however, there are several reasons to think that geoengineering will be at least marginally more viable politically than other proposals. The first reason concerns cost. Geoengineering would be *radically* less expensive than alternative policies.<sup>25</sup> Three quarters of Americans are unwilling to pay even forty dollars per month to fund policies to combat climate change.<sup>26</sup> The relatively low price tag of geoengineering increases its political viability. Second, geoengineering requires far less collective action than alternative policies, thereby lessening the institutional problems discussed above.<sup>27</sup>

There is also some suggestive evidence that treating geoengineering as a viable policy alternative will counteract climate change skepticism. *Solution aversion*—a fear of the policy response to a problem rather than the problem itself—may explain why some are skeptical of climate change.<sup>28</sup> In particular, researchers found that conservative skepticism of anthropogenic climate change is at least partly attributable to resistance to the proposed political responses, which tend to rely heavily on government regulation of the economy.<sup>29</sup> A different study found that those with conservative leanings became *more* concerned about climate change risks when presented with information about geoengineering. The authors report:

Geoengineering is consonant with a narrative that depicts human technological ingenuity as the principal means by which our species has succeeded in overcoming environmental constraints on its flourishing. Geoengineering permits climate change to be assimilated into this story [ ... ] From this point of view, the anxiety that geoengineering might

<sup>25</sup> On the costs of geoengineering, see Scott Barrett, "The Incredible Economics of Geoengineering," *Environmental and Resource Economics* 39, no. 1 (2008): 45–54.

<sup>26</sup> Energy Policy Institute at the University of Chicago, "New Poll: Nearly Half of Americans Are More Convinced Than They Were Five Years Ago That Climate Change Is Happening, With Extreme Weather Driving Their Views." 1.22.18 Accessed 2.13.20. Available online at: [http://www.apnorc.org/projects/Documents/EPIC\\_press\\_release.pdf](http://www.apnorc.org/projects/Documents/EPIC_press_release.pdf)

<sup>27</sup> This point is discussed in greater detail in Gernot Wagner and Martin Weitzman, *Climate Shock: The Economic Consequences of a Hotter Planet* (Princeton, NJ: Princeton University Press, 2015). That geoengineering requires less collective action than alternatives comes with costs as well as benefits, however. For instance, a nation that expects to suffer particularly large harms as a result of climate change may decide to unilaterally geoengineer and perhaps put other nations at risk. Yet nations that are at a comparatively low risk for climate change harms may be motivated to pursue effective mitigation policies precisely because they wish to avoid the risks posed by unilateral geoengineering. For discussion, see Adam Millard-Ball, "The Tuvalu Syndrome. Can Geoengineering Solve Climate's Collective Action Problem?" *Climatic Change* 110, nos. 3-4 (2012): 1047-1066; Adrien Fabre and Gernot Wagner, "Availability of Risky Geoengineering Can Make an Ambitious Climate Mitigation Agreement More Likely," *Humanities and Social Sciences Communications* 7 (2020), <https://doi.org/10.1057/s41599-020-0492-6>. Thus, the prospect of unilateral geoengineering is something to take seriously, but it's unclear at this stage of inquiry what sort of results we should expect it to bring about.

<sup>28</sup> Troy Campbell and Aaron Kay, "Solution Aversion: On the Relation Between Ideology and Motivated Disbelief," *Journal of Personality and Social Psychology* 107, no. 5 (2014) 809–824.

<sup>29</sup> *Ibid.*

“let the air out” of efforts to arouse political concern with climate change has things exactly backward.<sup>30</sup>

Whether exposure to information about geoengineering will ultimately help or hinder political efforts to combat climate change is an empirical question. But at this stage, we lack evidence indicating that the inertia problem is severe enough to rule out research on geoengineering entirely.

A final point: as a general style of objection, the inertia argument proves too much—at least if the argument is taken to allege that the *mere possibility* of inducing inertia is enough to defeat the case for research. It implies that we shouldn’t research diabetes drugs because the research might encourage diabetics to eat poorly, thus ultimately forcing them to use the drugs. The research would create a self-fulfilling prophecy. A similar argument applies to treatments for particular patients. But a doctor shouldn’t refrain from considering whether a diabetic patient is a suitable candidate for a drug simply because it might make the patient complacent about making fundamental lifestyle changes.<sup>31</sup> For the inertia objection to be a decisive one, we’d need evidence that research will, in fact, induce inertia.

Still, the inertia argument identifies a real worry. Remedial measures do come with a risk of causing complacency about the root problem. But there are risks associated with *not* considering remedial measures as well—for instance, the patient might see their condition worsen for lack of a pharmaceutical fix. To know the risks and rewards of the drug, we need to research the drug. Similarly, taking geoengineering seriously may indeed make inertia even worse. That’s a risk, but it’s a risk that has to be weighed against the risk of ignoring geoengineering’s potential to mitigate the harms of climate change. And to know how risky *forgoing* geoengineering might be, we need to research its safety and efficacy.<sup>32</sup>

<sup>30</sup> Dan Kahan, Hank Jenkins-Smith, Tor Tarantola, Carol Silva, and Donald Braman, “Geoengineering and Climate Change Polarization: Testing a Two-Channel Model of Science Communication,” *The ANNALS of the American Academy of Political and Social Science* 658, no. 1 (2015): 192–222, 206.

<sup>31</sup> A variation on the inertia objection could allege that geoengineering research will have a tendency to spotlight geoengineering’s benefits and understate its costs, thereby de-motivating the pursuit of alternative climate policies. This strikes me as a plausible concern (although I suspect the widespread skepticism of geoengineering would mitigate this tendency.) However, I don’t regard this as a decisive objection to geoengineering because a similar worry applies to its alternatives as well. All policy and technological responses to climate change have costs and benefits, and it’s natural that those invested in any given response downplay the former and highlight the latter. Thanks are due to an anonymous referee for raising this objection.

<sup>32</sup> The importance of knowing the risk of not geoengineering explains why arguments alleging that geoengineering might be appropriately regarded as “unthinkable” are unpersuasive. See Gardiner *A Perfect Moral Storm*, 383–85. On the “unthinkable,” see Bernard Williams, *Utilitarianism: For and Against*, with J. J. C. Smart (Cambridge: Cambridge University Press, 1973). I provide a more detailed defense of the consideration of opportunity costs in environmental ethics in Christopher Freiman, “Cost-Benefit Analysis and the Value of Environmental Goods,” *Georgetown Journal of Law and Public Policy* 13 (2015): 337–47.



### B. *Inappropriate preparation*

A further objection to researching geoengineering alleges that planning for a disaster instead of preventing it can be morally wrong—especially when the disaster is of one’s own making. Gardiner writes,

One can certainly see someone arguing that advance planning for a nightmare scenario is itself morally inappropriate when that nightmare is to be brought on by one’s own future moral failure. Hence, some will say that it is morally inappropriate to start planning for geoengineering when mitigation and adaptation are still on the table; instead, all of our energies and efforts should go into preventing the nightmare scenario—where geoengineering starts to look acceptable—from arising.<sup>33</sup>

Before exploring the relevance of moral failure, let me register an initial worry about Gardiner’s suggestion that all of our resources should be routed toward prevention. It’s certainly intuitive to think that one should deploy one’s resources to stop harms from materializing in the first place rather than to cushion the blow after they arrive. Still, the claim that “all of our energies and efforts should go into preventing the nightmare scenario” is surely too strong.<sup>34</sup> Even if we should allocate most of our resources to prevention, it would be irresponsible to forgo planning and preparation for the nightmare scenario entirely. By analogy, even if one should prioritize a collision avoidance system when purchasing a car, one should still spend on features that reduce the chance of harm should a collision occur.

Perhaps this case is not analogous to a climate catastrophe. You can take all reasonable precautions, drive responsibly, and still have a car accident through no fault of your own. But a climate catastrophe would be brought on by our own irresponsible choices—in Gardiner’s words, by our “own future moral failure.”<sup>35</sup> Preparing for the nightmare scenario is morally worse when you could simply buckle down and take sensible steps to prevent the nightmare from occurring in the first place.

Whether this line of objection succeeds depends on our assessment of the likelihood that we will, in fact, take the sensible preventative steps. Ideally we’d change our ways so that the nightmare scenario never comes to pass. That much is uncontroversial. The problem is, there’s no guarantee that we *will* change our ways. Indeed, the only reason why we are considering an undesirable course of action at all is because the prospects for prevention are uncertain. That’s a failure on our part. But we only compound the problem by failing to prepare.

By analogy, the best option for a single parent struggling with a potentially deadly drug addiction would be to wean off the drug. This course of

<sup>33</sup> Gardiner, *A Perfect Moral Storm*, 383.

<sup>34</sup> *Ibid.*, italics mine.

<sup>35</sup> *Ibid.*

action would prevent the nightmare scenario—their death—from occurring at all and lessen the urgency of preparing their children for life without them. Nevertheless, the parent ought to make custodial arrangements for their child in the event that the nightmare scenario does come to pass. It would be morally irresponsible to *not* prepare. Or suppose Pam is a pyromaniac. Her best course of action would be to stop setting things on fire. But if her repeated attempts to reform haven't gone well, it would be wise for her to buy a fire extinguisher.

### III. SHOULD WE GEOENGINEER IF IT'S THE LESSER EVIL?

I've argued that geoengineering is, at a minimum, worth researching. Now suppose that research has produced a significant amount of evidence that suggests it to be a sufficiently safe and effective option for avoiding a climate catastrophe. Moreover, suppose we reach a point at which we are forced to choose "between allowing catastrophic impacts to occur or engaging in geoengineering."<sup>36</sup> Should we do it?

I will argue that we should. None of the considerations mobilized by critics of geoengineering are sufficiently powerful to defeat our duty to prevent a climate catastrophe.

#### A. A duty of environmental preservation

Why should we have moral reservations about geoengineering? That is, why count it as an evil at all, albeit a lesser one than climate catastrophe?

One answer is that geoengineering violates a duty of environmental preservation. Dale Jamieson offers a representative formulation: "It is wrong to interfere dramatically with fundamental natural processes."<sup>37</sup> Paul Taylor likewise admonishes attempts to "manipulate, control, modify, or 'manage' natural systems."<sup>38</sup> Others have put forth similar worries about interfering with nature generally and geoengineering schemes in particular. Clive Hamilton, for example, suggests that a willingness to geoengineer reveals an underlying belief that "a natural Earth has no intrinsic claim over a human-made one."<sup>39</sup>

There are at least two ways to respond to this objection. First, one might simply deny that we have a direct duty to preserve the environment. We surely have an *indirect* duty to preserve the environment—we owe it to humans and other sentient creatures. Thus, when environmental preservation conflicts with human and animal welfare, we're under no obligation to preserve the environment.

<sup>36</sup> *Ibid.*, 353.

<sup>37</sup> Jamieson, "Ethics and Intentional Climate Change," 325.

<sup>38</sup> Paul Taylor, *Respect for Nature* (Princeton, NJ: Princeton University Press, 1986), 175.

<sup>39</sup> Clive Hamilton, "Geoengineering and the Politics of Science," *Bulletin of the Atomic Scientists* 70, no. 3 (2014): 17–26, 24.

A second reply accepts that we have a direct duty of environmental preservation but argues that the duty can be overridden to secure a sufficiently valuable good. By analogy, one might have a duty not to ruin the treasured family painting, but one may set it ablaze to prevent hypothermia. Similarly, perhaps we have a duty not to modify the planet but we may nevertheless geoengineer to stave off climate catastrophe. This outcome would be regrettable, but sometimes we ought to do regrettable things.

The view that our duty of environmental preservation is defeasible is plausible if only because preserving human life requires violating this duty to at least some degree. The production of food, water, shelter, and clothing all interfere with natural systems.<sup>40</sup> So do vaccines and fluoride toothpaste. But few, if any, would say that brushing your teeth is an all-things-considered moral wrong.<sup>41</sup>

Indeed, decarbonization itself will require us to violate a duty of environmental preservation. Solar power requires lithium mines, and hydroelectric facilities dam rivers. These modifications of nature are justified all things considered because they secure a sufficiently valuable good, namely a renewable energy economy. The same reasoning applies to geoengineering—the modifications involved may violate the *prima facie* duty of environmental preservation, but they are justified all things considered because they secure a sufficiently valuable good, namely the prevention of a climate catastrophe.

Moreover, the use of geoengineering to avoid a climate catastrophe would also *preserve* certain parts of the natural environment, such as those species that would have otherwise gone extinct. In some cases, the only way to preserve one part of the natural environment is to modify another. Indeed, this is the same trade-off we make in the widely accepted examples of permissible environmental modification mentioned above—that is, mining lithium and damming rivers for the sake of producing cleaner energy.<sup>42</sup>

### B. *Treating the symptoms*

A further objection, in the words of Jeffrey Kiehl, alleges that geoengineering would be “treating the symptom, not the cause.”<sup>43</sup> Stephen Schneider analogizes geoengineering to using methadone to treat a heroin addiction

<sup>40</sup> For a similar point, see Preston, “Re-Thinking the Unthinkable,” 461–62. Preston, however, thinks that “meddling with the earth’s *fundamental* processes,” as geoengineering would, may be morally different. “Re-Thinking the Unthinkable,” 463 (italics mine).

<sup>41</sup> I explore worries about a duty to not interfere with nature in Christopher Freiman, “Why Parents Should Enhance Their Children,” in *The Ethics of Ability and Enhancement*, ed. Jessica Flanigan and Terry Price (New York: Palgrave Macmillan, 2017), 158–59.

<sup>42</sup> I owe this observation to an anonymous referee.

<sup>43</sup> Jeffrey Kiehl, “Geoengineering Climate Change: Treating the Symptom Over the Cause?” *Climatic Change* 77, no. 3 (2006): 227–28, at 228. See also Holmes Rolston III “The Anthropocene!” 68.

rather than weaning the addict over time.<sup>44</sup> Similarly, we should solve the root climate problem and wean off fossil fuels instead of trying to simply mitigate the effects via geoengineering.

I suspect that this argument violates the conditions of the lesser-evil debate. It is uncontroversial that “curing the disease” is the best option. Ideally, the world would decarbonize, thereby obviating the need to consider geoengineering in the first place. However, we are now considering the question of how to proceed if we arrive at the point at which geoengineering is our only viable option for avoiding a climate catastrophe. If we are unable to cure the disease, I see little reason not to treat the symptoms.

To further motivate this view, consider a small-scale case that is roughly analogous to climate change. Suppose that a storm threatens to flood your town, but if everyone pitches in to build a levee, the flood can be averted entirely. This is the first-best option—everyone’s lives and property will be spared. But too few people are pitching in. Perhaps the townspeople succumb to the free-rider problem. Each individual can receive the benefits of the collective effort without contributing, and so few, if any, individuals contribute. Or maybe they all preferred to contribute so long as others did their fair share, but didn’t trust that others would pull their weight. They might also have disagreed about how, exactly, to distribute the costs associated with building the levee. Let us suppose that, for one reason or another, the levee goes unbuilt and it’s looking highly likely that the town will flood.

It is morally appropriate—and probably morally *obligatory*—to pack an emergency bag for your family in the event that you’ll need to evacuate. It’s true that the first-best solution wouldn’t require you to pack an emergency bag because sufficiently many people would have pitched in to prevent the flood and you would have been able to stay at home. But the collective effort was unsuccessful, thereby rendering the first-best solution untenable. Thus, you should turn to the second-best solution. This second-best solution only treats the “symptoms” (that is, the danger posed by the flood) rather than the underlying cause (preventing the flood in the first place), but it remains the appropriate course of action.

Before moving on, let me also note that treating the symptoms of a problem doesn’t preclude us from *also* treating the underlying cause going forward. Diabetics may take Metformin while at the same time changing their diet and exercise regimen. Similarly, we may allocate some resources to geoengineering in order to “buy time” while allocating other resources to long-term decarbonization.

<sup>44</sup> Stephen Schneider, “Geoengineering: Could We or Should We Make It Work?” *Philosophical Transactions: Mathematical, Physical and Engineering Sciences* 366 (2008): 3843–3862, 3857. See also Stephen Schneider, “Geoengineering: Could—Or Should—We Do It?” *Climatic Change* 33, no. 3 (1996): 291–302.

### C. *Succumbing to moral failure*

Several critics allege that resorting to geoengineering would amount to an admission of moral failure. It would show that we weren't up to the task of preventing climate change and this result would be cause for regret. As Hamilton puts it, "A fleet of planes daily delivering sulfate particles into the upper atmosphere would be a grim monument to the ultimate failure of unbridled techno-industrialism and our unwillingness to change the way we live."<sup>45</sup> Gardiner suggests that "our willingness to facilitate (or engage in) geoengineering might show that we have failed to take on the challenge facing us and instead have succumbed to moral corruption. [ ... ] Think about what people mean when, in tragic circumstances, they say, '*Has it really come to this?*'"<sup>46</sup>

Hamilton and Gardiner may well be right.<sup>47</sup> Still, those who are guilty of moral failure should choose the lesser evil when the menu lists nothing but evils—even when it's their fault they're in the bind. In support of this thought, consider the following case:

Four wounded patients arrive at the hospital. Three have moderate wounds and one has severe wounds. If Larry the surgeon begins work now, he can save all four. However, Larry has been looking forward to watching Monday Night Football all week. So he waits to operate until the game is over. Now, because of his irresponsible choice, Larry only has time to save the three with moderate wounds or the one with severe wounds.

Larry is no doubt guilty of a moral failure; he shouldn't have skipped the surgery to watch the game. Had he not failed in this way, he wouldn't be forced to choose to let one die or three die—he could have saved them all. Moreover, Larry should lament that his own irresponsible behavior is what forces him to make this choice between two evils.

Still, Larry should choose the lesser evil—he should save the three and let the one die. The fact that he could have avoided the dilemma doesn't undermine the claim that choosing the lesser evil is the correct response to the dilemma once it's upon him. Similarly, the possibility that we could avoid having to choose between geoengineering and climate catastrophe

<sup>45</sup> Clive Hamilton, "Geoengineering Is Not a Solution to Climate Change," *Scientific American*. 3.10.15. Accessed 2.13.20. Available online at: <https://www.scientificamerican.com/article/geoengineering-is-not-a-solution-to-climate-change/>

<sup>46</sup> Gardiner, *A Perfect Moral Storm*, 392, italics in the original.

<sup>47</sup> It's worth noting, though, that those who research or even engage in geoengineering need not themselves be guilty of a moral failure. Perhaps they are attempting to mobilize support for alternative measures, but foresee that their attempts may not persuade enough people to succeed. Here it seems blameless to research, and even implement, geoengineering as a backup plan in case their best efforts fall short. I owe this thought to an anonymous referee.

doesn't undermine the claim that we should choose geoengineering, if it comes to that.<sup>48</sup>

#### D. *Redistributing harm*

A further objection to geoengineering grants that it may reduce harm overall, but in doing so, it will *redistribute* harms. Here's Gardiner:

Suppose, for example, that geoengineering really does cause less harm than climate catastrophe but that this harm accrues to different individuals [ ... ] When we choose geoengineering, innocents are harmed through our agency, and this may be a marring evil even if it is in some sense a "lesser evil" overall. One can certainly imagine it being something that people find, as the expression goes, *hard to live with*.<sup>49</sup>

Perhaps we have reason to refrain from geoengineering because it will bring harm to people who would not have been harmed otherwise, even though it will lessen the harm overall.

The harm redistribution argument is unpersuasive because *any* policy response to climate change will harm people who would otherwise have been unharmed. Consider various measures we can take to decarbonize. We could pursue hydroelectric, wind, and solar power to a greater extent. But dam failures have resulted in over 100,000 deaths.<sup>50</sup> Accidents in the production of wind and solar power have killed people as well.<sup>51</sup> More mundanely, shifting away from fossil fuels to other energy sources will cause some people to drive to locations that they otherwise wouldn't have driven to, thus causing some deadly traffic accidents that wouldn't have occurred if not for decarbonization. For all of these reasons, decarbonization will harm some who would otherwise have gone unharmed. But we shouldn't be

<sup>48</sup> Christopher Preston ("Re-Thinking the Unthinkable," 470) makes a similar point:

Our failure to address greenhouse gas emissions means [ ... ] the blighting has already occurred. Any discussion of the tarnishing or blighting that might result from the decision to geoengineer may be moot. The moral damage already been done. Clearly the fact that we are already blighted does not provide free reign to compound our moral condition by performing additional evils. But climate engineering may not in the end be a compounding evil. Rather, it could serious attempt to make amends.

<sup>49</sup> Gardiner, *A Perfect Moral Storm*, 393, italics in the original. On risk redistribution, see also American Meteorological Society, "Geoengineering the Climate System," 2013.

<sup>50</sup> James Conca, "How Deadly is Your Kilowatt? We Rank the Killer Energy Sources," *Forbes*. 6.10.12. Accessed 2.14.20. Available online at: <https://www.forbes.com/sites/jamesconca/2012/06/10/energys-deathprint-a-price-always-paid/#390f347a709b>

<sup>51</sup> James Conca, "Forget Eagle Deaths, Wind Turbines Kill Humans," *Forbes*. 9.29.13. Accessed 2.14.20. Available online at: <https://www.forbes.com/sites/jamesconca/2013/09/29/forget-eagle-deaths-wind-turbines-kill-humans/#6c2b70895467>; David Biello, "Explosive Silicon Gas Casts Shadow on Solar Power Industry," *Scientific American*. 4.2.10. Accessed 2.14.20. Available online at: <https://www.scientificamerican.com/article/explosive-gas-silane-used-to-make-photovoltaics/>

deterred from decarbonization for this reason. Harm redistribution is permissible in this case because the harms caused by continued reliance on fossil fuels are vastly greater than the harms caused by decarbonization. Similarly, harm redistribution in the case of geoengineering is permissible in the “nightmare scenario” because the harms caused by a climate catastrophe are vastly greater than the harms caused by geoengineering (we are assuming for argument’s sake).

Moreover, this analysis generalizes to other cases. Smallpox vaccinations kill roughly one or two people for every million vaccinated.<sup>52</sup> A policy of allowing ambulances on the road saves many lives but inevitably kills a few innocent drivers and pedestrians in traffic accidents. In these examples and others, the policy redistributes benefits and harms; however, the benefits outnumber the harms to such a significant extent that the redistribution is justified. (Perhaps those harmed have a claim to compensation under certain conditions.)<sup>53</sup> And so it goes with geoengineering: if its benefits far exceed its harms, then we ought to pursue it.

### *E. Hubris*

Thomas Hill asks us to consider what might be wrong about someone’s decision to pave over their beautiful yard, filled with grass, flowers, and an avocado tree.<sup>54</sup> The puzzle, on Hill’s view, is how this decision to destroy nature could be wrong even though it doesn’t violate any rights or cause any suffering—indeed, it may even promote the homeowner’s happiness.

Hill suggests that a willingness to destroy nature reveals a lack of certain virtues, including an appropriate sense of humility. To be humble is, among other things, to soberly acknowledge and accept one’s limitations and to appreciate one’s place in the natural world. A number of geoengineering’s critics argue in this spirit: geoengineering would be wrong in part because it represents a monumental failure of humility. Hamilton notices “a gut reaction to the hubris of it all—the idea that humans could set out to regulate the Earth system, perhaps in perpetuity.”<sup>55</sup>

<sup>52</sup> World Health Organization, “Global Vaccine Safety,” 1.7.09. Accessed 2.14.20. Available online at: [https://www.who.int/vaccine\\_safety/committee/topics/smallpox/questions/en/](https://www.who.int/vaccine_safety/committee/topics/smallpox/questions/en/)

<sup>53</sup> Eric Mack argues that we may be within our rights to violate our ordinary moral obligations in emergency conditions, but that we must provide compensation when we can. In his example, you may break into an empty cabin to avoid freezing to death, but you are obligated to compensate the owner of the cabin. Eric Mack, “Non-Absolute Rights and Libertarian Taxation,” *Social Philosophy and Policy* 23, no. 2 (2006): 109-141. This style of view might permit geoengineering if it is the only way to avoid a catastrophe but insist that the beneficiaries compensate those harmed.

<sup>54</sup> Thomas Hill, “Ideals of Human Excellence and Preserving Natural Environments,” *Environmental Ethics* 5, no. 3 (1983): 211–24.

<sup>55</sup> Clive Hamilton, “The Risks of Climate Engineering,” *The New York Times*. 2.12.15. Accessed 2.14.20. Available online at: <https://www.nytimes.com/2015/02/12/opinion/the-risks-of-climate-engineering.html>. See also Gardiner, *A Perfect Moral Storm*, 391; Rolston III, “The Anthropocene!” 67.

There are at least two different ways to interpret the hubris objection. According to the first, a willingness to make radical changes to complex, long-standing systems is, in itself, vicious or indicative of a flawed character. According to the second, we have strong pragmatic reasons to avoid such changes. I'll argue that the first interpretation is implausible and that the second interpretation, while plausible, doesn't undermine the case for geoengineering. Rather, it suggests only that we ought to geoengineer cautiously.

One reason to be skeptical of the claim that pursuing radical change is, in itself, vicious is simply that there are complex, long-standing systems that ought to be changed. Historically, hubris arguments have been lodged against a variety of social reforms, including legally recognizing same-sex marriage and distributing birth control.<sup>56</sup> The arguments alleged that humility obliges us to respect the underlying fabric of society and refrain from radically disrupting it. But few today would argue that those who pushed for the relevant reforms were acting viciously.

Here's a second objection to the claim that a radical response to climate change is objectionable in itself: it would rule out decarbonization as well. Holmes Rolston III suggests that defenses of geoengineering seem "like panic on a planet that engineers are realizing that they have messed up in ways almost beyond their control [ ... ] Our power to make changes exceeds our power to predict the results, exceeds our power to control even those adverse results we may foresee."<sup>57</sup> But sufficiently large-scale decarbonization will involve deep changes to complex social and economic systems. Indeed, as the UN Intergovernmental Panel on Climate Change puts it, we must make "rapid, far-reaching and unprecedented changes in all aspects of society" to meet the challenge posed by climate change.<sup>58</sup> To think that we can anticipate and control all, or even most, of the consequences of such changes is, in a word, hubristic. Nevertheless, we ought to decarbonize.

David Schmidtz draws attention to an underappreciated similarity between economics and ecology:

Like economic reasoning, ecological reasoning is reasoning about competition and unintended consequences, and the internal logic of systems, a logic that dictates how a system responds to attempts to

<sup>56</sup> For instance, Supreme Court Justice Samuel Alito argued that same-sex marriage clashes with the "traditional" understanding of marriage: "For millennia, marriage was inextricably linked to the one thing that only an opposite-sex couple can do: procreate." *Obergefell v. Hodges*, 576 U.S. 644 (2015). The author Pearl Buck apparently believed that the birth control pill "would destroy the nation's sexual mores and unravel the fabric of marriage and family, leading to social chaos." Elaine Tyler May, *America and the Pill: A History of Promise, Peril, and Liberation* (New York: Basic Books, 2010), 72.

<sup>57</sup> Rolston III, "The Anthropocene!" 67.

<sup>58</sup> Brandon Miller and Jay Croft, "Planet Has Only Until 2030 to Stem Catastrophic Climate Change, Experts Warn," CNN 10.8.18. Accessed 9.24.20. Available online at: <https://www.cnn.com/2018/10/07/world/climate-change-new-ipcc-report-wxc/index.html>



manipulate it. Environmental activism and regulation do not automatically improve the environment. It is a truism in ecology, as in economics, that well-intentioned interventions do not necessarily translate into good results. Ecology (human and nonhuman) is complicated, our knowledge is limited, and environmentalists are themselves only human.<sup>59</sup>

Critics are right to stress the distinction between how we might *want* geoengineering to work and how it *will* work. But it's also important to stress the distinction between how we might *want* decarbonization to work and how it *will* work.

To take just a few examples, it's hard to predict how decarbonization will change the price of food and heating and how consumers and voters will respond to the change. We don't know how firms, politicians, and bureaucrats will adjust their behavior in light of the incentives generated by carbon taxes or cap-and-trade schemes. The geopolitical landscape could be radically altered as the shift away from fossil fuels toward different sources of energy redistributes economic power among nations. Yet even though decarbonization risks unpredictable and large-scale disruption, it remains worth doing. Since the mere risk of unintended consequences doesn't defeat the case for decarbonization, it shouldn't defeat the case for geoengineering either.<sup>60</sup>

Still, the hubris objection is right to emphasize the need for humility—it's easy to make a mess of things when we tinker with complex systems. But this is a reason to geoengineer with caution rather than a reason not to geoengineer at all. By analogy, there is nothing morally wrong with a doctor's decision to prescribe a new pharmaceutical treatment for her patient. Still, it would be wise to start with a modest initial dose, see how things go, and scale up from there.

We could take a similar approach to geoengineering should it turn out to be our least bad option. For instance, researchers are planning to experiment with geoengineering measures on a small scale.<sup>61</sup> Moreover, David Keith

<sup>59</sup> David Schmidtz, *Person, Polis, Planet* (New York: Oxford University Press, 2008), 235.

<sup>60</sup> Stephen Schneider ("Geoengineering: Could We or Should We Make It Work?" 3858) considers an objection along these lines and responds in part by noting that "'geo' and 'social' engineering" are both "sufficiently unprecedented on the scales being considered here that estimates of impacts will remain highly uncertain and subjective for some time to come. Moreover, values will dominate the trade-off: for example, risk aversion versus risk proneness or the precautionary principle for protecting nature versus the unfettered capacity of enterprising individuals, firms or nations to act to improve their economic conditions." This style of response, however, does not adequately address the worry I raise here, which is that risk aversion itself, not "the unfettered capacity of enterprising individuals, firms, or nations to act to improve their economic conditions," is a reason for precaution in the case of economic change.

<sup>61</sup> Lisa Mullins and Lynn Jolicoeur, "Harvard Scientists Plan First-Ever Field Experiment Related To Solar Geoengineering," *WBUR Earthwhile*, 7.22.20. Accessed 9.24.20. Available online at: <https://www.wbur.org/earthwhile/2020/07/22/harvard-solar-geoengineering-climate-change>

and Douglas MacMartin advocate for “temporary, moderate and responsive” implementation.<sup>62</sup> Such an approach involves setting a specific end date for geoengineering measures, reducing the rate of climate change rather than attempting to offset it entirely, and gradually initiating and adjusting the process in light of feedback while remaining open to the possibility of shutting it off completely.<sup>63</sup>

In closing, let me reemphasize: my position is not that we should geoengineer. Significantly more research is needed to determine whether geoengineering is a safe and feasible means of avoiding a climate catastrophe.<sup>64</sup> But geoengineering *is* worth researching. If all else fails, and evidence suggests that geoengineering is sufficiently safe and effective, it would be worth doing, too.

*Philosophy, College of William and Mary, USA*

<sup>62</sup> David Keith and Douglas MacMartin, “A Temporary, Moderate and Responsive Scenario for Solar Geoengineering,” *Nature Climate Change* 5, no. 3 (2015): 201–206.

<sup>63</sup> There is of course no guarantee that even cautious geoengineering will not result in long-term, unforeseen harms. But climate change itself threatens to produce long-term, unforeseen harms. Thus, in the event we reach a point where geoengineering is considered as a last resort to avoid a climate catastrophe, the mere fact that geoengineering might result in long-term, unforeseen harms would not suffice to rule it out as an option given that the alternative *also* risks long-term unforeseen harms.

<sup>64</sup> On the need for further research, see Royal Society, *Geoengineering the Climate: Science, Governance and Uncertainty* (Royal Society: London, 2009); National Research Council, *Advancing the Science of Climate Change* (Washington, DC: The National Academies Press, 2010); National Research Council, *America’s Climate Choices* (Washington, DC: National Academies Press), 2011.