



# Geoengineering Harms and Compensation

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## I. ACC, SRM AND GEOENGINEERING HARMS

In contemporary discourse, geoengineering is usually taken to refer to the idea of intentionally intervening in the climate to limit global warming. The very idea of geoengineering sets many people on edge, all the more so when this idea is qualified to focus on large-scale interventions. As Gardiner argues, it seems the quintessence of an arrogant attitude toward Nature.<sup>1</sup> Nonetheless, even assuming that the world community gets down to the essential business of de-carbonizing the global economy, what if we stabilize above a safe level of parts per million of CO<sub>2</sub> in the atmosphere? Indeed what if we are already above that level?<sup>2</sup> Then what?

Natural processes will take a long time to set things right. In the meantime, geoengineering research poses two questions. First, might we be able to accelerate the natural rate of removal of CO<sub>2</sub> from the atmosphere by carbon capture (ACC)? Second, in the meantime, might we be able to counteract the effects of CO<sub>2</sub> in the atmosphere by solar radiation management (SRM)? Whether ACC can work is an open question revolving around energy requirements. But if it does work, the undertaking would be both massive and slow. In contrast, SRM holds out the prospect of being relatively cheap and quick if sulfur dioxide (SO<sub>2</sub>) can be effectively introduced into the stratosphere. But SRM of this kind offers neither a comprehensive nor a long-term solution. Unlike ACC, it does not counter ocean acidification. And because SO<sub>2</sub> has a limited life in the atmosphere, it needs continual replenishment. In the face of a bona fide climate emergency, SRM using SO<sub>2</sub> might be useful temporarily, but it is not plausible to think that SRM can fully counter the effects of CO<sub>2</sub> in the atmosphere. Its benefit in offsetting those effects will be uneven if only due to variations in local cloud cover producing non-

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<sup>1</sup> Stephen Gardiner, *Is "Arming the Future" With Geoengineering Really the Lesser Evil? Some Doubts About the Ethics of Intentionally Manipulating the Climate System*, in CLIMATE ETHICS 284, 302-03 (Stephen Gardiner, Dale Jamieson, & Henry Shue eds., 2010).

<sup>2</sup> See James Hansen et al., *Target Atmospheric CO<sub>2</sub>: Where Should Humanity Aim?*, 2 OPEN ATMOSPHERIC SCI. J. 217, 218 (2008); James Hansen, Lecture at the American Geophysical Union Fall Meeting: Climate Threat to the Planet: Implications for Energy Policy and Intergenerational Justice (Dec. 17, 2008) (slides available at <http://www.columbia.edu/~jeh1/presentations.shtml>).

uniform global warming.<sup>3</sup> Moreover, unlike ACC which simply removes CO<sub>2</sub>, using SO<sub>2</sub> SRM reduces short wave radiation reaching the earth as a way of offsetting the long wave radiation that CO<sub>2</sub> blocks from leaving the earth.<sup>4</sup> This imperfect match raises the prospect that (unlike ACC) SRM itself may do harm by making some *worse off than they would be with global warming alone*.<sup>5</sup> In support of this inference, Robock et al. have a model that suggests that sub-Saharan Africa would have less cloud cover after geoengineering and thus be hotter and drier than it would be with climate change alone.<sup>6</sup>

It is worth noting that a *sine qua non* of geoengineering is that if SRM were implemented, it would need to be done in a coordinated fashion on behalf of the international community. Anything else would pose a grave risk that multiple efforts with conflicting cooling goals might either undermine each other or even produce more cooling than any of the parties desired. Let us assume SRM proceeds as a collective act of the world community, but nonetheless produces the damage that Robock et al. write about. We might think of such an outcome as paralleling the problems of inequality caused by global warming itself. In both cases, on whom the obligation falls to compensate those made worse off may be plausibly grounded on one of two principles. One, the obligation could be allocated according to causal responsibility for creating the problem. Two, the obligation could be allocated based on an assessment of comparative wealth.<sup>7</sup>

So far we have only considered those who might be made worse off by SRM relative to losses suffered through climate change itself. But there is another class to consider as well: those who might be made worse off by SRM relative to gains made through climate change. At least in the short run, some populations will be winners when it comes to climate change. Their lot will improve with rising temperatures,<sup>8</sup> but they will forfeit that improvement if SRM is used to cool the planet. In the next section I will examine how we should compare these two positions and ask if they are equally deserving of compensation.

## II. COMPENSATING GEOENGINEERING LOSERS

This issue is akin to a general issue that arises in discussion of mitigation. To the extent that climate change produces winners and losers, mitigation will harm some individuals and benefit others. Posner and Sunstein propose the principle that efficiency

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<sup>3</sup> See Stephen Schneider, *Geoengineering: Could—Or Should—We Do It?*, 33 CLIMATIC CHANGE 291, 297-98 (1996); Stephen Schneider, *Geoengineering: Could We or Should We Make it Work?*, 366 PHIL. TRANSACTIONS OF THE ROYAL SOC'Y A 3843, 3856 (2008).

<sup>4</sup> Gabriele Hegerl & Susan Solomon, *Risks of Climate Engineering*, 325 SCIENCE 955, 955-56 (2009).

<sup>5</sup> Here and throughout, I use “harm” as equivalent to “being made worse off.” As such, not all “harms” are deserving of compensation.

<sup>6</sup> Alan Robock, Luke Oman, & Georgiy Stenchikov, *Regional Climate Responses to Geoengineering With Tropical and Arctic SO<sub>2</sub> Injections*, 113 J. OF GEOPHYSICAL RES. D16101, doi:10.1029/2008JD010050 (2008).

<sup>7</sup> By and large, causal responsibility and wealth go hand except in so far as wealth is a function of natural resources. For a discussion contrasting the two, see Paul Baer, *Adaptation to Climate Change: Who Pays Whom?*, in CLIMATE ETHICS, *supra* note 1, at 247.

<sup>8</sup> For the expected increases in temperature in this century, in the range of 2-3 degrees Celsius, counteracting global warming primarily benefits people living in poorer countries. That said, over longer periods of time, on a worst-case scenario, we all benefit. See Hansen, *supra* note 2.

might be achieved if those who suffer losses from mitigation are compensated by those who gain.<sup>9</sup> Carson responds that, while such a principle may produce an efficient outcome, that does not make “it a just agreement or even create a presumption that it is a just agreement.”<sup>10</sup> The argument that follows examines the fundamental question of whether or not we should differentiate between two classes of losers when it comes to SRM, and if so, on what basis.

Assume that as the world gets hotter, Canadian farmers’ crop yields increase by \$x. Assume also that as the world gets hotter, Ugandan farmers’ crop yields decrease by \$y. When SRM is used to cool the planet, the Canadians’ crop yields decrease by \$x as temperature is reduced. But assume that for the Ugandans, SRM causes local temperature to rise and precipitation to decrease as compared to the levels after climate change, producing a reduction in crop yields of \$x above and beyond the loss of \$y produced by climate change itself. The Canadians and the Ugandans suffer identical loss due to SRM, but for different reasons. The Canadians lose because their gains from climate change are offset by SRM. The Ugandans lose because their losses from climate change are made worse by SRM.<sup>11</sup>

Should these two harms be given equal moral standing *all other things being equal*? That is, in absence of confounding differences such as concerns over health impact, loss of livelihood, and unequal economic baselines, should the harms be treated the same? I will argue that they should *not* be given equal moral standing.

Let us assume that any historic causal responsibility of the “West” or “North” for creating the problem in the first place plays no role in differentiating between current Canadian and the Ugandan farmers. If you like, let “Canada” name a hypothetical country that abuts Uganda but has an idiosyncratic local climate for Africa that is identical to the country we know as Canada—the one north of the United States.

Let us also assume that the Canadians suffer an actual loss as a consequence of the implementation of an SRM cooling policy and do not simply receive fewer benefits than others.

Judged relative to the post-climate change environment, both the Canadians and the Ugandans suffer an equal loss. But judged relative to the pre-climate change environment, only the Ugandans suffer a loss. So far, so good. But *which* pre-climate change environment should constitute the baseline? It turns out not to matter if we make some simplifying assumptions. Assume that the impact of rising temperatures over time has been uniformly good for the Canadians and uniformly bad for the Ugandans since anthropogenic climate change began. This means agricultural productivity has gone up for the former and down for the latter. Consequently, SRM cooling measures will leave a Canadian farmer no worse off than he or she would have been relative to any arbitrarily chosen earlier time predating climate change, since those earlier times were characterized by lower productivity. On the other hand, if SRM harms a Ugandan, the harm makes the Ugandan worse off no matter what the time to which it is compared, since in earlier times productivity was higher.

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<sup>9</sup> Eric Posner & Cass Sunstein, *Climate Change Justice*, 96 GEO. L.J. 1565, 1610-11 (2008).

<sup>10</sup> Jonathan Carlson, *Reflections on a Problem of Climate Justice: Climate Change and the Rights of States in a Minimalist International Legal Order*, 18 TRANSNAT’L L. & CONTEMP. PROBS. 45, 50 (2009).

<sup>11</sup> Here and throughout, the discussion is about whether individuals in Canada and Uganda have suffered harms deserving of compensation, rather than nation states.

“So what,” the Canadian objects. “The fact is, you have caused me harm and as such I deserve compensation from you. The fact that you can point to a baseline relative to which I am not harmed is irrelevant to the harm for which you are responsible.” And indeed this is surely the underlying rationale that a legal regime would take to the matter. Broadly speaking, the law of torts does not place qualifications on what counts as harms, except that they be losses caused by actions or failures to act of another. On this view, the claims of the Canadians and the Ugandans stand or fall together.<sup>12</sup>

But outside of a purely legal framework, do moral imperatives pull in a different direction? In consideration of this possibility, let us focus on the nature of the Canadians’ gains instead of their harms. An analogy to taxes will help us along.

Inheritance or estate taxes have a history rooted in the necessity of raising revenue. The first such tax in the United States, in 1797, was enacted to pay for a naval buildup. Other such early taxes were enacted to pay for the Civil War in 1862 and the Spanish-American War in 1898. That is not to say that some have not advanced arguments to justify such taxes on moral grounds. Bill Gates Sr. and Chuck Collins defend income taxes on the grounds that “some of us have disproportionately benefited from the fertile economic soil we have cultivated together.”<sup>13</sup> But that would seem as much an argument for income taxes as inheritance or estate taxes. What differentiates these taxes is the idea that income is (at least in theory) earned while inherited money is not. The basis for such a claim of a moral difference rests on two related notions. One is that the benefits of earned income are deserved, whereas the benefits of unearned inheritance are undeserved. The second is that inheritance violates a principle of equal opportunity.

These two notions are unified in the principle of luck egalitarianism. Luck egalitarianism is an extension of an egalitarian conception of equity. As my colleague Larry Temkin puts it, “[a]mong *equally* deserving people, it *is* bad, because *unfair*, for some to be worse off than others through no fault or choice of their own. But among *unequally* deserving people it isn’t bad, because not unfair, for someone less deserving to be worse off than someone more deserving, even if the former is worse off through no fault or choice of his own.”<sup>14</sup> The role of distributive justice on this conception is to balance these inequalities and by extension to limit the effects of luck.

Temkin’s explanation underscores the idea that there is a difference between the Canadian and the Ugandan losses. For if it is unfair for some to be worse off than others through no fault of their own among equally deserving people, it follows that it is also unfair for some to be better off than others though no more deserving. But in that case, those who are better off under such circumstances can have no complaint if they lose their better-off status. By this logic the Canadians have no legitimate claim of harm; their gain is a lucky windfall to which they have no inherent right.

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<sup>12</sup> For an interesting discussion of tort law as an avenue for international claims for compensation for climate change, see Michael Faure & André Nollkaemper, *International Liability as an Instrument to Prevent and Compensate for Climate Change*, Symposium, *Climate Change Risk*, 26A STAN. J. OF INT’L L. 124, 147 (2007).

<sup>13</sup> Bill Gates, Sr. & Chuck Collins, *Estate Tax Breathes Life into Economy*, ONEIDA DAILY DISPATCH, Dec. 1, 2009, available at <http://www.oneidadispatch.com/articles/2009/12/01/opinion/doc4b15e4e9a4ef7833585135.txt>.

<sup>14</sup> Larry Temkin, *Justice, Equality, Fairness, Desert, Rights, Free Will, Responsibility, and Luck*, in RESPONSIBILITY AND DISTRIBUTIVE JUSTICE 51, 51 (Carl Knight & Zofia Stemplowska, eds., 2011).

The problem with this conception is that it is hard to limit its reach. Luck produces all sorts of gains for people that we want to treat as legitimately “theirs” irrespective of desert. At the most extreme level, consider a hypothetical nation-state that conducts a lottery to assign mineral rights for particular plots of land. You get lucky, I don’t. To say you have no right to your gain would undermine the point of the lottery, which is to assign rights according to a fair process. What makes the ultimate assignment fair is not that you deserved it and I did not, but that we all had an equal chance to end up lucky.

But our attitude toward the lottery of life is more nuanced. For instance, we treat bad luck differently from good luck. Good fortune makes for all sorts of inequality. Some are born smart and some are not. Some stay healthy and some do not. Accidents befall some but not others. Yet, except under the most minimalist conception of the state, we expect social policy to level some of these playing fields through education, health and other welfare initiatives. Imagine a vaccination that we know will harm a few individuals while imparting universal immunity against disease X. It may seem self-evident that the few who are harmed as a result of our action should be compensated, even when the state causes the harm and may be legally insulated from liability. But suppose those damaged fall into two groups. One group is made sick by the vaccine. The other group is made up of people who have natural immunity to disease X that is mildly superior to the immunity granted by the vaccine. However, group members lose that superior natural immunity when vaccinated. Now they are just like the rest of us. They too have been harmed. And we, too, caused that harm, but it seems unlikely that anyone would recognize a need to compensate this second group.<sup>15</sup> There may not be a recognizable entitlement to a condition superior to the average when the public welfare demands sacrifice of this condition.

Under this view, the Ugandans deserve compensation but the Canadians do not. But notice that the reasoning is based on considerations of *welfare*.<sup>16</sup> On those grounds, does it matter how the Canadians came to have the gain they have now lost? Suppose SRM is deployed in the face of a climate emergency that requires immediate state action. If harm is caused by SRM, the state may cite the defense of public necessity. Such a defense invokes the welfarist idea that the good of many outweighs the needs of the few. Although as a principle this cuts evenhandedly against both the Canadians and Ugandans, the state might nonetheless impose a voluntary compensation program that differentiates the two groups by compensating the Ugandans but not the Canadians. The lesson of the vaccination case is that relying on considerations of welfare alone, it may not matter how the Canadians came to have the gain they have now lost—society may be simply unwilling to recognize an entitlement to a windfall.

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<sup>15</sup> At least for this harm. But, as an anonymous referee points out, if the harm was a loss of 10 IQ points for those above an IQ of 150, we might think differently. What is the difference? I think it is one of degree not kind. If the loss of IQ was just one point, I doubt we would consider any claim deserving. Of course by the same token, if natural immunity granted an added year of life expectancy above the average, that would likely be a loss worthy of compensation.

<sup>16</sup> So much for the better, since absent world government, an argument based on luck egalitarianism would have been hard to extend from individuals to nation states, between whom distributive justice has no purchase—unlike welfare considerations which do.

Thus far I have argued that the Canadians suffered a harm of the same degree as the Ugandans, only theirs is not the type of harm that deserves recognition or compensation. But is what the Canadians suffered then really a “harm”?

Suppose my tree blocks your view of the ocean. I decide to cut it down (maybe it is diseased) and you gain an ocean view. When I decide to plant a new tree, though, you try to stop me, claiming it would deprive you of your newly gained ocean view. Think about this harm in absence of any relevant property law considerations. Now that you have an unobstructed view, my planting a new tree will cause you harm: the lost opportunity to see the ocean. But he who taketh also giveth, in the past—I am the one who caused the gain that you have now lost. Another way of looking at this is that on a short time scale I have hurt you, but on a longer time scale my actions balance out and you have suffered no harm. Or suppose our properties abut each other. You rebuild a retaining wall next to and reinforcing my retaining wall. When you subsequently redesign your wall, mine is weakened relative to when your wall was reinforcing mine. The redesign causes me real harm. But in the long view, that harm is balanced by my previous gain because your actions offset each other.

Even without appealing to the notion of detrimental reliance, time is a crucial factor here in delimiting the number of acts affecting my welfare. When the act of giving and the act of taking are conjoined, the distinction between the two gets lost, like a shop clerk who gives me too much change and immediately acts to correct the error.

Can we analogize these hypotheticals to SRM? Both agency and time would seem to stand in the way of a perfect corollary. Suppose SRM were implemented and the Canadians complained of harm due to local cooling. Suppose the world community responded as follows, much as I might respond to you if you complained about my new tree. “Canadians, you have no cause for complaint. We warmed the planet in ways in which you benefited and now we are cooling it. In all, you are no worse off from our actions.” But who is this “we”? Global warming was not caused by collective action. It was caused by the uncoordinated actions of millions of individual actors. The critical difference between the example of SRM and the example of my tree is that with SRM there is no strict identity between the actor who caused the gain and the actor who caused the loss. But identity may still be retained in a metaphorical sense, for instance, when governments try to right the wrongs of their citizens through actions like war reparations payments.<sup>17</sup>

What about the role of time? The longer the Canadians adjust to and come to rely on the new, warmer regime, the more compelling their claim of harm.<sup>18</sup> You have little complaint if you luxuriate in your view of the ocean for just one week between the removal of the old tree and the installation of the new one. But if it has been years, and you bought the property with the view reflected in the price, you begin to look more sympathetic.

As a final consideration, then, there may be one basis for rationalizing our differential treatment of Canadians and the Ugandans *over time* that carries moral if not legal force. That is to implement a policy of forewarning. So as to avoid detrimental

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<sup>17</sup> For treatment of this issue from various ethical perspectives, see *WAR CRIMES AND COLLECTIVE WRONGDOING* (Alexander Jokic & Anthony Ellis eds., 2001).

<sup>18</sup> Indeed, to the extent that the Ugandans have fertile soil, they might be viewed as “lucky.” But here too time, and with it expectations and reliance is on their side.

reliance on the status quo, we should warn individuals in the position of the Canadians that gains from climate change may be lost through corrective action.

Climate change will produce winners and losers. So, too, may mitigation of climate change. But the use of SRM as a mechanism of mitigation raises the possibility that there may be two kinds of losers: those already harmed by climate change who are made yet worse off by SRM, and those who gain from climate change and are made worse off by losing that gain. I have argued that even if both these losses are caused by the same action and are losses of the same degree, they should not be treated as equally deserving of compensation.