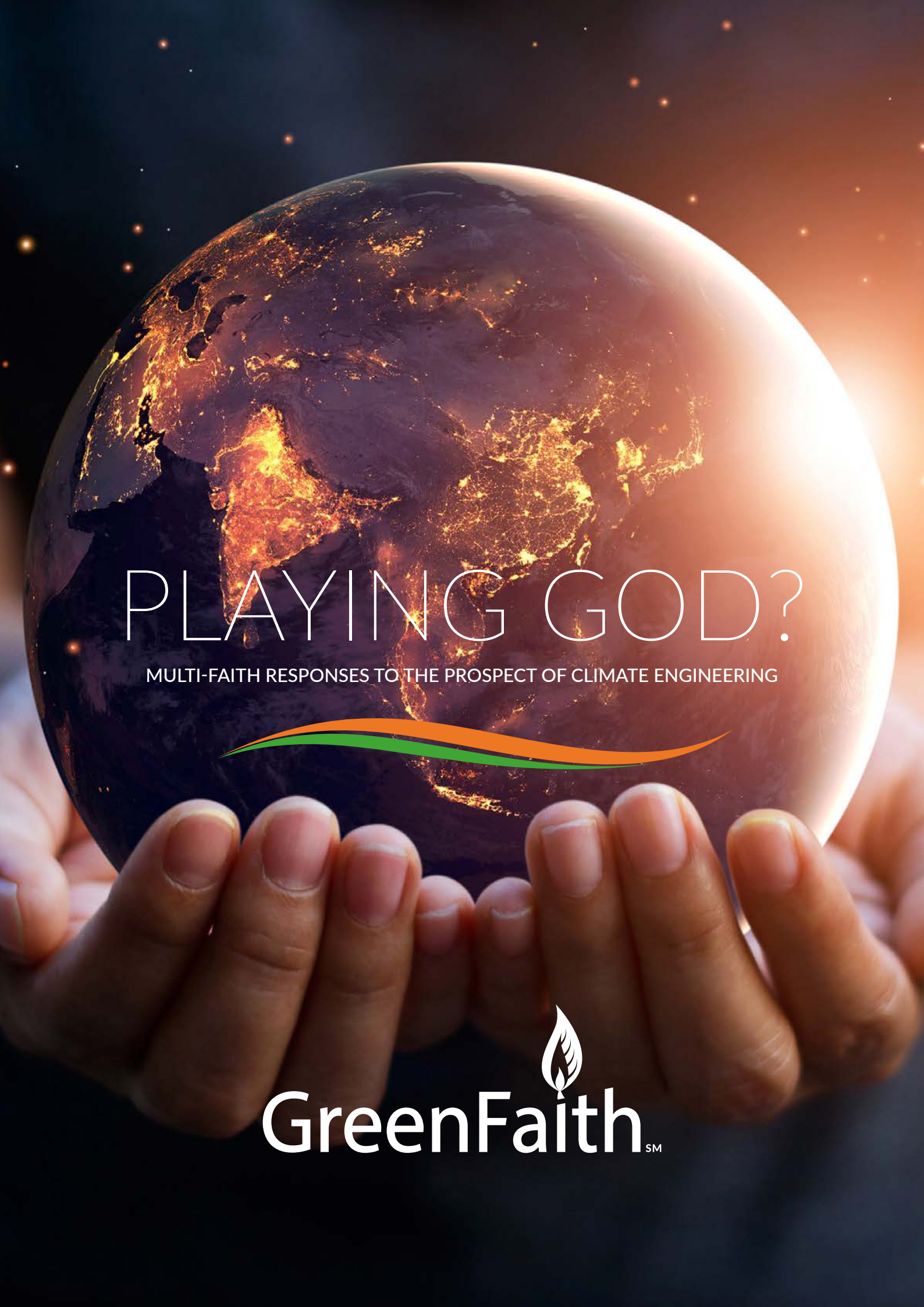

PLAYING GOD?

MULTI-FAITH RESPONSES TO THE PROSPECT OF CLIMATE ENGINEERING

GreenFaith℠

PLAYING GOD?

MULTI-FAITH RESPONSES TO THE PROSPECT OF CLIMATE ENGINEERING

A GreenFaith Report

Editors: **Forrest Clingerman** (Ohio Northern University) and **Gary Gardner** (Consultant to GreenFaith)

Contributing Authors: Arianne van Andel, Saffet Abid Catovic, Forrest Clingerman, Celia Deane-Drummond, Çağdaş Dedeoğlu, Gary Gardner, Fletcher Harper, Laura M. Hartman, Mat McDermott, Duncan McLaren, Kevin J. O'Brien, Hava Tirosh-Samuelson, Ven. Bhikkhu Vivekānanda, Adinarayanan Venkatachalam, Smrithi Rekha Venkatasubramanian, Kyle Whyte

Project Director: **Rev. Fletcher Harper** (Executive Director, GreenFaith)
This project was funded by the **Christopher Reynolds Foundation**

Published by GreenFaith
Highland Park, NJ USA

Citation: Forrest Clingerman, Gary Gardner, Fletcher Harper, Arianne van Andel, Saffet Abid Catovic, Celia Deane-Drummond, Çağdaş Dedeoğlu, Laura M. Hartman, Mat McDermott, Duncan McLaren, Kevin J. O'Brien, Hava Tirosh-Samuelson, Ven. Bhikkhu Vivekānanda, Adinarayanan Venkatachalam, Smrithi Rekha Venkatasubramanian, and Kyle Whyte, Playing God? Multi-faith Responses to the Prospect of Climate Engineering (Highland Park, NJ: GreenFaith, 2018), www.greenfaith.org/geoengineering.

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Foreword

When the IPCC released its 1.5°C report in October 2018, the results seemed unequivocally clear: the world needs to move away from fossil fuels, end tropical deforestation, electrify transportation, adopt low-carbon lifestyles and more--at scale and with urgent speed--or face certain, devastating consequences from climate change.

What received less attention was an additional caveat. The report made it clear that any scientifically realistic pathway to a future in which temperature rise is limited to 1.5°C requires the use of "negative emissions" approaches and technologies. In other words, scientists now assert that the only way ultimately to limit temperature rise to 1.5°C is to use a range of methods and technologies, all untested at scale, to remove CO2 from the atmosphere. While we do not necessarily agree with this assertion, it is fair to say that it represents a scientific consensus in a growing number of influential forums.

Collectively, these "negative emissions technologies," together with other potential technologies that will attempt to reduce the amount of sunlight reaching Earth, are referred to as climate engineering. We wish we did not need to write about them. We would much rather continue working with many of you who are reading this report to speak out, educate, mobilize, organize, divest, invest, and advocate for the kinds of responses to climate change that we know can reduce greenhouse gas emissions and accelerate renewable energy development.

However, ignoring this part of the policy conversation is no longer an option. We are far enough behind in our collective response to global warning that, like it or not, we must now acknowledge that some forms of climate engineering are integrated into the most sophisticated projections about how we might avoid a future ravaged by an out-of-control climate. Other forms of climate engineering, while still at highly preliminary stages of development, are receiving increasing attention as emissions levels stubbornly fail to fall at the necessary rate.

For us, broaching the climate engineering topic evokes painful emotions. Anger at the ineffectiveness of our political systems to address a problem that has been recognized for decades. Fears of a future in which untested technologies are unleashed on an unsuspecting world by global elites who decide "where to set the global thermostat." Anxiety that discussing this topic, by offering a seeming technological fix, will lessen the intensity that governments and businesses feel to reduce emissions and to work with vulnerable communities on needed adaptation. Despair at a situation which, in 2015 at COP21, seemed finally to be heading in the right direction, only to slip back out of control. Stunned realization that climate engineering schemes had been hiding in plain sight within scientists' projections even before the Paris Agreement. Discomfort that we are engaging in a new form of "playing God" in a way that will affect every person on the planet.

We have wrestled with these emotions and with the information that scientists are sharing about what is required to achieve a 1.5°C future. In response, and because discussion of this topic is growing in public and among leaders in science, government, industry and leading climate NGOs, we have decided

that the time has come for religious groups to play our role by sharing moral and religious responses to climate engineering.

This report is our first effort to do just that. As we engaged with theologians, ethicists, and scholars of religion, we found that most knew little about the topic, so we provided some introductory education on the issue. Because of this, we wish to emphasize that these essays represent a first effort to examine the topic from a diversity of moral and religious perspectives. We are grateful for these authors' reflections, as we are grateful for the editorial guidance of Dr. Forrest Clingerman, the writing of experienced researcher Gary Gardner, and the insights of Cynthia Scharf of the Carnegie Climate Geoengineering Governance Initiative (C2G2). Their contributions have made this complex and consequential topic far more accessible.

We welcome your feedback and look forward to responding to further developments in the climate engineering conversation with perspectives informed by our collective faiths. The world's religious traditions affirm care for the most vulnerable and a profound respect for the interconnectedness of our global environment. Our advocacy about this topic will be guided by these commitments, and by our belief that the climate crisis requires a moral transformation in the personal, cultural, economic and political dimensions of human society.

In the meantime, as this discussion develops, GreenFaith will continue to press for equitable climate action—above all, reduction in emissions and renewable energy development at the fastest possible rate—to minimize or even avoid the use of geoengineering.

In faith,

Rev. Fletcher Harper

Executive Director, GreenFaith

Acknowledgements

This project was made possible through the generous support of the Christopher Reynolds Foundation.

Expert advisory support was provided by ***Ernst Conradie*** (University of the Western Cape), ***Elisabeth Graffy*** (Arizona State University), ***Irene Krarup*** (V. Kann Rasmussen Foundation), ***Simon Nicholson*** (American University and Forum for Climate Engineering Assessment), and ***Cynthia Scharf*** (Carnegie Climate Geoengineering Governance Initiative).

GreenFaith staff members ***Deborah Convery*** and ***Brett Nadrich*** provided important logistical and communications support.

Introduction

Authors

Forrest Clingerman

Gary Gardner

Climate engineering[1]—deliberate human intervention in the climate to counter the impacts of climate change—presents a vexing ethical dilemma. On one hand, the current rising interest in geoengineering is often framed as a result of massive societal failure: the human family's refusal, despite ample warnings from scientists, to adopt policies, business practices, and behavior changes that would ward off a warming climate. In this framing, humanity has fiddled as the Earth burned, a fundamental ethical lapse on an issue of critical importance to all people.

Who bears the most responsibility for this colossal ethical failure? All human residents of the planet? Citizens of countries that historically benefited the most from industrialization, globalization, and consumerism? Elite business leaders and policy-makers with an outsized impact on national and international policy? Regardless of who is blamed, it is clear that the need to consider technological climate intervention is a consequence of societal failure (or even sin, to use a word more common to Abrahamic theology than scientific circles). Now we face a new ethical dilemma: does climate engineering worsen or redeem our original climate carelessness?

On the other hand, geoengineering in some form, and under some circumstances, may be a morally defensible response to the challenge of the current moment. Centuries of reliance on fossil fuels for power, light, and transportation are rapidly becoming obsolete and, literally, death-dealing. In this framing, climate intervention to correct the damage done can be viewed either as a responsible antidote to societies' earlier inaction or as the rational, even morally sound, part of a transition to a clean energy future. The lives and livelihoods of millions of human and non-human beings are at stake today—at risk now and in the decades ahead—because of inaction over the last 40 years. Might climate engineering be viewed as an act of protection for the vulnerable, a way of turning away from our past actions and turning toward what is required now, in this urgent moment?

Beneath the overarching ethical question—To engineer, or not to engineer?—lie many specific conundrums. Is a quick but risky engineering fix better than a slow but safer one? How do we define

risky and safe? Are solutions rooted in nature always ethically superior to those built from technology? Are nations ever justified in deploying a geoengineering initiative unilaterally? Which leaders are responsible for making these choices and to whom are they accountable? What voice should poor and marginalized people have in decision-making? What trade-offs are acceptable? And who is the final arbiter of these questions?

Policymakers and publics alike are challenged to navigate the tricky ethics surrounding geoengineering, both now and in the decades ahead. What makes such deliberations more difficult is the fact that climate engineering proposes a *global* response to a *global* problem, but there is no single, uniform worldview that the entire human community uses to determine value and meaning. The diversity of ethical and value frameworks across human societies and cultures must be acknowledged. More to the point: 84% of the world's human population is identified with a faith tradition.[2] Religious beliefs and rituals are foundational for understanding what is right and good, how to assign responsibility and value, and how to hope and imagine. Religion assists us in interpreting the relationships we have with each other and the world itself. Insofar as religious beliefs and practices are resources that individuals and communities use to frame some of the most pressing questions that confront us, how will religion help—or hinder—the political and social discussions that surround climate engineering?

This report is meant to assist in the discernment process. Part I begins with a brief description of geoengineering, framed from an ethical perspective, and describes the field's technologies and practices. It is intended to be a primer for those unfamiliar with the basics of climate engineering.

Part II of the report contains recommendations meant to guide both faith communities and policy-makers in considering the use of climate engineering technologies and practices.

Part III contains essays, written by thinkers from a diverse set of faith and spiritual traditions. In the essays, authors apply the wisdom of communities of belief to questions like these:

- Why religion? Why and how should religious communities engage the geoengineering issue?
- What are the most pressing moral or ethical concerns raised by geoengineering, from accountability of leaders to protection of vulnerable communities to moral hazard, unforeseen consequences, and the control or misuse of technology?
- Are ethical concerns the same for all types of climate intervention?
- Are we humans trying to play God? Does geoengineering change how faith communities understand creation or nature?
- What resources do religious and spiritual communities offer to help frame the geoengineering discussion in a thoughtful, productive way?

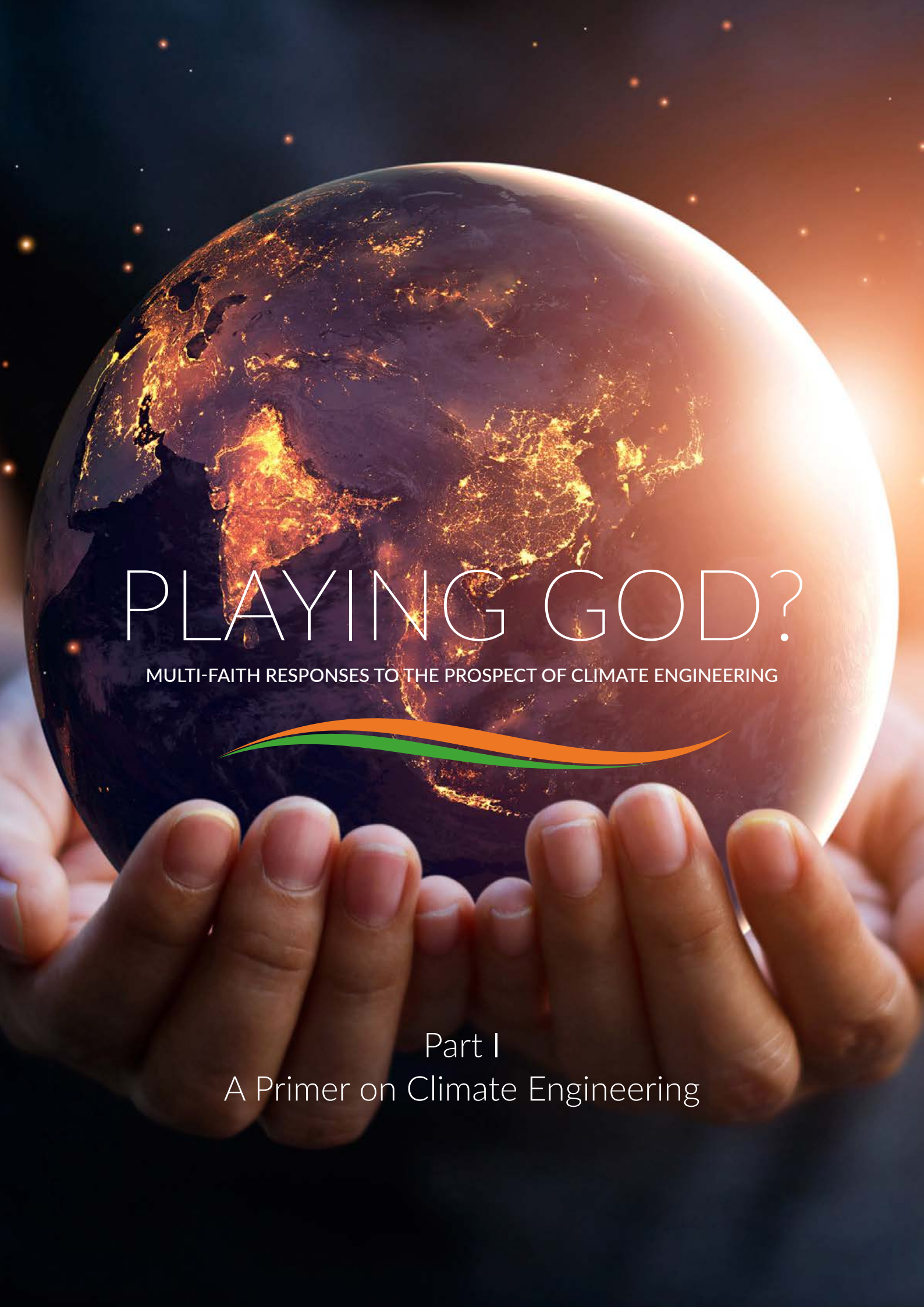
The essays are designed to advance a discussion of the ethics of geoengineering in two ways: to help the world's faith and spiritual communities engage with these important issues, and to assist publics and policymakers as they grapple with the topic. In both cases, we hope this report will help serve as a bridge between policy and faith, science and ethics. The encounter between religious and climate engineering communities is still in its early stages. With that in mind, the reflection contained in these essays—coming from scholars with expertise in a number of the world's faith traditions—are a starting point for a more nuanced, multileveled conversation on climate policy and action.

What might be most surprising (at least to readers unfamiliar with religious discussions of ethics and social issues) is how the essay authors represent a diversity of religious belief, and yet this diversity nonetheless leads to several common themes. For example, whether it is found in the law of karma (Buddhism), *tikkun olam* or "mending the world" (Judaism), or stewardship (Islam and Christianity), scholars see important claims of human responsibility as essential for assessing the appropriateness of climate engineering. Similarly, the care of the dispossessed and the marginalized—human and non-

human alike—is expressed by the authors from a number of traditions, from care-centered ethics to Indigenous communities to the Abrahamic faiths. And reconciling the importance of individual commitment and action with the expectations that rest on the community as a whole is seen in many traditions, from Hindu expressions of the Divine within all to Muslim expectations of justice. Thus, the essays contained in Part III of this report showcase the rich diversity of ethical reflection found in faith communities, as well as offering a new lens to approach questions of policy and ethics.

The multitude of ethical issues surrounding geoengineering highlights a central truth of this moment in our climate history: easy responses to climate change are no longer available. Risks abound in deploying geoengineering technologies, *and* in rejecting geoengineering. Even a comprehensive and intensive commitment to long-overdue emissions reduction work now carries the risk that it will be too little, too late. No matter the course chosen, the way ahead is filled with difficult tradeoffs and uneasy ethical dilemmas. This volume is intended to advance the conversation and encourage the development of a shared action-guiding ethical compass, among people of belief and between them and policymakers, around these challenging issues.

1. *In this report, the terms "climate engineering" and "geoengineering" are used interchangeably.*
2. *"The Future of World Religions: Population Growth Projections, 2010-2050," accessed November 25, 2018,*



PLAYING GOD?

MULTI-FAITH RESPONSES TO THE PROSPECT OF CLIMATE ENGINEERING

Part I
A Primer on Climate Engineering

A Primer on Climate Engineering

Author

Gary Gardner

Geoengineering is a topic largely unfamiliar to the public and to many political leaders, but its profile is expanding rapidly. It is now debated in scientific venues and policy arenas, portrayed in films, and discussed in popular media. Given the broad ramifications of geoengineering for people and the planet, education on geoengineering basics for a broad audience is essential.

Part I presents basic information on climate engineering, with particular attention given to ethical questions raised by the field's technologies and practices.

The Context: This Moment in Climate History

Geoengineering is the latest chapter in the long history of human-generated climate change. That story started around 1750, with the invention of the steam engine and the birth of the Industrial Revolution, a shift in economic model that was fueled by burning coal (and later, oil and gas) to power factories and other industrial installations. The use of fossil fuels, along with deforestation and expanded agricultural activities, caused carbon dioxide and other greenhouse gases to accumulate in the atmosphere. (See Box 1.) Humans had relied on wood, dung, and other carbon-rich energy sources for millennia, but the increasing prevalence and intensity of fossil fuel utilization led to dramatically increased emissions from 1900 to the present day. Those gases are now 40 percent thicker in the atmosphere than at the start of the industrial era. They act, in effect, as a blanket around the planet, raising the average global temperature by about 1° Celsius compared with the middle of the 19th century. [2]

One Degree?

The seemingly innocuous 1°C increase in temperature is meaningful from a historical perspective. Over the past 11,000 years, global average surface temperature has never varied by more than about 1°C from the average, a stability that is credited with facilitating human civilizational advance.[3] Over these eleven millennia, human economies shifted from hunting and gathering to farming and then industrialization, an evolution that spurred related innovations in art and commerce, religion and science, and government and industry. The ancient Egyptians, Chinese, and Greeks, the rise of the world's faiths and spiritual traditions, development of written language and Arabic numerals, innovations in crop farming and celestial navigation, the invention of the printing press and newspapers, the advent of flight, space travel, and the internet—these and myriad elements in the drama of human progress were facilitated by the steady underpinning of a stable climate. Now this foundation of human achievement is in peril.

Box 1. Carbon on the Move

Carbon emissions originate as coal, oil, or gas, or as decaying trees or other biomass. Human activities convert this solid or liquid material to CO2 gas when they are burned for energy, and the gases escape to the atmosphere. Some of the CO2 stays there and warms the planet. Other CO2 molecules continue to migrate from the atmosphere into the oceans, and from the atmosphere into plants.

Several geoengineering initiatives seek to reverse this flow of carbon. They propose to pull CO2 from the atmosphere and send it back into underground storage (in soils or deep geological formations), or into biomass (plants and trees). Other proposals would pull CO2 from the atmosphere and lock it away in products such as concrete and construction lumber. In some cases, reclaimed CO2 could be processed back into liquid fuels in a closed loop.

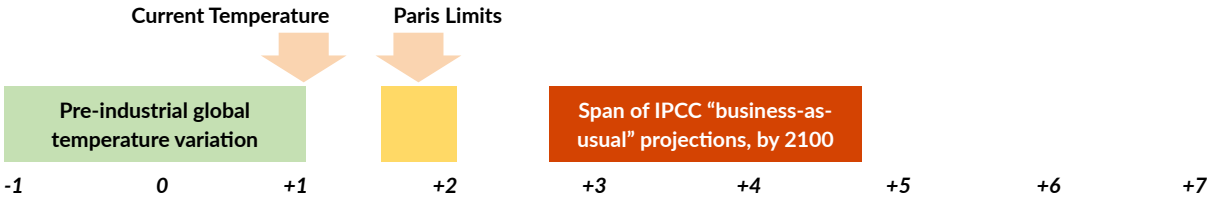
The 1°C rise since 1850 sits at the edge of the range of normal temperature variation of the past 11,000 years. But emissions over the past two decades have likely "baked in" another half degree C, meaning that temperature is set to rise to at least 1.5°C above preindustrial levels, probably in the next ten to thirty years—even if we stopped all new emissions today.[4] Meanwhile, today's ongoing emissions of CO2 will pressure temperature upward still further if nothing changes.

Against this background, the 2015 Paris Agreement takes on historical significance. This landmark compact, agreed to by virtually all of the world's nations, calls for capping the increase in global average temperature at "well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C."[5] In other words, in the Paris agreement, modern societies have agreed to allow global temperature to increase ***possibly twice as much as occurred over the past 11,000 years***, the era of climate stability and human advance. In this sense, the Paris agreement could be characterized as scientifically lax.

On the other hand, the Paris agreement is politically and economically ambitious, because it requires a major shift in the world's economies, from carbon-intensive industrialization to low-carbon alternatives. Indeed, if the world's economies remain on their current, carbon-intensive path, ***temperatures could reach 4.8°C above pre-industrial levels by 2100***, according to a 2014 report from the Intergovernmental

Panel on Climate Change (IPCC), the scientific panel that studies climate.[6] (See Figure 1.) Other studies published since the IPCC report suggest that temperatures could reach much higher levels. A set of respected climate scientists estimated in 2015 that, without action on climate, we face a "1 in 10 risk of going beyond 6°C" by 2100.[7] Dare we accept such odds—the statistical equivalent of tolerating a risk of 10,000 airline crashes worldwide each day?[8]

Figure 1: Variations in Global Temperature, Past and Future



Degrees variant from the 11,000-year preindustrial average

The 1°C rise in global average temperature since 1850 means that temperature increase is already more than halfway to the 2°C upper limit set at Paris, and two-thirds of the way to the preferred lower limit of 1.5°C. Put differently, human societies are losing the maneuvering space needed for a transition to cleaner economies. Indeed, without serious, immediate, and widespread remedial action, average global temperature is likely to increase beyond the 2°C boundary set in Paris.

How Hot is Too Hot?

The consequences of missing the Paris target range are huge. Even the difference between 1.5 and 2°C, the Paris target range, can be substantial, suggesting that efforts to limit warming to 1.5°C are worth the trouble. (These averages in Centigrade are equivalent to average temperature increases of approximately 3-4° Fahrenheit, which is enough to affect seasonal patterns and undermine the viability of many ecosystems. Note, too, that regional and local temperatures can be higher or lower than the global average.) Table 1 summarizes the differences as analyzed by the IPCC 1.5 study and reported by the World Resources Institute.[9]

Table 1. Impacts of 1.5° and 2° increases in Global Average Surface Temperature

Area of Concern	1.5°C (3°F)	2.0°C (4°F)	2° compared to 1.5°
Ice-free Arctic Ocean	Once per century	Once per decade	**10 times more often**
Coral reefs	Decline by 70-90 percent	Decline by more than 99 percent	**Up to 2.9 times worse**
Extreme heat waves	Experienced by 14 percent of global population at least once every 5 years	Experienced by more than 33 percent of global population at least once every 5 years	**2.6 times worse**
Vertebrates that lose at least half their range	4 percent	8 percent	**2 times worse**
Area of Arctic permafrost that will thaw	4.8 million km	6.6 million km	**38 percent worse**
Reduction in corn yields in tropics	3 percent	7 percent	**2.3 times worse**
Decline in marine fisheries	1.5 million tons	3 million tons	**2 times worse**

Source: *see endnote* [10]

Although worrisome, the IPCC temperature projections are often regarded by scientists as conservative. This is in part because the Panel's scenarios do not take into account feedback loops—warming that leads to impacts that lead to more warming. [11] An example is the melting of Arctic sea ice, which replaces a large expanse of heat-reflecting white area (the ice cap) with dark sea that absorbs heat, causing a further rise in temperature. Similarly, thawing permafrost in Siberia and Alaska releases methane, a powerful greenhouse gas that drives further warming once released into the atmosphere. These spirals of impact could spark "runaway" temperature increases that are potentially irreversible on a timescale meaningful to humans.

The environmental impacts of temperature increases will have profound human consequences as well. The IPCC asserts that climate change is projected to be a "poverty multiplier" that increases the number of poor people and deepens the poverty of the already-poor (a cruel irony, given that people on the economic margins are least responsible for our changing climate). [12] In the decades ahead, tens and possibly hundreds of millions of people are projected to be climate refugees--people who conclude that they can no longer make a life in their homelands because of rising seas, drought, and floods caused by climate change. The ethical considerations of migration and policies that welcome or restrict those fleeing harsh conditions cannot be considered apart from the ethics of energy and climate responses. They are related.

The dangers of a warming world require that the Paris goals be taken seriously, and possibly made even more ambitious, which in turn requires serious work. The IPCC calculates that net human-caused emissions of carbon dioxide must be cut by 45 percent by 2030 and must reach 'net zero' around 2050 to respect the 1.5° ceiling. [13] To remain within the 2° cap, CO2 must be cut by 25 percent by 2030. No society today is on track to meet even the less stringent, 2° challenge. [14]

In part because of the steep path to the needed carbon reductions, some climate models envision temperatures rising beyond the 1.5-2°C limits, then brought down through emissions reductions and carbon removal initiatives (a type of geoengineering, as described below). These "overshoot" scenarios, in which temperature could be elevated for several decades, could lessen the pressure for stringent emissions reductions and result in a global average temperature that exceeds international limits indefinitely. To avoid overshoot, some advocates call for adopting carbon removal strategies well before 2050. [15]

Evolving Responses to Warming

For decades, concern over a disrupted climate has prompted two main responses: emissions reductions (often called mitigation) and adaptation. Today, two more policy options--carbon removal and solar engineering, together known as geoengineering—are bubbling to the surface of climate policy. (See Figure 2.) Climate responses can be categorized in other ways, but the four-part organization used in this report was chosen because each policy bucket has minimal overlap and a distinct ethical profile. Alternative categorizations could blur the ethical dimensions of geoengineering. (See Box 2.)

Figure 2. Policy Responses to Climate Change

		(Geoengineering)	
Emissions Reductions	**Adaptation**	**Carbon Removal**	**Solar Engineering**

Emissions reduction focuses on scaling back the root causes of a changing climate: the emission of greenhouse gases, typically from fossil fuel use, as well as changes in land use (for example, converting

forests to agricultural land). Reducing emissions involves switching away from fossil fuels to renewable energy for both power and transportation through the adoption of more energy efficient technologies such as LED lighting, and transitioning to electric cars. The emissions reduction strategy has been embraced only slowly and weakly to date. Indeed, despite decades of growing use of clean and efficient sources of energy, carbon emissions began to plateau only in the past three years—then turned upward again in 2017. [16]

A second response, ***adaptation***, has emerged as sluggish global action on emissions reductions has rendered some climate change unavoidable, requiring societies to invest in defensive measures. A dramatic example of adaptation is the movement of entire communities from coastal areas to higher ground, as for example in the South Pacific island of Vanuatu. Less extreme adaptation includes building coastal protections, using drought-tolerant crops, and shoring up flood defenses. Measures like these are now in place or under consideration in planning offices worldwide. Adaptation initiatives are often essential to protect people and economies; they remind us that climate policy is not merely about carbon and other greenhouse gases but about humans and their well-being.

After decades of insufficient progress to reduce emissions, the world's nations have reached a crossroads. An exclusive focus on emissions reductions is no longer sufficient to cap temperature rise at 1.5°, according to the IPCC 1.5 report. Whether a 2° goal is possible with emissions reductions alone is not clear, but it certainly requires much greater political, economic and social commitment than is evident today. For example, emissions reduction pledges made by signatory nations to the Paris agreement cover only a third of the cuts needed to meet the 2° goal.[17]

Box 2. What's in a Name?

Climate policy can be categorized in various ways. Some classifications and labels are not used in this report, or are used in a restricted way, to avoid muddying the ethical implications of various climate policies. Avoided or restricted terms include:

Mitigation: Often used to describe emissions reductions (curbing emissions at the factory, tailpipe, or farm) the mitigation bucket is enlarged by the IPCC and other climate analysts to include carbon removal as well. Because mitigation in this expanded sense overlaps with a form of geoengineering, it blurs some of the ethical distinctions between the two policy families. For this reason, this report avoids using the term mitigation. When referring to emissions reductions, it uses the term "emissions reductions."

Geoengineering: The two families of geoengineering, carbon removal and solar engineering, have different approaches, impacts and consequences that require separate analyses. This brief uses the term geoengineering only as a general descriptor of the two families together. For specific discussion of impacts and ethics, carbon removal and solar engineering are analyzed separately.

Given the very real possibility that societies will not step up efforts sufficiently, or that even robust efforts might not be enough, and that climate emergencies could unfold that threaten people and risk destabilizing societies and economies worldwide, scientists and policymakers show growing interest in ***carbon removal*** and ***solar engineering*** as possible new tools in the climate change policy kit. These strategies would remove carbon already in the atmosphere or deflect sunlight, respectively, either of which could moderate or stop warming. They encompass an array of perhaps a dozen strategies. All are still experimental, and the risks and benefits of each remain only partially known.

Importantly, carbon removal and solar engineering do not absolve nations of their responsibility to scale back emissions. For biological, engineering, moral, and other reasons described in later sections, cutting emissions remains a required response to climate change, even in a climate-engineered world. Simply put, geoengineering is not a substitute for reducing emissions.

Geoengineering 101

Two Distinct Approaches

As noted, geoengineering refers to two families of at least a dozen technologies and practices that are meant to slow the increase in global temperatures associated with climate change. Carbon removal efforts would pull carbon dioxide out of the atmosphere. Solar engineering initiatives are intended to deflect some of the sun's rays away from Earth (without changing the amount of greenhouse gases in the atmosphere). Some of the most widely cited proposed approaches from each family are listed in Table 2.

Table 2. Select Geoengineering technologies

Carbon Removal			Solar Engineering
Natural (Forestry and Agriculture)	**Combined**	**Technological** (Energy and Industry)	**Technological**
Afforestation	Bioenergy with Carbon Capture and Storage (BECCS)	Direct Air Capture	Stratospheric Aerosol Injection
Biochar		Accelerated Weathering and Ocean Alkalinity	Marine Cloud Brightening
		Ocean Fertilization	Cirrus Cloud Thinning
			Surface Albedo Modification

Source: *See endnote* [18]

Each proposed geoengineering initiative carries a unique package of risk, cost, effectiveness, and other characteristics. These characteristics represent a vexing set of tradeoffs. Some carbon removal practices are relatively natural, such as tree planting or soil remediation, and carry relatively little environmental risk, at least at a small scale (on a large scale, environmental factors become more relevant). But these natural processes require vast tracts of land and can be expensive. They also may require decades to be fully effective, making them unhelpful as emergency options for temperature stabilization. Biological carbon storage is also vulnerable to being reversed—carbon stored in trees and other biomass could be released by fires and floods.

Other carbon removal options require non-natural interventions, such as spreading chemicals in the ocean, the full effects of which are not known. Meanwhile, perhaps the least environmentally risky carbon removal option, known as Direct Air Capture, is very expensive and creates the additional need to dispose of the captured carbon. Finally, and fundamentally, it is not clear how well carbon removal initiatives will work at the scale required.

The following chart, from the Carnegie Climate Geoengineering Governance (C2G2) Initiative, briefly describes several frequently mentioned carbon removal proposals.[19]

Types of Carbon Removal, Maturity, Governance & Challenges

Proposed Method		Maturity/Governance	Challenges
	Planting of forests and restoration of ecosystems that result in long-term storage of carbon in above- and below-ground biomass.	• Technology available at large scale and ready for deployment; • Governance covered to some extent by customary international law, CBD decisions and UNFCCC Paris Agreement.	• Competing land uses; • Lack of incentives for adoption; • Risks for biodiversity and food security; • Requires on-going management; • Reversible.
	Biomass burning under low-oxygen conditions (pyrolysis) yields charcoal "biochar" which is then added to the soil to enhance soil carbon levels.	• Technology well estab- lished, but not yet demon- strated at scale; • Governance covered to some extent by customary international law, CBD decisions and UNFCCC Paris Agreement.	• Incentives for widespread adoption; • Costs of process; • Limited practice or policy support; • Environmental pollution from process; • Competition for land-use.
	Burning biomass for energy generation and capturing and permanently storing the resulting CO_2.	• Bioenergy from power plants well established but CCS not demonstrated at scale; • Governance covered to some extent by customary international law, CBD decisions and UNFCCC Paris Agreement.	• Costs; • Land use competition; • Food security concerns; • Biodiversity loss concerns; • Deforestation and forest degradation; • Health impacts; • Impacts on soil and water.
	Enhancing natural weathering of rocks by extracting, grinding and dispersing carbon-binding minerals on land, or adding alkaline minerals to the ocean to enhance carbon uptake.	• Technically ready, but not demonstrated at scale; • Governance somewhat covered by customary international law, CBD and LC/LP decisions and Paris Agreement. Not in carbon accounting agreements.	• Incentives for widespread adoption; • Potential human health risks associated with fine grained material; • Ecological impacts of massive mineral extraction and transport.
	Capturing CO_2 directly from ambient air by a chemical process, followed by permanent storage or use.	• A wide range of technologies at various stages of maturity, some at pilot plant scale. CCS not demonstrated at scale; • Governance covered to some extent by customary international law, CBD decisions & Paris Agreement.	• High capital and energy costs; • Leakage concerns; • Access to adequate low carbon energy and water needed for process.
	Fertilising ocean ecosystems to accelerate phytoplankton growth, which partly sinks to transport carbon from atmosphere to seabed.	• Technically feasible but various technical challenges; • Banned under LC/LP; • Governance covered to some extent by customary international law, CBD and UNFCCC Paris Agreement.	• Incentives for adoption; • Impacts on ocean and marine life; • Changes to nutrient balance; • Increased production of other greenhouse gases.

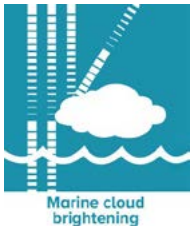
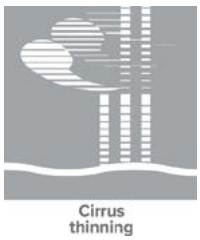
Although carbon removal initiatives face various challenges, and some are still on the drawing board, climate scenarios developed by the IPCC to stay under the Paris temperature caps often assume a large role for the strategy—an important point that is widely unknown among policymakers and the public. No IPCC scenarios would keep warming below 1.5°C by 2100 without resorting to carbon removal efforts, and even the 2° goal often assumes negative emissions (another name for carbon removal). By some calculations, scenarios that include carbon removal assume that ten to twenty-five years' worth of emissions, at current rates, could be sequestered over the remainder of the century.

The profiles of solar engineering initiatives are notably different from those of carbon removal ideas. Solar engineering proposals tend to be relatively inexpensive and quick-acting, which makes them tempting for use in climate emergencies, such as a sudden release of greenhouse gases. But solar engineering efforts are risky because they are built around untested and unnatural processes or technologies, such as spraying the stratosphere with particulates or chemicals in aerosol form. Some advocates point to volcanic eruptions as reassuring natural experiments—volcanos spew sulfur dioxide into the atmosphere, cooling the climate for months or years afterward--but that analogy may only go so far.[20]

In addition, solar engineering approaches do nothing to reduce the buildup of greenhouse gases in the atmosphere: with solar engineering these gases would continue to accumulate and produce important environmental consequences even if temperatures are moderated. Carbon buildup also creates a potential "termination effect": ending the use of the technology could result in a rapid rise in temperature as now-abundant greenhouse gases trap the energy of a resumed flow of solar rays. Few organisms on Earth could adapt to such rapid warming. Another concern is the potential impact of "global dimming" practices on monsoons, agricultural production and basic photosynthesis.

The following chart, also from C2G2, briefly describes several frequently mentioned solar engineering initiatives.[21]

Solar Radiation Modification Technologies, Maturity, Governance and Challenges

Proposed Method		Maturity/Governance	Governance/Technical Challenges include:
	Injecting reflective aerosol into the lower stratosphere to increase planetary albedo (reflectivity) and thereby reduce temperatures.	• Technology theoretical, based on natural analogues and computer models; • Outdoor experiments possible as early as 2019; • Governance covered by customary international law and CBD but not yet comprehensive.	• Regional variation in impacts (e.g. temperature and hydrological); • Risk of ozone depletion; • Impact on vegetation and crop growth; • Risks of premature termination; • Risk to implementation of many SDGs; • Responsibility for implementation, financing and compensation; • Public concern, informed consent; • Privatization and patenting issues; • Intergenerational ethics.
	Seeding clouds above ocean surfaces (e.g. with self-steering, autonomous ships), or whitening clouds above land to reflect sunlight back into space.	• Technology still theoretical based on observations and simulations; • Governance covered by customary international law, CBD and LC/LP, but not yet comprehensive.	• Technical limitations to scope and delivery ; • Regional variation in impacts (e.g. temperature and hydrological) expected; • Depends on weather conditions; • High levels of uncertainty about aerosol and cloud behavior; • Risk to implementation of many SDGs.
	Thinning of cirrus clouds to allow more infrared radiation from Earth to escape.	• Technology still theoretical, based on simulations; • Governance covered by customary international law and CBD decisions, but not comprehensive.	• Technical limitations to scope; • Regional variation in impacts (e.g. temperature and hydrological) expected; • High levels of uncertainty about aerosol and cloud behaviour; • Risk to implementation of many SDGs.
	Making surfaces (urban areas, roads, agricultural land, grasslands, deserts, polar ice-caps, oceans) brighter to reflect solar radiation.	• Mechanism confirmed by simulations and demonstrations, but not yet at scale; • Governance covered by customary international law and CBD but not comprehensive.	• Small on global scale (up to 1-3°C on regional scale); • Land-use and deployment costs; • Impacts on hydrological cycles, plant growth and aquatic systems.

While possibly justified, carbon removal and solar engineering initiatives are dangerously seductive because they reduce pressure for the hard work of emissions reductions. A huge challenge in any use of climate engineering is to ensure that emissions reductions remain the principal focus of climate policy and that climate engineering is at most a supplemental strategy, sparingly used. Otherwise, opting for geoengineering could be the climate equivalent of using liposuction, rather than diet and exercise, to fight obesity: the root of the problem goes unaddressed.

Evaluating the Challenges

The previous descriptions of approaches to climate engineering reveal a broad variety of challenges, some shared by two or more geoengineering technologies or practices. Many of these challenges hint at ethical dilemmas inherent in carbon removal, solar engineering, or both.

Huge resource requirements—Bio-Energy with Carbon Capture and Storage (BECCS) and afforestation require large expanses of land. Some analysts cite area equivalent to 1-2 Indias as the land requirement for BECCS. Can such areas be secured and properly managed, and can this be done without affecting food supplies?

Limited storage—Soils and trees have a limited capacity to absorb carbon. Once they are saturated, the rate of carbon uptake drops off sharply. This means that strategies such as afforestation and soil sequestration cannot offset carbon emissions indefinitely.[22]

In addition, some analysts believe that geological storage capacity may be too limited to accommodate extensive use of strategies such as BECCS and DAC. Opting for a strategy with limited storage would seem to require simultaneous and substantial emissions reductions.

Extended ramp-up—Securing investments and undertaking testing of new industrial technologies require years, and sometimes a decade or more. Similarly, newly planted trees need a decade or more to reach their maximum rate of carbon uptake. Understanding a strategy's readiness is important in the race against ongoing emissions.

Overshoot—Extended ramp-up times suggest that for some technologies, a carbon overshoot period could characterize the near to medium term, meaning that carbon concentrations might exceed desired levels temporarily, then be dialed back after the geoengineering technology is developed and deployed.

Indefinite commitment—Unless accompanied by efforts at emissions reductions or carbon removal, solar engineering would need to be used indefinitely; withdrawal of the technology would result in a sudden spike in temperatures. Is it realistic to assume that any political commitment, especially at the global level, can be kept indefinitely? If not, does a solar engineering option require iron-clad linkage to emissions reductions?

Incomplete solution—Because solar engineering efforts leave atmospheric concentrations of CO2 untouched, they would not address other consequences of emissions, such as air and water pollution, ocean acidification, and ecological disruption from changes in patterns of plant growth.

Trust in commitments—Some strategies require confidence that policymaker promises will be kept. For example, a typical IPCC 2° climate scenario could require 16,000 BECCS plants, whereas only three are in operation today.[23] If today's emissions limits are relatively permissive based on expected future reductions, and those reductions are never realized, the impact on temperature increases could be huge.

Varied results—Some measures to restrain temperature increases could have detrimental effects at the regional or local levels. For example, some forms of solar engineering could cause changes in rainfall in parts of Africa. What safeguards can be put in place to protect vulnerable regions, and are people in those regions part of decision-making on geoengineering?

Uncertain results—Many of the estimates of potential benefits from geoengineering must be bracketed with significant caveats. Analysts often

- *estimate technical or theoretical potential, with little or no analysis of the social costs of implementation or impact*
- *do not consider the logistical difficulties of scaling lab or field successes to a global level*
- *assume rules and governance structures that are yet to be created, and could be difficult to achieve, especially on a democratic basis.*
- *assume that funding for initiatives will be secured and sustained as needed.*

These and other challenges suggest that critical evaluation of geoengineering initiatives is needed.

Emerging Ethical Questions

The essays in Part III will wrestle with the various ethical questions associated with geoengineering and with emissions reductions. Here we suggest possible ethical guideposts and offer a preliminary sorting of ethical issues. (See Table 3.)

Table 3. Dimensions that Inform Ethical Assessment of Emissions Reductions and Geoengineering

		EMISSIONS REDUCTIONS		GEOENGINEERING	
	Dimension of Interest and Possible Ethical Guideline	**Energy efficiency/ Clean energy/Sustainable land management**		**Carbon Removal**	**Solar Engineering**
TECHNICAL	**Risk** Less risk is preferred to greater risk, other things equal	Little or no unknown environmental risk. Social and economic risks are mostly known, limited and can be managed.		Risks emerge particularly at large scale. Slow-acting. Inherently a medium to long term. Fundamentally manages the "Earth's thermostat."	Introduces novel global risks especially at large scale. Fast-acting. Inherently short term. May result in rapid fluctuations in the "Earth's thermostat."
	Maturity of Technologies Established technologies are preferred over those that are novel	Emissions reduction technologies such as solar panels, bicycles, and vegetarian meals are established and safe.		Some technologies like afforestation, soil remediation, and biochar are long-established, while others, such as enhanced alkalinity or direct air capture, are untried at a large scale.	Most solar engineering technologies are untried except in very small scales or in modeling simulations.

		EMISSIONS REDUCTIONS		GEOENGINEERING	
PERFORMANCE	**Effectiveness** The more an effort frontloads climate stabilization, the more it is preferred, all things equal	Technologies and practices offer immediate emissions reductions, but putting them in place requires time.		May produce only modest climate effects, over decades, for example, as young trees mature. DAC could potentially maintain carbon balance over centuries.	Can produce substantial climate effects, relatively quickly.
	Comprehensive Coverage Approaches that address more climate dysfunctions are better than those that address fewer	Addresses the root cause of climate change (emissions), and the full range of impacts created by carbon pollution.		Does not address root cause (emissions) but does address carbon buildup in the atmosphere. Use of CDR is intended to complement, not replace emissions reduction.	Addresses neither carbon emissions nor carbon buildup. Use is intended to complement, not replace, emissions reduction. Also does not address ocean acidification or air and water pollution.
	Pace Solutions that address climate at the needed pace, while allowing for course corrections, are best	Could be implemented aggressively to make stabilization within Paris caps possible, although at some cost.		Could be tested and implemented incrementally or at large scales, depending on circumstances.	Could be implemented suddenly, with largescale impacts before research is available to understand the risks relative to inaction. Could also be implemented gradually.
	Scale of negative impacts The smaller the geographic scale of negative impact, the better, all things equal	Most impacts are positive for climate, the larger environment, and human wellbeing.		Potential for negative impacts across oceans and large masses of land with some methods. Negative impacts of DAC would likely take time to understand.	Potential for global-scale negative impacts by disrupting monsoons, droughts, and farming.
	Withdrawal Abrupt termination of activity should not have an adverse effect on the environment	Designed as a permanent restructuring of economies, so no withdrawal concerns.		For likely future emissions scenarios, abrupt termination would have limited consequences. Some point to withdrawal as a remedy in the event of overshooting removal.	For likely future emissions scenarios, abrupt termination of some technologies would produce significant consequences from rapid heat build-up.
	Social & Economic Solutions should deliver social cohesion, jobs, better health, and other positive social outcomes	Varies by jurisdiction, but most sustainability initiatives, properly designed, deliver positive socioeconomic outcomes.		Depends on design.	Depends on design.
RESOURCES	Cost Low cost is better than high cost, other things equal	Expensive, but much of the expense is investment in creating new, carbon-free economies.		Are currently expensive (or comparable to the cost of emissions reduction).	Are inexpensive to deploy (relative to cost of emissions reduction).
	Resource Intensity Fewer resources is preferred to more resources, other things equal	Energy and transport infrastructure could require extensive quantities of metals and cement.		Large areas of land, or extensive quantities of minerals or energy, could be required.	Relatively low resource requirements, although for some solutions, a permanent resource commitment is required.

		EMISSIONS REDUCTIONS		GEOENGINEERING	
GOVERNANCE	**Moral Hazard** The incentive to reduce emissions should not be undermined, even if geoengineering is chosen	Little risk that early successes in reducing emissions could breed complacency and lack of commitment to full reductions.		Clear risk that successful carbon removal could dampen commitment to reduce emissions, but this is muted by the delayed results of implementation.	Clear risk that successful solar engineering could dampen commitment to reduce emissions and leave a host of climate issues unaddressed if initial experiments prove successful.
	Historical Responsibility Emissions histories should inform the calculus of nations' cost burden	The largest historical emitters can assist with technology transfer and investments to build sustainable economies.		The largest historical emitters can bear the costs in proportion to their responsibility.	The largest emitters historically can bear the costs in proportion to their responsibility.
	Openness Inclusive, transparent, consultative, and public is better than not	Paris Agreement provides strong framework on which to build, but stronger commitments are required.		Initiatives raise fewer and less difficult governance issues in the short-term but may raise thorny issues medium and long term.	Initiatives raise difficult issues with respect to global governance. Unilateral action is a particular concern.
	Rules First Rules should be in place before research or implementation takes place	Largely does not apply, because of low risk of large-scale harm, although actions coordinated across jurisdictions can be helpful.		Rules should be agreed ahead of research or implementation for those technologies that carry risks on a large scale. However, research is already underway and some implementation would be hard to distinguish from ongoing practices.	Rules should be agreed ahead of research or implementation for those technologies that carry risks on a large scale. However, whose rules? Governments? Universities? International Organizations?
	Militarization Climate solutions should not be weaponized	Weapons are not a part of the vision of emissions reduction initiatives.		Carbon removal initiatives are not typically of military value, at least not in the short term.	In some conceptualizations, solar management could become a military tool.

Source: *See endnote* [24]

The many pros and cons of various climate engineering technologies and practices make assessment of them difficult. As people of faith and spirituality work through the issues, it may be helpful to keep in mind the following assessments of the two geoengineering families by authoritative sources:

> *Carbon Removal*—The European Academies Science Advisory Council notes that carbon removal "may have a useful role to play but, on the basis of current information, not at the levels required to compensate for inadequate mitigation measures." It concludes that the limited potential of CDR underlines the need "to strive as hard as possible to mitigate emissions…"[25]

> *Solar Engineering*—The IPCC 1.5 report observes that although solar engineering measures "may be theoretically effective in reducing an overshoot, they face large uncertainties and knowledge gaps as well as substantial risks, institutional and social constraints to deployment related to governance, ethics, and impacts on sustainable development. They also do not mitigate ocean acidification."[26]

Climate, Geoengineering, and Development

Climate change threatens the development of people and nations alike, as the number of extreme weather events and other climate-related disruptions grows. These maladies have direct and indirect economic costs. Analysts at Munich Re, a firm that insures insurers, tallied the cost of weather- and climate-related disasters in 2017 at $320 billion globally.[27] In the United States, the cost of storm damage and the health impacts of a warming climate totaled approximately 40 percent of its GDP growth in 2017.[28] And Citigroup estimates that climate change could reduce gross world product by *tens of trillions of dollars* between 2016 and 2050.[29] Absolute economic losses and their share of GDP are both expected to rise in the decade ahead as the climate becomes increasingly unstable.

For some proponents of geoengineering, the rising cost and disruption of climate change is a strong rationale for using geoengineering: by moderating Earth's warming, they argue, investments in geoengineering could protect a nation's development options. This view could soon dominate discussion if the economic and human toll from climate change becomes so great that the public clamors for an immediate climate solution. Solar engineering projects might hold particular appeal if they are viewed as quick-acting and relatively inexpensive. But actions driven by public panic could result in ill-considered decisions and outcomes that bring widespread dislocation and suffering. Before this point is reached, a sober analysis is needed of geoengineering and development, and of how alternatives to geoengineering might affect development.

Sustainable Development Goals and Geoengineering

A thorough analysis of the impact of geoengineering on development is difficult because of the lack of hard data regarding the effectiveness, side effects, and true cost of various climate interventions. But the C2G2 has taken a first look at the question by analyzing geoengineering initiatives from within the framework of the Sustainable Development Goals (SDGs) developed by the United Nations.[30] The SDGs are a set of 17 development goals ranging from ending hunger and improving access to clean water to safeguarding oceans and the climate. Their aim is to increase the development status of all nations, specifically by addressing the needs of the poorest people and nations, by 2030.[31]

The C2G2 assessment, based on a review of relevant literature, finds that 13 of the 17 SDGs would be affected in one way or another by the deployment of solar engineering or carbon removal projects. At least 9 of the 17 SDGs could be affected negatively, in particular for the provision of clean water, health, poverty reduction, and peace and justice. (For more detail, see Annex 1.) The assessment concludes that solar engineering is more likely than large-scale carbon removal to increase the risk of falling short in achieving the SDGs.

Of course, *how* development initiatives are undertaken can affect whether a geoengineering strategy is helpful or damaging to development. For example, managing forests sustainably can provide food and clean water, and protect ecosystems, while taking up carbon. Alternatively, the carbon uptake could be pursued by converting natural forests or forests under indigenous ownership to plantations for bioenergy production. This approach could threaten food and water security, create conflict over land rights and result in biodiversity loss.

Sustainable Development as an Alternative to Geoengineering

Before geoengineering is sold as a development strategy, it is worth asking: Is everything possible being done to reduce emissions of greenhouse gases, the direct cause of Earth's destabilized climate? Clearly the answer is no. After decades of discussions, global emissions continue to rise, and recently some high-emitting nations have adopted policies that could *unleash* emissions. The failure to act is a moral lapse that arguably should be corrected before risky initiatives such as geoengineering are undertaken. This critique is especially powerful given that ***emissions reduction itself can be a development strategy.***

Lord Nicholas Stern, a prominent economist who analyzes the impact of climate change on economies, has authored several studies since 2006 showing that not acting on climate is much more expensive than taking action. He writes that the cost of staying within a 2°C temperature cap is "no more than 2% of global GDP," and possibly much less.[32] Stern further finds that more than half of the reductions in greenhouse gas emissions needed to meet a 2° cap would carry co-benefits beyond climate stabilization, such as better health.[33] Thus, while the required investments are substantial, action to slow warming can be framed as investment in new and sustainable economies—investments that should be made in any case.

Indeed, as co-chair of the Global Commission on the Economy and Climate, Stern found in 2018 that aggressive pursuit of sustainable economies would create economic gains of $26 trillion by 2030 compared with business as usual.[34] Such an effort would involve major commitments to five areas of development: clean energy systems, smarter urban development, sustainable land use, wise water management, and circular economies.[35] Stern summarizes the value of sustainability investments this way:

> ***The transition to a low-carbon economy looks to be a path of development and growth that is very attractive in its own right: cleaner, quieter, more efficient, less congested, less polluted, more bio-diverse and so on. And in addition, and fundamentally, it carries much less climate risk. It does require investment and change. It will involve some dislocation. But it seems a very sound and attractive strategy.*** [36]

The Commission also stresses that commitment to sustainable economic activity is urgent. An estimated $90 trillion will be spent on infrastructure by 2030, with many of those investment decisions to be made in the next 2-3 years.[37] As long-lived assets, infrastructure locks in a development path for decades, and can accelerate, or slow, the building of sustainable, climate-stabilized economies. Moreover, Stern estimates that two financing innovations—subsidy reform and carbon pricing—could generate $2.8 trillion in government revenues annually by 2030. This figure is roughly 2 percent of projected global GDP in 2030—about the level of investment that Stern had estimated would be required to keep warming below 2°C.[38]

Other studies give a glimpse of what a low-carbon economy could look like. Entrepreneur Paul Hawken's 2017 book *Drawdown* lists 100 solutions for stabilizing the climate.[39] Very few carbon removal or geoengineering technologies and practices are found among the 100 solutions—most are emissions reduction initiatives, such as replacing fossil fuels with renewable energy, or replacing fossil-powered trips with biking and walking. Others are tweaks to current practices that would sequester carbon but which are not typically thought of as geoengineering, such as restoring marginal farmland and improving the way rice is cultivated. The book gives a strong sense of unrealized potential to move economies away from the emission of greenhouse gases.

In sum, despite growth in the use of renewable energy and other technologies that can reduce emissions, the world's nations have not made an all-out effort, equivalent to a wartime commitment, to reduce emissions. It is reasonable to ask, before embracing geoengineering solutions, how efforts to reduce emissions might be stepped up, quickly and monumentally.

The Interests Behind Geoengineering

Every geoengineering technology or practice has a set of advocates who are interested in seeing their approach adopted as a solution for stabilizing the climate. The chance to profit, to advance research, to help vulnerable people, or to gain military advantage—these and other motivations stand behind various pro-geoengineering interests. Another group, the general public, stands largely on the margins of the issue, yet arguably has the greatest stake in geoengineering questions. For this reason, and because climate is the common patrimony of all people rather than a private resource, public benefit should be the lens through which the interests of geoengineering advocates are evaluated.

Groups that have shown interest in geoengineering include the following:

Research groups are interested in investigations of geoengineering, both as a scientific challenge and as a source of funding. Whether their interests align with the public interest depends on what the public has identified as the appropriate approach.

Corporations and other private firms can contribute technology and expertise that could be important for the success of any geoengineering initiative. Some companies could align closely with the public interest if they are involved in a geoengineering project that is supported by the public. On the other hand, some firms might fund geoengineering initiatives in order to preserve their core business—and this may already be happening. A study from the Center for International Environment Law (forthcoming in early 2019) investigates the role of the fossil fuel industry in developing, patenting, and promoting key geoengineering technologies to justify the continued production and use of oil, gas, and coal--and to avoid or reduce the need for true systemic change. Clearly, however, burning more fossil fuels does not align with the public interest in reducing emissions.

Humanitarian/development groups may see geoengineering as an important option for ensuring that vulnerable people are not harmed by an increasingly unstable climate. Particularly in the face of a climate emergency such as melting permafrost, which could accelerate temperature increase and with it, sea level rise or drought, aid and development agencies may see a quick-acting climate solution as a justifiable response.

Military groups could see geoengineering as a way to manipulate climate for strategic gain. For example, in the 1960s, the Pentagon seeded clouds to augment rainfall and slow the movement of supplies between North and South Vietnam.[40] Geoengineering could be next: a research arm of the Pentagon, the Defense Advanced Research Projects Agency, or DARPA, held a meeting in 2009 focused on the topic, raising fears that geoengineering could become weaponized. The militarization of climate engineering is not in the public interest.

Non-profit research or advocacy groups have proposed initiatives that are sometimes classified among the most benign forms of geoengineering. Groups that promote forestation, agroforestry, or regenerative agriculture—activities that would increase biomass and absorb carbon--have a mission interest in seeing such approaches adopted. Because these activities are low-risk and generate co-benefits such as soil health, water retention, and more resilient farming, the interests of such organizations arguably align comfortably with the public interest. And involvement of such groups could ensure that seemingly benign solutions are carried out in ways that protect vulnerable people.

Conclusion

The October 2018 Special Report on Global Warming of 1.5°C sounded the IPCC's loudest alarm yet of the dwindling prospects for a stable climate and human development. From the report's perspective, securing a stable climate could well require the use of geoengineering. If so, the question is how to manage and govern climate policies to minimize the use of climate engineering and ensure that vulnerable people and the natural environment are protected.

However, it is worth remembering that emissions reductions will be needed, likely at large scale, even if geoengineering initiatives are pursued. Societies would do well to commit to aggressive reductions, taking advantage of the development opportunity inherent in redesigning economies to be sustainable. Prudence suggests a determined approach: mobilization of societies as in wartime, for example, with entire citizenries engaged in re-creating economies to be low-carbon and equitable. Such an insistent strategy could contribute enormously to minimizing the use of climate engineering, while creating environmentally and socially robust futures for the world's civilizations.

A cautious and responsible approach to geoengineering is needed if this strategy is to be employed. Part II offers some recommendations for creating such a responsible path.

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PLAYING GOD?

MULTI-FAITH RESPONSES TO THE PROSPECT OF CLIMATE ENGINEERING

Part II
Principles for Advocacy on
Climate Engineering

Principles for Advocacy on Climate Engineering

GreenFaith Recommendations to Faith Groups

People of faith have a vital role to play in the growing public debate about geoengineering. GreenFaith's public response to this emerging field will be guided by the themes outlined below. We invite other faith groups to consider adopting a similar stance in their engagement of the topic.

Our guidelines are informed by factors which include the ethical values that guide GreenFaith advocacy; the ready availability of clean and affordable renewable energy technologies; the political-economic context that shapes humanity's response to climate change; and expert assessments of the feasibility of various geoengineering technologies and approaches. These recommendations will be relevant, in varying ways, to the work of scientific and academic research guilds, national governments and intergovernmental processes and bodies.

Require aggressive emissions reductions alongside any climate engineering; prevent geoengineering from extending the life of fossil fuel use.

Geoengineering creates a "moral hazard" in which visions of a technological fix to the climate crisis lessen pressure on governments and businesses to maximize climate mitigation efforts and scale back fossil fuel use dramatically and rapidly. People of faith should take the lead in calling for mechanisms to address this temptation directly.

Society's primary response to climate change must be emissions reductions, on a dramatically accelerated basis. Geoengineering must never substitute for robust emissions reductions. If geoengineering approaches prove viable and are regulated appropriately, they should supplement emissions reduction efforts only temporarily, in limited circumstances, and under carefully prescribed conditions.

To prevent geoengineering from spawning "emissions reductions backsliding," GreenFaith calls for legal measures to ensure that any use of climate engineering be accompanied by clear, ambitious, public, verifiable, and adequately financed plans to reduce emissions on a scale required to meet the Paris Agreement's 1.5°C aspiration.

Furthermore, geoengineering should not be deployed without analysis of how its use might prolong the use of fossil fuels. The fossil fuel industry is involved in developing, patenting and promoting key geoengineering technologies, an indicator that this powerful industry will likely play a lead role in advocating for geoengineering as a means of prolonging its own life. GreenFaith calls on governments, universities, and other groups conducting geoengineering research to reveal the sources of research funding, and to include in research findings a warning about the levels of continued fossil fuel usage that proposed geoengineering usage would enable- similar to warnings that accompany other dangerous technologies or products. Then, as above, if a national government opts to implement geoengineering, it should be legally required to commit to clear, ambitious, public, verifiable, and adequately financed plans to reduce emissions to a level that at a minimum offsets the emissions enabled by the geoengineering.

Insist on robust, transparent, inclusive governance that prioritizes the interests of climate-vulnerable constituencies.

No nation, industry, interest group, or individual should set the direction of geoengineering in isolation. Geoengineering affects a broad set of public interests and should be managed using public institutions and processes, models of which exist today. For instance, the global Paris Climate Agreement was developed through the United Nations Framework Convention on Climate Change (UNFCCC), while the Intergovernmental Panel on Climate Change (IPCC) has offered science-based climate assessments. These structures should be strengthened to prepare them for the emerging possibility that large-scale carbon removal projects may be necessary.

We address governance of SRM research below. Effective governance of CDR research (at all levels, from global to local) and of the deployment of any geoengineering technologies must prioritize concern for the most vulnerable. The interests of vulnerable communities, represented by coalitions such as the Climate Vulnerable Forum and by voices from civil society, should have significant representation within climate engineering governance frameworks. Similarly, research and implementation of geoengineering initiatives should involve a wide range of stakeholders, especially those potentially most affected and vulnerable. A code of conduct regarding research should be agreed to before any research is undertaken. Research plans and research results should be publicly available, and decision-making should be transparent.

One particular area of concern is the rights of Indigenous peoples. Carbon removal schemes such as afforestation and Bio-Energy with Carbon Capture and Storage (BECCS), if implemented at scale, would require massive amounts of land. National governments might well eye traditional lands of Indigenous peoples for such purposes. While these lands are often protected by law, governments have frequently been unwilling or unable to enforce these protections when faced with demands for access by extractive industry and agribusiness interests.

To protect Indigenous peoples' rights, international human rights law has created processes and standards that encourage their participation in decisions that affect them. One of these tools is Free, Prior, Informed Consent (FPIC), which gives Indigenous people a measure of self-governance through the power to veto government projects that directly affect their lives, cultures, and traditional territories. GreenFaith calls for governments and intergovernmental institutions involved in any form of geoengineering to affirm and uphold FPIC for Indigenous peoples. Large-scale afforestation and BECCS initiatives must not be allowed to violate the rights of Indigenous peoples to their legally ancestral homes and territories.

Remember: the issue is bigger than climate alone; attend to the full range of impacts.

Geoengineering initiatives will have impacts far beyond the climate-related concerns of temperature and atmospheric carbon levels. Climate engineering's effects on a wide range of environmental and social factors, such as the effect on ecological systems, biodiversity, food supplies, land use, air pollution, and much more must also be of concern to decision makers. GreenFaith calls for scrutiny of geoengineering initiatives in relation to these additional concerns. And, if climate engineering is implemented, it should be carried out in ways consistent with the sustainable development objectives of nations, international human rights law, and the full range of international environmental treaties and conventions.

One example is Particulate Matter (PM - also known as soot), which, like carbon dioxide, is a by-product of burning fossil fuels. PM emissions are responsible for extensive health damage including heart disease, respiratory illnesses, and lung cancer. According to the World Health Organization, deaths

from PM pollution number in the millions annually, with the poor, children, the elderly, and chronically ill persons being most vulnerable.

Public health and environmental justice advocates have long recognized that one of the benefits of reducing the burning of fossil fuels is that it reduces both CO2 and PM emissions, resulting in significant benefits in relation to climate change and public health. However, geoengineering approaches would allow for the continued use of fossil fuels, removing CO2 from the atmosphere or masking its impacts, without realizing PM emissions reductions. Given the magnitude of PM's public health impact, GreenFaith could not support implementation of any geoengineering plan that did not include ways to address otherwise unabated PM emissions levels.

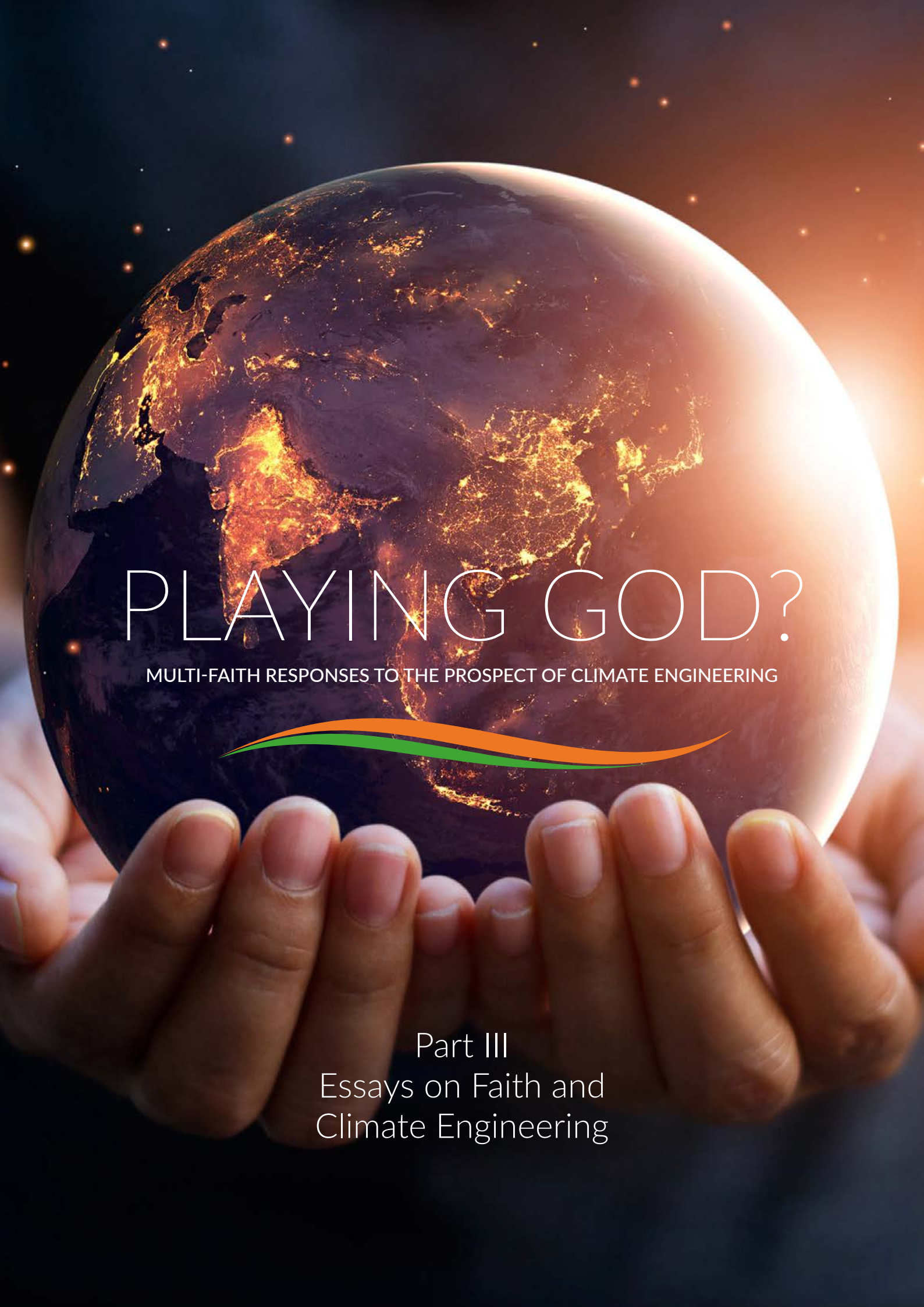
PM emissions are just one of many ways that geoengineering would have impacts beyond those related to climate change. GreenFaith calls on climate engineering advocates to recognize these impacts and address them responsibly as a precondition for receiving consideration from society for any use of geoengineering.

Enact a moratorium on solar geoengineering

Because solar radiation management carries a high level of uncertainty in relation to risk and effectiveness, GreenFaith calls for an international moratorium on the deployment of this group of geoengineering technologies. GreenFaith also supports effective governance of any solar geoengineering research through a combination of national regulation or legislation, professional codes of conduct, and multilateral agreements. Open-air testing and field research on solar radiation management should not proceed until such agreements are in place.

Require only peaceful use

No nation, industry, interest group, or individual should set the direction of geoengineering in isolation. Geoengineering affects a broad set of public interests and should be managed using public institutions and processes, models of which exist today. For instance, the global Paris Climate Agreement was developed through the United Nations Framework Convention on Climate Change (UNFCCC), while the Intergovernmental Panel on Climate Change (IPCC) has offered science-based climate assessments. These structures should be strengthened to prepare them for the emerging possibility that large-scale carbon removal projects may be necessary.



PLAYING GOD?

MULTI-FAITH RESPONSES TO THE PROSPECT OF CLIMATE ENGINEERING

Part III
Essays on Faith and
Climate Engineering

Introduction

Author

Forrest Clingerman

Faith communities are intertwined with the societies and cultures in which they find themselves. Therefore, it is not surprising that religious communities have been involved in theological and ethical reflection on climate change for decades. The gamut of religious institutions, denominations, and ecumenical and interfaith organizations have grappled with how best to respond to the climate crisis as people of faith, using the rich emotional and intellectual resources of their traditions. Religion scholars have likewise treated to the topic of religion and climate change using the methods and tools of academic research on religion.[1] Theologians and ethicists, in particular, have sought to critique religion's complicity in the climate crisis, and to retrieve wisdom that might serve as a resource to encourage human and more-than-human flourishing in the face of climate change. In many respects, a document that is the culmination of a faithful and scholarly response to climate change is Pope Francis' encyclical, *Laudato Si': On Care of Our Common Home*.[2] As a pastoral and theological statement *Laudato Si'* has been influential not only in religious settings, but also in policy and scientific discussions.

While religious traditions are involved in a rich discussion around environmental change, the discussion of climate engineering and religion is still in its beginning stages. In Part II of this report, researchers of religion, theology, and ethics attempt to advance this discussion by reflecting on how theological, spiritual, and ethical resources might inject a hitherto unheard perspective into discussions of geoengineering policy and ethics. But why should religion scholarship even be part of the climate engineering discussion? One obvious reason, of course, is the fact that the majority of the world's human population is connected with a faith tradition. But there are further reasons to include religion in the climate engineering discussion: for instance, religion defines how humans see themselves and their societies, religion frequently has a role in affirming or challenging scientific authority, religion suggests stories and symbols to frame our understanding, and religion provides a vocabulary for moral deliberation.[3] How might faith communities respond to climate engineering? The authors of the essays that form Part II of this report accept this challenge, furthering the discussion into how specific faith traditions might approach this controversial topic.

The first essay of Part II of this report approaches climate engineering through the lens of Hindu ethics. Authors **Mat McDermott, Adinarayanan Venkatachalam, Smrithi Rekha Venkatasubramanian** explain how Hindu ethics are grounded in an understanding of God as being in creation. There is no separation between the transcendent Divinity and the world; this fundamental relationality is at the heart of **"How Hindu Ethics Can Help Weigh the Potential Risks or Benefits of Climate Engineering Methods."** The

authors explain some resulting principles for Hindu ethics, which highlight the need for reverence, responsibility, and non-exploitation in the human-creation relationship. From these principles, the authors offer a number of questions and responses to the appropriateness of carbon dioxide removal and solar radiation management from a Hindu perspective.

In **"Geoengineering, Sacrifice, and the Scale of Love,"** Christian theologian **Arianne van Andel** writes a contextual theological reflection about the "sacrifice zones" that might be one of the side effects of climate engineering. Sacrifice is a rich and important word in religious traditions. But who is to suffer? Too often, both Christianity and climate engineering see the sacrifice of marginalized communities as inevitable byproducts. Within a liberatory Christian faith, sacrifice should be accepted only when it invites compassion and service, not suffering and violence. Thus for van Andel, a Christ-centered meditation on sacrifice provides an alternative to the "pragmatic" sacrifice zones of climate engineering. In other words, the limits we enforce on climate engineering should be defined by love, rather than power.

"Do large scale, global engineering projects fall under the category of *Tikkun Olam*?" asks **Hava Tirosh-Samuelson**. Providing an overview of the depth of Jewish concern for the environment, Tirosh-Samuelson explains how Jewish ethics has a terrestrial orientation. This sees science in positive terms, but also requires humans to take responsibility in their involvement with the world. In **"Redemptive Activism: Judaism, Climate Change, and Climate Engineering,"** she says this is clearly seen in the Jewish emphasis on tikkun olam, or "mending the world," in the face of climate change. Thus while a Jewish ethics of responsibility has no reason to condemn climate engineering in principle, there are a number of areas of concern—akin to areas of concern with transhumanism and other emerging technologies—for the Jewish ethicists and jurists to confront.

Celia Deane-Drummond begins her Christian theological discussion by placing climate engineering in the context of Pope Francis' *Laudato Si'*, which already has become a significant statement on religion and the environment. In the essay **"Taking the Earth into Our Own Hands: Practical Wisdom in an Age of Climate Engineering,"** Deane-Drummond explains how practical wisdom offers "wisdom principles" to our reflection on climate engineering. These principles are to include broad representation in policy discussion, to remember cultures and communities that are impacted by climate change, to bring an element of caution to the debate, to actively try to understand different knowledges and points of view, and to work on robust predictions, especially in how climate change will affect vulnerable populations.

In his essay **"Islam and Climate Engineering,"** religion scholar **Çağdaş Dedeoğlu** explains how Islam—and, indeed, all religions—are structured through ontologies (theories of being), epistemologies (theories of knowledge), and ethics (theories of right and wrong). He summarizes how the textual and theological tradition of Islam offers several resources—such as an emphasis on the oneness of God, stewardship, and a focus on justice—through which to build an environmental ethics. Using this Islamic background, Dedeoğlu raises and answers ten questions about the relationship between Islam and climate engineering.

There is a recognition that the material and economic impacts of climate engineering will not be uniformly shared. A scholar of Indigenous peoples, **Kyle Whyte** highlights how the frequent criticisms of climate engineering as a form of "playing god" forget a longer historical trajectory. Whyte reminds us that the arrogance and ignorance of "playing god" is present historically in how human communities have treated each other, especially in the case of colonization in the modern period. Focusing his reflection on the violence that occurred to North American Indigenous communities for centuries, his essay **"Geoengineering: Playing God—Again!"** reframes climate engineering as another chapter in the ongoing story of how some human groups have used their power to play god with other human and more-than-human communities.

According to the **Ven. Bhikkhu Vivekānanda**, "Buddhist teachings are setting high hurdles for the research and deployment of climate engineering measures and instead advocate changes in human behavior towards the environment and changes of lifestyle." Explaining the Buddhist "Divine Abidings"

and Five Precepts in his essay **"A Buddhist Perspective on Climate Engineering,"** he explains how a Buddhist worldview interprets the human relationship with the natural world. As individuals, we are placed in a position to seek individual transformation; climate engineering can be seen as responsible when aligns with such qualities as non-violence, loving kindness, compassion, sympathetic joy, and equanimity.

In debates over the ethics of climate engineering, both sides of the argument often invoke a reverence for nature. **Duncan McLaren** argues that this notion of reverence should be unpacked, and then replaced, in our discussions of climate engineering ethics. In effect, talk of reverence overlooks that humans and nature are intertwined. In **"Good God! Care, Reverence and the Ethics of Climate Engineering,"** McLaren argues for an alternative: an ethics of care. An ethics of care is centered on collaboration, rather than mastery. As McLaren writes, "If care is understood…as an ongoing maintenance of the world, the quest is not dependency, but autonomy and agency for the subject of care." In other words, questioning how climate engineering is, or is not, a form of care should influence how we weigh motivations and design of climate engineering.

Forrest Clingerman, Laura M. Hartman, and **Kevin J. O'Brien** speak from and to faith communities among the "climate privileged." They use a story from Jesus' ministry in their essay **"Climate Privilege and Climate Engineering: Lessons from the Story of Zacchaeus."** The authors argue that faith communities that come from a place of privilege have unique responsibilities to other communities when deliberating over climate engineering. Upholding these responsibilities means recognizing the power and privilege of one's faith community, using them in effective and appropriate ways on behalf of those without a voice, and, most importantly, sharing power with others in more equitable and life-giving ways.

In the final essay, **Saffet Abid Catovic** examines how the "life-enabling and life-protecting" principles of Islamic Law can be used to investigate the morality of climate engineering. In **"Islam, the Religion of Nature, and Geoengineering: Let there be no altering of the work wrought by Allah,"** he offers a discussion of Islamic ethical and legal principles, showing how these might relate to the issues that we face with technological responses to climate change.

These essays are only some of the many potential voices that emerge from religious traditions, and represent just a beginning point for a wider discussion between faith communities, policy-makers, and climate engineering researchers. The conclusions drawn present a complex view, suggesting that there is no single "religious view" that can be applied to questions surrounding emissions reduction, solar radiation management, or even climate adaptation. At the same time, together these essays show how faith traditions provide important perspectives that raise otherwise neglected dimensions in the discussion of climate engineering policy and ethics.

1. *For example, in 2001 Daedalus: The Journal of the American Academy of Arts and Sciences, published a special issue "Religion and Ecology: Can the Climate Change?" that contained treatments by scholars from a number of world religious traditions. This was one of the first multifaith investigations of climate change. "Religion and Ecology: Can the Climate Change," Daedalus 130 (2001).*
2. *Pope Francis, Laudato Si': On Care for Our Common Home (2015), http://w2.vatican.va/content/dam/francesco/pdf/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si_en.pdf*
3. *Forrest Clingerman and Kevin J. O'Brien, "Playing God: Why Religion Belongs in the Climate Engineering Debate," Bulletin of the Atomic Scientists 70 (2014): 27-37.*

How Hindu Ethics Can Help Weigh the Potential Risks or Benefits of Climate Engineering Methods

Authors

Mat McDermott is Director of Communications of the **Hindu American Foundation** and Advisor to The **Bhumi Project.**

Adinarayanan Venkatachalam is co-founder of the **Anaadi Foundation**. He is a yogi and visionary working for societal well-being based on Indian knowledge systems.

Smrithi Rekha Venkatasubramanian is co-founder of the **Anaadi Foundation**. She is a spiritual mentor, educator and researcher of Indian knowledge systems.

The release of another report by the Intergovernmental Panel on Climate Change shows,[1] despite some progress and political commitments made at the Paris climate talks a few years ago, human actions are continuing to dangerously change our planet's climate. The latest data demonstrates that the effects of climate change well may be worse than previously forecast. Unless we do more (much more) and more quickly (much more quickly) than we are to reduce greenhouse gas emissions, the planet our children and grandchildren will inherit will be a much less fertile and hospitable place than it currently is, let alone the one that existed two centuries ago, when the total human population was one-seventh that of today and before the Industrial Revolution.

> *To avoid the worst of climate change, we must act with more force than we are currently.*

The foremost action, perhaps it's obvious to say, must be actually significantly reducing the amount of greenhouse gases our human activities themselves cause. We must adapt our lives, our communities, the global economy to support this goal—our electricity production, our travel, our dietary and

consumer choices, are a good place to start.

These efforts at adaptation alone may not be enough, however, to reduce emissions as quickly or as deeply as the science indicates is required to limit warming.

Alongside these, proponents of geoengineering posit another set of proposals: proactive methods of increasing the ability of soil, forests, and oceans to sequester carbon, capturing and storing carbon emissions at the source of pollution, and attempting to reduce incoming solar radiation into the atmosphere, have all been proposed. In this there are a number of specific methods, ranging low- to high-tech, low- to high-risk, and well-tested to essentially theoretical.

The purpose of this paper isn't to explicitly advocate for or against any specific geoengineering technology or methodology, but rather to elucidate how Hindu spiritual teachings on the relationship between the individual and all of existence can help in evaluating geoengineering, including whether and how it might play a role in minimizing anthropogenic climate change.

Keep in mind that Hinduism is very diverse faith internally, with no single central spiritual leader, and is one that accepts multiple perspectives on the Divine and practices of worship as valid. For many issues it is impossible to say that x is "the" Hindu perspective, without specifying which lineage or which of the main complementary Hindu philosophical systems you are referring. Nevertheless, with that caveat, there are unifying themes in Hindu thought as applied to the relationship between the individual, manifest existence, and the Divine which can offer guidance to Hindus and non-Hindus alike.

> *God is not separate from creation, but is creation in both a material and causative sense.*

Hindus do not conceive of God as a central authority, separate from the world we experience, controlling it from afar, but rather as a core intelligence present in and making up all of existence. There is no fundamental separation between the Divine and humanity (or any other part of the universe). At the most basic level God is not there and humans here, humans this and God that. The same can be said of the relation between humans and other animals. Differences in form, behavior, and other external characteristics are certainly recognized but at the core there is the same transcendent Divinity.

The *Isha Upanishad* tells us, "Those who see all creatures in themselves and themselves in all creatures know no fear. Those who see all creatures in themselves and themselves in all creatures know no grief. How can the multiplicity of life delude the one who sees its unity?"[2]

Thus, realizing this divine presence everywhere, the Hindu spiritual person both takes responsibility for his actions, being mindful of not excessively disturbing the dynamic interconnected equilibrium of being, as well as recognizes that all actions are an interaction with Divinity—both literally and symbolically.

Guiding this fundamental understanding it's important to also recognize the perspective of the Vedas—the ancient series of spiritual texts, reverence for which in one of the things that distinguishes a Hindu from a Jain, from a Buddhist, from a Sikh, in the extended family of Indic thought. The philosophical sections of the Vedas, the Upanishads, capture the essence of the Hindu worldview in the *mahavakya* (great sayings).

> The most common of these great sayings are:
>
> प्रज्ञानम् ब्रह्म, prajnānam brahma, consciousness is brahman;
>
> अहम् ब्रह्म अस्मि, aham brahmasmi, I am brahman;
>
> तत् त्वम् असि, tat tvam asi, you are that;
>
> अयम् आत्मा ब्रह्म, ayam ātma brahma, this self is brahman.

All of these further emphasize that the ultimate reality is one and the individual is identical with it, meaning that everything we see within and outside of us is divine.

This unified vision of the universe is a key aspect defining the Hindu spiritual worldview. This leads to an approach to nature where the individual is considered part of an interconnected universe and understand that their actions impact the society and environment around them.

Guiding individual actions throughout life for Hindus are the *purushartha*, the four goals of human life: *dharma*, *artha*, *kama*, and *moksha*. With *moksha* (spiritual liberation) as the ultimate aim, *artha* (material prosperity) and *kama* (worldly pleasure) can be acquired and enjoyed within the framework of *dharma*.

Dharma, broadly defined, is a set of principles and practices that both sustains the cosmic order (*ṛta*) as well as binds us in harmony with that order. An understanding of dharma informs how we behave and guides what we do, on a daily basis as well as throughout our lives, as we all love, attempt to have a good life, look for inspiration and insight, and ultimately strive for liberation.

Add into this foundational mix of principles the first *yama* (ethical guideline): *ahimsa*, commonly translated as non-violence. An absolute in Jain philosophy and for spiritual renunciates—and sometimes posited as such for everyone today, based on the inspiration of Mahatma Gandhi—traditionally speaking for the vast majority of Hindus *ahimsa* is a contextual ethic. For example, it is not a violation of *ahimsa* for a soldier to cause harm in a battle, nor for a police officer to use reasonable force to detain a suspected criminal. However, for either to use more force than is required or to engage in cruel actions, would be—as it would be for anyone. Recognizing that doing no harm is often a practical impossibility, especially when it comes to environmental impact, the goal to strive for is to minimize unnecessary and/or intentional harm in any situation. This outlook provides a very practical ethical benchmark for our own efforts in creating a more ecologically, social, and spiritually sustainable global civilization.

> *With these concepts as a foundation, the resulting approach to nature is one of reverence, responsibility and non-exploitation, with a clear understanding that the individual is part of nature, all beings come from the same source, and the microcosm and macrocosm are interconnected.*

The natural resources that we utilize everyday are thus seen as *prasad* (divine gifts) and not to be exploited or manipulated for one's own benefit, if the cost of doing so is upsetting the overall balance or creating unnecessary harm. Heedless exploitation of natural resources would translate to the pursuit of *artha* or *kama* without the guiding principle of *dharma*.

Such a worldview can lead us to evaluating geoengineering methods, and indeed whether or not they should be deployed at all, in the following manner:

We should reflect on the causes of climate change and refine actions that lead to better harmony.

We can look at these from different angles: *abhyantara* (internal), *bahya* (external), *sannikrushta* (immediate), *viprakrushta* (distal), *pradana* (prime), *vyabhichara* (multiple) and *gauna* (secondary). Examining causes at various levels helps to bring out not just global approaches to climate but also individual thoughts and actions that are leading to climate change.

> *What, then, are the systemic causes of climate change and how are our individual actions either perpetuating these causes, constrained by these causes, or reducing these causes?*

Are we doing all that we can to reduce the base causes of climate change as the primary solution? Will this be enough to solve the problem quickly enough?

We already have answers to these questions, in the form of the latest IPCC report. Commitments made under the Paris Agreement are not enough to limit global temperature increase to 1.5°C above pre-Industrial levels, "even if supplemented by very challenging increases in the scale and ambition

of emissions reductions after 2030." [3] In other words, we are not doing all we can to reduce carbon emissions quickly enough to stop some significant amount of dangerous climate change from happening.

Through the lens of ahimsa, we are simply not doing enough to minimize the harm, the violence, caused by climate change today and that will be caused in the future.

In minimizing that harm all methods and technologies must be on the table, including geoengineering. However, pushing forward with any of them without an assessment of whether in attempting to reduce the harm of climate change we are simply causing or seriously risking another harm elsewhere would itself be counter to ahimsa.

Through the lens of the purushartha, failing to take meaningful action to stop climate change is critically adharmic (counter to dharma). It is failure to uphold the welfare of all beings in a broad sense, as well as the continued collective pursuit of artha and kama at the expense of disturbed cosmic and ecological order.

In practice, thinking along these lines is similar to applying the precautionary principle—that is taking action to prevent potential harm even though there is still uncertainty about the exact nature or degree of the harm that may be caused by a particular action.[4] There is a significant conceptual difference, however, when apply this with a Hindu worldview. From this perspective the potential harm being considered could be to other humans, other animals, plants, rivers (which are often all taken to be manifestations of the goddess Ganga), ecosystems, planets. Despite differences in form all of these are manifestations of the Divine, imbued with spirit, and worthy of both worship and protection. None are inert material separate from God.

How then can we apply these principles to evaluate proposed methods of geoengineering?

Geoengineering methods, as previously stated, fall into two broad categories:

Solar radiation management techniques are intended to reduce temperatures, either by reducing the amount of solar radiation entering the atmosphere (via stratospheric aerosol injection, for example) or by using reflective materials on buildings or man-made surfaces to lower ambient temperatures (painting roofs and roads light colors, for example). None of these are intended to prevent greenhouse gas emissions from occurring or remove them from the atmosphere, but as climate mitigation technologies, they have a use.

In evaluating the wisdom of actually using these technologies, several factors must be considered.

Painting roofs white or making them from light-colored materials has essentially no risk of harm to the surrounding ecosystem. Indirectly, white roofs have the potential to reduce emissions through lower energy consumption, as well. Injecting reflective particles into the atmosphere, however, requires a much deeper consideration of the potential harm caused, assuming such a scheme could ever be deployed at scale.

Who manages such a system, since it would have to be done essentially indefinitely, unless done simply as a stopgap until greenhouse gas emissions themselves are greatly lowered?

And then, might not the intellectual, material, and financial effort to deploy such a system be better allocated towards building out more renewable energy sources, low-carbon transportation systems, or anything else that directly tackles emissions?

What unintended harm for other species might be created should such a system not work as planned?

At the very least, great precaution must be taken with such interventions into the climate, assuring to the greatest degree possible that the harm potentially caused is far less than the harm being avoided. From a Hindu perspective, all of these questions are ones of ahimsa, in the sense of ensuring that our actions cause as little harm as possible, and of dharma, in that we are actively working to promote the

welfare of all beings.

Carbon dioxide removal technologies span a similar gamut of aggressiveness as do those of solar radiation management.

On the low- to no-risk end of the spectrum are afforestation and methods of soil improvement to increase carbon storage. Not only are these likely effective in taking greenhouse gases out of the atmosphere—leaving aside questions about the speed with which they will do so or the amount that can be removed—they are the exact opposite of creating harm. Even if they pulled zero carbon out of the atmosphere, from the perspective of increasing wildlife habitat, improving particulate air pollution, increasing soil quality and agricultural sustainability, more trees and better soil are unquestionably good things. Even if climate change was not a danger, both would be worthwhile dharmic activities, when one interprets dharma as ensuring the welfare of all beings.

Less tested and with lesser known practical risk are industrial methods of capturing carbon emissions at the source (at power plants, for example) and then storing them securely. Alongside this, we can include ocean iron fertilization, which consists of intentionally creating algae blooms in the open ocean with the intent of these absorbing carbon emissions and then sinking to the bottom of the sea.

As with stratospheric aerosol injection, there are serious questions with these methodologies that must be examined through the lens of ahimsa and the purushartha. How will these greenhouse gas emissions be stored indefinitely? (This is really where the risk resides.) Who manages and monitors such a system? Even more so than other geoengineering technologies, might this just be used by polluting industries to continue business as usual burning fossil fuels (even though there is more environmental and social harm caused by these today than those of climate change)? In our avidya, are there unintended harms associated with these technologies that we're not considering? Discussing ocean iron fertilization, in practice at large scale (not merely in small-scale tests) what are the greater effects on the ocean ecosystem?

> *Science can tell us what is technologically possible, but it is ethics that helps us find the wisdom to decide what should be done.*

A dharmic approach to solving the problem of climate change does not just factor in technological or financial feasibility but encourages a systems thinking approach, where the impact on all connected systems from the point of view of finance, ethics, sustainability and well-being are evaluated. This can be compared to symptomatic treatments in medicine compared to root-cause analysis and balance-restoring mechanisms available in some therapeutic paradigms like yoga and Ayurveda. This calls for solutions that align with nature's own healing mechanism rather than creating new interventions and altering natural mechanisms the effects of which are not well understood.

Chapter 5 of the Bhagavad Gita opens with Arjuna saying to Lord Krishna, "You have recommended both the path of selfless action and the path of renunciation. Tell me definitely which is better." Krishna responds, "Both renunciation of action and the selfless performance of action lead to the supreme goal. But the path of action is better than the renunciation."[5]

Though the supreme goal directly intended in the text is moksha, that is spiritual liberation, there is something powerful here as applied to climate change, geoengineering, and environmental issues more broadly.

Refocusing Krishna's words a bit, there is a temptation to renounce, in a way, by concentrating primarily on what each of us individually can do to prevent climate change. In a consumerist society a large part of that is stepping outside of that, living simpler, more considered, mindful, minimal lives. This is good, necessary, and for many people all attractive.

But what is also required is action—engaging on the metaphorical battlefield, facing our environmental challenges directly and forcefully. When it comes to climate change that means doing everything possible to reduce greenhouse gas emissions at the source, minimizing the harm caused by our

unbalanced pursuit of artha and kama. Only as a companion to that should geoengineering methods be considered, and only then when they have been thoroughly examined through the lens of ahimsa, which urges caution and consideration of unintended harmful consequences that may be brought about to all beings.

1. *IPCC, Global warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty (World Meteorological Organization, Geneva, Switzerland, 2018), http://www.ipcc.ch/report/sr15/.*
2. *Eknath Easwaran and Michael N. Nagler, The Upanishads (Berkeley, CA: Nilgiri Press, 2007), 58.*
3. *IPCC, "Summary for Policy Makers," http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf.*
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Geoengineering, Sacrifice, and the Scale of Love

Author

Arianne van Andel is a Dutch reformed feminist theologian, based in Chile, who specializes in ecology and climate change.

From August 2018 onwards, more than a thousand inhabitants of Quintero and Puchuncaví, two neighboring coastal towns in Chile, were hospitalized with severe symptoms caused by the high levels of pollution emitted by the 17 industrial plants concentrated in the region.[1] Since many children were affected, the government temporarily closed the schools, yet the industrial plants were allowed to remain functioning. The government still hasn't invested in effective research to define and measure the chemicals to which the people continue to be exposed, and it is unknown which plants are responsible for the tragedy. Partly due to a strong business lobby, Chile doesn't have restrictive laws that limit air and soil pollution, and companies ironically keep claiming to obey all the (non-existing) rules.[2] The region is one of Chile's six so-called "sacrifice zones": regions of low-income communities that are heavily industrialized under the promise of "progress," and disproportionally affected by environmental contamination.

In this essay I take the existence of sacrifice zones, in Chile and in other parts of the world, as a starting point for my theological reflection on climate engineering.[3] One of the most polemic aspects of "deliberate and large-scale manipulation of the planetary environment" is that it is likely to create new disposable areas where life conditions will be compromised.[4] An ethical question raised by many is this: who will be in charge of technological climate interventions, and who will be affected by its unforeseen effects? Even more pressing, though, is this question: will the people and ecosystems that could suffer the consequences of geoengineering be given voice, value, or real power in the decision-making processes about the necessity of these interventions and the alternatives?

Although geoengineering proposals vary, and will generate diverse impacts on ecosystems, there seems to be consensus that none of them is completely predictable or harmless, and others might simply cause an "existential threat."[5] Probable effects of more accepted strategies such as carbon storage and removal (often called BECCS) include massive changes in land use, displacement of small farmers, and disruption of global food production, apart from the need of enormous supplies of freshwater. The more controversial proposals of solar radiation management and cloud brightening might affect the planetary hydrological cycle and photosynthesis processes, causing enormous droughts in different areas of the globe and altering crop production, among others.[6] All the effects mentioned would affect the life conditions of thousands of people and destroy the ecosystems that sustain them. However, the case of Quintero shows at a small-scale level that our current economic system accepts the sacrifice of certain

people and ecosystems as collateral damage. Is there any reason to believe that sacrifice zones caused by geoengineering will be viewed differently?

Climate engineering is presented as a technological global solution for a scientific problem, but the impacts will be suffered by human beings and the Earth in concrete places. Even if scientists arguably may not have the obligation or the expertise to analyze the moral aspects of the consequences of their solutions, theologians and ethicists have. As Pope Francis observes in his Encyclical *Laudato Si'*, "our immense technological development has not been accompanied by a development in human responsibility, values and conscience."[7] Similarly, philosopher Karl-Otto Apel indicates that after the globalization of science, technology, and economics, we now are in great need of the globalization of a universal ethics of responsibility.[8] It is urgent to start this ethical reflection on geoengineering, not only with policy-makers, academics and business executives, but especially with the people who are the most vulnerable and will be affected most by its negative impacts.

I approach this reflection as a Dutch reformed theologian, coming from a privileged and highly innovative country in technological sense. My concern for the voice of vulnerable people and communities is inspired by Christian liberation and feminist theology from Latin America, a continent where the costs of global development are much more visible than in the North. In the years that I have been living in Chile, the Scriptures and the path of Jesus have become tightly connected with the fate, struggles, and dreams of concrete people who are not invited at the table of the decision-makers. Jesus opted for those who were marginalized in his time, and promised life in abundance for them all (John 10:10). Following that call, this essay searches for justice and inclusion of the most ill-protected to the effects of climate change, and pleads for their participation in the debate about its solutions.

Christian narratives offer a reinterpretation of the need for sacrifice, which should be part of how to address the ecological crisis. This is a necessary contribution to the ethical debate, as the concept of sacrifice has clear religious connotations. The concept can be either prone to misuse and become a justification for avoidable suffering, or it can be an invitation to service and compassion. Firstly, I will reflect on the impact of scale in the acceptance of "sacrifice," while indicating the importance of contextual thinking in discussions of the ethics of climate engineering. Secondly, I address the "playing God" argument and the image of God behind it. Finally, I conclude with some reflections on how a more Christ-centred perspective can change our understanding of sacrifice and invite smaller-scale oriented solutions to climate change.

Scale and Context

The utilitarian narrative that underlies our current economic system defends the idea of the need to sacrifice some places and people for a supposed larger good, identified with "development," "progress," or the growth of the economy. This is always presented as a matter of scale: the sacrifice is necessary to benefit a wider context, although in practice it might only serve the interests of a minority. Theologian Sallie McFague indicates that we still believe in creating a consumer society for all, although this is far beyond the carrying capacity of our planet.[9] Economist and theologian Franz Hinkelammert describes how the occidental capitalist economic system promotes an ideology in which there is an exchange in "life value" between inert fetishisms (such as money and growth) and living human beings (who are considered mere objects).[10] Climate change is a consequence of an ideology that adores the market, infinite growth, and unlimited profit, and that accepts the costs in human life and the destruction of ecosystems that these demand. I agree with Klein, Foster, and the other authors who claim that geoengineering is part of the same idolatrous logic that brought about climate change, not only because climate engineering provides an excuse to carry on emitting greenhouse gasses, but also because it is part of a belief that accepts the sacrifice of many for the benefit of some.[11]

What is most disconcerting about geoengineering initiatives is the scale on which they need to be implemented to sort the effect needed. Globalization of markets has shown that the larger the scale,

the easier it is for those who perpetrate actions to escape from accountability. If we don't see and feel what the consequences of our actions are for others, it's much easier to filter them away. Distance yields indifference.

Philosopher Adela Cortina shows the neurological origins of this phenomenon in her recent book about our rejection of the poor, which she names "Aporophobia." She explains that our brain is structured to feel emotionally affected by the fate of people that are close to us, but not to those we do not know. She also points out that, biologically speaking, the reason that human beings have to attend to their consciousness towards others depends on the visibility of their conduct.[12]

Many multinational companies have elaborated systems to escape any direct relationship with the people affected by their actions. In the anonymity of a large scale, "collateral damage" is just a word or a number: the cost "we" have to pay. But who are "we"? Climate change is hitting vulnerable countries first, and within them the poorest, under whom women, children and indigenous people form an important group. Activist Naomi Klein remarks that geoengineering experiments will probably be planned to perpetuate this injustice: "So we are left with the question less about technology than about politics: does anyone actually believe that geoengineering will be used to help Africa if that help could come only by putting North America at greater risk of extreme weather?"[13]

The large-scale view taken by geoengineering has yet another distancing effect. Klein well describes this as the illusion of the astronaut's eye view. Creating the image of ourselves as manipulators or care-takers of that beautiful blue ball in the universe called Earth actually suggests our independence of the planet, and our power over it.[14] It denies our inability to escape from the physical contexts that sustain our living. "Why don't you go to another place?" someone asked a woman from Quintero. "I would run, if I could, but I'm a laborer, and poor," was the answer. In geoengineering solutions, we have to ask ourselves what happens to "context" if the whole planet is affected: who has the means to run from its consequences, and who hasn't?

Much religious and theological thinking tends to be universal and generalizing as well, although with the best intentions. In Christian ecotheology we now talk about "the care of our common home" by visualizing the entire planet, and reflect upon the relationship between Creation, Human Beings and God in general terms. In contrast, Christian liberation theology has highlighted the importance for theology to take context seriously. This invites to dialogue with other denominational and religious traditions, which often have developed wisdom and resources based on different contexts. It also makes us aware of socio-political differences that are intertwined with faith expressions. Although we are part of one human race, and we all have a tendency to the sins of greed, selfishness and pride, some of us have much more power to do harm with these tendencies than others. Only in concrete situations on a smaller scale are we able to visualize people's faces and earth's suffering.

Playing God and God-Images

Large-scale natural phenomena in faith communities are often associated with God as the Creator of the Earth. Some religious communities therefore preach against any scientific alteration in the "natural course" of life. Sometimes they also deny human-caused climate change. Conversely, I consider that critical religious views on geoengineering should address its scale and unpredictable impact, rather than the fact that climate engineering interventions use emerging technologies. As ethicist Laura M. Hartman argues, an ontological dualism between God's and human's power in intervening with creation is complicated, as human beings have already intervened in nature to such an extent that "nostalgia for uninterrupted nature" is difficult to sustain.[15]

Environmental theologian Forrest Clingerman describes how ethical standpoints on the topic depend on the way the relationship between God and human beings is defined, interpreting geoengineering either as a sign of "hubris" or as a culmination of human's possibility to shape and save creation.[16] Instead

of choosing a side, in both cases we should ask ourselves about the image of God that underlies the argument, and what it means to be created in God's image. When we talk about geoengineering as a way of playing God, we reduce God's presence in Creation to regulation and ordering nature, and our own cooperation with God to our rational capacity to intervene and form creation in a scientific way. In the Jewish-Christian tradition, however, God reveals Godself in a much broader sense than only through nature. Most important of all, God is described in relationship with human beings, as someone who wants to hear and love, and to be heard and loved.

Theologian Román Guridi describes the history of theological interpretations of what it means for human beings to be created in the image of God (Gen.1: 26-28) and distinguishes a substantial, relational and functional meaning.[17] In the "playing God" argument, we only emphasize our substantial and functional likeness with God (the uniqueness of language and self-consciousness given to us, and the power to participate in creative activities according to those capacities). However, crucial relational aspects that come with the specific role God has given us in creation, such as responsibility, awe, compassion, solidarity and love, are not taken into account. That is significant, because it might reveal that while we humans are able to "play God" on a global scale by creating and intervening in nature, we have a much harder task in developing relationships based on responsibility and compassion on such a large anonymous scale. Although people with almost divine powers might be indifferent to the sacrifice of others, God in the Christian tradition never is.

Christian narratives radically question the utilitarian sacrifice of human beings and other life-forms. In contrast with other divine powers in the imperia of biblical times, Jewish tradition slowly moves away from an image of God that needs sacrifices. We observe that in the divine promise to Noah not to destroy again (Gen. 1:20-22), in the story of Abraham and the near-sacrifice of Isaac (Gen. 22:1-19), and in several texts in Samuel, Psalms and Prophets: "For I desire steadfast love and not sacrifice, the knowledge of God rather than burnt offerings" (Hosea 6:6).[18] The New Testament radicalizes that image of God in the incarnation. Christian tradition focuses on how God reveals Him/Herself in the life and death of Jesus of Nazareth. In order to know what it means to be created in the image of God, and how we may play God, we need to look at Christ. Then we see that God's almightiness is defined by love, as Muslim and Christian religious scholars noted by Hartman indicate.[19] Therefore, the limits of geoengineering interventions are not so much determined by our power; they are to be given in love. And love sheds another light on sacrifice.

Christ: From Sacrifice to Service

As we turn to a more Christ-centred view in the debate on geoengineering, we find different criteria for rejecting it than the ones at stake in the playing God argument. Traditional Christian doctrine is founded upon the conviction that Jesus freed us from sin by giving his life on the cross. God voluntarily sacrificed His Son, in which He Himself was completely present, in order to save us. Guridi proposes that in Jesus' *kenosis*, traduced as his "making himself empty" or "his not benefitting of divine powers for his own interests" (Phil. 2: 5-11) we can find the true way in which God invites us to participate in creation. Guridi describes this as a movement from self-interest to service.[20]

In Jesus we meet God face to face, in loving relationship rather than rational conviction or controlling power. Jesus meets with the most vulnerable, heals the sick, lives with the poor and socially marginalized: those who were sacrificed under the regime of his era. He accompanies them personally, on a small scale. And ultimately, he gives his life on the cross in order to restore the lives of others, showing that God sacrifices Him/Herself rather than sacrificing others. Guridi argues that as disciples of Jesus we are invited to do the same on a human scale. Instead of sacrificing others in order to save our interests, we should be willing to sacrifice ourselves, in the sense of giving our lives in service and love. In times of ecological crisis that could mean that we need to let go of some of our comforts so that others may live.[21]

The question that geoengineering solutions raise is this: are the ones who have the power to implement climate engineering driven by service and love? Are they willing to sacrifice part of their own privileges and power to make life possible for others, or are they inflicting sacrifice on others in order to save themselves or a certain lifestyle? Of course it is difficult to respond to or judge people's intentions, but the experiences of people in already existing sacrifice zones don't promise a lot of good. In Quintero, governing officials and company owners alike are ignoring people's call for a proper investigation into the causes of their health problems, and turn a deaf ear to requests to clean the soil of family farms or protect the sea for the local fishermen. Given this fact, would climate engineers and their financial funders be willing to invest as much in research on how to protect small agricultural businesses from their interventions as they are granting money to the experiments themselves? Are they ready to take responsibility for the costs of large scale risks and sacrifice? And if the scale of intervention doesn't permit the complete avoidance of sacrifice, should we then not respond to the precautionary principle, and look for the many alternatives that are available to counteract climate change in another way?

In the urgent situation that we face, the only way to restore life is to be willing to empty ourselves of our wish to magically create "divine" large-scale solutions, and instead put our lives at the service of those who are most affected by the multiple crises in which we live. Communities that have suffered the destruction of their ecosystems and are struggling for the protection of their territories have learned to value life in all its interdependence. Maybe our only salvation is to listen to those people when we define a transformative way to a different kind of progress. Might it not be that indigenous people in the Amazon, women from Quintero, and many other people that have been victims of exploitative and extractivist economic interventions have the most valuable ideas and wisdom on how to find a way towards resurrection from the death? Christian communities should stand side by side with those people, defend their voices, and advocate for their right to live in a healthy environment. Christian service means also that we refrain from the power of providing all the answers and solutions. A lot of our scientific technologies were born in a Christian culture, and some of the powerful legitimize their solutions with the idea of being stewards of God's Creation. However, Jesus invites us to service, which means first and all that we give space and empower the ones that have not been at the table until now. As Christians we should urge decision-makers to facilitate participative mechanisms in which the message of the vulnerable is not only heard, but also decisive and binding in the agreements we make on an international level.

Right now, it seems that the communities already affected by climate change wish to promote smaller-scale solutions for the crisis than geoengineering. They stand for an ecological revolution on a local basis. Alternatives exist, such as ecological restoration, agro-ecological farming, rapid transformation to renewable energy, massive reforestation, and a radical change to a humbler lifestyle. These can all be forms of Christian service, which will help to adapt to the consequences of climate change and open the possibility for a sustainable future. Indigenous people, small farmers, small fishing communities, women in resistance—like those in Quintero—and environmental movements are crying out for those solutions, as expressed in their recent manifesto against geoengineering "Hands off Mother Earth!"[22] They suggest multiple small-scale actions around the globe, serving the Earth and all human beings with love and justice, so that nobody needs to be sacrificed. Let's listen to them, as they might be the ones that represent Christ in our midst today.

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2. *Informe Especial, "Quintero: el plan que no funcionó", 24horas, October 2018, https://www.24horas.cl/programas/informeespecial/informe-especial-quintero-el-plan-que-no-funciono-2849138*
3. *Climate engineering and geoengineering refer to the same kind of interventions: I use them interchangeably in this essay.*
4. *The name "Sacrifice Zone" is being used only for areas suffering from a disproportionate amount of pollution through industries. Rather than to broaden the definition to other environmentally damaged areas and so decrease its strength of meaning, my aim is to question the need for sacrifice because of technological human intervention.*

5. *Forrest Clingerman and Kevin J. O'Brien, "Playing God: Why Religion Belongs in the Climate Engineering Debate," Bulletin of the Atomic Scientists 70 (2014): 27-29.*
6. *John Bellamy Foster, "Making War on the Planet: Geoengineering and Capitalism's Creative Destruction of the Earth", Science for the People, Summer 2018, https://magazine.scienceforthepeople.org/making-war-on-the-planet/.*
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9. *Sallie McFague, Life Abundant, Rethinking Theology and Economy for a Planet in Peril (Minneapolis: Fortress Press, 2001), 88.*
10. *Franz Hinkelammert, Las armas ideológicas de la muerte (Salamanca: Ediciones Sígueme, 1978), 13-85.*
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12. *Cortina, Adela, Aporofobia, el rechazo al pobre: un desafío para la democracia (Buenos Aires: Paidos, 2017), 61-95, especially 76 and 93.*
13. *Klein, This Changes Everything,386.*
14. *Ibid.,397-406.*
15. *Laura M. Hartman, "Climate Engineering and the Playing God Critique", Ethics & International Affairs, 31 (2017), 7-8.*
16. *Forrest Clingerman, "Between Babel and Pelagius. Religion, Theology and Geoengineering" in The Ethics of Solar Radiation Management, ed. Christopher J. Preston (New York, Lexington Books, 2012), 201-219.*
17. *Román Guridi, Ecoteología: hacia un nuevo estilo de vida (Santiago de Chile: Ediciones Universidad Alberto Hurtado, 2018), 203-223.*
18. *Other texts include 1 Sam 15:22, Psalm 40, 6-8, Psalm 51: 16-17, Proverbs 21:3, Amos 5: 21-24, Jeremiah 7: 22-23 a.o.*
19. *Hartman, "Climate Engineering and the Playing God Critique," 5-7.*
20. *Guridi, Ecoteología, 223-242.*
21. *Ibid., 259-266.*
22. *"Manifesto Against Geoengineering," Monitoring Geoengineering, October 2018, http://www.geoengineeringmonitor.org/2018/10/hands-off-mother-earth-manifesto-against-geoengineering/*

Redemptive Activism: Judaism, Climate Change, and Climate Engineering

Author

Hava Tirosh-Samuelson is Regents' Professor of History, Director of Jewish Studies, and Irving and Miriam Lowe Professor of Modern Judaism at Arizona State University.

Climate Change: A Manifestation of the Anthropocene

The climate is changing and humanity—the primary cause of the change—is obligated to respond. Manifestations of anthropogenic climate change and its related phenomena abound. They include global warming; shifting weather patterns; extreme weather events; retreat of glaciers; rising sea levels; mega-droughts and desertification; threats to available water, food and shelter; mass extinction of species; loss of fisheries and forests; acidification of oceans; pollution of air, water, and soil; and shifts in the range and prevalence of diseases. The human activities that brought about anthropogenic climate change mark the dawn of a new geological age: the Anthropocene.[1] In the Anthropocene humankind becomes geological force, since the boundary between "nature" and "humanity" collapses as "people and nature interact reciprocally and form complex feedback loops."[2] Consequently, all forms of life on planet Earth, including human life, are impacted by human activities permanently and irreversibly.

The environmental crisis characteristic of the Anthropocene poses momentous technological, economic, social, political, legal, and moral choices. Paul J. Crutzen, who popularized the Anthropocene thesis, warned: "a daunting task lies ahead for scientists and engineers to guide society towards environmentally sustainable management during the era of the Anthropocene. This will require appropriate human behavior at all scales, and may well involve internationally accepted, large-scale geo-engineering projects, for instance to 'optimize' climate."[3] Crutzen's statement seems to imply that geoengineering could address our current ecological crisis, but that claim has been vehemently debated. Techno-optimists see the Anthropocene as an extraordinary opportunity to remake the world so as to create Eden on earth, whereas their critics who counsel caution claim that the Anthropocene demands a modification of human behavior and curtailment of human hubris that has given us the environmental crisis in the first place. In between these two positions are technoscientific pragmatists, who recognize that although technology is not an unproblematic solution to climate change, geoengineering might be the best available option for the future of the human species.

Climate engineering, which illustrates the merger of humanity and nature, is seen by its advocates as

the technology most characteristic of the Anthropocene. For the advocates of climate engineering, the Anthropocene is indeed an "Engineered Age,"[4] namely, an epoch in which humans launch "the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change."[5] The two generally-accepted categories of geoengineering are carbon dioxide removal (CDR) and solar radiation management (SRM); their feasibility and desirability have been argued at length.[6] As Mike Hulme has rightly noted, the debates are not about observable facts and physical realities but rather about the *interpretations* of those facts, the meaning we ascribe to them, and the cultural, social, political and ethical practices that flow from them.[7] Put differently, climate change is not only a technoscientific matter to be decided by scientists and engineers but a social, cultural, and ethical issue that requires humanity to marshal its deep moral, religious and spiritual resources as it ponders the appropriate response. Hulme was correct that "climate change is increasingly discussed using language borrowed from religion, theology and morality."[8]

World Religions and Climate Change

For the past four decades, the academic discourse on religion and ecology has explored the diverse responses of world religions to the environmental crisis.[9] World religions matter greatly to the debate on climate change because the overwhelming majority of people in the world conceptualize reality in religious categories.

Human beings understand themselves, their societies, and their daily life through sacred narratives and symbolic rituals that point beyond themselves to an ultimate reality. Within religious worldviews that human beings organize their life and find meaning, purpose, and hope as they face an unknown future. Religion provides the moral lens through which humans evaluate every aspect of life and decide what is good and bad, what is permitted and forbidden. Religion also expresses human existential and emotional needs and frames that which we came most about, namely, our ultimate concern. Because religion manifests a person's ultimate concern about ultimate reality, people are willing to sacrifice their life for it and this commitment makes religion a force that mobilizes people to action. If we are to change human conduct so as to mitigate environmental degradation, we must frame the appeal in religious categories. In the Anthropocene, when the challenges for the survival of humankind are planetary in scope, religion must play a prominent role in the public deliberations of global civil society, because religion offers the most comprehensive framework for theorizing about the order of things and the purpose of human life.[10]

Religion, however, is not a set of fixed beliefs or dogmas but a comprehensive way of life that encompasses human attitudes toward time, space, place, embodiment, sex and gender, family, community, and ultimately life and death. This is especially evident in the case of Judaism, a numerically small but foundational and influential religion. All world religions have inspired environmental activism in regard to climate change through "protests, lobbying, letter/petition campaigns and elections activities" that engage federal, state, and local governmental action on topics such as "fuel and energy efficiency, promoting alternative energy sources, regulating CO2 emissions by industry, working for a carbon tax or a cap-and-trade program, curtailing deforestation and halting extractive industries in ecologically sensitive areas."[11] Along with other religious traditions, Judaism has responded to the environmental crisis by giving rise to Jewish environmental movement and by working with other faith-based environmental organizations on behalf of the environment to encourage actions that might mitigate our ecological crisis, especially in regard to climate change.[12] Nonetheless, a recent book that reviews religious responses to climate change makes no mention of Judaism.[13] This omission enhances the mistaken view that Judaism is no more than a prelude to Christianity, or that Judaism was absorbed into Christianity while being superseded by it. Judaism should be understood on its own terms and its distinct approach to the environmental challenges of the Anthropocene, including climate change, should be recognized. Indeed, Christian environmentalism can be seen as an affirmation of the distinctly Judaic roots of Christianity.

Speaking as a Jew by birth and a scholar of Judaism who has contributed to the field of religion and ecology,[14] I maintain that life on Earth has become so precarious not because the Bible has sanctioned human mastery and exploitation of nature, as Lynn White Jr. argued,[15] but rather because in the modern period the twin developments of secularization and the rise of modern science were predicated upon the disenchantment of nature. The environmental crisis is the result of the modern view that nature is mere inert matter to be exploited by human beings for their benefit. The field of religion and ecology demonstrates the potential of all world religions, each in its own unique way, to harbor profound ecological wisdom that guides humanity to care and protect the natural world. Religion and ecology also shows how modernity has occluded this message. In the Abrahamic traditions ecological wisdom is expressed in the doctrine of creation, according to which God is the sole creator and sustainer of nature. Since the created world ultimately belongs to God, God has commanded humanity to care for it.

If humanity is to address the challenges of the Anthropocene so that life on Earth can flourish, humanity will have to reenchant nature, viewing it once again as divine creation that points beyond itself to yet deeper level of existence.[16] As Norman Wirzba succinctly put it, "'Creation' names the ongoing reality of human beings, animals, plants, land and weather, all connected to each other and bound to God as their source, inspiration, and end. As such, the teaching of creation provides a moral and spiritual map that enables us to see the significance of things and then move faithfully through the world."[17] From this perspective, the environmental crisis can be viewed as the "unmaking of Creation," to use a phrase coined by the Jewish environmentalist, Rabbi Everett Gendler. The impulse to reenchant nature, characteristic of contemporary religious environmentalism, is but one aspect of our post-secular age, in which religion is no longer a private affair, but a force that shapes the public sphere.[18]

Judaic Environmental Ethics of Responsibility

Three beliefs frame Jewish environmental activism:

- that God created the world and continues to sustain it;
- that God revealed His Will in the form of Law, the Torah, spelling out instructions for human care of creation; and
- that the God will redeem the world in the remote future in response to human conduct and in collaboration with human efforts.
- The Jewish environmental movement has applied these theological doctrines to human relations with the natural world, thus giving rise to Jewish environmental theology.[19]

Judaic covenantal theology posits an ongoing relationship between God and humanity, and in particular with God's Chosen People, Israel. This covenantal theology defines an ethics of responsibility: humans are ***responsible*** for the well-being of the created world and ***responsible*** to God for the treatment of the divinely created world.[20] Created in the image of God (Gen. 1:28), the human is commanded "to till and to protect" the world that God has created (Gen. 2:15). The proper treatment of the Earth is evident most specifically in the case of the Land of Israel, the collateral of the covenant between God and Israel. Viewed first as a Promised Land and later a Holy Land, the Land of Israel exemplifies how humanity should treat the Earth. If humans act in accord with divine commands, the land and its inhabitants flourish, but when humans fail to heed divine commands, the land ceases to be fertile and its inhabitants suffer (Deuteronomy 11:13-17).

Scripture consists of explicit laws in regards to land, water, vegetation, animals, and human beings—laws and legal principles that were further elaborated by Rabbinic Judaism in subsequent centuries.[21] Thus Scripture as interpreted by the rabbinic tradition prohibits wanton destruction of natural resources; prevents humans from inflicting suffering on other living beings; curtails and regulates human consumption of other animals; commands human to rest on the Sabbath; and extends imposed rest to the land itself during the Sabbatical year. Most significantly, Scripture asserts the connection between

caring for the socially vulnerable (i.e., social justice) and caring for the Earth (i.e., eco-justice) by insisting that the human task of caring for God's creation has to be carried with justice. Since law and morality are intertwined in Judaism, environmental remediation is framed both in terms of duties toward the natural world and in terms of the virtues that dispose a person to act in the appropriate way. The main virtues cultivated by Judaism, including humility, modesty, temperance, generosity, and simplicity, are all conducive to behavior that is consistent with environmentalism.[22]

Human responsibility for God's creation and the care that flows from it is rooted in the insight that the world God created is good but it is not perfect; it does include evil, sin, pain, suffering, and death. Living in this imperfect world (in Hebrew, *ha-olam ha-zeh*), humans are called to improve, perfect, and repair the world by acting in accordance to divine commands (in Hebrew, *mitzvot*). The observance of divine commands enables human beings to sanctify the world, to hallow the physical world through their intentional activities, and make it morally better in anticipation of the transcendent world-to-come (in Hebrew: *ha-olam ha-ba*). Yet engaging in the repairing the imperfect world is a never-ending task because the eschaton is always an ideal, not a present reality. Living in the pre-redeemed world, human beings always sin, commit errors, and inflict injustice on themselves, on other human beings, and on the natural world. Yet divine commands provide a normative framework for acts of justice and lovingkindness that can make the imperfect world more just, peaceful, and fecund. The well-being of the natural world, then, depends on deliberate human activity that engages in the repair of the world (in Hebrew, *Tikkun Olam*). The mandate to repair the world makes human observance of divine commands an ongoing redemptive activity.

Tikkun Olam has become the slogan of Jewish environmental activism.[23] Emerging in the 1980s, the Jewish environmental movement has brought about the "greening" of Jewish institutions (e.g., synagogues, schools, communal organization, Jewish community centers and youth movements) in the context of fighting climate change.[24] Today a variety of organizations, programs, and initiatives promote sustainable practices (e.g., energy efficiency, elimination of plastics, recycling, and waste reduction programs); reduce consumption and promote new eating habits; plant community gardens; link sustainable agriculture to urban Jewish life and education; include environmental issues in the education of youngsters and adults, organize nature walks and outdoor activities; celebrate Jewish holidays (especially Sukkot, Shavuot and Tu Bishvat) with attention to environmental agricultural themselves; promote justice in food production with attention to sustainable agriculture and compassionate treatment of farm animals; and encourage Jews to live sustainably. These programs transcend congregational and denominational boundaries and are often carried out in inter-faith settings in collaboration with non-Jewish organizations. Most recently, the ritual of Tisha b'Av, the day of mourning that commemorates the destruction of the First and Second Temples, has been applied to climate change in an attempt to energize Jewish environmental activism.[25] Whether it is coherent or not, Jewish eco-theology is secondary in importance to environmental activism. However, the attention to climate change among Jews did not translate to reflection about climate engineering.

Can climate engineering be considered a form of redemptive activity? Do large scale, global engineering projects fall under the category of *Tikkun Olam*? To date, Jews have been very involved in climate advocacy but they have not applied the concept of *Tikkun Olam* to climate geoengineering.[26] I shall return to this point below, inviting Jewish jurists and ethicists to join the debate about climate engineering but merely posing potential lines of inquiry rather than stating what the Jewish position should be in these contested matters.

Climate Advocacy

Climate advocacy is one aspect of Jewish environmental activism and education. In Jewish public discourse, the reality of climate change is taken as a scientific fact that requires no further validation. Climate change is viewed not merely as a scientific issue to which there are technoscientific solutions.

First and foremost, climate change is a social and moral issue, to which Judaism can and must respond. At the forefront of climate advocacy stands Arthur Waskow, a Jewish environmental activist, institution builder, eco-theologian and educator. Through his Shalom Center and Aleph: Alliance of Jewish Renewal, Waskow has expressed the Jewish position on climate change. Evoking Mishnah Tractate Avot 1:14, "If not now, when?" Waskow has relentlessly claimed that climate change is ***the*** Jewish issue of our time, and appealed to Jews and non-Jews "to reflect upon the impact of climate change on this Holy Temple that is our Planet Earth, to turn and take action, large and small, toward a better future."[27] Waskow has popularized the concept of "Eco-Kosher" which links Jewish ritual requirements, food production and consumption, social justice, and eco-justice, articulating pithy shorthand for Jewish environmental activism.[28] In his numerous print publications and online communications Waskow has railed against "the burning and extraction of fossil fuels, such as coal, oil and methane, and the destruction and development of critical habitat and vast forest, all [of which] contribute greatly to the climate crisis, which is commonly called global warming but which is actually a human fueled imbalance in our global climate systems".[29] For Waskow, who was a Left-leaning social ecologist before he became an ordained rabbi, climate change was brought about by greedy capitalistic practices and narrow economic self-interests of today's "Carbon Pharaohs," the transnational corporations.[30] To engage in climate advocacy requires one to denounce their unjust and immoral economic agenda. As Waskow aptly put it, environmental redemptive activism is literally "down-to-earth Judaism" because it concerns how Jews engage every aspect of life in light of environmental imperatives.[31] Put differently, Judaic redemptive activism is decidedly terrestrial in its orientation.

Many Reform, Conservative, Reconstructionist and Orthodox rabbis have joined environmental advocacy and activism. On October 29, 2015, 425 rabbis signed the Rabbinic Letter on the Climate Crisis influenced by the plans for and release of the papal encyclical ***Laudato Si'***.[32] The Rabbinic Letter calls for vigorous action to prevent worsening climate disruption and to seek eco-social justice. Indeed, awareness of the severity of climate change impact has generated inter-religious consensus and collaboration, to which the work of GreenFaith bears witness. Addressed "to the Jewish people, to all communities of spirit, and the world," the Rabbinic Letter specifically asserts the doctrine of creation as the response to our climate crisis. It states: "although we accept scientific accounts of earth's history, we continue to see it as God's creation, and we celebrate the presence of the divine hand in every earthly creature." The Rabbinic Letter calls for "a new sense of eco-social justice—a ***tikkun olam*** that includes ***tikkun tevel***, the healing of our planet."[33] Therefore, the signatories "urge those who have been focusing on social justice to address the climate crisis, and those who have been focusing on climate crisis to address social justice."

Jewish environmental organizations such as the Coalition of Environment and Jewish Life (COEJL) have been very involved in recommending specific energy policies such as "incentives to develop efficient technologies, tax credits to encourage the purchase of such technologies, energy standards for new buildings and appliances, heightened fuel economy standards, and provisions for public transit" are thus grounded in Jewish religious values.[34] Legislation and regulation of human behavior are at the very core of the Judaic approach to the challenges of climate change. Unfortunately, so far that approach has yielded limited results, leading scientists to doubt the ability of religions to mitigate climate change through legislation and modification of human conduct.

Jews are deeply involved in faith-based environmental advocacy, but the Judaic voice is conspicuously missing from discussion of climate engineering. This is somewhat surprising since Judaism takes a pro-technoscience stance and considers scientific knowledge and technological innovations to be integral part of God-given human capacities. So long as technology and science are evaluated from the perspective of Jewish law, any technology that does not violate the principles of the Halachic tradition can be employed to repair the world and improve human life. Jewish bioethicists have welcomed genetic research, genetic engineering, genetic medicine, and even cloning of humans and regarded them permissible albeit it in need of regulation because they fall under the principle of ***Tikkun Olam***.[35] Precisely because the human being is viewed as a "partner of God" in the created world, human

intervention in biological processes is permitted and even encouraged.[36] The trope of "playing God," which is commonly invoked by Christian authors to either curtail technoscientific interventions in natural processes or to justify them,[37] does not play a role in Jewish public discourse about biomedicine.

To date there has been no systematic theological reflection about the permissibility of technologies that either caused the depletion of natural resources (e.g., extraction and fracking) or technologies that are proposed to remediate our environmental challenges (e.g., geoengineering) although Jewish organizations have opposed extracting technologies. For example, The Union for Reform Judaism has been very outspoken about its opposition to technologies that have given us the current crisis. In 2009 Reform Judaism issued "The Resolution on Climate Change and Energy" and in 2018 it endorsed the "Resolution on Hydraulic Fracturing" in which specific policy recommendations were spelled out.[38] While these documents illustrate faith-based climate advocacy, they fall short of theorizing a Judaic ethics of geoengineering (let alone a legal theory of geoengineering).[39] Why? Here are few possible reasons. To begin, Judaism focuses on the terrestrial realm whereas various geoengineering technologies, such releasing sulfur dioxide into the stratosphere, pertain to regions of the cosmos not occupied by humans.[40] Second, the pro-technology stance of Judaism is justified by appeal to the biblical mandate (Ex. 21:19) to heal the human body (in Hebrew, ***verafo yerape***), but geoengineering concerns human bodies only indirectly or secondarily.[41] Third, Jewish bioethics welcomes biotechnology because it can help generate, maintain, and perpetuate life, hence the overwhelming Jewish preoccupation with assisted reproductive technologies, whereas geoengineering is about the atmospheric and climatic conditions for life rather than about life itself. Fourth, the very framing of redemptive activism in socio-moral terms of human lived experience makes geoengineering appears outside the scope of Jewish ethics. Finally, because geoengineering is still mostly hypothetical it has not yet generated specific ethical and legal cases that can be framed within Jewish law. When a technology of geoengineering generates legal conundrums, it is reasonable to assume that Jewish jurists will become interested in the issue.

Jewish jurists and ethicists are to be encouraged to enter the debate about climate engineering by reflecting on these and other related questions: Can the Judaic covenantal theology and Judaic ethics of responsibility be extended to geoengineering, and if so, how? Are all strategies of climate engineering of equal worth or are some preferable to others? If the latter, what is the criterion for preferring one technology over another (e.g., human welfare, social justice, intentionality, responsibility, precaution, humility)? Is the Judaic prohibition on wanton destruction—the principle of "Do Not Destroy"—applicable to climate engineering or should geoengineering be justified instead by appeal to another Judaic principle, such as the concern for future generations? Should the debate about climate change be framed in terms of rights of humans and other beings, or rather in terms of duties and obligations to God's created world? Does the Judaic emphasis on redemptive activism in this world justify climate engineering, or does climate engineering exemplify the very human hubris that Judaism seeks to curb by highlighting the virtues of humility, modesty, and self-control? How does Judaism's commitment to the sanctity of life apply to geoengineering which might harm life as much as it promises to save life? Does that commitment overshadow the risk involved in large scale interventions or does that commitment restrain humans for engaging in activities whose consequences humans cannot be foresee? Geoengineering is one more contemporary technology that Judaism must engage from its own religious-moral perspective as it has done with other technologies including assisted reproduction, genetic engineering, and cloning. If and when the conversation between Judaism and geoengineering takes place, it will enhance Judaic reflections on the environment and technology, while potentially also offering a new framework for the debate on geoengineering.

Nothing in Judaism precludes extending the theological principles of creation care and the legal reasoning of Judaism to climate engineering. As much as environmentalism has inspired Jewish scholars to examine the tradition in light of the contemporary ecological crisis and genetic engineering has led to theorizing Jewish position on biotechnology, it is reasonable to assume that in time Jewish ethicists, theologians, and jurists will regard geoengineering as an issue that requires Jewish theorizing. However,

it is impossible to know in advance how Judaic legal reasoning will be applied to geoengineering because Jewish thinking is hermeneutical and casuistic rather than systematically theological.[42] When geoengineering is engaged from the perspective of Judaism, the contested issues of risk, unintended consequences, the limits of human knowledge, and intergenerational responsibility will be assessed from within the framework of Judaism and its religious values. Having written extensively about religion and technology, I join the critics of geoengineering for the same reasons that I critique transhumanism: the Promethean impulse of secular modern science has given us the "end of Nature," as Bill McKibben called it,[43] characteristic of the Anthropocene as much as it has envisioned the obsolescence of humanity.[44] The emergence of technological beings capable of autonomous decision making will indeed signify profound development in evolution, but if we embrace it uncritically biological humans will eventually become obsolete.

Conclusion

The Anthropocene signifies the new condition of life on Earth as humanity has become a geological force. World religions have a special role to play in the Anthropocene because they articulate comprehensive worldviews that articulate the telos of human life, they offer people hope and they mobilize people to act so as to mitigate the harmful impact of climate change.[45] Within the Abrahamic traditions the doctrine of creation offers the framework within which to articulate a holistic, non-reductionist worldview that sees the physical world as imbued with religious significance rather than as mere inert matter. Jewish environmentalism, which is rooted in the doctrine of creation, coheres perfectly with evolutionary theory, because the act of creation, at least according to the Jewish mystical tradition is non-temporal.[46] The Anthropocene, which encompasses the massive environmental crisis as well as technoscienfic advances, compels us to think anew the relationship between humanity and nature and between science and religion so as to overcome some of the fissures posited by secular modernity. In the post-secular world, Jewish religious environmentalism demonstrates how a religious tradition responds to climate change and why climate change is not a mere scientific issue but a religious and moral issue. Since humans have disrupted God's created world, they have the moral obligation to repair the damage and indeed the Jewish tradition offers specific ways for ethically managing the created order. The repair of the world (*Tikkun Olam*) will require the engagement of religion and not only technoscience.

1. *The term Anthropocene was coined by scientists, but the Anthropocene discourse consists of scientific, legal, political, and cultural dimensions that go beyond the scope of science. For an overview see Erle C. Elis, The Anthropocene: A Very Short Introduction (Oxford: Oxford University Press, 2018).*
2. *Liu J. et al, "Complexity of Coupled Human and Natural Systems, Science 317 (2007): 1513.*
3. *Paul J. Crutzen, "Geology of Mankind," Nature 415, no. 23 (January 3, 2003): 23.*
4. *"The Anthropocene: An Engineered Age?" was the title of a 2014 panel discussion at Berlin's Haus der Kulturen der Welt. See T.J. Demos, Against the Anthropocene: Visual Culture and Environment Today (Berlin: SternbergPress, 2017), 26.*
5. *Geoengineering the Climate: Science, Governance and Uncertainty (London: The Royal Society, 2009), 1.*
6. *For discussion of various strategies of geoengineering see Dale Jamieson, Reason in a Dark Time: Why the Struggle against Climate Change Failed—And What It Means for Our Future (Oxford: Oxford University Press, 2014), 201-38. Advocates of geoengineering are aware of the risks involved in geoengineering, but they maintain that seriously considering the costs and benefits of geoengineering is morally superior to ignoring that option.*
7. *Mike Hulme, Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity (Cambridge: Cambridge University Press, 2009), 145.*
8. *Ibid., 173.*
9. *Several references books have captured the accomplishments of the field, Roger Gottlieb (ed.), The Oxford Handbook of Religion and Ecology (Oxford: Oxford University Press, 2006); Willis Jenkins, Mary Evelyn Tucker and John Grim (eds.), The Routledge Handbook of Religion and Ecology (New York and London: Routledge, 2017); John Hart (ed.), The Wiley Blackwell Companion to Religion and Ecology (Hoboken, NJ: Wiley Blackwell, 2017).*

10. *An example of various religious responses to the challenges of the Anthropocene is Celia Deane-Drummond, Sigurd Bergmann and Markus Vogt (eds.), Religion in the Anthropocene (Eugene, OR: Cascade Books, 2017).*
11. *Laurel Kearns, "The Role of Religions in Activism," in The Oxford Handbook of Climate Change and Society, ed. John S. Dryzek, Richard B. Norgaard and David Schlosberg (Oxford: Oxford University Press, 2011), 418.*
12. *For overview of Jewish environmental movement see David Seidenberg, "Jewish Environmentalism in North America, in The Encyclopedia of Religion and Nature, ed. Bron Taylor et al (New York: Continuum, 2005), 909-13. On Jewish environmentalism in Israel see Daniel E. Orenstein, Alon Tal, and Char Miller (eds.), Between Ruin and Restoration: An Environmental History of Israel (Pittsburgh: University of Pittsburgh Press, 2013).*
13. *See Robin Globus Veldman, Andrew Szasz and Randolph Haluza-Delay (eds.), How the World Religions Are Responding to Climate Change: Social Scientific Investigations (London and New York: Routledge 2014).*
14. *See Hava Tirosh-Samuelson (ed.), Judaism and Ecology: Created World and Revealed Word (Cambridge, MA: Harvard University Press, 2002); idem; "Judaism," Oxford Handbook of Religion and Ecology, pp. 34-65; idem, "Judaism," Routledge Handbook of Religion and Ecology, 60-69.*
15. *Lynn White Jr., "The Religious Roots of Our Ecologic Crisis," Science 155 (1967): 1203-07.*
16. *My approach resonates with Alister McGrath, The Reenchantment of Nature: The Denial of Religion and the Ecological Crisis (New York: Doubleday, 2002); Mats Walberg, Reshaping Natural Theology: Seeing Nature as Creation (New York: Palgrave Macmillan 2012); Norman Wirzba, From Nature to Creation: A Christian Vision for Understanding and Loving our World (Grand Rapid, MI: Baker Academic 2015). The distinction between "nature" and "creation" was similarly important to modern Orthodox Jewish thinkers such as Samson Raphael Hirsch (d. 1888) and his grandson Isaac Breuer (d. 1946) who articulated an environmentally sensitive position that was grounded in Jewish Law (Halakhah).*
17. *Wirzba, From Nature to Creation, 20-21.*
18. *Hava Tirosh-Samuelson, "Religion, Science and Technology in the Post-Secular Age: The Case of Trans/Posthumanism," Philosophy, Theology and the Sciences 4 (2017): 7-45.*
19. *Lawrence Troster, "From Apologetics to New Spirituality: Trends in Jewish Environmental Theology," http:// www.greenwisdomrabbi.com/from-apologetics-to-new-spirituality-trend-in-jewish-environmental-theology; idem, "Caretaker or Citizen: Hans Jonas, Aldo Leopold, and the Development of Jewish Environmental Ethics," in The Legacy of Hans Jonas: Judaism and the Phenomenon of Life ed. Hava Tirosh-Samuelson and Christian Wiese (Leiden: Brill, 2008), 373-396. Jonas's scientifically grounded and existentially informed environmental philosophy differentiates between modernist conception of "nature," which lacks meaning and value, and the Judaic understanding of "creation," which invests the physical world with meaning, value, and purpose.*
20. *Hava Tirosh-Samuelson, "Jewish Environmental Ethics: The Imperative of Responsibility," in The Wiley-Blackwell Companion of Religion and Ecology, ed. John Hart (Oxford: John Wiley & Sons, 2017), 179-194.*
21. *For a summary of biblical environmental legislation, see essays of Tirosh-Samuelson listed above; for discussion of how biblical legislation was elaborated by the rabbinic and post-rabbinic jurisprudence see Eilon Schwartz, "Bal Tashchit: A Jewish Environmental Precept," in Judaism and Environmental Ethics: A Reader ed. Martin J. Yaffe (Lanham MD: Lexington Books, 2001), 355-374.*
22. *See Moshe Sokol, "What Are the Ethical Implications of Jewish Theological Conceptions of the Natural World?" in Judaism and Ecology, 261-282. On environmental virtue ethics, see Ronald Sandler and Philip Cafaro (eds.), Environmental Virtue Ethics (Lanham, MD: Rowman and Littlefield, 2005). To date, Jewish ethicists have contributed little to this discourse, although the virtues cultivated by Judaism are environmentally relevant.*
23. *Lawrence Troster, "Tikkun Olam and Environmental Restoration: A Jewish Eco-Theology of Redemption," Jewish Education News (Fall 2008), http://www.caje.org.*
24. *See Rachael Rosenfeld Jacob, "Jewish Organizations Fight Climate Change," Journal of Jewish Communal Service Spring 88 1/2 (2013): 88-94.*
25. *Judy Weiss, "Tisha b'Av in the Age of Climate Change: Binding Ourselves to One Another in Activism," Notes from a Small Planet (Summer 2016): 19-21. This essay too illustrates the activist orientation to climate change and the avoidance of systematic ethics of climate engineering.*
26. *A recent essay by Julia Watts Belser, "Privilege and Disaster: Toward a Jewish Feminist Ethics of Climate Silence and Environmental Unknowing," Journal of the Society of Christian Ethics 34 (2014): 83-101 illustrates how the Judaic discussion of climate change has little to do with ethics of climate engineering.*
27. *Waskow, "Tackling Climate Change: If Not Now, When?" http://aleph.org/resources/tackling-climate-change-if-not-now-when.*
28. *Waskow, "What Is Eco-Kosher," in This Sacred Earth: Religion, Nature, Environment, ed. Roger S. Gottlieb (New York: Routledge, 1996), 297-300.*
29. *Waskow, "Tackling Climate Change."*
30. *Arthur Waskow, "Move Our Money, Protect Our Planet: A Jewish Plan of Action on Climate Change," Jewish Currents (Autumn 2014): 9-11.*

31. *Arthur Waskow, Down-to-Earth Judaism: Food, Money, Sex and the Rest of Life (New York: Harper Collins, 1997).*
32. *See the statement issued by COEJL, "Judaism, Climate Change, and Laudato Si," www.coejl.org/climatechange.*
33. *In Hebrew the word "olam" has many meanings, referring to the physical world, the social world, and even to time; the term "tevel" refers here to the planet as a whole and all its inhabitants, humans and nonhumans.*
34. *See "Judaism, Climate Change and Laudato Si."*
35. *See Elliot Dorff, Matters of Life and Death a Jewish Approach to Modern Medical Ethics (Philadelphia: Jewish Publication Society, 1998); Elliot Dorff and Jonathan K. Crane (eds.), The Oxford Handbook of Jewish Ethics and Morality (Oxford: Oxford University Press, 2013). The volume covers many contemporary technologies says nothing about climate change or climate engineering.*
36. *See Miriam Z. Wahrman, Brave New Judaism: When Science and Scripture Collide (Hanover NH: University of New England Press and Brandeis University Press, 2002).*
37. *For a critical examination of that motif see Laura M. Hartman, "Climate Engineering and the Playing God Critique," Ethics and International Affairs 31 (2017): 313-333.*
38. *See "Climate Change and Energy," http://urj.org/what-we/believe/resolutions/climate-change-and-energy; "Resolution on Hydraulic Fracturing," http://urj.org/what-we-believe/resolutions/resolution-hydraulic-fracturing.*
39. *On the ethics of geoengineering, see Stephen M. Gardiner, "Geoengineering: Ethical Questions for Deliberate Climate Manipulations," in The Oxford Handbook of Environmental Ethics (Oxford: Oxford University Press, 2017), 501-514. This essay makes no mention of religious ethics, just as much as the essay by Julia Watts Belser (cited above) makes no reference to the ethics of geoengineering.*
40. *Christopher J. Preston, "The Multiple Anthropocenes: Toward Fracturing a Totalizing Discourse," Environmental Ethics 37 (2015): 307-20, differentiates between the terrestrial and the atmospheric perspectives in regard to the Anthropocene. The Judaic perspective aligns with the former.*
41. *The health impact of climate change has already been noted by the year-long study between The Lancet and University College London Institute for Global Health. See Anthony Costello et al, "Managing the Health Effects of Climate Change," The Lancet 373 (May 16, 2009): 1693-1733. Climate change will impact the poorest populations that already suffer the negative effects of global warming, but the message has failed to penetrate the public debate about climate change. The health impact of climate change should be of concern to Jewish ethicists.*
42. *The work of Forrest Clingerman and his collaborators on environmental hermeneutics could be especially relevant to Jewish thinkers given the centrality of Midrash in Jewish religious culture. See Forrest Clingerman, Brian Treanor, Martin Drenthen and David Utsler (eds.), Interpreting Nature: The Emerging Field of Environmental Hermeneutics (New York: Fordham University Press, 2014).*
43. *See Bill McKibben, The End of Nature (New York: Random House, 2006 [1989]). McKibben has definitely lamented the loss of Nature and the inauguration of our post-natural epoch contrary to climate engineers who relish the new human ability to control and manipulate nature.*
44. *See Hava Tirosh-Samuelson, "In Pursuit of Perfection: The Misguided Transhumanist Vision," Theology and Science 16 (2018): 200-222.*
45. *For a Christian framing see Christopher Doran, Hope in the Age of Climate Change: Creation Care This Side of the Resurrection (Eugene, OR: Cascade Books, 2017) and for a more universal framing see Anna Peterson, "Climate Change and the Right to Hope," in Tikkun Magazine 30, no. 2 (2015): 42-43.*
46. *The biblical narrative of creation indeed uses temporal terms such as "day," "evening," and "morning" to depict the process of creation, but medieval Jewish mystics already insisted that these terms pertain to emanative processes within the deity, prior to the emergence of the physical world. Within the discourse of Jewish mysticism creation and evolution are compatible. See Arthur Green, "Kabbalah for the Environmental Age," in Judaism and Ecology: Created Word and Revealed Word, 3-16. For a broader Judaic attempt to show the compatibility of creation and evolution see Lenn E. Goodman, Creation and Evolution (London and New York: Routledge, 2010).*

Taking the Earth into Our Own Hands: Practical Wisdom in an Age of Climate Engineering

Author

Celia Deane-Drummond is currently Professor in Theology at the University of Notre Dame, IN, USA. She is also Director Designate of the Laudato Si' Research Institute, to be based at Campion Hall, Oxford University starting in the academic year 2019-20.

"The Earth is Our Common Home" claims Pope Francis in an encyclical entitled ***Laudato Si'***, drawn from the words of St. Francis' praise poem to the sun and all creatures.[1] What marks out this encyclical, quite apart from the fact that it has been more heavily cited than any other papal documents in recent history, is that it is addressed to everyone, not just Roman Catholics. Coming at a time just before the Conference of Parties meeting on climate change in Paris in 2015, few could have anticipated its impact and influence.

However, while he attributed credit to scientists of all stripes, including climate scientists, ecologists and those working in conservation, his treatment of the possibility of actively manipulating the planet was either not there at all, or hinted at in negative terms. So, how could a Pope be both affirmative of the creativity of scientists, claiming that "science and technology are wonderful products of a God given human creativity"[2] and yet when it came to technological interventions pull back in suspicion?

The root of the issue seems to be that Pope Francis wants to avoid a too easy escape into technological fixes, which he fears will undercut the need to take real responsibility for significant spiritual and cultural changes that are required to catalyze effective emissions reductions and adaptation. Behind such concerns is a deeper one, however: that obsession with technological devices becomes a substitute for healthy human relationships and acknowledgement that those living in the poorest and most vulnerable communities have needs. But does that necessarily mean that all technologies should be ruled out as a matter of course? Pope Francis clearly believes that medical doctors and even agriculturalists are justified in their use of technology for service to the wider community in providing medicine and food security. Further, mobile devices have been used effectively as tracking devices in global health provision for some time, leading to far greater efficiency and provision where help is most needed. [3] So, it is not technology as such that is problematic, but the substitute of technology for human relationships or the too quick resort to what are claimed to be technological solutions.

Climate engineering is deliberate human intervention on the climate, either by solar radiation technologies or large-scale carbon removal. Scientists, among others, acknowledge that one of the

difficulties with the climate engineering agenda is the public connotations of the use of terms like "technology" and "engineering." Engineering sounds in the public context like a carefully planned, human-centered control of our planet, which of course is impossible. While scientists recognize the difficulties and risks associated with such interventions, the term engineering implies solidity to the enterprise that can easily stir up fears in the public mind. It is not surprising that fears around ***genetic*** engineering elicited a similar sort of reaction at the turn of the twentieth century, this time that our human natures might be designed rather than accepted as gift.[4] So, genetic engineering was, with some caveats, acceptable for the botanic and zoological world, but a wall went up when it came to human interventions, especially those that were anticipated to be long-term and inherited. Climate engineering also has a similar threat of "playing God," though this time what is at stake seems even higher, since it has the potential to impact on the lives of billions of humans and other creatures.

It is not really surprising, therefore, that policy makers who wanted to explain the different models in the IPCC reports, have shifted the terminology used. Now, instead of the more general term "climate engineering," we find the more specific, but still extremely broad language of "negative emission technologies" (NETs). [5] The Paris Agreement (arising out of Conference of Parties in 2015) called for a balance between sinks and sources, so enhancing sinks through carbon capture techniques allowed the possibility of ***negative emissions*** to surface. The idea that we might become carbon neutral, or to actively take out carbon from the atmosphere, intuitively seems more positive compared to a more threatening language of engineering, even though NETs are dependent on a wide variety of methods, some of which are more technologically sophisticated than others. The Vatican is aiming to become carbon negative in its emissions, which shows that the papal stance on this issue has been re-aligned with the most recent scientific consensus. Certainly, it has been well-established in climate science for some time that cessation of carbon emissions will be followed by a lag before any real response is in place, due to the persistence of carbon dioxide in the atmosphere. Responsiveness to changes will also vary between geographical regions, with the most vulnerable nation states being at a relative disadvantage in terms of deceleration of damage, or, possible recovery and restoration.[6]

But are there ways in which theological reflection can contribute to scientific and policy discussions about the use of technologies in impacting climate change, rather than providing a barrier to all developments? My argument in this short paper is that ***practical wisdom*** is one of the most helpful ethical frameworks to use in order to think through complex and difficult ethical questions about the use of such technologies.[7] Practical wisdom has a long tradition within Christian ethical and theological reflection. It also can be recognized as important in a decision-making process by those of other faiths, as well as by those do not hold to any faith tradition. It therefore should be easier to convince international bodies to incorporate into their thinking what I will call the ***wisdom principles***, even though practical wisdom emerges from a discussion of virtue ethics. The advantage of practical wisdom is that it aims to be inclusive, because it is oriented towards the common good. In this case, the good to be sought is an obvious one: the survival of planet Earth as a functioning system that can support life. Unlike other definitions of the good, which could potentially be contested, the good of the continuation of the planet in such a condition to support life, and human life in particular, is presupposed in all other goods. I am assuming, for the sake of argument, that there is general agreement that life as we know it on Earth will not continue in its present form if we do nothing in response to climate change. I think that is necessarily the precondition for any collective agreement on technologies such as carbon capture. Scientists seem to have reached a consensus on this, even if there are different ways of modeling how the Earth System will respond to either doing nothing or more active intervention. [8]

So, what would practical wisdom look like if the good to be sought is not just the health of a single community or even nation, but the good of planet Earth? Practical wisdom entails deliberation, judgment and action.

It is important state at the outset that practical wisdom does not assume that all uncertainties are taken away. Rather, it is an ability to make good decisions in spite of uncertainties. There is no greater need

for this capacity for decision in the face of uncertainty than in the use of technologies in the climate agenda. No climate engineering technologies are yet sufficiently developed to be sure of their impacts, and even those more obvious actions to mitigate carbon (such as tree planting) are not necessarily entirely predictable in their outcomes in terms of their relative efficacy (as well as land-use trade-offs). If we are dealing with the whole Earth community rather than a single community, then finding ways to foster action that is coordinated across different communities is challenging, to say the least. How can the decision of a small group of scientists, whatever their relative skill or expertise, be responsible for making decisions on behalf of the globe as a whole? Practical wisdom will seek that deliberation to be representative, as far as it is possible, of the global commons.

Further, giving priority to representation from minority and other marginalized groups needs to be woven into the decision-making process. One of the difficulties in doing this is that representation by some minority groups who are economically disadvantaged is difficult, not least because of the educational challenges that are concurrent with living in poverty. However, given that there is a strong option for the poor among religious communities, and among Catholic communities in particular, finding ways of articulating that representation so that it is respectful of the dignity of the individuals concerned is vitally important. Building in principles or structures that will assist in governance and policy-making will fail at an ethical level if those principles are framed through the decisions of a minority elite.

Arriving at the important phase in practical wisdom of judgment, it is useful to parse out the different components of practical wisdom and see which aspects are the most useful. The first aspect is ***memoria***, the ability to remember with accuracy that which has gone before. As we struggle to find ways to make good decisions, the weight of responsibility for cultures and species that have gone extinct needs to remain alive in our minds rather than forgotten. But it needs to be an accurate rather than romantic understanding of the past, one that is true, as far as it is possible to recollect, to those histories. For their sake, as much as for our own and future generations, there is a need to put in all our effort to come to a consensus on how to act. Second, precaution, which environmental ethics often develops into a precautionary principle. However, when this principle is the only one used, it fails to recognize the complexity of the decision making to hand. Some measure of caution is needed, which is why solar radiation technologies—due to their unpredictable effects and the possibly disastrous surge in temperatures should these tools be damaged or even vandalized—are less desirable compared with carbon capture methods. Third, ***solertia***, which is the ability to act well where there are situations of emergency and in the face of the unexpected. Some scientists have suggested that the use of solar radiation management would be of this type: an emergency deployment in the event of extreme need, when the risk of collapse is so great that any action seems better than none. I don't think that we are in this situation yet, but would it be wise to begin to undertake research on such large-scale installations or not? Given what is at stake, it would depend on consensus being reached by decision-makers who are fully representative from a global perspective, as well as suitable governance structures being worked out in advance and greater scientific knowledge of the risks, benefits and trade-offs.

A fourth element of practical wisdom is ***docilitas***, the ability to be taught. This characteristic is essential in cases where decisions are complex and involve so many different parties. Scientists may be frustrated by the lack of progress, but there needs to be willingness to learn on all sides, and not just assume that once the science is known action will follow. My sense is that this lesson has already been learnt, but taking the next step and becoming actively involved in knowledge exchange is more challenging. Fifth, ***reason***, which is rather deeper than the kind of rational positivism of science in that it is inclusive of different branches of knowledge. Sixth, ***foresight***, which is the ability to predict what may happen in the future in a given scenario or after a set of decisions have been taken. Thomas Aquinas believed that foresight was one of the marks of what makes us human, in that we shared God's providence, ***provencia***.[9] Seventh, ***insight*** is the ability to hold all different aspects of practical wisdom together and come to a good decision even in the face of uncertainty. Eighth, ***circumspection***, or having accurate knowledge of the situation in hand. Of course, this is extremely difficult, given the present state of ignorance, but

scientific research would fall broadly into this category, as would other areas of social science. Scientific knowledge, therefore, is integral to a decision of practical wisdom, but not the only element in making such a decision. So far there is insufficient research being done and that ignorance only fuels suspicion and fear. The priorities for scientific research also need discernment; for instance, discernment suggests carbon capture technologies are more promising compared with solar radiation methods for reasons already discussed.

Taken together, these eight wisdom elements encourage appropriate action in different scenarios. For example, my own reading is that carbon capture technologies need to be filtered through such principles in further research development. The IPCC endorses negative emission technologies as they believe that reducing emissions through standard emission reduction strategies alone are not going to be sufficient to reach a 1.5° Celsius target. My point is that when developing new NETs, practical wisdom can help shape the direction of research. At the same time, implementation on a broader scale would require more than this, such as governance structures being in place that also take into account wisdom principles.

In sum, the wisdom principles that I believe are most relevant for technological intervention in the Earth's climate are the following:

1. *Include broad representation* in any decision-making, actively including those from the poorest communities of the world and most impacted by climate change.
2. *Remember rather than eliminate* those cultures and species already lost through climate change.
3. *Bring in an element of caution* where potential effects are extremely poorly understood.
4. *Actively seek to understand* different strands of knowledge from different disciplines and traditions.
5. *Aim to predict* as accurately as possible what a given decision or set of decision might lead to, especially in relation to the most vulnerable.

These principles are, I suggest, in alignment with *Laudato Si'*s overall intent. The need for hearing the cry of the poor is epitomized in 1, treasuring all of God's creatures and cultures as a gift from God rather than subjects that can be dispensed with at will are epitomized in 2, a requirement not to rashly implement new technologies without recourse to the primacy of broader emission reduction and adaptation strategies is expressed in 3, the need for dialogue across disciplines and between those of different religious persuasion is found in 4, and the need to look to the future, including what could be understood as a future hidden in God, finds expression in 5.

Overall, the time is right for not just talking about climate change and the need for particular steps, but also for implementation and action. I have suggested one way such actions might be filtered through a wisdom paradigm, one that I believe with not just be resonant with Christian believers, but with people who adhere to other religious traditions or no tradition at all. Finding ways to encourage positive collective action that will not be viewed either the time or in the future as oppressive remains a serious ethical challenge, but it is not one that is impossible to overcome.

1. *Pope Francis, Laudato Si': On Care for Our Common Home (London: Catholic Truth Society, 2015).*
2. *Pope Francis, Laudato Si' § 102.*
3. *Carole Déglise, L Suzanne Suggs, Peter Odermatt, "SMS for Disease Control in Developing Countries: a Systematic Review of Mobile Health Applications," Journal of Telemedicine and Telecare, 18 (2012): 273-281, https://doi.org/10.1258/jtt.2012.110810.*
4. *These ideas stem from the early work of Christian ethicist Paul Ramsey, such as Paul Ramsey, Fabricated Man: The Ethics of Genetic Control (Newhaven: Yale University Press, 1970).*
   S. Fuss, C.D.Jones, F. Kraxner, G.P. Peters, P. Smith, M.Tavoni, D.P. van Vuuren, J.G. Canadell, R.B. Jackson, J. Milne, J.R. Moreira, N. Nakicenovic, A. Sharifi, and Y.Yamagata, "Research Priorities for Negative Emissions," Environmental Research Letters 11

(2016): 115007; Jan C. Minx, William F. Lamb, Max W. Callaghan, Sabine Fuss, Jérøme Hilaire, Felix Creutzig, Thorben Amann, Tim Beringer,Wagner de Oliveira Garcia, Jens Hartmann, Tarun Khanna, Dominic Lenzi, Gunnar Luderer, Gregory F Nemet, Joeri Rogelj, Pete Smith, Jose Luis Vicente Vicente1, Jennifer Wilcox and Maria del Mar Zamora Dominguez, "Negative emissions—Part 1: Research Landscape and Synthesis," Environmental Research Letters 13 (2018) 063001; Sabine Fuss, William F Lamb, Max W. Callaghan, Jerøme Hilaire, Felix Creutzig, Thorben Amann, Tim Beringer, Wagner de Oliveira Garcia, Jens Hartmann, Tarun Khanna, Gunnar Luderer, Gregory F Nemet, Joeri Rogelj, Pete Smith, José Luis Vicente Vicente, Jennifer Wilcox, Maria del Mar Zamora Dominguez and Jan C Minx, "Negative emissions—Part 2: Costs, potentials and Side Effects," Environmental Research Letters 13 (2018), 063002; Gregory F Nemet, Max W. Callaghan, Felix Creutzig, Sabine Fuss, Jens Hartmann, Jérøme Hilaire,William F Lamb, JanCMinx, Sophia Rogers and Pete Smith, "Negative Emissions—Part 3: Innovation and Upscaling," Environmental Research Letters 13 (2018) 063003.

5. *H. Damon Matthews, Kirsten Zickfeld, Reto Knutti and Myles R Allen, "Focus on Cumulative Emissions, Global Carbon Budgets and the Implications for Climate Mitigation Targets," Environmental Research Letters 13, no. 1 (2018) 010201.*
6. *I am using the categorization of practical wisdom that Thomas Aquinas lays out. Thomas Aquinas, Summa Theologiae, Prudence, Vol. 36 (2a2ae. 47-56), trans. Thomas Gilby (London: Blackfriars, 1973). I have also used practical wisdom to good effect in other situations of complexity, including environmental ethics and genetic engineering. I did not develop in those cases particular principles for action in the way I am attempting to do here. I believe the scenarios are rather different in that the situation is one that is more urgent and also one where discussion of governance principles is required.*
7. *Fuss et al., "Research Priorities;" Fuss et al., "Negative Emissions" Parts 1-3.*
8. *Aquinas, Summa Theologiae, Prudence, 2a2ae, Qu. 49.6.*

Islam and Climate Engineering

Author

Çağdaş Dedeoğlu is Research Associate at the Center for Critical Research in Religion. He has a Ph.D. in Political Science & International Relations.

Introduction

When reading about solar geoengineering techniques, it is easy to be reminded of the Laki volcanic eruption of 1783 in Iceland and its impacts on different geographies of the 18th century. In the last chapter of Alan Mikhail's book, *Under Osman's Tree*,[1] focusing on Ottoman environmental history through the themes of climate, energy, and plague, the author discusses the Laki eruption and its climate implications for the rest of the world, including Ottoman Egypt. Sulfur dioxide spread from the Laki fissure, covering the sky in a vast area ranging from Iceland to Mongolia. These particulates caused the reflection of sunlight back to space for more than five months. As a result, extreme weather struck the Northern Hemisphere in the summer of 1783 and the winter of 1784. In the same period, the new climate conditions affected the Nile system in Egypt, which eventually proved troublesome for the Ottoman socio-economic system given its heavy dependence on crops produced in Egypt and distributed to other provinces. If the Ottoman administration had been able to oversee this climate event and counteract comprehensively, the outcome might have been different.

Our age is mostly defined with the concept of Anthropocene—a new era that started with the Industrial Revolution and is characterized by the nearly all-encompassing human influence on nature. The influence of the Anthropocene finds its reflection in the potential for nuclear calamity, ongoing chemical and biological pollution, the creation of genetically modified organisms, and needless to say, the unintended climatic changes caused by modern use of fossil fuels. However, it is also argued that humanity can oversee and counteract climate change by using technology and science to intentionally respond to anthropogenic global warming.

Policy decisions are necessitated by the development and implementation of such capacities. According to the American Meteorological Society, climate change policy consists of four dimensions: mitigation, adaptation, climate engineering, and knowledge base expansion.[2] In Part 1 of the present report there an overview of climate policy, which shows a similar continuum of policy options. In these discussions, it is apparent that different climate policy options are being pushed by different actors in scientific communities and business circles. Climate engineering has recently become more prominent in the policy discussion. Big names and some newcomers, separately or in collaboration, have initiated startups to seek "techno-fix solutions" for climate change, such as direct air capture of carbon dioxide or injecting particles into the stratosphere (in effect mimicking a volcano like the Laki) to reflect sunlight to space. Some consider this as an opportunity to make money for good purposes. Others accuse

geoengineers of "playing God" and unbalancing nature.

This debate also corresponds to an expansion of the knowledge base on climate change from a different angle. That is to say, since there are different ways of knowing, there also are different systems of knowledge that can potentially contribute to the debate on climate change and climate engineering policy. This essay assumes that there is a relationship between ontology (how individuals "perceive" their existence) and epistemology (what they "know" about the reality), as well as between ethics and climate change policy options. The ontological and epistemological pillars ground the character of humans (following the discussion of Clingerman, O'Brien, and Ackerman about character and climate engineering[3]) and religious traditions play an important role in shaping the character of both individuals and systems.

This role of religion holds true for the Islamic culture. Islam is a monotheistic, global faith with over 1.5 billion adherents worldwide. In general, Islam refers both to peace and submission, meaning the absence of conflict complemented by absolute harmony. Moreover, *din*, the Arabic word for religion, stands for the integrated codes of behavior ranging from personal hygiene to natural order to keep the world in harmony.[4] This essay attempts to discuss the integrated codes of Islamic behavior—and their ontological and epistemological background—regarding climate policy and engineering. If being Muslim is the second most popular religious identity today, and will most likely rank number one in only a few decades, the ideas Islam brings to a discussion of climate engineering are important for policy discussions and should be considered.

A Brief History of Islam-Nature Interaction

Witnessing the side effects of modernist growth attempts, researchers introduced the ecological crisis as a new societal concern in the intellectual atmosphere of the 1960s. Triggered by historian Lynn White Jr.'s 1967 critique of Christianity's role on the rise of the ecological crisis,[5] various subsequent efforts have tried to understand the link between religion and nature. Almost in the same period, philosopher Seyyed Hossein Nasr introduced an Islamic critique of modern individual and modern comprehension of the natural order. In the mid-1980s, Fazlun M. Khalid took a similar approach when he founded the Islamic Foundation for Ecology and Environmental Science in Birmingham, UK. Reflecting these attempts, the original Assisi Declarations gave voice to a religious discourse on humans' interaction with their environments. Named after St. Francis of Assisi, the meeting hosted Buddhist, Christian, Hindu, Jewish and Muslim leaders in the Italian city of Assisi, in 1986.

The debate on religion and nature continued in the 1990s among academic and non-academic circles. For example, the *Religions of the World and Ecology* conference series was organized starting in 1998 after a three-year research project by the Center for the Study of World Religions (CSWR) at Harvard Divinity School. From these conferences, Harvard University Press published a series of ten books with a theme of "World Religions and Ecology." Following this, a book called *Faith in Conservation* [6] was published by the World Bank in 2003, in which the Assisi vision was enriched by the contribution of Baha'iyyat, Jainism, Sikhism, Shintoism, Taoism, and Zoroastrianism. *The Encyclopedia of Religion and Nature* [7] was edited in 2005 and this collaboration led to the establishment of the International Society for the Study of Religion, Nature, and Culture in 2006. All of these attempts welcomed Islamic intellectuals and helped the Islamic dimension to become part of the debate on religion and nature.

Meanwhile, the main focus has shifted from the ecological crisis to climate crisis, and the 1992 dated United Nations Framework Convention on Climate Change (UNFCCC) became the first institutional effort to address the climate change issue. This updated vision has also triggered various attempts to raise ecological awareness among adherents of different religions. Like other faith communities, Muslim communities started to act against climate change. For instance, Muslim Associations for Climate Change Action (MACCA) was established in 2009 within the *Muslim Seven Year Climate Change Action Plan 2010-2017*, a plan initiated by the Alliance of Religions and Conservation and United Nations

Development Programme. More recently, the *Islamic Declaration on Climate Change* was publicized.[8] Launched in Istanbul in 2015, this declaration aimed at giving an environmental point of view to Muslims.

Islam, Nature, and Climate

In their assessment report of the 2017 CEC conference session, "God(s) and Greenhouse Gases: Religion and Climate Engineering," Thomas Bruhn, Forrest Clingerman, and Laura Hartman sort ten groups of questions.[9] Based on these questions, I wish to offer a new set of questions to scrutinize the links between Islam, nature, and climate.

1. *Climate engineering as a humanitarian ideal*—Can climate engineering be interpreted as a humane idea for the Muslim communities?
2. *Who speaks for nature?*—Does the Islamic tradition enable Muslims to speak for nonhuman creation?
3. *Problems of power and justice*—How should the climate engineering community deal with issues of power and justice, and what does the Islamic tradition provide us to understand these issues better?
4. *Science and spiritual values*—How might Islamic spirituality affect the policy options of the scientific community and business circles?
5. *Sustainability and climate engineering*—Can Islamic codes of behavior be considered sustainable? Do these codes offer a model for sustainability and climate engineering?
6. *Compassion and mindfulness*—How might the ideas of compassion and mindfulness be integrated into the climate engineering debate from an Islamic point of view?
7. *Models and metaphors*—What models and metaphors might be derived from an Islamic epistemology?
8. *Emotion and reflection*—How might Islam provide ways to understand emotional responses to climate engineering?
9. *Responsibility*—How might the idea of responsibility for the climate be interpreted within Islamic tradition?
10. *Religious authority*—Is there a potential for spiritual leadership and influence within Muslim communities regarding climate engineering?

As these questions make clear, religion involves, but is not limited to, ethics. Religion also includes ontological and epistemological aspects. Some might say that it is a strained interpretation to assert that there is a clear Islamic vision specifically related to climate change, but it seems reasonable to say a Muslim can follow the Qur'an and hadiths as a manifestation of environmental ethics. The Qur'an, the ultimate word of God for Muslims, and the hadiths, or the recorded sayings of the Prophet Muhammad, can guide Muslims to find answers to the questions above.

First and foremost, Islamic ontology assumes a close relationship with the ideas of God and creation, because there is not an existential distinction between spiritual and natural environments. It is accepted that the Qur'an consists of 114 surahs (chapters) and *6666 ayats* (verses, composing the chapters). Indeed, the concept of *ayat*, meaning "sign" in Qur'anic vocabulary, allows a Muslim to interpret nature as the sign of God. The Qur'an holistically approaches cosmos and relates it to the amr (order) of God. Although the human being is placed at the center of the Universe, they have God-ordered responsibilities within it. The concept of *khalifa* (steward) is mostly interpreted in this way. Moreover, the concept of *mizan* (balance) takes a central place in performing these responsibilities.

Islamic epistemology also leads to certain methods that define how Muslims seek natural knowledge. The way Muslims understand nature, and their obligations toward it, become reinforced through religious teachings and required behaviors. For instance, the saying "even a leaf does not move without God's permission" forms an epistemological extension, because it underscores the level of obligation for which humans steward creation in even the smallest details. In an interpretation of such an epistemology, *khalq* might be one of the keywords. Creation (met by the trilateral root khā lām qāf, in Arabic) is mentioned in 261 ayats. God has the name *al-Khalid* (creator), which is found alongside the names of *al-Wali* (manager), *Malik al-Mulk* (real owner), ar-Razzaq (assuring), *al-Muqit* (nourishing) and *al-Hafiz* (protector). Here, a potential interpretation might be that the existence of nature follows God's order in a teleological way, referring to the Aristotelian idea of purposeful design. This divine, teleological order is a personal existential principle assuming a relationship between everything in nature.

Interestingly, the pronunciation of English word "calculator" reminds us of the Arabic word for creation. Although there is a reference to abundance in the Qur'an as the mercy of God, Muslims should calculate the pros and cons of their activities. In this calculation, human knowledge, with the Divine guidance, goes beyond the intrinsic boundaries of human experience.

In light of these concerns, Islamic climate ethics seems to have four pillars: *tawhid*, *khalifat*, *shari'a*, and *'adl* and *i'tidal*. *Tawhid* stands for the oneness of God and posits respect for God's creation in Islamic climate ethics. In a similar vein, the human being is the steward of God (*khalifat*) in the world. Therefore, an honest, conservationist attribute is a fundamental part of a human's moral being. *Shari'a*, or Islamic canonical law, can be considered as the ethics of action. The *halal-haram* (lawful-forbidden) distinction of shari'a might be considered to have a sanction power for the implementation of Islamic climate ethics. *Shari'a*'s ethical approach relies on "to do the right" instead of "to be good." This reliance corresponds to an absolute ethical stance. Finally, the concepts of 'adl and *i'tidal*, originated from the same root, support such an ethical understanding. While the former means justice, the latter means moderation.[10] Without a moderate approach, justice among God's creations cannot be maintained. Together the two concepts of *'adl* and *i'tidal* point out a balance between God, nature, and history.

There is no word that corresponds to the modern, conceptual understanding of nature in the Qur'an. Instead, *bi'a* (meaning habitat or surrounding) is the closest word to "natural environment" in modern Arabic. Out of 114 *surahs*, 31 refer to nature, natural powers, natural phenomena, and natural assets. Also, there is special attention to the theme of water. Although there is no consensus on this, out of more than 6000 ayats, 900 deals with the conservation of water resources, 1400 refers to economic problems, and the rest focus on nature and the problems caused by human beings.[11] The seventh chapter of the Qur'an, *Surah al-A'raf*, rests on a creation story, but still ethically holds individuals responsible. According to this story, human superiority over other members of nature is deeply dependent on their responsibilities. Therefore, the human domination of nature cannot be seen as limitless. Besides, the idea of cosmic justice is very much related to *zulm an-nafs*, that is, the wrongdoing of harming oneself. This relationship implies that individuals will always face the results of their actions. The Qur'an (42:30) is very clear on this, even though the same ayat also indicates that God "pardons much." So, individuals should learn lessons from the past and work for a better future.

The hadiths are crucial from the perspective of the *fiqh* (the philosophy of Islamic law), since knowledge production has been historically affected by the interpretations of hadiths. *Sahih* (accurate) hadith writing started in the 9th century. The following century witnessed the writing of more hadith books reflecting the views of *Sunni* and *Shia* branches of Islam. These hadiths include various themes, such as general composition and meaning of nature, land-seeding and agriculture, construction of buildings, animals and husbandry, water resources, birds, and plants.

Discussion of these themes are built upon the *hima-haram* (private pasture vs. inviolate zone) doctrinal distinction. Such a difference helps decide on the planning of rural and urban settings, for instance. This makes *hima* is an ecological issue, as well as an issue of distributive justice and law. According

to the Maliki School of Fiqh, the environmental aspect of hima comprises four principles all of which have legal outcomes: necessity and justice, moderate approach to the size of *hima* site, environmental harmlessness and societal welfare. On the other hand, the Hanefi School of Fiqh has an additional perspective on mawat, or the issue of wastelands, with special rules related to wasteland management.

In a nutshell, ethical and environmental concerns are hand-in-hand in these early writings. As indicated in *Sahih Al-Bukhari*, one of the hadith books, Prophet Muhammad said: "The earth has been created for me as a mosque and as a means of purification." This statement has direct links to an ethical perspective. The hadiths of "even if the end of time is upon you and you have a seedling in your hand, plant it" or "Muslims have a common share in three [things]: grass, water and fire" are also mentioned within nature-related Islamic ethics. Moreover, there include many hadiths about the fair treatment of animals—for instance, horses. It is important to note that the concerns towards animals even existed during the military affairs and wars. This understanding treats animals as separate individuals born out of distinct existential causes. The ecological vision of Abu Bakr the Caliph also seems to follow the Qur'anic foundations and Prophet Muhammad's philosophy. In this respect, they ordered their armies not to harm women, children and weak as well as animals, damage crops or cut trees.[12] This vision does not seem to treat human condition distinctly.

Discussion: Climate Engineering and Islam

It is evident that the Islamic tradition has a vital role in shaping ontologies, epistemologies, and ethics of the believers related to their environments. Although religion and theology scholars emphasize the individual aspect of this role, that is the belief aspect, and one should also consider its socio-political aspect. This dual character of religion increases Islam's potential influence within the climate engineering debate. Drawing on the discussion of the Islamic tradition above, I would like to revisit each group of questions given in the previous section.

1. *Climate engineering as a humanitarian ideal*—A Muslim might support climate technologies, but Islamic climate ethics urge them to act with *'adl* and *i'tidal*. Therefore, there will always be a need for a comprehensive understanding of reality in climate engineering proposals, which balances both justice and moderation.
2. *Who speaks for nature?*—Although Islam belongs to the Abrahamic tradition, which is known for anthropocentrism, being God's supreme creation and being held responsible for God's creation, human beings should speak for nature as a whole. This is important for assessments of particular climate engineering proposals.
3. *Problems of power and justice*—The idea of shari'a, together with tawhid, requires "doing right," a principle that guides issues of power and justice among human and nonhuman members of nature. Also, the idea of hima, which points toward the intertwining of ethics and nature, might help shape an eco-justice perspective to be used in determining the appropriateness of climate engineering.
4. *Science and spiritual values*—The ontological dimension of Islam, which situates humans in a larger cosmos of diverse ways of knowing, might help investigate and perhaps even combine different kinds of knowledge in ways that would be beneficial for both the scientist and the general audience. Islam has a holistic understanding that is there is no distinction between sacred and profane or between the human world and the natural one. Insofar as climate engineering neglects this holistic understanding, it will be critiqued by an Islamic understanding.
5. *Sustainability and climate engineering*—As can be seen from the hadiths, Prophet Muhammad emphasized sustainability on various occasions. Notably, water sustainability is at stake in an Islamic ethical perspective. Indeed, Islam emerges as

a lifestyle, not "only" a religion. Therefore, a Muslim's integrated codes of behavior might enable or disable some practices of climate engineering. It will be important for the Islamic community to identify what forms of climate engineering will hinder the forms of sustainability emphasized in the hadiths, especially those proposals that affect regional hydrology and water quality.

6. *Compassion and mindfulness*—Considering the hadiths and the principles such as *hima-haram* distinction, Muslims might infer that sympathy for the creation lies at the heart of the philosophy of Islamic law. This idea of compassion aims at the continuation of peaceful conditions for all. Thus, the question that Islam raises for climate engineering projects is whether a project fosters or, conversely, lacks harmony with(in) nature.
7. *Models and metaphors*—Islam is more than ethics, and Muslims still employ models and metaphors to help their framing of reality. Linking the emergence of ecological catastrophe with the desacralization of nature[13] is an example of how the ecological crisis is framed from an Islamic perspective. This perspective offers, therefore, resacralization of the nature based on harmony between *al-'amal* (action) and *al-'ilm* (knowledge). In other words, the Islamic community sees the importance of determining whether a climate engineering proposal is an avenue for the desacralization or resacralization of nature.
8. *Emotion and reflection*—The Islamic statements and declarations prove that an Islamic discourse, like other religious discourses, would potentially appeal feelings for or against climate engineering projects. These appeals to the mind and emotion will not only impact the 1.5 billion Muslims in the world, but the human community more generally. In this respect, what the resacralization of nature might mean for climate change policy should be taken seriously in climate engineering discussions.
9. *Responsibility*—The Qur'an encourages each Muslim to take responsibility. It is evident that the concept of *khalifa*, or steward, places a burden on human species for the climate change policy. This encouragement is an essential aspect of Islamic climate ethics, and provides an important ethical concept for determining how to judge one's involvement in climate engineering research, funding, political support, and implementation.
10. *Religious authority*—Although there is no clergy in Islam, some institutions are governing religious affairs in Muslim societies. There are many examples of collaboration between these institutions and environmental NGOs working to increase Muslim awareness of ecological issues worldwide. These authorities should be part of discussions of climate engineering policy and ethics, and be informed on the subject.

Until now, I tried to portray the relationship between Islam and climate change policy concerning the former's potential role in shaping ontologies, epistemologies, and ethics. However, there is also a risk in the applicability of Islamic climate ethics. The Muslim community is not exempt from the modern monopolization of bits of knowledge, beliefs, and values. For this reason, a quest for Islamic climate ethics is promising; yet, seeking wealth as a sign of success in life also dominates the hegemonic Muslim ontology as a meaningful purpose (Qur'an 62:10). Material realities are still there affecting the human condition.

Following this, I conclude that climate engineering, like other parts of climate change policy, has never been just about scientific knowledge and technology, but also about ontologies and epistemologies. Therefore, a Muslim ontology backed by various ideas including *tawhid, khalifat, 'adl, i'tidal, mizan, et cetera*, can provide balance to a scientific and technologically-focused ontology. Here, the issue is not about any specific religion, but about how religiosity is constructed. A "dark green" religiosity,[14] that is,

a greener understanding of reality and of Homo sapiens' configuration within nature, might, therefore, translate Islam's potential into practice.

1. *Alan Mikhail, Under Osman's Tree: The Ottoman Empire, Egypt, and Environmental History (Chicago: University of Chicago Press, 2017).*
2. *American Meteorological Society (AMS), "Climate Policy (an American Meteorological Society Project)," accessed October 21, 2018, http://www.climatepolicy.org/climatepolicy/index.cfm/the-basics/there-are-many-possiblepolicy-responses/. It is important to note that the boundaries of these dimensions are also fuzzy. For example, there is not a consensus on whether carbon removal technologies should be considered under mitigation or climate engineering. And this fuzziness also proves the importance of the fourth pillar of knowledgebase expansion. Knowledge should be expanded in order to clarify the policy options for public.*
3. *Forrest Clingerman, Kevin J. O'Brien, and Thomas P. Ackerman, "Character and Religion in Climate Engineering," Issues in Science and Technology 34, no. 1 (Fall 2017): 25-28.*
4. *Fazlun M. Khalin "Islam and the Environment," in Encyclopedia of Global Environmental Change, ed. Ted Munn (Chichester, UK: John Wiley & Sons, 2002), 332-339.*
5. *Lynn White Jr, "The Historical Roots of Our Ecologic Crisis," Science 155 (New Series), No. 3767 (March 10, 1967): 1203-1207.*
6. *Martin Palmer with Victoria Finlay, Faith in Conservation: New Approaches to Religions and the Environment (Washington, DC: The World Bank, 2003).*
7. *Bron Taylor (ed), The Encyclopedia of Religion and Nature, two volumes (New York: Continuum, 2005).*
8. *"Islamic Declaration on Climate Change," http://www.ifees.org.uk/wp-content/uploads/2016/10/climate_declarationmMWB.pdf, accessed November 21, 2018.*
9. *Thomas Bruhn, Forrest Clingerman, and Laura Hartman, "God(s) and Greenhouse Gases: Religion and Climate Engineering," Post-Conference Assessment, CEC17, 9-12 October 2017, Berlin, Germany. http://www.researchgate.net/publication/321081051_CEC17_final_report_Gods_and_Geoengineering_conference_session, accessed November 21, 2018.*
10. *S. Parvez Manzoor, "Environment and values: the Islamic Perspective," in Touch of Midas: Science, Values and Environment in Islam and the West, ed. Ziauddin Sardar (Manchester: Manchester University Press, 1984), 155-159.*
11. *Janardan Kumar, "Islam and Ecology," in Ecology and Religion: Ecological Concept in Hinduism, Buddhism, Jainism, Islam, Christianity and Sikhism, eds. Rajdeva Narayan and Janardan Kumar (Ramana, Institute for Socio-legal Studies; New Delhi: Deep & Deep Publications), 147-150.*
12. *Fazlun M. Khalin, "Islam and the Environment," 333.*
13. *Seyyed Hossein Nasr, Religion & the Order of Nature (New York, Oxford, Oxford University Press, 1996).*
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Geoengineering: Playing God—Again!

Author

Kyle Whyte (Potawatomi) teaches philosophy and community sustainability at Michigan State University.

Some geoengineering technologies are poised to make dramatic interventions in the Earth system. Perhaps such interventions will be too dramatic, causing as many problems as they are meant to solve. That is, humans may not know fully what they are doing when they engage in regional- or planetary-scale alterations to the environment. They may be trying to exercise a problematic form of overarching control of nature. The results could be harmful. Hence some critics of different geoengineering technologies argue that some humans may be seeking to ***play god*** with the environment in bad ways. The purpose of this essay is to ***contextualize*** one version of the playing god argument as it relates to my work as a scholar and activist focusing on Indigenous peoples and climate justice.

I have in mind geoengineering technologies that are being assessed as temporary measures to reduce the severity of certain climate change impacts (often categorized as "solar radiation management") or to remove some of the carbon dioxide in the atmosphere ("carbon dioxide removal"). One way of looking at these technological proposals is that they will serve to buy human societies more time to lower emissions of greenhouse gases. Multiple scientific reports, such as the recent U.S. 4th National Climate Assessment, as well as the testimonies from people living in areas sensitive to environmental change, such as coastal areas and Arctic latitudes, express concern that warming trends in the climate system will continue to threaten human well-being. As nation-states and transnational businesses continue to stall in their efforts to agree on how to lower emissions, geoengineering technologies can be deployed to lessen both the risks and the concentration of carbon in the atmosphere.

Perhaps the most god-like of all geoengineering technologies are approaches to solar radiation management (SRM). Stratospheric aerosol injection, for example, seeks to alter the planet's albedo by introducing particulates into the atmosphere. According to modeling studies, the results will induce cooling without a reduction in emissions of greenhouse gases. At the same time, this means that other issues related to the presence of carbon dioxide, such as ocean acidification, are not addressed.

Even though solar radiation management has received the most attention in critiques concerned with human overreach, other geoengineering technologies have god-like attributes too. Ocean fertilization, an approach to carbon dioxide removal (CDR), involves the injection of iron into ocean waters to increase the amount of the gas that oceans remove from the atmosphere. Though perhaps less so, even

technologies like Bioenergy and Carbon Capture and Storage (BECCS) and afforestation can be seen as humans exercising over-arching control given that they can involve massive changes in land-use across entire regions for the sake of removing greenhouse gases.

Are some humans aiming to play god when they investigate the potential to use any of these technologies? Some SRM approaches, for example, will change the climate system directly so as to lessen temporarily the impacts of high concentrations of greenhouse gases in the atmosphere. Some CDR and BECCS approaches aim to amend, to varying degrees, the workings of the carbon cycle. According to one version of the ***playing god*** argument, the idea of humans intervening in the environment at the Earth system scale is akin to exercising extra-natural control. Moreover, some scientists are showing reasons humans ought to be careful about potential risks these technologies generate themselves or fail to address. As discussed in Part I of this report, some of the risks being investigated include increased extreme weather events (SRM), altering ocean ecosystems (CDR), and pollution and biodiversity loss (BECCS).

Playing god touts human arrogance. Playing god is also a failure to admit of human ignorance about the ultimate implications of our species tampering with an Earth system that is still not entirely understood. Furthermore, since people with privileged educational backgrounds, racial identities, levels of political authority, and socioeconomic statuses will likely be those in charge of any large-scale geoengineering projects, it seems that geoengineering threatens to further entrench the power of the financially well-off, socially elite, and politically powerful. In times when many environmentalists are trying to persuade people to be more humble and respectful of the non-human world, the very idea of geoengineering asserts a deplorable belief in the right of humans—even more to the point, ***some*** humans—to control nature.

Yet I want to suggest that people who are concerned about the morality of playing god can be wrong to use such figurative language when they seek to critique certain geoengineering technologies. As I will discuss in more detail, the focus on some technologies as cases where humans play god can occlude certain critical moral issues about geoengineering and climate justice more broadly.

Certainly here I have in mind criticism of some types of SRM. My suggestions also apply to the moral appraisal of other technologies I have referenced earlier, even ones that are more akin to emissions reduction and mitigation, such as BECCS and afforestation. By singling out some technologies as problematic because they supposedly involve humans playing god, critics of different approaches to geoengineering miss a larger and more pressing moral concern about climate justice: ***namely, unchecked forms of playing god have occurred historically and persist today—apart from the potential deployment of any geoengineering technologies***.

A dominant version of the argument of playing god assumes a particular Christian theological underpinning. The theology singles out certain actions as god-like—in the sense of a being who has extra-natural control—in order to interpret whether a certain decision or action is right or wrong or just or unjust. Whether they believe this to be so in actuality or merely rhetorically for the sake of persuasiveness, some advocates of the playing god argument make the case that humans should not ever play the role of overarching controllers of the environment and climate. In the rigid hierarchy of the cosmos, then, humans should be careful to avoid usurping the divine role of Creator, but instead be obedient to their place as stewards.

This theology runs the risk of focusing too much on one type of playing god, which obscures how myriad human decisions and actions in the past and present have already been in the business of playing god, so to speak. These other decisions and actions are pivotal to understanding climate justice, and ought not be obscured in serious discussions and policy-making processes about geoengineering.

The other decisions and actions are central to my argument. In its focus on the human-nature relationship, the playing god critique often neglects the relationship between different human communities. Readers must understand how for centuries, some populations of people—many of whom are of diverse Christian faiths—have played god with the lives of others. Colonialism, slavery, patriarchy,

forced assimilation and the exploitation of wage labor are among some of the examples of dramatically immoral decisions and actions that intervened into the lives of others. These interventions—which significantly altered the environment—literally changed the worlds of those who suffered from suffocating work conditions, serial sexual assault, and complete removal from their homelands, among other violence too numerous to be entirely named here. Of course, the perpetrators of these forms of oppression often expressed that they were committing such violence for the sake of the good of the victims or even by appealing to the will of a supernatural entity, like the God of Abrahamic religious traditions.

Consider the histories and current situations of Indigenous peoples living in North America for centuries. This is a topic I have specialized in pertaining to environmental justice issues that Indigenous peoples face in this region. Colonialism in North America stripped Indigenous peoples of nearly all of their recognized land tenure. Land dispossession continues today through activities such as the building of the Dakota Access Pipeline, which threatens the water quality and cultural integrity of nearby Indigenous peoples, including the Standing Rock Sioux Tribe. In the 19th century, settler Americans claimed that it was right for them to alter Indigenous peoples' lands, transforming the lands into private property, and forcing Native persons to become farmers. Thomas Morgan, a U.S. Commissioner of Indian Affairs, wrote at the time that

> The Indians must conform to the "white man's ways" peaceably if they will, forcibly if they must. They must adjust themselves to their environment, and conform their mode of living substantially to our civilization. This civilization may not be the best possible but it is the best the Indians can get.[1]

The period Morgan writes about involved the U.S. advocating for the break-up of Indian reservations into private property. This process not only divested Indigenous peoples of some 90 million acres of land, but permanently transformed the landscape for farming, mining or non-occupancy. "Friends of the Indian," which referred often to faith-based groups that sought to support Indigenous rights, were among the biggest advocates of allotment because they saw it as an opportunity to dismantle Indigenous extended family networks. In one study, scholar Rose Stremlau documents how Indian "reformers" at the time, such as Merrill E. Gates, made arguments on religious grounds about the nuclear family. "The family is God's unit of society. On the integrity of the family depends that of the state."[2] Such views back dramatic interventions that dismantled Indigenous families and established norms of patriarchy.

Even American environmentalist John Muir argued that, as scholar Michael Johnson documents, Indigenous peoples in North America are "most ugly, and some of them altogether hideous." In relation to Yosemite, "they seemed to have no right place in the landscape, and I was glad to see them fading out of sight down the pass." As Johnson's work shows, a major part of Muir's legacy was to ensure that Indigenous peoples displaced for parks like Yosemite never returned to their homelands. Ironically, Indigenous practices, such as systematic burning, that played a huge role in shaping the beauty that people like Muir so admired were officially banned or were simply stopped from occurring further.[3]

In each of these examples, settler colonial populations played god with Indigenous peoples. They dispossessed them of their lands, degraded ecosystems that had been cultivated for productivity for centuries, intervened in their family and sexual lives, committed child abuse, and subverted more gender fluid and egalitarian family systems with patriarchal ones. They did so by drastically altering the ecological conditions in North America, from deforestation, to changing soil types and hydrological systems, to building massive urban centers. These alterations are not unlike climate change since deforestation and urbanization affect temperature, among other climate-related dimensions of ecosystems. Of course, when we fast forward to today, the industrial and capital-intensive landscape in North American countries like the U.S. is known through science to contribute to the warming trend. Scholar Megan Bang calls colonialism a "climatic move."[4]

Scholar David Martinez argues that "Indians typically regarded the European invasion of Indian Country

as a force of nature, comparable to famine, plague, and natural disasters. As such, it was not something one could reason with, but rather something that one had to accept as a given in order to begin figuring out how to survive in the aftermath".[5] Indigenous peoples, then, for centuries already have experienced foreign groups of people exercising drastic, over-arching control over the environment. It is ironic, as scholars Heather Davis and Zoe Todd point out, that "the Anthropocene or at least all of the anxiety produced around these realities for those in Euro-Western contexts—is really the arrival of the reverberations of that seismic shockwave into the nations who introduced colonial, capitalist processes across the globe in the first half-millennium in the first place."[6]

Beyond its specific geological definition, the term ***Anthropocene*** is used to convey a time in which the industrial, capitalist, and colonialist activities of some human societies have environmental impacts at the planetary scale. In their critical study of how the term is used, Davis and Todd see a harmful irony. The descendants of those who began playing god in the lives of others generations ago are now facing the consequences of the actions that their ancestors started. For the current climate change crisis is produced by the extractive industries, consumer lifestyles, and land-use changes for the sake of which colonialism dispossessed Indigenous peoples in countries like the U.S.

Some geoengineering technologies are a response from dominant members of the world, who are trying to address a crisis that their ancestors created and that current generations have failed to halt. They are seeing the world their ancestors created—a world rife with inequalities and injustice for groups such as Indigenous peoples—become threatened by the combined effects of their interventions into environmental and climatic systems. Whether in North America or globally, numerous United Nations reports, firsthand testimonies and research attest to how Indigenous peoples still face violence against their lands and bodies for the sake of other peoples' desires for economic, social and political control. Moreover, Indigenous peoples are among the populations who are facing some of the most immediate harmful climate change impacts, such as the effects of sea-level rise and extreme drought.

It is ironic that some people might feel that different geoengineering technologies could be ***outrageous*** or ***unique*** attempts to play god. For the world we live in is one deeply shaped by some groups playing god in the lives of others through making interventions into environmental and climatic systems, as I have just discussed. SRM, CDR, and BECCS are potentially just more specific and contemporary cases of interventions by people who have been playing god all along, continuing what their ancestors started generations ago. While I have primarily referred to Indigenous peoples in North America, and specifically in relation to the U.S., I am not surprised when my conversations with Indigenous persons globally suggest they have gone through hauntingly similar experiences in relation to industrialization, capitalism, and colonialism.

As a speculation, I think that many religious communities should be concerned with the points I am making here. I think religious persons who are white, wealthy, and live in North Atlantic countries—for example—may jump to the argument that some geoengineering is wrongful because the deployment of particular technologies is akin to playing god. Yet perhaps they will make this argument at the expense of ignoring their communities' historic and contemporary complicity in problems such as the domination of Indigenous peoples. That is, they will ignore how morally righteous arguments appealing to the power of a god have been used to justify, minimize, and hide violence. I think persons in these social, economic, and political categories need to reflect carefully on their theological assumptions.

When some people emphasize how geoengineering is wrongfully about playing god with the planet, they run the risk of obscuring history and the current state of affairs. Indeed, the suspension of warming (SRM) or the removal of carbon (CDR, BECCS) will not stop the construction of fossil fuel pipelines, the expansion of consumer economies, and growth of recreation that continue to threaten the ecosystems that matter to many Indigenous peoples. The emergency of climate change as a rhetorical tool, then, seeks to cover up work that still needs to be done in order to render equity and justice for Indigenous peoples.

I am not, in this essay, taking a position for or against any particular geoengineering technology. Rather, my intent is to highlight that those who critique some geoengineering technologies as involving humans playing god run the risk of ignoring a key focus. The problem is not that a technology like some SRM applications is a stopgap measure requiring a disturbing degree of human control over nature. The problem is that there are still so many people today who do not want to accept just how many times, leading up to the present, that humans have played god violently against other humans, non-humans, and ecosystems.

A particular geoengineering technology is neither good or bad ***because*** of how it involves playing god. People who hold a version of the playing god argument similar to what I described need to criticize how playing god persists today globally in ways that disadvantage groups such as Indigenous peoples, from the building of the Dakota Access Pipeline to violations of free, prior, and informed consent against Indigenous peoples that are reported to occur in relation to climate change solutions, including hydropower, nuclear energy, and forest conservation. I hope to see more moral arguments about geoengineering take up complex historical and contemporary accounts of climate justice that center the issues I have shared here.

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A Buddhist Perspective on Climate Engineering

Author

Ven. Bhikkhu Vivekānanda teaches insight meditation at Panditārāma Lumbini, Nepal and also internationally.

Normative Buddhist Concepts on Environmental Conservation

In Buddhism the four *Brahma-vihāras* and the Five Precepts (*pañca-sīla*) are particularly influential in defining our attitude towards the natural world. The Brahma-vihāras are referred to as the "Divine Abidings" and consist of loving kindness (mettā), compassion (karuṇā), sympathetic joy (*muditā*) and equanimity (*upekkhā*), which encourage the protection of all sentient beings and ensure their well-being. These are extended by the Five Precepts. The Five Precepts are:

1. Abandoning the taking of life one dwells refraining from taking life, without stick or sword, conscientious, compassionate, trembling for the welfare of all living beings.[1]
2. Having abandoned the taking of what is not given, he abstains from taking what is not given. He does not steal the wealth and property of others in the village or in the forest.[2]
3. One undertakes to observe the precept to refrain from sexual misconduct.[3]
4. Abandoning false speech, one abstains from false speech; one speaks truth, adheres to truth, is trustworthy and reliable, and is not a deceiver of the world.[4]
5. One undertakes the precept of refraining from intoxicants that cause heedlessness.[5]

Among the Five Precepts, three in particular are relevant to attitudes and actions toward the natural world. We can apply these three to discussions of climate engineering.

The first precept (*pāṇātipāta veramaṇī*) calls for the abandoning of the destruction of life and the abstaining from killing living beings. It encourages us to abide in compassion toward all living beings.[6] Underlying this precept is the Buddhist ethical principle of non-harming (*ahiṃsā*), which includes a sense of deep respect for living beings, sometimes expressed as "respect for life" or "the sanctity of life."

In India, ahiṃsā seems to have been emphasized most among the unorthodox renouncer (*sāmaṇa*) movements, such as Buddhism and Jainism. These movements emphasize concern (*dayā*) and sympathy (*anukampā*) for living creatures, and an increasing empathy with them based on the awareness that others dislike pain and death just as much as oneself.[7] As the Dhammapada, one of Buddhism's

pertinent scriptures, notes, "All tremble at violence, all fear death. Comparing oneself with others one should neither kill nor cause to kill."8

As a result of its association with *ahiṃsā*, Buddhism is generally perceived as non-violent and peace-loving. While Buddhist countries have not been free from war and conflict, Buddhist teachings constantly praise non-violence and express disapproval of killing or causing injury to living things. Again, in the words of the *Dhammapada*, "He who has renounced violence towards all living beings, weak or strong, who neither kills nor causes others to kill—him do I call a holy man."9

Though ecology and animal rights are unlikely to have been a distinct topic in the philosophical agenda of the ancients,10 under the influence of *ahiṃsā*, rules and practices have developed which concretely aim at avoiding damaging animals and even plants. Regarding plants, for example, well before the Buddha's time there was a custom in India that wanderers would stay in place for the rainy season, both to avoid having to negotiate muddy roads and to avoid trampling plants. *Bhikkhus* (ordained Buddhist monastics) in the early years of the Buddha's teaching career were criticized by the Jains for not observing this custom, so the Buddha gave his permission for them to stop wandering for three months of the Rains ("I allow that you enter for the rains"[11]). Later he imposed a penalty for not observing this custom.[12]

Regarding animals, concrete rules and principles also have emerged. For example, animal sacrifice, which had played an important part in Brahmanical religious rites in India from ancient times, was rejected by Buddhism as cruel. The Buddha was very critical of animal sacrifices as part of rituals.[13] The Indian emperor Ashoka (268-239 BCE) banned animal sacrifices (at least in his capital city), gave up hunting for sport, and prohibited the castration or branding of animals on various holy days due to his conversion to Buddhism. He also completely banned the killing of young goats, lambs, and pigs, as well as their mothers while still providing milk for them.14 Due in part to the influence of Buddhism, blood sacrifices in the orthodox Brahmanical tradition came increasingly to be replaced by symbolic offerings such as vegetables, fruits and milk. Many Buddhists—especially followers of the *Mahāyāna* tradition in East Asia—have embraced vegetarianism, as this diet does not involve the slaughter of animals.[15]

In light of the principle of ahiṃsā, some forms of climate engineering raise questions of whether they are a modern case of potential violence (*hiṃsā*) towards nature. For instance, beginning in the early 1990s thirteen ocean iron fertilization projects were carried out in the open ocean with varying results. Researchers concluded that ocean fertilization would alter the productivity of large regions of the ocean and since plankton forms the base of the marine food chain, significant side effects on marine ecosystems could be expected.[16] The World Wildlife Fund pointed out that this could damage many species of fish, turtles, penguins, marine iguanas, and corals.[17]

The second precept (*adinnādānā veramaṇī*) encourages abstaining from taking what is not given, and cultivating honesty. This includes abstention from fraudulence, breach of trust, embezzlement of funds and public goods such as trees, or possibly a healthy environment. Similarly, the second among the training rules for *bhikkhus* (Buddhist monks) requiring expulsion states: "Should any *bhikkhu* in the manner of stealing, take what is not given from an inhabited area or from the wilderness…he is defeated and no longer in communion," i.e. he is no longer considered a *bhikkhu*.[18]

In relation to nature, the second precept means that out of gratitude for the bounty of resources nature provides us, we should protect and care for nature. An adage states: "If one were to sleep or sit under the shade of a tree, one may not break the branches of that tree. If one does so, one is an evil, false friend." H.H. Dalai Lama leaves no doubt about our responsibility to take action to protect the future of our planet and ensure the survival of human kind: "The key thing is the sense of universal responsibility; that is the real source of strength, the real source of happiness. If our generation exploits everything available—the trees, the water, and the minerals—without any care for the coming generations or the future, then we are at fault, aren't we?"[19] The responsibility of care and protection is important when determining the permissibility of climate engineering.

Finally, the fourth precept (*musāvādā veramaṇī*) calls for the abandoning of false speech, an ethical injunction that encourages the adherence to truth, transparency, and making scientific research available to the public. False speech is not only disruptive to social cohesion but it also creates an illusion. Vital decisions concerning the research of climate change and the potential deployment of climate engineering measures have to be based on reality, not on some fiction.

Karma in an Environmental Context

In Buddhism, the fundamental law of cause and effect is termed *"kamma and vipāka."* In essence it states that wholesome deeds by body, speech, and mind bring about wholesome results, while unwholesome deeds lead to unwholesome results. The Buddha emphasizes very clearly that the state of mind determines the quality of our actions, and consequently the results.

By identifying the mind as the origin of suffering or joy, the concept of *kamma* is deeply linked to the other Buddhist teachings and concepts. Grounding one's thoughts, words, and actions on a realization of interrelatedness, as well as trying to act out non-violence or respect for life (*ahiṃsā*) and the Divine Abidings of loving kindness (*mettā*), compassion (karuṇā), sympathetic joy (*muditā*), and equanimity (*upekkhā*), creates joy rather than suffering. Thus for a Buddhist interpretation, it is not only important what forms of environmental action are taken (e.g., actions towards emissions reduction, adaptation, or climate engineering in response to climate change), it is also crucial to consider the motivation and mindset of those deciding on and carrying out the actions.[20]

As discussed in the overview found in the first part of this report, climate engineering is the deliberate, large-scale, and technology-based intervention in the Earth's climate system, focused on lessening the adverse effects of anthropogenic global warming. Climate engineering comprises measures that mainly fall into two categories: greenhouse gas removal and solar radiation management. Greenhouse gas removal (carbon dioxide removal proposals represent the most prominent subcategory here) addresses the cause of global warming by removing greenhouse gases from the atmosphere. Solar radiation management attempts to offset effects of greenhouse gases by causing the Earth to absorb less solar radiation.

There are many possible states of mind and motivations for undertaking the research, testing, and implementation of climate engineering. Climate engineering measures might be taken unilaterally with a profit-oriented motivation or for military purposes with little consideration for the impact on the environment, the general population, and other countries. In contrast, measures might be taken in support of a stable climate, with great care, respecting ethical norms such as the sanctity of life, in line with international conventions, approved by the international community, based on scientific research, and carefully monitoring the effects. As climate engineering measures may have a substantial impact on the Earth system, they should be undertaken fully understanding cause and effect.

Application of Buddhist Principles to How Humanity Relates to the Environment Through Climate Engineering

The Buddha's teachings offer tools to individuals for an objective investigation of the factors that drive his or her actions within these processes at the individual level. Particularly, meditation practices allow people to better comprehend and redirect the motivations and drivers that influence their observations, interpretations, and decision-making. In general, Buddhism emphasizes the transformation of the individual as the starting point for change at the collective level.[21]

This emphasis on individual transformation provides a framework for considering how to approach climate engineering. For example, the first precept—to abandon the taking of life and to be conscientious of the welfare of all living beings—strongly suggests that climate engineering technologies

must not be developed for military or violent purposes. The first precept also implies that a potential application of climate engineering techniques, even if done in "self-defense" against those who continue to emit greenhouse gases, should only be carried out under the condition that one has absolutely no intent to harm others. This does not provide a principle of absolute opposition to the implementation of climate engineering, but sets an additional, very high hurdle for its implementation.[22]

Furthermore, the five precepts, the respect for life, and the four qualities of loving kindness, compassion, sympathetic joy, and equanimity are universal in nature. Human beings are seen as being a part of nature. Hence, our relationships across societies should be one of equality, free of discrimination, where developing societies are as important as wealthy societies.

In order to respect fundamental equality, any form of climate engineering research or deployment should not be imposed by some against the will of others and should not be to the disadvantage of developing nations. This sets a further, nearly insurmountable hurdle if taken literally, but when interpreted more broadly in the context of the global society, any kind of climate engineering research or deployment that possibly affects others should be legitimized through some form of common governance structure (e.g. the United Nations) and not unilaterally. Within this structure, states and other possible relevant entities representing people should be able to jointly assess and mutually determine which effects of climate engineering measures they potentially deem acceptable. This would include, ***inter alia***, the political, economic, ethical and legal evaluations of specific climate engineering actions and the weighing of their potential effects against other values, ethical concerns, objectives, and even legal requirements. Given the largely unclear costs, risks, and impacts of climate engineering techniques and research, weighing values, concerns, objectives, and legal requirements and ultimately reaching decisions will likely be very challenging. In order to ensure that Buddhist ethics are applied, this process would need to be carried out carefully and with the mindsets discussed above (i.e. with considerations such as compassion, loving kindness, and precaution).[23]

One may argue that emissions reduction strategies outrank climate engineering measures since they primarily aim at limiting, eliminating, or reversing the actions that lead to the unwanted effects. Similarly, adaptation strategies help to make the negative consequences of climate change more bearable, without imposing new, potentially harmful effects on the environment on a large scale. Furthermore, within the group of climate engineering measures, based on these principles, one would generally prioritize carbon removal techniques, which are largely targeted at reversing the chain of damage causes by carbon dioxide emissions by removing it from the atmosphere. A lower priority would be placed on solar radiation management techniques, which introduce further perturbations to the environment (e.g., modifying aerosol particle layers and clouds) in exchange for reducing other existing perturbations (e.g., increased temperatures). However, this is not completely unambiguous: especially biomass-based carbon dioxide removal techniques can also be seen as causing perturbations to ecosystems in exchange for the removal of carbon dioxide from the atmosphere. Nevertheless, carbon dioxide removal techniques are generally focused closer to the cause end in the chain of cause and effect, and thus will likely generally be favored over solar radiation management techniques in future detailed analyses based on Buddhist ethics on a case-by-case basis. It is interesting to note that favoring carbon dioxide removal over solar radiation management reflects the current general tenor of the international discourse of climate engineering.[24]

One of the most commonly discussed forms of solar radiation management is stratospheric aerosol injection. While stratospheric aerosol injection and related measures have the potential to avert "climate emergencies," or to serve as a stopgap measure to buy time for effective emissions mitigation responses, they also pose serious risks. Stratospheric aerosol injection involves increasing the amount of aerosol particles in the lower stratosphere (at altitudes above about 20 km) as a means to increase the reflection of sunlight beyond what is reflected by the naturally occurring stratospheric aerosol layer. Particles could either be injected directly or formed via injection of precursor gases such as sulfur dioxide (SO2), which are then converted into particles.[25] Many commentators have focused on

intergenerational risks, such as changes in precipitation patterns, or increases in sulphur dioxide loads in the troposphere. Future generations have the right to be passed on a healthy environment. However, solar radiation management approaches like this may also pose grave threats to future generations should their use ultimately cease without concomitant reductions in greenhouse emissions, termed the so-called "rebound effect." This would amount to depriving future generations of a healthy environment, which would be in violation of the second Buddhist precept as well as the international legal principle of intergenerational equity.[26]

With a view to the institutional and procedural aspect of governing climate engineering, the fourth precept, i.e. abandoning false speech, suggests increasing transparency, providing opportunities to participate and making available information to those potentially affected throughout all stages of all related activities. The realization of this precept could be furthered, for example, by promoting publicly available scientific research.[27]

The cultivation of the mind may lead to the realization that the consumption of consumer goods or energy ultimately does not lead to inner happiness. When true inner happiness arises fewness of desires (*appichatā*) and contentment (*santutthi*) follow naturally. The development of contentment may contribute to a reduction in consumption of material, consumer goods, and also energy generation.

In summary, Buddhist teachings are setting high hurdles for the research and deployment of climate engineering measures and instead advocate changes in human behavior towards the environment and changes of lifestyle.

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25. *Schäfer et al., EuTRACE, 41.*
26. *William Burns, "Solar Radiation Management and Intergenerational Equity," accessed November 22, 2018, https://www.spp-climate-engineering.de/files/ce-projekt/media/download_PDFs/CERSYM%20PresentationTeil8.pdf.*
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Good God! Care, Reverence and the Ethics of Climate Engineering

Author

Duncan McLaren is a Research Fellow at Lancaster University with interests in ethics, geoengineering and climate policy.

Introduction

Tackling climate change through emissions reduction alone would require radical action. Leading climate scientist Kevin Anderson has suggested that we could cut global emissions by one third in just a few years by limiting the emissions of the richest 10% to the European average.[1] Alternatively, tough regulation of the 100 companies responsible for over 70 percent of global emissions might also put emissions on a rapid downward track.[2] Modelling studies, however, suggest that strong mitigation efforts—even combined with dramatic behavioral shifts in diet and transportation, to slash consumption of meat and air travel—would still need to be supplemented with carbon removal from the atmosphere to deliver the Paris goal of keeping the average global temperature increase to no more than 1.5°C.[3] Moreover, international corporate regulation, radical redistribution of consumption, and wholesale behavioral change are all typically deemed to be practically or politically infeasible in a climate discourse which struggles to get existing powerful actors to take action.[4] How such a judgment of feasibility is drawn, and by whom, is a deeply ethical question, which I have explored elsewhere.[5] But it has significant implications for climate geoengineering.

For many commentators, the apparent impracticability of avoiding dangerous climate change exclusively through emissions reduction ("mitigation") suggests a case for researching and perhaps deploying climate geoengineering. They argue that, not only is serious climate harm unavoidable by other means, but these harms will impact poorer groups in human society most severely and cause huge damage to the natural world and other species. Sadly, even if it is not already physically impossible to avert dangerous climate change through mitigation alone, the chance of doing so falls lower with every further year of delay. Consequently, in this line of thinking, mastering and deploying climate geoengineering may amount to an ethical or moral duty. In this essay, I start from the assumption that some climate engineering (at least in the form of large-scale carbon removal) is likely to prove necessary—as an addition to emissions reduction—in response to increasing climate harm, and that it could reduce that harm. In treating climate geoengineering as a supplement to mitigation, I also set aside for the purposes of this discussion, the (potentially serious) concern that consideration of geoengineering might, of itself, encourage further delay, or otherwise deter mitigation.[6]

Playing God?

Some leading advocates of research into solar geoengineering have offered an ethical case based on the arguments set out in the preceding paragraph.[7] Others have argued that in the longer term and in the face of natural climatic cycles—should we survive that long—humanity will inevitably need to use climate geoengineering to avert an ice-age.[8] One common theme that links such advocacy for climate geoengineering research is a sense that humans have obtained god-like powers to impact Earth systems, and we should learn how to use these powers responsibly. To paraphrase ecomodernists such as Stewart Brand,[9] Mark Lynas,[10] and Erle Ellis,[11] "humans have become as gods, we ought to learn to do it well." Human impacts are, unintentionally but dramatically, changing the planet, and being written into the geological record—creating an "Anthropocene" era, and authors like Grinspoon and Ellis argue that we now need to learn to intervene responsibly and intentionally to repair those harms.[12] We should not "*play* God," perhaps, but rather become serious and competent "planetary stewards."

Others counter that there is the hubris implied in such a view of humans as planetary controllers (whether as gods or stewards). Carr notes the powerful influence of religious views on the framing of, and responses to climate geoengineering, noting that injunctions against interfering in "God's stuff" are widespread in global religious traditions.[13] And for some critics of climate geoengineering, the ethical or religious idea that humans should refrain from seeking god-like powers would seem to suggest that even research into climate engineering might be irresponsible in principle.[14]

Such values would also seem to sit behind some civic society campaigns inspired by deep ecology, such as the "Hands off Mother Earth" campaign launched by the ETC group (also known as the Action Group on Erosion, Technology and Concentration).[15] This example would appear to directly invoke ideas of the Greek earth-goddess Gaia—the name adopted by renowned environmental scientist, James Lovelock, for his hypothesis that earth systems were integrated, powerful, evolving and goal-oriented[16]—underlining the sacred nature of nature. Other critics of climate geoengineering also invoke Gaia. For ethicist Clive Hamilton, humankind's failure to love and revere nature in our technological "enlightenment" has left us bereft of God, whom "once we could both fear and love," and dependent instead on a defiant Gaia, whom we can only fear. Confronting this form of Gaia, we face not utopia but catastrophe.[17] His critique of our "wilful neglect" of the Earth hints at care as a foundation for a "new orientation" to the Earth (acknowledging our embedded and entangled state), but he falls short of bringing it center stage. Hamilton instead bewails our failure—as the uniquely free-willed human agents of his "new anthropocentrism"—to take a somewhat paternalistic "responsibility for the Earth."

In his language of "wilful neglect" and "lack of responsibility," Hamilton is still more conciliatory than activist deep ecologists, such as the members of ETC, who see geoengineering as a deliberate strategy to avoid responsibility: a "high-risk technofix" that benefits "current polluters, extractive industries and the military-security complex."[18] But such groups also seek reverence as a response to nature; ETC argues that "Mother Earth is our common home, and its integrity must not be violated by geoengineering experimentation or deployment."[19]

Reverence for Nature

Regardless of their differences, however, all sides in this debate appear to invoke some form of reverence for nature. Publics—religious and secular alike—appear to agree that "messing with nature" is not only ethically a bad idea, but also a risky business in terms of human wellbeing.[20] Deep ecologists find ultimate meaning and transformative power in nature[21] and treat it as sacred, and untouchable.[22]

The ETC group and its co-signatories of the Manifesto against Geoengineering, call for action to defend:

> ...ecosystems and all life from geoengineering technologies and practices that violate the natural laws, creative principles and the Territorial Integrity of Mother Earth and Father Sky.[23]

Terms such as "violate" and "integrity" emphasize the reverence such activists offer to nature. Yet eco-modernists also invoke forms of reverence. They describe their proposed interventions as necessary to protect "critical," "beloved," "mysterious" and even "magical" nature in a context where climate engineering is inevitable.[24] For example, David Keith, one of the foremost physical scientists in climate engineering research, concludes his book *A Case for Climate Engineering thus*:

> It's my hope that deliberate management of climate change—including geoengineering—can be the beginning of a renewed commitment to build a thriving civilization that honors its intimate connection to the natural world.[25]

We see his reverence for nature in comments such as:

> "Wilderness has shaped my life..."[26]

> "For me the utilitarian benefits of nature are a grossly insufficient measure of its value."[27]

> "I am transfixed as I look straight down ... onto a scalloped face of rock and snow ... Views are made magical by the cloud's teasing, as with clothing that half-reveals the body underneath."[28]

Erle Ellis, a leading self-described ecomodernist, says, similarly:

> Protection and connection at the planetary scales needed to sustain wild creatures and wild spaces through the Anthropocene will not succeed without connecting deeply with the abiding human love and concern for wild nature.[29]

And David Grinspoon, best known as a planetary scientist and writer, argues explicitly in his book Earth in Human Hands, that:

> An appreciation of wildness as something we need, and do not fully comprehend, can also encourage humility, restraint, gratitude, respect, and wonder at the world. These are values we will need to cultivate ... Respect and reverence for the integrity and mystery of wild nature remind us that our innovation must be tempered with caution.[30]

For advocates of climate geoengineering research, therefore, reverence for nature can be both motivation and caveat: protecting the Earth and its biodiversity is a reason for climate engineering, and an important condition in determining how such an exercise is carried out. For their critics, reverence for nature rather argues against interventions in Earth systems, and instead for interventions in human behavior, economics, and politics. Even if it were possible to do climate geoengineering "well," this would still constitute a denaturing (and violation) of the Earth, turning it into a human artifact.[31]

It would be easy to critique this case against intervention from a scientific stance, noting the impossibility of ecologically separating humans from nature in the Anthropocene, and indeed such arguments are mobilized by climate geoengineering advocates. On the other hand, it is also easy to be suspicious of the "have our cake and eat it" stance of ecomodernists who might seem to be only instrumentally adopting reverence for nature as a means to sustain their boosterish fantasies of humans in the planetary control room. Nonetheless, for the individuals concerned, their reverence might be just as real as that of the deep ecologists they argue against on other counts.

Reverence, or Care?

Here I do not aim to adjudicate between these groups, but rather want to argue that the underlying stance of reverence should be questioned and unpacked (and to suggest that both scientific and ethical resources might help us to do so constructively). I believe that to treat nature appropriately in the Anthropocene means simultaneously recognizing that humans and nature are inextricably entangled, and that nature is not an object (to be revered or not), but an active and powerful agent or subject.

Moreover, it is an active subject that is being gravely harmed and destabilized by human activity. This implies—in many ethical and religious approaches—a normative obligation or duty to act to reverse that harm. It also reminds us that to "play God" in this context is not a matter of taking control, in the model of the omnipotent, interventionist God of early monotheism. However, neither does this context demand the basically "hands-off" God of a deistic religion, although such a "setter-in-motion" of human agency—mistakes and all, may be a more helpful starting point.

"Playing God" in the Anthropocene would appear to demand a process of collaboration, not only across divided human societies, but also between humans and non-human agents in ecological and earth systems. Genuine collaboration cannot be rooted in an asymmetric relationship where one party uncritically reveres the other, but nonetheless needs a deep ethical foundation. I suggest that this foundation can be found in accounts of "care," particularly those from a feminist perspective.[32] I argue that genuine care in this context demands respect and recognition, but not reverence—it means getting our hands dirty. Reverence distances, where care connects. As Victoria Held argues, the ethics of care "characteristically sees persons as relational and interdependent,"[33] and that care is both a value and a practice, whether in mothering, nursing or in citizenship. Moreover, care demands not only the ongoing maintenance and repair of our world[34]; but also defined interventions that restore the (relational) autonomy and agency of the cared for.[35]

In these respects, ecomodernist arguments for climate geoengineering fail on both counts. First they envision a paternalist, controlling "god" rooted in a modernist administrative social imaginary (in which interventions can be justified, delivered, monitored and modulated by objective technocrats somehow outside of social and political debate).[36] These visions are communicated in an objectivist register that largely denies any potential for the social construction of either the objects or techniques of geoengineering. But both the definition and reality of nature, and of technologies are in part at least, social constructs. Thus it is a mistake to reify a "pure nature" in an objective "scientific world" as an object of reverence, rather than to recognize a "nature" of multiple engagements, attachments and interests for diverse humanity. But nor are the deep ecology arguments convincing in this light. They might seek to resist paternalist god-playing, but they tend to avoid recognizing other alternatives; and while acknowledging our entanglement in the natural world, they essentialize it as sacred. By distancing humans from nature, neither gives us good guidance as to the appropriate response to our broken world.

Care, on the other hand, does. If care is understood—*inter alia*—as an ongoing maintenance of the world, the quest is not dependency, but autonomy and agency for the subject of care. So "doing climate geoengineering well" in this context probably means taking the controls only for as long as it takes to brake the current headlong rush off a climate precipice, and then seek to (re)enable the capacity of Earth-systems (Gaia) to self-regulate, however long that takes.[37] Humans might remain a feedback mechanism in those systems, but as embedded and entangled relational agents, not autonomous controllers. In other words, our ethical duty of repair is one of care for the non-human agents of earth-systems and ecosystems, one which enables their capabilities rather than dominating them. Such a view can be compatible with religiously-founded approaches to the ethics of human-environment relations. In *Laudato Si'*, Pope Francis makes a case for reverence for God's creation, but also advocates a duty of care which emphasizes the maintenance demanded by the biblical injunction to "keep and till" the Earth and criticizes the excess to which humans have exploited the earth. He also explicitly links the case for caring for nature with the practice of respectful caring relations with other people.[38]

I've argued elsewhere that a care-based perspective might change not only our motivations, but also the design of our interventions.[39] Care clearly implies new efforts to prevent the self-harm implicit in high-consuming lifestyles that damage human health and life through environmental degradation, to find just transitions for high-emissions industries, and to develop collective and fair approaches to emissions reduction and adaptation, rather than relying primarily on market mechanisms. But it does not necessarily reject climate geoengineering, not even solar radiation management. What it does

reject is top-down, technocratic, paternalist interventions. These are not limited to geoengineering, but can be found amongst all forms of climate response—from population reduction or relocation, to nuclear power and global stratospheric aerosol injection. Instead care calls for messy engagement with people everywhere, seeking responses that repair not only the climate, but also the relationships between planetary North and South, rich and poor; and between humans and their environments. Such responses would treat behaviour change as a product of political agency, rather than an instrumental market nudge. They would bring redistribution of wealth and power centrally into the debate. But they would not exclude forms of carbon removal that support climate justice, and might even include some forms of solar geoengineering to deal with temporary temperature overshoot.[40]

Like the care provided by nurses for the gravely ill or wounded, the sort of care involved in climate restoration is more deeply founded in respect and recognition for the subject than in reverence. It's less spiritual than it is material—like cleaning excrement, or changing pus-soaked bandages on a cantankerous, senile parent.[41] It also embodies the difference between worshipping from afar, and loving close up. Close up the object of our devotion becomes a subject, with their own will and aspirations—demanding of recognition as a full moral equal, yet still legitimately open to caring criticism. Many of us have experienced the challenges of loving and caring for a partner or a parent through thick and thin, illness and health. And more so than with any partner or even parent, our entanglement with, and attachment to the Earth is not one we choose, nor one we can abjure. As Held reminds us, attachments of care are not necessarily chosen, yet are moral obligations all the same.[42] Such a relationship with nature therefore extends to managed nature too—not just to wild nature, with respect and recognition again the key words in the practical and material engagements needed.

And such obligations rest on all of us, if more heavily on those who are more responsible for, or have benefited most from the causes of climate change. Yet this raises further questions, especially if we look to the aerospace industry to deliver some short-term solar geoengineering to temper the worst effects of climate change, or fossil fuel industries to help with carbon removal, for example; or even to farmers and foresters to drawdown carbon, rather than release it. This suggests challenges in the ethics of governance and decision making, but also commends the importance of a further form of care as repair and healing, in reconciliation and forgiveness.[43]

Conclusions

In conclusion, I've argued for a more embodied understanding of reverence, one which draws heavily on lessons from care ethics, which recognizes its object as a subject with agency and aims of its own, which gets its hands dirty in the material processes of repair and healing, which engages collaboratively with its subject as means of re-establishing the subject's own agency and autonomy, one which is a moral obligation arising from our physical entanglement with the planet on which we live, and one that extends to reconciliation and repair of our relationships with fellow humans and the planet.

I began by noting the political infeasibility of radical mitigation proposals. And here I have offered responses to the climate conundrum that probably appear equally—if not more—politically impractical. Yet the responses I advocate share with radical mitigation a reliance on the ability of humans to connect with one another, and with "god's stuff"—the natural world around us, rather than a reliance on abstract science or technology. Scholars of theology and practitioners of faith may have much to offer here alongside scientists and engineers. They have long experience of working with the politically impractical, and of defending and reconstituting normative imperatives in the face of the compromises and challenges of modern life. Religious communities and traditions also have much to teach us on care and connection—with learning from both successes and failures in connecting with other humans and the natural world. Here the contrasts between different spiritual and religious traditions could be particularly instructive insofar as they have challenged or legitimised practices such as industrialisation and consumerism. With reflexive analysis—such as that offered by Pope Francis in *Laudato Si'*—there

could be real opportunities for people of faith to combine their religious traditions with modern scientific learning to establish a new caring relationship with nature rooted in recognition, respect and repair.

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9. *Stewart Brand, "We are as Gods," Whole Earth Catalog (Fall 1968), accessed November 23, 2018, http://www.wholeearth.com/issue/1010/article/195/we.are.as.gods.*
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11. *Erle Ellis, "The planet of no return," Breakthrough Journal, Winter 2012, https://thebreakthrough.org/index.php/journal/past-issues/issue-2/the-planet-of-no-return#foot29*
12. *See Grinspoon, Earth in Human Hands; Ellis, "Planet of No Return."*
13. *Willie Carr, "'This is God's Stuff We're Messing With': Geoengineering as a Religious Issue," in Geoengineering Our Climate: Ethics, Politics and Governance, ed. Jason J. Blackstock and S. Low (London: Earthscan/Routledge, 2018).*
14. *Clive Hamilton, Defiant Earth: the Fate of Humans in the Anthropocene (Cambridge: Polity Press, 2017); Mike Hulme, Can Science Fix Climate Change: A Case Against Climate Engineering (Cambridge: Polity Press, 2014).*
15. *ETC Group, Manifesto against geoengineering, 2018, Online at: http://www.etcgroup.org/sites/www.etcgroup.org/files/files/home_manifesto_english_.pdfHOME*
16. *James Lovelock, Gaia: A New Look at Life on Earth (Oxford: Oxford University Press, 1979).*
17. *Hamilton, Defiant Earth.*
18. *ETC Group, "Hands Off Mother Earth!" October 4, 2018, http://www.etcgroup.org/content/hands-mother-earth-1*
19. *Ibid.*
20. *Adam Corner, K. Parkhill, N. Pidgeon and N. Vaughan, "Messing with Nature? Exploring Public Perceptions of Geoengineering in the UK," Global Environmental Change 23 (2013): 938–947.*
21. *Bron Taylor, "Earth and Nature-Based Spirituality (Part I): From Deep Ecology to Radical Environmentalism" Religion 31 (2001): 175-193.*
22. *Satish Kumar, "Sacred Nature," filmed November 2014at Future NOW conference, https://www.youtube.com/watch?v=5F_ZdepTA0A.*
23. *ETC Group, "Hands Off Mother Earth!," 2.*
24. *See Grinspoon, Earth in Human Hands; David Keith, A Case for Climate Engineering (Cambridge MA: MIT Press/Boston Review Books, 2013); Erle Ellis, "Nature for the people: Towards a democratic vision for the biosphere" Breakthrough Journal, Summer 2017, https://thebreakthrough.org/index.php/journal/past-issues/issue-7/nature-for-the-people.*
25. *Keith, Case for Climate Engineering, 172.*
26. *Ibid, xiii.*
27. *Ibid, xvi.*
28. *bid, 161-2.*
29. *Ellis, "Nature for the People."*
30. *Grinspoon, Earth in Human Hands, 251-2.*

31. *Both sides invoke visions of the form of nature deserving reverence as something wild, untouched and independent of humanity. Both also accept that nature might be managed to human ends: ecomodernists argue for high-tech intensive agriculture to minimize the area affected, while deep ecologists often cite indigenous and traditional land management practices as more respectful of nature. But both cases suggest an ideal that remains as wild and untouched as possible.*
32. *Victoria Held, The Ethics of Care (New York: Oxford University Press, 2006); Chris Groves, Care, Uncertainty and Intergenerational Ethics (London: Palgrave Macmillan, 2014).*
33. *Held, Ethics of Care, 13.*
34. *Ibid, citing Tronto and Fisher.*
35. *Ibid.*
36. *Duncan P. McLaren, "Whose Climate and Whose Ethics? Conceptions of Justice in Solar Geoengineering Modelling," Energy Research & Social Science 44 (2018): 209-221.*
37. *This might be a long period in human terms, even multiple generations, but still only a brief moment in Earth-system terms.*
38. *Pope Francis, Laudato Si': On Care for Our Common Home, 2016, http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html*
39. *Duncan P. McLaren, "In a Broken World: Towards an Ethics of Repair in the Anthropocene," Anthropocene Review 5 (2018): 136–154.*
40. *Keith, Case for Climate Engineering.*
41. *This is not to reject the possibility of a spiritual dimension to care, but to argue that care also requires a material dimension, and that this materiality can run counter to the ideals of reverence as understood here.*
42. *Held, Ethics of Care.*
43. *McLaren, "In a Broken World."*

Climate Privilege and Climate Engineering: Lessons from the Story of Zacchaeus

Authors

Forrest Clingerman is Professor of Religion and Philosophy at Ohio Northern University. He teaches and writes about environmental theology.

Laura M. Hartman is Assistant Professor at Roanoke College, where she teaches environmental humanities with a special interest in environmental justice.

Kevin J. O'Brien is an ethicist, Professor of Religion, and Dean of Humanities at Pacific Lutheran University.

Introduction

The Gospel of Luke tells the story of Zacchaeus, a rich tax collector who is anxious to see Jesus passing through Jericho. Unable to see over the crowd "because he was short in stature," Zacchaeus climbs a tree, where Jesus sees him (Luke 19:3, NRSV). To everyone's surprise, Jesus tells Zacchaeus that he wants to stay at his house that night. Even as the crowd grumbles about Jesus' willingness to lodge with a sinner, Zacchaeus seeks to make amends, saying "Look, half of my possessions, Lord, I will give to the poor; and if I have defrauded anyone of anything, I will pay back four times as much." Jesus responds, "Today salvation has come to this house" (Luke 19:8-9).

In the following pages, we reflect on the story of Zacchaeus as a parable of social location, which can be used to shape a conversation about climate engineering (and climate change more generally). Calling it a parable of social location means focusing on what it tells us about class and other forms of privilege, thus drawing lessons that we think can be instructive to for both Christians and non-Christians. We suggest that the most productive conversations about the ethics of climate engineering rest on a foundation of understanding about climate change and climate privilege, so establishing an understanding of climate privilege is central to our task. However, climate engineering poses additional questions related to justice, which will lead us to many of the conclusions we draw here.

For a discussion like this, it is wise to name the authors' own locations and privileges. For example, the authors were all born in the United States, appear and identify as white, and are cisgender. Two of us are male, and one is female. All three were raised and are connected to the Christian faith in a culture that assumes the normativity of Christianity. All three have economic security, with an expectation that this security will continue to be provided by a politically and militarily powerful society. This makes us exceptionally privileged by any global standard. It is from that status that we ask: how should religious people of privilege respond to the possibility and prospect of climate engineering?

The story of Zacchaeus illustrates how to answer in three steps: First, Zacchaeus puts himself into a position where his power can be recognized. Second, he accepts that this power has led him into sin. Third, he takes action to relinquish some of his privilege and to repair the damage he has caused. ***These steps show what it might mean for religious people of privilege to respond to climate engineering***.

Brokenness & Responsibility: Recognizing Our Power

People of faith who have security, access to resources, and economic resilience must first learn to accept the ways that we are privileged. This creates a responsibility to act.

No matter who we are, people of privilege rarely have as much money as we'd like, as much recognition as we think we deserve, or as much authority in our political systems as we want. And while we might be more protected from extreme weather than many of our neighbors across the globe, we are nevertheless victims of the changing climate in small and large ways. Privilege does not mean a lack of problems, and it is tempting to emphasize this whenever we are faced with our privilege.

Zacchaeus might have wanted to make this point to the crowd in Jericho. He had more money than most. He was granted unique access to the celebrity preacher and healer in town. But he must have been tempted to talk about the challenges he faced, noting that his career made him unpopular, or that his stature led others to ignore him. It would have been tempting to emphasize that Jesus was visiting him not because of his privilege, but because of the hard work and initiative that sent him up a tree. But rather than trying to justify himself, Zacchaeus accepts the premise that he is too rich and seeks to make amends by giving away half of what he owns. He models an alternative to defensiveness: taking responsibility for his privilege, admitting that he has abused it, and accepting that he has contributed to the brokenness of the world.

In our Christian traditions, we tend to articulate that brokenness using language of sin.[1] But much as Zacchaeus climbed a tree to see a fuller perspective, those of us who have privilege will get a larger perspective when we listen for other voices. For instance, we learn from Muslim colleagues that our brokenness might best be understood as deviance from God's plan that degrades the world around us, as demonstrated in the Qur'an: "Corruption has appeared on the land and in the sea because of what the hands of humans have wrought" (30:41). We learn from Buddhist peers that our brokenness might also be understood as striving desire, as the Dhammapada suggests: "If this sticky, uncouth craving overcomes you in the world, your sorrows grow like wild grass after rain" (335).

There is much to say about the difference between Christian ideas of sin, Muslim ideas of disobedience, and Buddhist ideas of craving. For our purposes, though, it is most important to note that each of these—and every other religious tradition we know of—offers language for human brokenness and encourages adherents to take some responsibility for those failings in their own lives and characters. This is especially germane for those of us with climate privilege. Our power means that we are more deeply invested in the broken systems and institutions that exacerbate cravings and corruption, and it also means that we have some capacity to change them. If we accept and take responsibility for our brokenness, we can begin to make amends.

The climate is changing because of human greed, because we privileged people (past and present) want more than the world can afford to sustainably give us. It is changing because human beings refuse to

live within the limits of creation, because we privileged people do not attend to limits.

Accepting this brokenness provides a starting point for addressing issues of climate engineering more responsibly. People of privilege need to ask: what characteristics are present in calls to engineer the climate originating among the climate privileged? Are these symptoms of complicity and embeddedness in broken systems that are responsible for climate change? Would it be easier (on us) to engineer the climate than to break free from our dependence on fossil fuels? Do we hope that if we engineer the climate the world's limits will expand, allowing us to pursue our cravings without check? Or are we considering a technological response because we believe it can help us to live responsibly within the world's limits, because it allows us to repair what we have broken?

These questions are a starting point for the self-examination of our faith communities. They call faith communities with climate privilege to examine a variety of factors about any climate engineering proposal:

- Have we reflected on why we believe we now face the problem of climate change, what brokenness, sin, or accident led to our current predicament?
- Does climate engineering help us directly address the root of our problem? If so, does it address it as fairly and directly as possible? If not, does it at least help to make us more capable of addressing that problem?
- How are we seeking to heal the brokenness of sin in our lives, to better obey God's plan for the world, and/or to free ourselves from selfish greed?
- What sacrifices will be made in order to engineer the climate, and who will be making those sacrifices? Will the sacrifice zones of climate engineering, as discussed by Arianne Van Andel in this report, impact those who disproportionately suffer from climate change already? What sacrifices are taken up by those of us who disproportionately caused climate change?
- Whose voice is being heard in our discussions of climate engineering? Whose is not? Are we working to listen especially to those who have not previously been given voice?

These questions are challenging, vital reminders that climate engineering is a moral issue.

As our religious traditions teach us, we have the agency to live well in the world or poorly. We can sin or repent, obey or corrupt, see truth or be lost in craving. If it helps us to heal, then climate engineering is a good and righteous thing that privileged people should support. If it contributes to the brokenness of the world, then climate engineering is a dangerous thing that privileged people should oppose. To discern which it is, we must first accept our privilege and the fact that we have not always used it well or wisely.

Climate Privilege: Using Our Power

When we accept our brokenness, we are more ready to accept our limitations. We inevitably miss some truths about climate change, and therefore about climate engineering, unless we learn from others who come from other social locations. We can then also accept our power: our privilege gives us agency and responsibility specific to the issue of climate change. This is particularly the case in nearly all forms of climate engineering, which generally have unevenly distributed benefits and impacts. Furthermore, participants in research and policy discussions on climate engineering disproportionately represent developed countries that have a high degree of historical carbon emissions. Unless other voices are lifted up, it will be all too easy for privileged people to blindly mistake the individual benefits we accrue from climate engineering (for instance, the ability to continue to use of fossil fuels, the lack of accountability for climate change, and the ability to have a say in the shape of the climate going forward) with a universal, common good for the whole human community.

Like Zacchaeus, who had to climb into a tree in order to see Jesus, we do not get the whole picture until we change our position. In more privileged contexts, this means facing the problem of climate change head-on. Making the effort to learn about climate change is both intellectually difficult (it is not a simple phenomenon) and emotionally difficult (it is painful to consider). The challenge of learning about climate change stems in part from an empathetic response to those who suffer from its effects, both now and in the future. It also stems from a mixture of guilt (how responsible am I for this?) and horror (how could "we" have done such a thing?).

People of faith in privileged communities actively need to create opportunities to listen to those who are vulnerable to climate change, seeking a fuller perspective from which to evaluate climate engineering. Perhaps this means research, reading books and articles, viewing documentaries, or seeking news sources that center in vulnerable parts of the world. It also likely means seeking knowledge from those in other countries, through local refugees and immigrant communities, through sister city and sister congregation organizations, and so forth. Zacchaeus did not speak first, and neither should we.

Facing climate change this way is worthwhile even if this doesn't solve it. There is value in understanding and witnessing the tragedy as it unfolds. People of faith know the power of prayerful solidarity and compassionate engagement with the world's sorrows. On this level, witnessing the damages of climate change may be a religious duty.

Furthermore, the continuing tragedy of climate change is not a foregone conclusion.[2] Fatalistically assuming that tragedy is inevitable is another way of denying our power. The climate privileged are frequently the climate powerful: we have the resources to focus on mitigating climate change and the political leverage to work toward a 1.5° future. From a global perspective, even an average citizen in the global north has levels of privilege—time, education, a context of participatory democracy—to shape the world on local, national, and international levels.

When people of privilege consider climate engineering, then, we must do so with an assumption of our own power. Since we have the agency in the face of the threat of climate change, should the pursuit of climate engineering be part of what we do? Climate engineering is nearly always framed as an option that might be necessary in a context where political will fails to mobilize adequate emissions reductions and other such climate mitigation measures.[3] It's a last resort, an extra boost for our otherwise-inadequate attempts. This means that, ideally, we would address climate change through more standard means, such as efficient use of energy, alternative energy sources, biological carbon sinks, and the like.

We only have a clear head and a clear conscience to consider climate engineering if we have done our best to reduce emissions all around. Privileged people must recognize that ***we have the power to make this happen***. To prematurely throw up our hands and say "the politics is too hard!" or "denial is too strong!" is to hide behind our privilege.[4] Those suffering from climate change's worst impacts have no choice but to deal with it, and have relatively few resources with which to do so. In solidarity with them, we must do the hard work that we are able to do. For example:

- Have we educated our communities about climate change?
- Do our houses of worship run on 100% renewable energy? Can we make this a standard expectation for our communities of faith, with solar panels on the roof and/or geothermal systems under the memorial garden?
- Have we found ways in our communities to support each other in low-carbon lifestyles? For instance, can we make 100% renewable energy an expectation for our congregants' households and find ways to support one another to fulfill this?
- Have our congregations, denominations, and other institutions divested from fossil fuels?
- As a religious community, have we cut our parking lot in half (perhaps even replacing

it with native forest or prairie), added spaces for bicycles, and encouraged the use of public transportation?

- Have we hounded our lawmakers to create political and economic systems that discourage the use of fossil fuels and encourage alternatives?
- Have we been advocates for our local utility to transition from fossil fuels to renewables?
- Have we lobbied our cities to become more bike-friendly and walkable?
- Have we supported efforts to localize food production and reduce food miles?
- How are we helping our religious communities to deal with the guilt and pain that comes from honestly facing climate change? What would climate repentance look like?[5]

There is much to do. There are so many ways that people of faith can use our privilege and our citizenship to mitigate climate change.[6]

In the face of a fast-moving, climate emergency, many have come to the conclusion that climate engineering will be necessary in some form. As suggested in the scientific and policy overview of this report, carbon removal is increasingly seen as unavoidable if the world is to meet the Paris target. But climate engineering is a false solution if it begins from a belief that we are powerless to do anything else. We should not engineer the climate if it is done with a shrug, dismissing other solutions as simply too hard. We, the climate privileged, can and must do everything we can to solve climate change before we are qualified to consider climate engineering. Like Zacchaeus giving up half his possessions and offering restitution to those he has defrauded, the climate privileged have a responsibility to dig deep to solve climate change, to reduce emissions and sequester carbon.

Empowering Others: Sharing Our Power

Already we have seen how the parable of Zacchaeus uncovers human brokenness and the importance of changing perspective. Finally, it gives us an example of genuine transformation: Zacchaeus begins as a corrupt man of wealth and ends as an eager, charitable follower of Jesus' ministry. In theological language, this is a ***metanoia***, or a change of heart, that aligns his thought and behavior toward a larger vision of reality. His ***metanoia*** is (by definition) a shift in who he is and how he lives in the world. He gives away his wealth and makes amends for his abuse of power, relinquishing some of the trappings of his privilege.

Talk of a repentant change of heart might seem an unlikely item for policy discussion. It becomes more understandable, however, when faith communities recognize how (as in the story of Zacchaeus) a change of heart can have very concrete economic and political consequences. When we love our neighbors in light of our repentant change of heart (something we as Christians are called to do), we follow Zacchaeus's example by listening to the troubles of those who have suffered and using our privilege to make amends.

Citizens of post-industrialized countries, whose wealth has accumulated over time through practices defined by significant historical carbon emissions, and whose ability to adapt to a changing climate is more assured, should recognize ourselves in Zacchaeus. Expert scientific, engineering, and policy communities that can see the realities of climate change and the possibilities of engineering better than most should also recognize ourselves in this tree climber. The corporations whose profit relies our current high-emissions socio-economic structures can also recognize themselves in this rich man. All should consider the fact that climate change is calling us to a metanoia.

But for this to be a real change of heart, it is vital to recognize who this story is ***not*** about. Focusing on the culpability and agency of the powerful easily becomes another form of privilege, because it places

the repentant Zacchaeus in the center while moving those he has harmed to the periphery, unnamed and without any real power in the story. So, to truly embrace this parable, communities of privilege should turn our attention to the others in the story: those who have been punished by the economic system, the victims of Zacchaeus' corruption, and the powerless who angrily and hungrily await the reparation he promises. A true ***metanoia*** means a shift in perspective that prioritizes the hitherto unheard voices and the otherwise unseen perspectives.

To have a truly transformative change of heart, then, faith communities of privilege need to lift up lost voices as the center of any deliberation on climate engineering. This means asking the people most threatened by changing climatic conditions how they are experiencing climate change and how they want the world to respond. It means considering that the people who have contributed least to climate change—those who have not or do not heavily use fossil fuels—might be better qualified to imagine a more sustainable future than those of us whose wellbeing is centered on generations of anthropogenic greenhouse gas emissions. It means considering what kind of conversation about climate engineering would make it possible for more diverse peoples to participate more broadly.[7] It means considering that we (like Zacchaeus) need to atone, which requires asking those we owe: how should we make amends?

Thus, privileged faith communities should think about climate engineering by working hard to listen to those with less climate privilege. A climate ***metanoia*** for congregations and individuals involves seeking reconciliation with those who are suffering from climate change and those who have not contributed as much to it. We must discover: do members of those vulnerable communities want climate engineering technologies to be developed? Who do those with less climate privilege trust to make decisions about the deployment and management of such technologies?[8]

A responsible approach to climate engineering requires communities of privilege to ask these questions and to listen patiently to the answers. This means active engagement: empowering others to speak, sharing our privilege. We might start with some challenging questions:

- How do we create meaningful conversations about climate change and climate engineering in our families, our neighborhoods, and our local and national politics?
- How do we then keep ourselves quiet enough in those conversations so that those who suffer most from climate change can speak and be heard?

This leads to more concrete questions for congregations and faith communities:

- What steps are required to move the values and ideals of our religious traditions—including justice, honesty, and care for the marginalized—closer to the center of conversations about climate change and climate engineering?
- How can we use religious communities' existing connections (such as sister congregation initiatives or congregational resources from denominational mission efforts) to raise the voices of those with less climate privilege in conversations about climate engineering?
- What are we—as individuals and religious communities—currently prioritizing in the ways we spend and donate our money? Should we change those priorities in light of climate realities?
- Can we question our motives as we balance different responses to climate change?
    - Are we prioritizing climate engineering because it does not require us to sacrifice?
    - Are we prioritizing CDR because we think it might allow us to continue our emissions unchecked?
    - Are we prioritizing SRM because it seems cheap and easy?
    - To compare with Zacchaeus, are we only giving away one-eighth of our wealth (or

effort to combat climate change) when justice and love demand that we ought to give away one-half?

These questions have the potential to demand careful examination of our communities and our lifestyles drawn from careful listening to other peoples.

Religious communities of privilege—that is, faith communities like the ones the authors are part of—are in a unique position in the climate engineering policy discussion. We have the capacity and the responsibility to be radically open to other voices, to act as amplifiers for those who are most endangered by climate change. The conversation about climate engineering—and any implementation that follows it—must not follow the same dynamics of power and privilege that caused climate change in the first place. Exploitation of the poor and unconscious yet complicit privilege will stop if we, like Zacchaeus, change the story of injustice into a story of *metanoia*. Then we can all say, "today salvation has come to this house" (Luke 19:9)!

Conclusion

Those looking for simple answers about climate engineering—should we do it? Should we avoid it? Are some forms of it better than others?—will be unsatisfied by this essay. But this is by design, because we do not believe that people of privilege should have answers all on our own. Instead, we have argued that we must recognize the brokenness of the current world, accept our place and responsibilities as privileged peoples, and then find ways to hear and empower the voices of others who must be part of this conversation. People of privilege have the power to be heard, and we must use and share that power.

Whatever else we decide about it, people of privilege should understand the possibility of climate engineering as a wake-up call. The social structures we live in—which disproportionately benefit us—have led the world to a point of crisis, with dire impacts for ecosystems and human communities across the globe. If the habits of thinking that created climate change go unnoticed and unchanged, then there is no reason to think that climate engineering would lead to better outcomes. By contrast, if we can ensure that the ways the global community considers these new technologies are more inclusive, more open, and more thoughtful, then there is a chance for healing.

Zacchaeus changed position to see from a different perspective, and consequently Jesus chose and empowered him. Zacchaeus used this as an occasion to examine himself, to publicly repent, and to surrender some of his privilege. Perhaps the prospect of climate engineering presents a similar opportunity for privileged faith communities in the 21st century.

1. *See, for example, the discussion of structural sin in Cynthia Moe-Lobeda, Resisting Structural Evil: Love as Ecological-Economic Vocation (Minneapolis: Fortress Press, 2013), 58-64.*
2. *See, for example, the special report from the IPCC that concludes it is possible to limit warming to 1.5 °C above pre-industrial levels while also moving toward sustainable development and eradicating poverty. It is worth noting that the report assumes the use of climate engineering techniques in the form of carbon reduction technologies. Intergovernmental Panel on Climate Change, "Global Warming of 1.5 °C: Summary for Policymakers" (Incheon, Korea: United Nations Environment Program), http://www.ipcc.ch/report/sr15/.*
3. *See, for example, David G. Victor, M. Granger Morgan, Jay Apt, John Steinbruner, and Katharine Ricke, "The Geoengineering Option: A Last Resort Against Global Warming?" Foreign Affairs 88 (March/April 2009).*
4. *This is well articulated by Kari Marie Norgaard, "Climate Denial and the Construction of Innocence: Reproducing Transnational Environmental Privilege in the Face of Climate Change," Race, Gender, & Class 19 (2012): 80-103.*
5. *See Kevin J. O'Brien, "'First Be Reconciled': The Priority of Repentance in the Climate Engineering Debate," in Theological and Ethical Perspectives on Climate Engineering: Calming the Storm, eds. Forrest Clingerman and Kevin J. O'Brien (Lanham, MD: Lexington Books, 2016), 187-204.*

6. *For further perspective on responsibility and climate change, see Genevieve Guenther, "Who Is the We in 'We Are Causing Climate Change'?" Slate, 10 October 2018. https://slate.com/technology/2018/10/who-is-we-causing-climate-change.html*
7. *See Marion Hordequin, "Geoengineering Justice: The Role of Recognition," Science, Technology, & Human Values 20 (2018): 1-30.*
8. *Some scholarly work addresses this question but more needs to be done; see Wylie Carr and Christopher J. Preston, "Skewed Vulnerabilities and Moral Corruption in Global Perspectives on Climate Engineering," Environmental Values 26:6 (December 2017), 757-777. Communities of faith are in a unique position to reach out to sister congregations across the globe to facilitate listening and learning from climate-vulnerable people.*

Islam, the Religion of Nature, and Geoengineering: Let there be no altering of the work wrought by Allah

Author

Saffet Abid Catovic is an American Muslim Environmental Leader of Bosnian-Anglo decent, who serves as the Imam and Muslim Chaplain at Drew University, Madison, New Jersey.

> *"It is He who hath made you (His) agents, inheritors and caretakers of the earth: He has raised you in ranks, some above others: that He may try you in the gifts He has given you: for Your Lord is quick in punishment: yet He is indeed Oft-forgiving, Most Merciful."*
> *(Qur'an 6:165)* [1]

> *"The roots of our ecological crises are axiomatic: they lie in our belief and value structures which shape our relationship with nature, with each other and the lifestyles we lead."*[2]

Introduction

Human activities are responsible for global warming and climate change, which threaten the delicate balance of life on our common home, Mother Earth. The impacts of climate change include stronger storms, more erratic weather, dangerous heat waves, droughts, fires, and other catastrophes leave trauma and grief in their wake. These are already being felt across ecosystems and human communities and economies. The 2018 Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C reported that 1.5° C could be reached in as little as 11 years—and almost certainly within 20 years without major cuts in CO2 emissions.[3] Even if such cuts were to begin immediately it would only delay, not prevent, 1.5° C of global warming and will have substantial consequences.

Of particular concern is the growing number of authoritative studies highlighting the health impacts of warming of 1.5° C or higher, in particular malnutrition, heat-related and ozone mortality, malaria, and dengue fever, to name a few. The conclusion of this IPCC report is that stabilizing climate requires a

mix of climate strategies. These include both land use and technological change. First and foremost, mitigation: individual and collective life-style and consumption behavior changes (including dietary shift to eating less meat and reduced material consumption), fossil fuel infrastructure phase out and replacement with renewable sources of energy, shifts to electric transport systems, reforestation and improving forest management (forests currently remove 25% of CO2 from the atmosphere as carbon sinks and in the cool the air and are key in creating regional rainfall in tropical area for growing food). But there is also increasing emphasis on the development and implementation of geoengineering technologies, or large-scale interventions into the Earth systems address either the causes or the impacts of climate change.

In this essay, I explore ways in which ethical considerations in keeping with the broad life-enabling and life-protecting principles and goals of Islam's Sacred Law—*Shariah*—may be utilized to understand the complex issue of geoengineering. In doing so, I hope to provide my humble contribution by giving voice to Islamic considerations, as well as to the larger conversation in which "religion will play an important role in public perceptions of geoengineering… [insofar as] religious narratives and symbols can provide frames for understanding geoengineering; and religion offers vocabulary for the moral debate." [4]

Overview of Islam's Ecotheology and Core Eco-Terminologies

A theological framing of an Islamic view on geoengineering requires an overview of Islam's *Weltanschaung* and its view of the earth, the Divine, and our role as humans. Islamic views on the environment can be found in (1) the Qur'an—Islam's Sacred Scripture, the Word of Allah revealed to the Prophet Muhammed, Peace be Upon Him (PBUH), via the Archangel Gabriel over 1400 years ago—and (2) the Sunnah/Hadith—the sacred traditions, sayings, and affirmations of the Prophet as they pertain to religious matters that Muslims hold as also being divinely inspired and directed. Taken together, these two texts serve as the agreed upon primary sources (*Usool*) for Islam's teaching and Sacred Law. Islam's modern ecotheology and environmental ethics utilizes this religious language, which pre-dates the modern jargon and terminology of (religious) environmentalism and conservationism, to translate and place the Islamic tradition into conversation with the modern environmental project. Even the term *Fiqh Ul Bi'ah* or Jurisprudence of the Environment, is new and now gradually becoming more accepted within Muslim scholarly circles as a specific sub-specialty of Islamic jurisprudence.

From these sources, we see that the Earth, our mother (*Umm*), is a creation of Allah and is our home, with sufficient resources and sustenance. The Qur'an states that there is enough provision on the earth for humanity and creation, if properly managed and not squandered (74:12 and 17:70). She is sacred, having been sacralized by the pronouncement of the Prophet Muhammed (PBUH) that Among the five (things) that was given God which were not granted to any of the previous prophets was that the Earth was made sacred and pure and a *Masjid* (mosque) and that her soil was made as a means of purification, so that whenever the time of prayer comes his followers should pray whenever he/she finds himself/herself. Under this Divine direction the Prophet Muhammed (PBUH) also expanded the boundaries of the sister Abrahamic traditions (People of the Book or *Ahlul Kitaab* in the Qur'anic terminology) and the thresholds of temples and churches where they worshipped to encompass the entire world and, in the process, sacralized all the earth. The message is clear: Mother Earth, which we all share as a pure entity and purifying agent and hence is a sacred space, is not unlike our Houses of Worship that are to be safeguarded, preserved and perpetuated.

The Earth herself and the natural world are in fact a type of Divine revelation (*wahy*): manifesting signs (*ayaat*) of His presence and majesty. The Arabic term *Ayaat* literally means signs and is the same term that is used to describe the verses of the Qur'an. There are over 750 verses in the Qur'an which speak about nature and natural phenomena as being signs (*Ayaat*) of God which testify to His Power and Glory. Nature may also point to what is beyond itself; in this sense, the role of nature is like that of a mirror which reflects the power, beauty and wisdom of its Creator. In keeping with this line of thinking,

it can be asserted that Allah (God) has revealed two Books through which human beings can receive guidance. One is written words, the Qur'an; the other is Nature—a cosmic Qur'an (Qur'an al-*Takwini*), as Seyyed Hosein Nasr argues. [5]

Islam as a religion self-identifies as the *Deen-Ul-Fitra*, or religion of natural disposition, tendency, and inclination; it is open, upright, pure, wholesome, noble, and ennobling, not fallen. In fact, Islam, which literally means "the way of submission," can be expanded and said to be the natural religion of all creatures. According to Islamic theology, everything in nature has been created to render absolute obedience to God and functions according to His laws; all creatures are Muslims. Every human being, regardless of their religion, is "muslim," since all bodies operate according to the natural laws and systems (physics) determined for them by God. This is Tawhid, the oneness of God, in action. A worldview based on *Tawhid* sees this universe as originating from God, returning to Him, and centered around Him.

Human beings enact the Divine Will in their divinely-instituted role as *Khalifatul Ard* or steward/guardian/protector of the Earth, with the ability to freely choose how to act in and upon the Earth. According to this view, human beings have been charged with the *amanah* (trust) (33:72), which is the just (*adl*) and effective (*ihsan*) administration of all that has been placed under our control and use (*taskhir*). This is done by maintaining the natural, cosmic order and balance (*mizan*) (55:7-9) through our multi-faceted role as *Khalifa* (6:165). This trust not only encompasses the web of human relations, but extends outward in ever-expanding concentric circles to include all within the natural world. With this awesome power and delegated authority comes the individual and collective responsibility for such actions. In this understanding, a Khalifa is not entitled to do what he/she pleases, but is obliged to carry out the will of his/her master. If a human were to begin thinking of him/herself as the real owner (and to use that authority in whatever manner he/she pleased), or if he/she were to acknowledge someone other than the real owner as lord and master, these would be deemed acts of infidelity and rebellion.

The Industrial Revolution, Scripture, and the Environment

Prior to the Industrial Revolution, environment and ecological consideration were not a global pressing issue for human beings. For in those pre-industrial times our daily lives and existences, though difficult and challenging, were at the deepest level intimately interconnected with the larger natural world. The fact of the matter is that the actions of "Mother Nature" controlled us much more than we controlled her, no matter what some parts of our religious texts may seem to say.

One could argue, as I am here, that pre-industrial religions were much more Earth-based and Earth-connected. This was indeed the case with many native (non-Abrahamic) traditions and spiritualties. Because of our interconnectedness and intimacy with the Earth, religious teachings could be understood as being eco-neutral, or even eco-friendly in some cases. Religious texts, in particular in the role they play within the Abrahamic faith traditions—religions of the "written word"—speak to the various ways in which we human beings locate ourselves within the cosmos, the universe, and the associated cosmologies and theologies we derive from them, so that we may make meaning out of the mysteries and order out of the chaos.

With the onset of the Industrial Revolution in the West (the "Muslim World," owing to various historical socio-political developments, was not a significant player at this time) and its fossil-fuel-driven machine economy, the calculus radically changed, as did the human relation with nature and the natural world. This resulted in a progressive disruption at many levels of the balance (*mizan*) found in the natural order, causing a dislocation of human beings from their previous place in the cosmos. These anthropogenic mega-changes would materially alter the physical systems of the natural world and our relations with her, ushering in what scientists and social scientists are calling "the Anthropocenic age." The result is that we now face an age of "geological havoc" thanks to climate change!

To make sense of this "scary new world," communities of interpreters utilize religious texts to consider these new dynamics and realities. Unfortunately, in many cases texts were interpreted to provide religious sanction, legitimacy, and justification for domination of the Earth and certain peoples by "Western" nations.

Seyyed Houssein Nasr provides an astute Islamic take on this, arguing that the core of the current ecological crisis is a crisis of values. As he stated "the environmental crisis has deep spiritual, philosophical, and religious roots and causes. It is not merely the result of bad engineering, for as soon as nature became an 'it', there was bound to be this [crisis]."[6] As a neo-traditionalist, one who holds Islam's traditional and classical teachings have the answers to the challenges of the modern world, Nasser held that the destruction of the ethical and spiritual vision of nature at the hands of the modern (Western) world was done in the name of growth, development, and so-called "progress." This is the basis for the crisis, "for to be modern (in this sense) is to destroy nature." In this regard he observed, "The traditional Islamic world view is one which did not seek to create a science whose application would destroy the world of nature and the harmony that must exist between man and the natural environment." [7]

Islamic Ethics: A Snapshot

Over the millennia different Muslim scholars from across the theological spectrum have devoted time, thought, research and scholarly writings to Islamic ethics (*ilm al-akhlaq*). A common thread through these diverse views is that the scope of Islamic ethics is wide, comprehensive, and far-reaching because it deals with the relationship between human beings and their Creator Allah, as well as between human beings and all other creatures. In all these senses the *Maqasid* (goals) of *Shariah* (which I will discuss later) give practical form to ethical norms and seek to construct human life based on the *Hisbah – Amr bil Maroof wa Nahy anil Munkar* (Enjoining the Right and Forbidding the Wrong). The Qur'anic term Ma'roof is defined as a universally accepted good: for what is good is well-known, generally recognized, and approved by Shariah. Munkar, which is the opposite of Ma'roof, means what is universally seen as wrong or evil: what is bad, evil, detestable, disagreeable, abominable, and disapproved by Shariah. In general, what is good (*Maroof*) and approved are the Halaal, the lawful. What is evil (*Munkar*) and disapproved are the *Haraam*, the prohibited. The enactment of the *hisbah* is a societal or communal obligation (*Fard Keefaya*), meaning it rests within the power of the State and legitimate governmental authorities. Should the State fall short in carrying this out with justice and fairness, this responsibility and obligation devolves to the individuals (*Fard Ayn*) who are the members of that State.

Shariah, Islam's Sacred Law: Definition, Goals, and Core Principles

Islamic ethics and norms are made real in the world under the rubric and through the application of the *Shariah*, Islam's sacred law.

Shariah literally means "the trodden path," which leads to the water well, the source of life, or the water way (stream) that leads to the river and sea itself, analogous to the Hebrew term *Halakha* ("the Way to Go"). *Shariah* is a foundation of wisdom, justice, and mercy. By the fourth century after the death of the Prophet (PBUH), these principles and objectives were formally categorized and organized into an architectural framework by the Ulema (scholars) and jurists into the sacred science of *Maqasid Shariah* (Higher Objectives of Sacred Law). Of particular import is the work of one of the religious geniuses Abu Hamid al-Ghazali who wrote categorically that the Shariah pursued five basic objectives: preservation (*hifdh*) of faith (*Din*), life (nafs), lineage/posterity/family (*Nasl*), intellect (*Aql*), and wealth/material resources/property (mal), and that these were to be protected as absolute priorities. He observed "Whatever ensures the safeguard of these five principles serves public interest (maslaha) and is desirable, and whatever hurts them is against public interest and its removal is desirable." Al-Ghazali's

five basic categories or essentials (al-darurah al-khamsah) remain the same but order is changed by some scholars and others have added additional categories to them.

Most Muslim scholars (*ulema*) have generally considered *Rahma* (Mercy and Compassion) to be the all-pervasive objective of the Shariah, and have, to all intents and purposes, used it synonymously with Maslahah. It is also part of the Rahma and hence Shariah to adhere to the general principle of not being the cause of harm/hurt to one another. In the words of the Prophet Muhammed (PBUH): La darara wa la dira ("There should be neither harming nor reciprocating harm. Ourselves and others, human non-human, our present and our future").

This hadith is the basis of one of the five universal/great maxims or principles (*al-Qawa'id al-kulliyah al-khams*) that are matters of consensus among all schools of Muslim jurisprudence. The universal maxims embody the ethical values that are substantially intended by the *Shariah*, namely: intention, certainty, removal of hardship, and elimination of harm and cultural usage shall have the weight of law. These are integral to the general Islamic concept of maslaha (public interest), besides their legal functions. The maxim that comes from this hadith is translated in Arabic as:(Al-Darar yuzalu). It can be explained as saying Islamic Law completely forbids that which causes harm. That which is harmful must be completely avoided whenever possible. When it is not possible, then the lesser of two evils should be perpetrated to avoid the greater. That which brings harm on a smaller scale is to be preferred to that which visits general harm to society. Likewise, the avoidance of harm takes priority over the attainment of some benefit.

Applying this maxim to climate change is imperative. Muslims make up approximately 20% of the world's population and Islam covers a very large geographic area, including places most vulnerable and under immediate threat of global climate change. Therefore, highlighting the eco-teachings of Islam, especially when grounded in Islam's Shariah, is beneficial for tackling climate change now, as well as becoming increasingly useful with the predicted exponential growth of the Muslim population in the coming decades. If Muslims across the globe develop a greater awareness of their Islamic duties to the environment, it also conceivable that they would be able to pressure their governments into making "green" decisions when it comes to water, food, recycling and energy use. Strategically considering any action or issue within *Shariah* is critical. Conveying to the faithful that their actions are contained within and will uphold the Shariah, and therefore ensuring that their Islam is complete and sound (and that to do otherwise is to violate the Shariah and compromise their Islam), is a critical step in this process for two primary reasons. First, Shariah influences the legal code in most Muslim countries. Second, according to the Pew Research Center 2013 survey findings, most Muslims (around the world) believe Shariah is the revealed word of God rather than a body of law developed by humanity based on the word of God. [8] Many Muslims around the world say Shariah should be the law of the land in their Muslim majority country, the survey reveals divergent opinions about the precise application of "the how's of implementing" Islamic law.

Islamic considerations and views regarding Geoengineering

What can a discussion of Shariah add to our understanding of geoengineering? To authoritatively speak about a complex issue and come up with an "Islamic view" on something as new and untested as geoengineering technologies, specifically SRM and CDR, requires a lot of scholarly work within the Islamic community worldwide. I suspect that there will be more than one Islamic perspective at the end of the day. Islam and Muslims have been characterized by some as akin to Luther's "priesthood of the believers" par excellence, since there is no denominational executive council, universal hierarchy, or Papal authority. Any authentic scholarly endeavor that investigates an issue of global magnitude must start with the basics of proposing ideas and sharing them with scholars across the religious spectrum and the geographic Muslim world. This, in turn, will result in critiques of the ideas and debate, subsequent deliberation and consensus building.

This matter is further complicated by the inescapable fact that scholars—even though they share the Muslim tradition—are only human and do not function within a social, economic, or political vacuum. They are subject to the pressures of various monied and profit-motivated interests, as well as the interests of the nation-states in which they reside. These nations include both those whose primary revenues come from the extraction and export of fossil fuel reserves and those that are driven by immediate existential threats, grasping at anything which offers the possibility of biological survival. According to *Usul-ul-Fiqh* (principles of Islamic Jurisprudence), scholars (*Ulema*) who are trained in the required Islamic sciences to render Fatawa (Islamic religious rulings regarding matters of concern) are required to render legal opinions free from undue economic pressure or political influence, if their ruling is to be authoritative and accepted.

Confronting human-caused climate change, which is a real threat to human existence, is a clear case of *Amr Bil Maroof* (Enjoining the Good) from an Islamic ethical perspective. The question then arises as to what tools and resources can be legitimately employed in this fight and to what extent and at what costs (economic and societal).

Here then is my humble contribution to the beginnings of this scholarly enterprise. To start—and this is a major area of agreement (jumhour, or clear majority, and ijma, or scholarly consensus)—Islamic views need to comply with Islam's all-encompassing *Shariah*. As discussed above, Shariah is found in the primary and Divinely originated sources of the Qur'an and Sunnah. The Shariah is also found in the secondary human originated sources of sacred law and legislation of Ijma and Ijtihad. The *Ijma* is the consensus of juristic opinions of learned *Ulema* and the agreement reached on the decisions taken by learned muftis or the jurists on various Islamic matters. The root word of ijtihad is "Juhd," which means "to try or strive." It is the process in which a scholar independently strives and exerts himself/herself fully (exhausting all mental energy) to find answers, reasons, or solutions to problems in which there is no clear answer provided for in the *Qur'an* and *Sunnah*. In this way Islamic law can adapt to the ever changing needs of society.

A primary tool through which Ijtihad is done is *Qiyas*, the process of deductive analogy in which factual resemblance is sought between the teachings of the Hadith which are compared and contrasted with those of the Qur'an, in order to apply a known ruling (*nass*) to a new circumstance and create a new ruling. According to this method, the ruling of the *Qur'an* or *Sunnah* may be extended to a new problem provided that the precedent (asl) and the new problem (far) share the same operative or effective cause (*illa*). The *illa* is the specific set of circumstances that trigger a certain law into action. This action would necessarily fall under one of five legal categories: wajib (obligatory), mandub (recommended), mubah (permitted), makruh (disliked), and haram (forbidden).

Let us look at the various types and methods of proposed climate engineering technologies and how we may understand, view, and evaluate them from an Islamic perspective. The two primary types of climate engineering have been discussed and debated are: Carbon Dioxide Removal and Solar Radiation Management. Carbon Dioxide Removal deals with one of the primary causes of climate change: excess levels of greenhouse gases. One of the most prominent proposed methods involves extracting CO2 from the atmosphere and sequestering it (Carbon Capture and Storage). Solar Radiation Management does not attempt to deal with the level of greenhouse gases in the atmosphere. It attempts to counteract increases in temperature and global warming by blocking solar radiation or increasing the reflectivity of the Earth's surface. Part I of this report offers more detail on the different forms of climate engineering in both of these categories.

Since this is a very new issue without precedent (not found within Islam's primary sources of the Qur'an, *Shariah*, and *Sunnah*), it is necessary to review any similar scholarly research and work and decisions that have been reached regarding a similar (*tamthil*) matter. Here parallels can be drawn to the issue of GMO technology, especially GMOs that are used in agriculture, where much Islam scholarly work has already been done. Both climate engineering and GMO technologies are about re-engineering and modifying at the most basic level the workings of natural bioprocesses. In the case of GMO's, Muslim scholars

have held that the default position of Islam in this matter rests on the Islamic conception and self-identification of itself being ***Deen-Ul-Fitra*** (a religion of natural disposition, tendency, and inclination, as discussed earlier). This is in keeping with the Qur'anic directive:

> So, set thou thy face steadily and truly to the Faith: (Establish) Allah's handiwork according to the pattern on which He has made mankind: ***no change (let there be) in the work (wrought) by Allah***: that is the standard Religion: but most among mankind understand not (30:30)

In a similar vein, the Prophet Muhammed (PBUH) was said to have once witnessed farmers graft branches of different species of date palms together to produce higher yields. He is said to have told the farmers to stop, and they obeyed him, but their yields decreased. When the farmers told Muhammad this, he replied that he is only a human being and the farmers should continue grafting.

While on the face of it, this story seems to allow for GMOs, at least as far as grafting or cross-breeding is concerned, but a more nuanced reading affirms that the position of the Prophet (PBUH) was to put an end to what he viewed as an unnatural process and attempt to alter the creation of Allah. When it was apparent that this resulted in lower yields, the Prophet reversed his previous directive and acknowledged that this directive came from him and not the result of Divine revelation. Here scholars surmise that the importance of providing sufficient food to those in need and warding off hunger which is very much a desired outcome of ***Shariah***. Still it would not be correct to understand this story to give unreserved support for all GMO technologies. Hence most scholars have concluded that while Islam may support a basic form/type of GMO technology (in this case represented by cross-breeding), its support is limited to those techniques and technologies which enhance existing natural processes rather than undermine them. Essential is the integrity of God's creation, with support only for the result that is known to provide benefit and not harm.

A similar process of Islamic scholarly reasoning and deduction methods can be applied to the situation for geoengineering technologies. However, unlike in the case of the cross-bred date palms, the certainty regarding many geoengineering technologies, results, and impacts on the environment are unknown. Nor is there certainty about the real possibility of successfully scaling up these technologies in a cost effective manner once they have been made functional. In fact, three combined research projects, led by teams from the Universities of Leeds, Bristol, and Oxford, have explored the implications in more detail. The central conclusion, according to Dr. Matt Watson of Bristol University, is that the issues surrounding geoengineering—how it might work, the effects it might have and the potential downsides—are "really, really complicated."[9] This is particularly true when it comes to SRM technology, which was not emphasized by the IPCC in its 2018 report due to lack of evidence. Thus Nobel Prize laureate Al Gore said: "The idea that we can put a different form of pollution into the atmosphere to cancel out the effects of global warming pollution is utterly insane." He continued: "We are already engaged in a planet-wide experiment with consequences we can already tell are unpleasant for the future of humanity. So, the hubris involved in thinking we can come up with a second planet-wide experiment that would exactly counteract the first experiment is delusional in the extreme."[10] Similarly, Professor Michael Oppenheimer of Princeton University provides a sobering and stark assessment regarding carbon Capture and storage technologies, saying:

> Policymakers should not assume that they can relax and wait for some mythical technology that's going to suck CO2 out of the air to be technologically feasible and affordable. That may never happen. They have to get on solving the problem now by, first, providing all incentives possible for a transition as quickly as possible from fossil fuels to renewable energy and from sloppy economies to highly efficient economies.
>
> And, number two, assuring that the possibility for the social transformation that has to accompany that—more compact living, less consumption of wasteful goods – can be done, that there are incentives in place, like a price on carbon, so that that people will want to do it. If all those elements come into place, we won't need the mythical technologies. [11]

In arriving at a religious decision, then, Muslim scholars seek to always to ensure that their Fatwa does not contradict the goals of Shariah: preservation (hifdh) of faith (Din), life (*nafs*), lineage/posterity/family (*Nasl*), intellect (*Aql*) and wealth/material resources/property (*mal*), and that these are to be protected as absolute priorities. Immediate, let alone the long term, negative effects and consequences of deploying these untested geoengineering technologies on a global scale contradict these goals of *Shariah*, and in my view would preclude the ability to render a Fatwa in their favor.

Furthermore, religious ruling should be done in accordance with the application of *istihla* (ensuring "*maslaha*" the public welfare and interest) which must benefit the general (*kulliyah*) community and society, both the current generation and to the best of our ability the future generations (to the extent that we can with relative certainty predict what impact our actions taken today will have collectively on the lives of our children and children's children). The general societal benefit cannot be ascertained with any degree of certainty for future generations. In fact the potential downside on the public welfare seems to be where the current scientific thinking is trending toward.

Finally, the principle (maxim) of sacred law that we have the obligation to do no harm comes into play when discussing geoengineering. That which is harmful must be completely avoided whenever possible. When it is not possible, then the lesser of two evils should be perpetrated to avoid the greater. That which brings harm on a smaller scale is to be preferred to that which visits general harm to society. This consideration applies to geoengineering. In the case of geoengineering there is a lack of certainty (*yaqeen*) and here when we apply another legal maxim, that which is established with certainty is not removed by doubt (*Al-Yaqin la yazulu bi-al-shakk*) This means we are unable to make a determination at this point in time given the state of reliable information and research that has been conducted thus far on the more radical geoengineering technologies.

In summary, at this point in time, and given the current state of research (at its infancy with no certainty as to its viability, effectiveness, and/or potential harms), it is my considered opinion that an Islamic view on geoengineering is one which not only permits (*mubah*) but also recommends the use and implementation of carbon capture and storage technologies that mimic and enhance natural processes. Some examples include CO2 removal and storage by terrestrial plants, burying biomass, reforestation, and afforestation (creating new forests). However, because of the reasoning presented heretofore I do not think the *Shariah* would allow for other types of more unnatural and detrimental technologies. When it comes to solar radiation management technologies, for example, I believe only painting roofs and other structures with reflective material and placing solar reflectors in the desert would be considered permissible (*halal*). These represent mere enhancements of natural processes rather than more unnatural and potentially dangerous enhancements. In the end *Allahu'Alaam* – God Knows Best.

1. *All verses quoted from the Qur'an throughout this paper are italicized and their English translations are taken from Abdullah Yusuf Ali, The Meaning of the Holy Qur'an (Brentwood, MD: Amana Corporation, 1992).*
2. *Ziauddin Sardar, Islamic Futures (New York; Mensell Publishing Limited. 1985), 218.*
3. *IPCC, Summary for Policymakers," in Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty (World Meteorological Organization, Geneva, Switzerland, 2018).*
4. *Forrest Clingerman and Kevin J. O'Brien, "Playing God: Why Religion Belongs in the Climate Engineering Debate," Bulletin of the Atomic Scientists 70 (2014): 27.*
5. *Seyyed Hosein Nasr, The Need for a Sacred Science (Albany, NY: State University of New York Press, 1993), 130.*
6. *"A conversation with Seyyed Hossein Nasr. March 14, 2007," accessed November 10, 2018, https://sistershalaqah.wordpress.com/2007/03/14/quotes-from-a-conversation-with-seyyed-hossein-nasr/.*
7. *Ibid.*

8. *"The World's Muslims: Religion, Politics and Society," accessed December 10, 2018, http://www.pewforum.org/2013/04/30/the-worlds-muslims-religion-politics-society-overview/.*

9. *"Geoengineering Our Climate Is Not a 'Quick-Fix,'" https://www.oxfordmartin.ox.ac.uk/news/2014-geoengineering-quick-fix-PR.*

10. *Suzanne Goldenberg, "Al Gore Says Use of Geo-Engineering to Head Off Climate Change is Insane," The Guardian (15 January 2014), https://www.theguardian.com/world/climate-consensus-97-per-cent/2014/jan/15/geo-al-gore-engineering-climate-disaster-instant-solutio*

11. *"In-Depth: Scientists Discuss Key Findings of IPCC's Special Report of 1.5° C," accessed December 10, 2018, https://www.carbonbrief.org/in-depth-scientists-discuss-key-findings-of-the-ipccs-special-report-on-1-5c.*

Annex: Possible Impacts of Climate Engineering on Development

Dimension of Development	Possible Impact of Carbon Removal	Possible Impact of Solar Geoengineering
Land use and food security	Conflict over land use, impacting livelihoods or food security.	Reductions in local rainfall from some forms of solar geoengineering could affect food security.
Water quality	Groundwater pollution from carbon storage or mineral mining processes. Nutrient runoff from bioenergy and sequestration-oriented forestry.	Change in the chemistry of lakes, rivers, and oceans from Stratospheric Aerosol Injection.
Water availability	High water demand for carbon capture processes or for farming or forestry that aims to increase biomass. On the other hand, some forms of farming or forestry which increase water retention could reduce downstream flood-risk.	
Biodiversity	Changes in land use could reduce biodiversity. But if designed properly, some land-use changes could advance conservation or restoration efforts	Stratospheric Aerosol Injection could affect ecosystems sensitive to acidification or alkalinisation, with positive or negative effects on plants and animals.
Health	Respiratory problems could result from exposure to substances and processes involved in production of biochar or minerals for enhanced weathering	Respiratory problems could result from production of particles for Stratospheric Aerosol Injection particles. Changes in skin cancer rates could result from solar geoengineering's various impacts on the ozone layer and ultraviolet light levels
Energy security	Strong competition for energy could result from energy demands of geological storage of CO2, direct air capture, biochar production or grinding, and transport of minerals for alkalinity enhancement or ocean fertilization.	Reduced yields of concentrated solar power and enhanced yields of photovoltaic cells could result from use of stratospheric aerosol injection. Reduced energy demand for cooling and air-conditioning through temperature decrease also possible.
Economic productivity	Competition for land, water or minerals and rising prices for key commodities. Large public expenditures could crowd out other desired investments and increase energy prices.	Impact on productivity of fisheries or agriculture, increased demands on transportation infrastructure. Research and development of carbon removal and Solar Geoengineering technologies could stimulate innovation.
Cultural impacts	Cultural implications for rural communities could result from land-use changes or changes in agricultural practices. Fundamental shift in human-environment relations could also have cultural consequences.	Changes in the color of the sky could result from some forms of solar geoengineering.

Source: *see endnote* [1]

1. *Matthias Honegger, Henry Derwent, Nicholas Harrison, Axel Michaelowa, and Stefan Schäfer, "Carbon Removal and Solar Geoengineering: Potential implications for delivery of the Sustainable Development Goals," (New York: Carnegie Climate Geoengineering Governance Initiative, May 2018).*

Glossary

Adaptation—Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.[1]

Albedo—The fraction of solar radiation reflected by a surface or object, often expressed as a percentage. Snow-covered surfaces have a high albedo, and vegetation-covered surfaces and oceans have a low albedo. The Earth's planetary albedo varies mainly through varying cloudiness, snow, ice, leaf area and land cover changes.[2]

Carbon Removal (also known as Carbon Dioxide Removal or CDR) —Techniques which remove CO2 from the atmosphere.

Climate Engineering—Intentional large-scale human interference in the earth system to combat climate change. Also called Geoengineering.

Emissions Reductions—The scaling back of emissions of greenhouse gases from human activities, often through the use of energy-efficient technologies, changes in land use, or reductions in consumption.

Geoengineering—Intentional large-scale human interference in the earth system to combat climate change. Also called Climate Engineering.

Greenhouse Gases—Atmospheric gases that trap heat and cause the planet to warm. Carbon dioxide, methane, nitrous oxide and fluorinated gases are common greenhouse gases. This report focuses on carbon dioxide.[3]

IPCC—Intergovernmental scientific body set up by the UN to provide policy-relevant information on latest scientific knowledge on climate change and its political and economic impact.

Mitigation—Refers to emissions reductions, but the term is used more expansively by the IPCC to include carbon removal activities as well.[4] The term is largely avoided in this report because of its ambiguity.

Negative emissions—see Carbon Removal

Solar Engineering (also known as Solar Radiation Management, or SRM) —Techniques to reflect more solar radiation into space, reducing temperatures and addressing a symptom (but not cause) of climate change.

1. *United Nations Framework Convention on Climate Change, "Fact sheet: The need for adaptation," at https://unfccc.int/files/press/backgrounders/application/pdf/press_factsh_adaptation.pdf, viewed November 25, 2018.*
2. *Glossary terms are from C2G2, "Geoengineering Glossary," at https://www.c2g2.net/glossary/ viewed November 25, 2018, except where noted.*
3. *USEPA, "Overview of Greenhouse Gases," at https://www.epa.gov/ghgemissions/overview-greenhouse-gases, viewed November 25, 2018.*
4. *IPCC, "Definition of Terms Used in the DCC Glossary," at http://www.ipcc-data.org/guidelines/pages/glossary/glossary_lm.html, viewed November 25, 2018.*

Online Resources on Religion and Climate Change

http://greenfaith.org
GreenFaith's website contains information and resources on a number of environmental issues. Further information on religion and climate engineering is available on the "Climate Engineering" page.

http://fore.yale.edu
The Forum on Religion and Ecology has created an online resource on the religions of the world and ecology. In addition to links and multimedia resources on religion and environmental issues, there is a section that provides important information about faith and climate change: statements and resolutions from religious bodies, articles on religion and climate change, and a bibliography of theological and ethical treatments of climate change.

Further Reading on Climate Engineering

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Contributors

Arianne van Andel has a Master´s degree in Systematic Theology from the Vrije Universiteit in Amsterdam. Based in Chile, she has been working as a researcher and educator on gender and climate justice at the Centro Ecuménico Diego de Medellín in Santiago. She is member of GEMRIP, the Study Group on Religion and Advocacy, and is a GreenFaith Fellow.

Saffet Abid Catovic is an American Muslim Environmental Leader of Bosnian-Anglo decent. He is one of the first GreenFaith Muslim Fellows and is Co-founder and Chair of the Green Muslims of New Jersey (GMNJ). He is a founding board member of the Islamic Society of North America's (ISNA) Green Initiatives. He was a consultant to the Drafting Committee of the Islamic Declaration on Global Climate Change and a founding member of the Global Muslim Climate Network (GMCN). He is also a member of the Parliament of World Religions Climate Action Task Force. He serves as the Imam and Muslim Chaplain at Drew University, Madison, New Jersey.

Forrest Clingerman, Ph.D., is Professor of Religion and Philosophy at Ohio Northern University. He has published theological and philosophical work on topics such as climate change, environmental aesthetics, the idea of place, and the Anthropocene. With Kevin J. O'Brien, he is co-editor of Theological and Ethical Perspectives on Climate Engineering: Calming the Storm (Lexington, 2016).

Celia Deane-Drummond, Ph.D., is currently Professor in Theology at the University of Notre Dame, IN, USA. She is also Director Designate of the Laudato Si' Research Institute, to be based at Campion Hall, Oxford University from the start of the academic year 2019-2020. Her research interests are in the engagement of theology and biological sciences. She has published over two hundred scholarly and scientific articles or book chapters, and is sole author or editor of twenty-five books, including Wisdom of the Liminal: Human Nature, Evolution and Other Animals (Eerdmans, 2014) and A Primer in Ecotheology: Theology for a Fragile Earth (Wipe and Stock, 2017).

Çağdaş Dedeoğlu, Ph.D., is Research Associate at The Center for Critical Research on Religion and a member of the International Society for the Study of Religion, Nature and Culture. He completed postdoctoral research at the University of Florida Department of Religion.
Dedeoğlu's research interests include political ecology of religion and security.

Gary Gardner is a researcher, writer, and speaker on global sustainability issues, with more than two decades' experience at the Worldwatch Institute. An educator at heart, Gary translates for lay audiences the science and policy surrounding the great sustainability challenges of our time. He is currently an independent consultant on sustainability education.

Rev. Fletcher Harper is Executive Director of GreenFaith, an international, interfaith environmental organization that supports leadership training for faith leaders from diverse backgrounds, activist campaigns, and advocacy on climate and environmental issues, and local multi-faith environmental organizing. He is author of GreenFaith: Mobilizing God's People to Protect the Planet (Abingdon 2015)

Laura M. Hartman, Ph.D., is Assistant Professor of Environmental Studies at Roanoke College. She specializes in religious and philosophical environmental ethics, transportation justice, and climate change ethics. Recent books include That All May Flourish: Comparative Religious Environmental Ethics (Oxford, 2018) and The Christian Consumer: Living Faithfully in a Fragile World (Oxford, 2011).

Mat McDermott is Director of Communications for the Hindu American Foundation. He has a M.S. in Global Affairs, with a concentration in energy and environmental policy, from New York University and a B.A. in Writing & Literature from Burlington College. Mat is a former editor at TreeHugger, as well as a regular contributor to Hinduism Today and numerous other online publications. He is the lead author of the 2015 Hindu Declaration on Climate Change, a joint project of HAF and The Bhumi Project.

Duncan McLaren, Ph.D., is a part-time Research Fellow at Lancaster University investigating the interactions between greenhouse gas removal and emissions reduction in climate policy. His PhD, completed in 2017, examined the justice implications of geoengineering. In his previous career, Duncan worked for many years as an environmental researcher and campaigner.

Kevin J. O'Brien, Ph.D. is Professor of Religion and Dean of Humanities at Pacific Lutheran University. He wrote The Violence of Climate Change (Georgetown University, 2017), co-edited Theological and Ethical Perspectives on Climate Engineering: Calming the Storm (Lexington, 2016) and co-wrote An Introduction to Christian Environmentalism with Kathryn Blanchard (Baylor, 2014).

Hava Tirosh-Samuelson, Ph.D., is a Jewish intellectual historian who has written on Jewish philosophy and mysticism, religion, science, and technology, and religion and ecology. She is Regents' Professor of History, Director of Jewish Studies, and Irving and Miriam Lowe Professor of Modern Judaism at Arizona State University. Tirosh-Samuelson is the author/editor of 30 books, including Judaism and Ecology: Created World and Revealed Word (Harvard, 2002); The Legacy of Hans Jonas: Judaism and the Phenomenon of Life (Brill, 2008); and Perfecting Human Futures: Transhumanist Visions and Technological Imaginations (Springer, 2016).

Ven. Bhikkhu Vivekānanda has been teaching insight meditation at Panditārāma Lumbini, Nepal and internationally for over two decades. He has written several articles about environment conservation and has co-authored an article on "An Assessment of Climate Engineering from a Buddhist Perspective," published in the Journal for the Study of Religion, Nature and Culture.

Adinarayanan Venkatachalam is co-founder of the Anaadi Foundation, and a yogi and visionary. With an MS from North Carolina State University he has more than 13 years of experience in industry and academia. He spent more than 100 days in intense meditation and works for societal well-being through a multidisciplinary approach blending Yoga, Neuroscience, Ayurveda and Sustainability.

Smrithi Rekha Venkatasubramanian is co-founder of the Anaadi Foundation, and a spiritual mentor, educator and researcher. She has an MS from State University of New York, Buffalo and Amrita University and more than 13 years of experience in industry, academia and research. She is passionate about drawing insights from Indian tradition for sustainable living and development.

Kyle Whyte, Ph.D. (Potawatomi), holds the Timnick Chair and teaches philosophy and community sustainability at Michigan State University. His research addresses moral and political issues concerning climate policy and Indigenous peoples, the ethics of cooperative relationships between Indigenous peoples and science organizations, and problems of Indigenous justice in public and academic discussions of food sovereignty, environmental justice, and the Anthropocene.