# CLIMATE ENGINEERING AND THE LAW

Climate change is increasingly recognized as a global threat, and is already contributing to record-breaking hurricanes and heat waves. To prevent the worst impacts, attention is now turning to climate engineering – the intentional large-scale modification of the environment to reduce the impact of climate change. The two principal methods involve removing some carbon dioxide from the atmosphere (which could consume huge amounts of land and money, and take a long period of time), and reducing the amount of solar radiation reaching the Earth's surface, perhaps by spraying aerosols into the upper atmosphere from airplanes (which could be done quickly but is risky and highly controversial). This is the first book to focus on the legal aspects of these technologies: what government approvals would be needed; how liability would be assessed and compensation provided if something goes wrong; and how a governance system could be structured and agreed internationally.

Michael B. Gerrard is a professor and Director of the Sabin Center for Climate Change Law at Columbia Law School.

Tracy Hester is a lecturer at the University of Houston Law Center.

# Climate Engineering and the Law

## REGULATION AND LIABILITY FOR SOLAR RADIATION MANAGEMENT AND CARBON DIOXIDE REMOVAL

*Edited by*

**MICHAEL B. GERRARD**
Columbia Law School

**TRACY HESTER**
University of Houston Law Center

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# Contents

# Contributors

**Michael B. Gerrard** is Andrew Sabin Professor of Professional Practice and Director of the Sabin Center for Climate Change Law at Columbia Law School, and Chair of the Faculty of Columbia's Earth Institute. From 1979 through 2008 he practiced environmental law full-time in New York City, most recently as partner-in-charge of the New York office of Arnold & Porter (where he is now Senior Counsel). He formerly chaired the American Bar Association's Section of Environment, Energy, and Resources. He received his BA from Columbia and his JD from New York University School of Law.

**Tracy Hester** is a lecturer at the University of Houston Law Center, where he directs the speaker activities and academic events for its Energy, Environment and Natural Resources Center. Prior to joining academia, he practiced environmental law for 24 years, most recently as the partner-in-charge of Bracewell LLP's Houston environmental group (where he still acts as Counsel). He has also served on the governing Council of the American Bar Association's Section of Environment, Energy, and Resources, and chaired its enforcement, congressional relations, young lawyers, and law professor committees. He received his JD from the Columbia Law School and his BA from the University of Texas at Austin (Plan II).

**Michael Burger** is Executive Director of the Sabin Center for Climate Change Law and Research Scholar and Lecturer-in-Law at Columbia Law School. Mr. Burger graduated from Brown University and Columbia Law School. He also has an MFA in creative writing from New York University.

**Justin Gundlach** is a Fellow at the Sabin Center for Climate Change Law and an Associate Research Scholar at Columbia Law School. He holds a BA from Wesleyan University, an MSc from the London School of Economics,

and a JD from New York University Law School. He previously worked as a clinical teaching fellow and staff attorney at Georgetown University Law Center's environmental litigation clinic.

**Eli Kintisch** is a contributing correspondent with *Science* magazine and an independent producer in Washington, DC. His book *Hack the Planet: Science's Best Hope – or Worst Nightmare – for Averting Climate Catastrophe* (2010) was given a starred review by *Publisher's Weekly*.

**Albert C. Lin** is a professor of law at the University of California, Davis School of Law. He previously was a trial attorney for the Environment and Natural Resources Division of the US Department of Justice and a law clerk to federal appellate judges James Browning and Merrick Garland. Professor Lin received his JD from the University of California, Berkeley School of Law and an MPP from the Kennedy School of Government.

**Jesse L. Reynolds** is a postdoctoral researcher at the Utrecht Centre for Water, Oceans and Sustainability Law of Utrecht University. He has degrees in international public law from Tilburg University; in environmental policy from the University of California, Berkeley; and in chemistry and environmental sciences from Hampshire College.

# Preface and Acknowledgments

This book is born out of our shared experiences and convictions. We have stood on beaches of islands facing creeping extinction from rising oceans, or watched sky-blue glacial ice melt irrevocably during its retreat to a shrinking spawning ground. Each of us picked through wreckage in our home towns left by hurricanes that reached astonishing size and inflicted immense damage, perhaps fueled in part by ocean waters raised and warmed by climate change (Sandy in New York, Ike and Harvey in Houston). And both of us know that if predictions of climate change prove true – even the moderate forecasts – all of us could soon forever lose hosts of imperiled species, irreplaceable landscapes, and fragile ecosystems. More urgently, and tragically, untrammeled and accelerating climate change could mean unanswerable suffering for entire populations of people who live in the most vulnerable areas with the least resources to adapt, and many of these people may not survive these ordeals.

These facts and experiences emphasize that climate change is among the most fundamental and important challenges of our era, and certainly the greatest in the realm of environmental law and policy. Both of us also share the conviction that, based on past performance and likely future behavior, the world's nations and leaders have not taken action that is remotely close enough to answer the peril. Until we collectively find a way to reduce, then stop, and then remove our emissions of greenhouse gases into the atmosphere, the urgency of the challenge and the threat of losses will only grow. This situation demands that we explore all options and possible solutions.

The two of us also share a common history in another respect. We both had long careers practicing environmental law in the private sector (Michael in New York, Tracy in Texas) and then transitioned to academia. This has given us a sense of the power and limitations of law, and the importance of exploring new legal approaches to emerging problems, while keeping an eye on what is achievable in the real, messy world.

We both firmly believe that the best solution to the climate problem is a major reduction in greenhouse gas emissions, especially from the most important sector, energy use. We have both worked very hard in advancing legal approaches toward this end.[1] It is also clear, however, that despite the world's best efforts, this transformation will not happen fast enough to avoid many adverse impacts, and it will be necessary to adapt to the climate change that is certain to occur. We have written extensively on the legal issues associated with adaptation.[2]

But even adaptation will not be enough. Barring unanticipated and swift technological and political transformations, concerted efforts at both mitigation (reducing emissions) and adaptation (preparing for the impacts that cannot be prevented) will still not be enough to prevent disasters in many parts of the world – maybe not next year, but in the decades to come.

This leads us to exploration of something we have also been writing about for several years:[3] climate engineering – the intentional manipulation of the Earth's environment and atmosphere to offset the effects of man-made climate change. These technologies are still in their earliest stages, and unsurprisingly the very concept has proven highly controversial. But as attempts to reduce greenhouse gas emissions continue to fall short and the prospects for sufficient future reductions grow dimmer, the calls for research and limited testing have grown more persistent and persuasive.

No one prefers climate engineering as the first and primary response to climate change, but we will almost certainly need large-scale carbon dioxide removal from the ambient atmosphere in the future, and the prospects that solar radiation management will be pursued appear strong enough to justify mapping out a governance plan for it before anyone attempts to test or deploy that technology. And, most important, the challenges of all climate engineering approaches make it all the more pressing to continue our efforts for effective and real reductions in global greenhouse gas emissions.

This volume helps further that debate and exploration. It is the first book devoted exclusively to the legal challenges posed by climate engineering research, development, and deployment. We are fortunate to have several extraordinary academics and practitioners join us in analyzing the legal issues posed to climate engineering by international law, national domestic environmental laws, and general principles for liability. The front lines of climate engineering – research and testing – receive their own separate consideration. For the most significant legal hurdles, we have tried to provide practical and useful perspectives on approaches to resolve the concerns raised by the legal challenge (where appropriate).

Michael would like to thank his colleagues at Columbia Law School, the Sabin Center for Climate Change Law, and Columbia's Earth Institute for stimulating conversations and legal and scientific insights; and Cullen Howe for his help in putting the manuscript in final form. Most importantly, he wants to thank his wonderful family – Barbara, David, William, Grace, and Anya – for their love and support.

Tracy would like to thank the many helpful colleagues who made his contribution to this book possible, including research grant assistance from the University of Houston Law Center and insights and feedback from his invaluable research assistants (Spencer Taylor and Lauren Stelck). And most important, he wants to thank Linda, his ever-supportive, wonderfully intelligent, and always inspiring wife. He couldn't have done this book without her.

## NOTES

1 E.g., *see* Michael B. Gerrard, ed., *The Law of Clean Energy: Efficiency and Renewables* (American Bar Association, Section of Environment, Energy, and Resources 2011); Michael B. Gerrard & John Dernbach, eds., *Legal Pathways to Deep Decarbonization in the United States* (forthcoming 2018).

2 E.g., *see* Michael B. Gerrard & Katrina Fischer Kuh, eds., *The Law of Adaptation to Climate Change: US and International Aspects* (American Bar Association 2012); Michael B. Gerrard & Gregory E. Wannier, eds., *Threatened Island Nations: Legal Implications of Rising Seas and a Changing Climate* (Cambridge University Press 2013).

3 See, e.g., T. Hester, *A Matter of Scale: Regional Climate Engineering and the Shortfalls of Multinational Governance*, 3 CARBON AND CLIMATE LAW REVIEW. 168 (2013); *Climate Change Geoengineering: Legal, Political and Philosophical Perspectives*, ed. W. Burns (Oxford University Press 2012) (chapter by T. Hester, Applying US Environmental Laws to Climate Engineering); T. Hester, *Remaking the World to Save It: Applying U.S. Environmental Law to Climate Engineering Projects*, 38 ECOLOGY LAW QUARTERLY. 851 (2011).