

[Stewart Brand](#)—a contender for the most interesting living person in the world—famously opened the [Whole Earth Catalogue](#) in 1969, “We are as gods and might as well get good at it.” Importantly (and often misunderstood), he meant not that we *are* gods, but instead that technologies have given humanity powers that had previously been exclusive to the gods. Given this, being good at it would be better than being bad or merely blindly moving forward. Of course, what “being good at it” encompasses is open to some debate.



Brand in 2020, via Cmichel67 at Wikimedia.

Forty years later, Brand updated this advice as “[We are as gods and have to get good at it](#)” in his [Whole Earth Discipline: An Ecopragmatist Manifesto](#), the book that led me to take seriously emerging technologies’ potential to further sustainability. By 2009, environmental challenges—especially climate change—were severe enough that humans have obligations to understand how technologies can help overcome them and to use these technologies, as appropriate. Twelve years later, this seems only more so.

Along these lines, I have been thinking about the ways in which we already “are as gods” through [our management of Earth systems at large scales](#). [In my research on solar geoengineering](#), [carbon dioxide removal](#), and [gene drives](#), I began to wonder whether these proposed technologies are—as many claim—fundamental breaks from past activities or merely additional points along a continuum, albeit somewhat further out.

I thus wrote the paper “[Earth System Interventions as Technologies of the Anthropocene](#),” which was published (open access!) this week in *Environmental Innovation and Societal Transitions*. I define Earth system interventions (ESIs) as intentional large-scale

interventions in Earth systems and consider possible past ones: agriculture, landscape burning, rearranging land and water, nitrogen cycle management, and ecosystem restoration. Despite this history, some emerging ESIs appear quite different from past ones in that their intentionality of large-scale effects is clearer, most use high-leverage technologies, and the scientists developing them are aware of, if not aiming to reduce, humanity's environmental impact. These emerging, high-tech ESIs include carbon dioxide removal, solar geoengineering, genetic modification of wild populations, gene drive organisms, de-extinction, and perhaps high-tech ecosystem restoration. Some of these appear both feasible and necessary to achieve important sustainability and human welfare objectives.

As a scholar of governance, I see that these new ESIs tend to share some social, political, and ethical challenges:

- *The goal of environmental governance*: Are they to restore pre-industrial conditions as much as possible, to help humanity sustainably thrive, to compensate for past wrongs, or something else?
- *Displacement of other responses*: Some are concerned that new technological ESIs could undermine other efforts—such as greenhouse gas emissions reduction and habitat conservation—that address problems closer to their causes.
- *Risk-risk trade-offs*: Emerging ESIs could reduce severe environmental risks and threats to human health while also posing risks of their own, but environmental governance has largely not been crafted with risk-risk trade-offs in mind.
- *Deep uncertainty*: We often know neither what we want nor what we do not know.
- *Technological lock-in and “slippery slopes”*: Some critics object that accelerating research could unduly bias future decision-making in favor of using the ESI.
- *Public good character*: From an economic perspective, ESIs will generally be public goods—nonexcludable and nonrivalrous—which must be subsidized or provided by state actors.
- *Decision-making authority*: Who—if anyone—has the legitimate authority to undertake them, especially the highly leveraged technological ESIs?
- *Distributional concerns*: Some people and groups would (perceive to) benefit more than others; some might even (perceive to) be harmed.
- *North-South divisions*: ESIs' expected or actual net effects might fall along common axes of international disagreement, especially between industrialized countries and developing ones.
- *Malicious use*: Critical observers sometimes claim that technological ESIs could be used maliciously.

- *Potential for nonstate governance*: Despite technological ESIs' high stakes, nonstate actors have substantial potential to govern them, in some cases because states are not acting.
- *Public communication and understanding*: The public may initially react negatively to technological ESIs, as many have the criteria of phenomena where lay views differ significantly from those of experts.
- *Ethics*: ESIs raise multiple serious and complex ethical issues.

The past half-century of research of and efforts toward sustainability have been dominated by reducing our impacts on the environment—and appropriately so. However, actual reductions seem insufficient, as suggested by increasing greenhouse gas emissions and biodiversity's continued decline, despite decades of international efforts on both fronts. Even though many observers may find ESIs unappealing, they deserve greater attention to help achieve sustainability. Much of this work falls within the natural sciences. Establishing well-designed governance to mitigate and manage the associated serious social, political, and ethical challenges will require informed examination of ESIs *as such*. Ultimately, humanity's relationship with the natural world in the Anthropocene—the “human epoch”—may include both an awareness that we already intervene in Earth systems as well as a resolution to do so consciously and responsibly. In other words, Brand may be correct. We should prepare for this possibility accordingly.

*If you have read this far, I'll let you know that my time at the UCLA School of Law has come to an end. I might occasionally post here to inform readers of a new publication that I wrote during my time there. You can follow my future work at [my webpage \(with blog\)](#) and/or [my Twitter feed](#). I thank you for reading, as well as my UCLA Law colleagues and Legal Planet co-bloggers for the supportive environment.*