



After Geoengineering: Climate Tragedy, Repair, and Restoration

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Introduction: Desperation Point



As philosopher Pak-Hang Wong argues, geoengineering needs to be seen “not as a one-off event but as a temporally extended process.”⁹ It’s not about the hero’s moment of action, the climax. I would add that this re-visioning of geoengineering must be directed not just into the future, but into the past as well, thereby placing climate intervention into historical context.

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January 18, 2020

Whatever form of capitalism we're living in now, it doesn't seem like a system in which carbon removal is going to evolve. The derivation of capitalism we're coping with is predatory, inelegant, and fragmented, seemingly incapable of delivering fixed-capital tools like carbon capture and storage or transformative bioenergy to extend its lifespan.

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Wark speculates on the emergence of what he calls the "vectoralist" class, a new postcapitalist ruling class that owns and controls the means of producing information: the vectors. This is actually worse than capitalism, Wark argues, because the information vector can render everything on the planet a resource.

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But unlike cleantech, Level 2 is a cleanup operation; in general, these scales of storage and disposal don't generate usable products.

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Level 2 requires a massive transformation: economic, political, cultural. It implies that we decide to treat carbon dioxide as a waste product and dedicate a significant portion of GDP to cleaning it up, at the least. It would require profound state regulation—the same sort that's needed for strong mitigation, and then some.

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There's an abyss in contemporary thinking about the role of industrial technology in coping with climate change. On one side of this abyss are people who appraise the potential of technology optimistically, but fail to articulate any real historical awareness of how technology has developed in and through contexts that are often exploitative, unequal, and even violent. On the other side of the abyss are thinkers who, on the contrary, have a deep understanding of colonialism, imperialism, and the historical evolution of capitalism, but dismiss technology as a useful part of responding to climate change.

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Wakanda forever

January 19, 2020



*Sociologist Jesse Goldstein, in *Planetary Improvement*, his critical ethnographic analysis of cleantech, observes that "the sociotechnical capacity is out there to transform the world in any number of ways," but realizing emancipatory visions will require "killing the investor" in our minds, "thereby liberating our imaginations, our sciences, and our technologies from the narrowing logic of capital."*

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Austerity Ecology and the Collapse-Porn Addicts: A Defence of Growth, Progress, Industry, and Stuff, derides the left's

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small-is-beautiful, local-retreat tendencies, pointing out that the left was not always this way: Historically, when we criticised the failings of the market, the left had no particular quarrel with industry, let alone science, technology, or medicine. We celebrated modernity. Rather, our demand had always been that the fruits of civilization should be extended to all of humanity. When did we turn away from the idea that capitalism was the problem, and begin to believe that it was modernity instead, or even the advent of mankind itself, that was the problem? 18

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 *In some kind of company with this book is Nick Srnicek and Alex Williams's *Inventing the Future: Postcapitalism and a World without Work*. Srnicek and Williams reject the localism of "folk politics" and call for repurposing technologies, pointing out that it's not just about seizing the means of production, but inventing new means of production. 19*

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 *David Keith and Josh Horton: At the risk of oversimplification, this line of argument essentially involves rich-country commentators criticizing solar geoengineering in an effort to shore up mitigation as their priority domestic climate policy, while ignoring the potentially huge distributional advantages SRM [solar radiation management] might confer on the world's poorest in the global South.*

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At the roots of this binary between geoengineering and social transformation, I think, are contemporary struggles around agriculture and food sovereignty. Contemporary agriculture is riddled with binary constructions: there's holistic agroecology versus reductionist and mechanistic industrial agriculture; resilient agroecology versus techno-fix drought-resistant crop breeding

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geoengineering is never going to be like those other emerging technologies, all of which played transformative roles in economies. Instead, carbon removal is likely to be analogous to waste control: a massive industry, but not a transformative one. Solar geoengineering, in particular, is ameliorative and not generative; that is, it doesn't generate new wealth.

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Infrastructure inscribes cultural messages in the landscape; it expresses both authorship and authority. Mega-engineering projects are hyperlegible; scale becomes a design factor.

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Part I: Cultivation

Hale's words are haunting: After all, these storehouses of gas, petroleum, and coal are precious endowments to man by nature. Human decency should teach us not to destroy them

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indiscriminately. Human kindness should teach us to preserve as much as possible for our children. Nevertheless, utter profligacy has gained the upper hand; as pirates and plunderers we seem destined to go down the road of defeated nations. 2

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bioenergy with carbon capture and sequestration (BECCS)

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For example, grasses like Miscanthus, trees like willow or poplar, and crop residues like wheat straw or woody biomass are all second-generation feedstocks. These advanced fuel crops often contain more energy, and they can grow on “marginal” land. Some of them are “cellulosic” biofuels, meaning combustibles can be produced from cellulose, the fiber of the plant.

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Algae could also be used with second-generation biofuel feedstock carbon capture in an integrated BECCS system. For example, one study proposed replacing soybean fields with algae and eucalyptus forests planted together: the biomass from the eucalyptus would provide the algae with heat, carbon dioxide, and electricity, with the remainder of the carbon stored. The system as a whole would produce more protein than soy does, with no increase in water demand. 29

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integrated multi-trophic aquaculture

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Dr. Yarish explains, “We can’t employ technologies that you see in Asia, where labor costs are very low; we have to adapt.” This means using techniques that require not ten people but one or two. Part of his approach to helping the industry get on its feet is to make all his work open source. “I made a decision a number of years ago that in order to develop a seaweed cultivation industry in North America—the biggest problem had been people trying to always do things quietly. Secretly ... And I felt that at least the primary research should be open source, so people would not have that as a limitation.” Yarish’s team has a free handbook for cultivating seaweed, as well as a great six-part introduction on YouTube.

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it’s tough for seaweeds to qualify as carbon sinks under the UN Framework Convention on Climate Change. The definition has been set up for trees—in terms of carbon turnover time—but with seaweeds, the carbon they draw down is easily decomposed and released again, and the turnover time is less than ten years (versus several decades for trees)

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But if it came from 3,000 meters below the ground in unnatural ways, asks an engineer, how can you put it back in a natural way?

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natural climate solutions. These practices are a climate-focused subset of “nature-based solutions” or “ecosystem-based solutions,” and are now an established part of the vocabulary in settings like these.

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Natural climate solutions are conservation, restoration, and land management actions that either increase carbon storage or avoid greenhouse gas emissions from ecosystems.

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this restoration narrative—which Kearnes and Rickards describe in conjunction with a “land aesthetic” that is deeply moral—is a powerful force underlying the rise of natural climate solutions, and terrestrial carbon removal in particular.

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To be “sustainable” is more like rearranging the deck chairs on the Titanic. It doesn’t do enough to move us beyond an extractive, degenerate relationship with nature. A regenerative approach is thus not about doing less harm, but about healing and restoration. His way of explaining it is with a regenerative spiral. Regeneration goes beyond just letting nature recuperate; it’s about actively working to increase flourishing.

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“Turns out that if you elevate the content in concrete with 8 percent to 12 percent biochar, it actually improves the quality of the concrete over what it had been with just sand,”

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Part II: Burial



Lackner suggests thinking of windmills as miners that pull kinetic energy out of the air.

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April 26, 2020

Even though CO₂ is dilute, it's relative—the CO₂, by this measure, is seventy times as concentrated as wind energy.

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Then, well, now you have ten tons of CO₂ at the end of the day out of your building; what are you going to do with that?

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"I got the final number," the man said, looking up from his tablet. "These units captured 406,781,200 tons of carbon over their operational cycle. That's almost all of Texas's emissions from the year 1980."

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Part III: The After-Zero Society

Many tenets of degrowth encompass what I think a best-case scenario of carbon removal would look like: directing innovation toward conviviality, frugality, and also justice. As Kallis sees it, "sustainable degrowth denotes an intentional process of a smooth and 'prosperous way down,' through a range of social, environmental, and economic policies and

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*institutions, orchestrated to guarantee that while production and consumption decline, human welfare improves and is more equally distributed.” 5 The “way down” dovetails with the narrative of removing emissions. Some of the proposals Kallis sets out in his book *In Defense of Degrowth* include basic and maximum income, green tax reform, cessation of subsidies for pollution and reallocation of these funds toward clean production, support for a solidarity society, optimization of the use of buildings, and abolition of the use of GDP as an indicator of economic progress. Many of these would enable carbon removal at scale.*

May 31, 2020

 *What about a democratically controlled industrial technology that doesn't exist to “conquer” nature?*

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July 3, 2020

 *There are tremendous opportunities for rural communities to benefit from carbon removal practices based in cultivation and burial. On the cultivation side, carbon removal policy could provide economic opportunities for farmers who take up regenerative agriculture. Public awareness and support from urban food consumers and taxpayers is crucial to bridge this gap between targets and reality, but so is demand from rural areas for subsidy redirection. On the infrastructure side, building out infrastructure and operations for carbon capture and storage with direct air capture or bioenergy would offer jobs with a similar skill set to those in the oil and gas industry, provided an effort were made to retrain workers into this field. Enhanced mineral weathering of mine tailings for fertilizer would offer mining and transport jobs. Connecting with unions and workers would be key here, and carbon removal could become part of a just transition away from fossil fuels. In any*

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case, carbon removal would be more likely to succeed and actually reach net-negative emissions if it emerged in dialogue with what rural communities need. There's

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There's a funny tension here

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here: Is this work a burden, or is it a privilege? It

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Affective labor, in contrast to alienated labor, writes Singh, involves self-expression; its ideal is a craftsman or artist, who expresses their inner self and gives to society as a whole. It can't be separated from the person doing it. The relationship between the person and the object of labor is crucial.

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What work can't be done by a computer without me?" Their answers: pursue design and creative thinking, provide a big-picture perspective, interrogate and synthesize multiple systems and results, elicit information, persuade humans to take actions, and deal with exceptions to rules—among others. They

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They point to the increased value of traits like empathy, humor, ethics, integrity, taste, vision, and the ability to inspire

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Yet this wish is in tension with the demands of the task at hand: the removal of gigatons of carbon. Are these going to be artisan jobs, performed by practitioners of a craft—as opposed to “remotely done power and glory”? Or does the scalability requirement demand remote control and configuration, orchestration? In the end, there will have to be serious engagement by the state.

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Let’s continue to imagine a world that has embarked upon carbon removal for climate restoration, and consider what they had to learn and unlearn to get there. In the following thought-experiment, I identify ten key capacities to build during early formal education, which might make realization of a carbon removal society more possible

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If oil prices were back up to one hundred dollars a barrel, the 1.7 trillion barrels of oil in reserves add up to \$170 trillion of unburnable carbon—two years of global GDP

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July 10, 2020

They are the ones that have developed and pioneered this technology—with heavy government subsidies and investment, of course. It'll be: Everyone knows climate change is bad; the international agreements aren't strong enough and aren't achieving enough; this carbon needs to be removed; and we're the only ones with the expertise, know-how, and get-things-done spirit to accomplish it.

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August 4, 2020

We need to organize an alternative narrative about how we think carbon removal should proceed, before the line that "there is no alternative" to the vision set out by the fossil fuel companies rears its ugly head. The longer we wait, the more entrenched their vision will be.

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August 4, 2020

We need Blockadia—it's helped transform the scene to the point where OPEC appears to be under siege. But for handling carbon removal, we also need a resistance that is more than reactive. We have to move from reflexive opposition of new technologies toward shaping them in line with our demands and alternative visions. To realize a just form of carbon removal, we need to challenge fossil fuel extraction differently—to take the question of what will happen to these companies head-on, and transform them ourselves.

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Part IV: Buying Time



Looking at solar geoengineering as an algorithm allows us to draw from the emerging literature on “algorithmic governance,” which questions how algorithms are used to make decisions that pattern an increasing number of aspects of our lives. One key issue is about transparency and the black-boxing of algorithms: How can a geoengineering system be designed for openness and “algorithmic accountability”—that is, explainability in real time?

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geoengineering discourses isolate geoengineering as a topic and only add in colonialism, capitalist exploitation, imperialism and other forms of domination later as governance challenges or stakeholders’ values or views that must be understood and weighed


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September 5, 2020

 Rather, reparation ecology is a way to see both history and the future: “Redistributing care, land, and work so that everyone has a chance to contribute to the improvement of their lives and to that of the ecology around them can undo the violence of abstraction that capitalism makes us perform every day.” With a similar focus on re-words, feminist science and technology theorist Donna Haraway suggests that our job “is to make the Anthropocene as short/thin as possible and to cultivate with each other in every way imaginable epochs to come that can replenish refuge.”⁵ She writes about replenishing refuges, about recuperation and recomposition—but describes these as partial, and stipulates that they “must include mourning irreversible losses.”

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January 24, 2021

 indigenous self-determination lies in the autonomy to remain unreconciled.


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 One could make a tunnel in the bedrock


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 Managing collapse implies softening deep losses. Indeed, reckoning with geoengineering in all its forms means coming to terms with loss; to explore what it means to “live in the ruins,” in anthropologist Anna Tsing’s phrase. Solar geoengineering comes as a shock to people who are attached to the idea of wilderness, who don’t currently feel as if they are living in the ruins, and who haven’t yet come to terms with the losses being experienced.

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January 24, 2021

 *The kind of lives many progressives imagine—where we are gardening, living in reasonably sized and energy-efficient homes, riding our bicycles, feeling healthy, and healing our relationships with each other and with other forms of life—are more likely to be possible at the end of the century, for our descendants, if we pursue multiple methods of carbon removal.*

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Notes

 *John Moore et al., “Geoengineer Polar Glaciers to Slow Sea-Level Rise,” *Nature**

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