Which is better for the Earth: Nature-based or human-made solutions?

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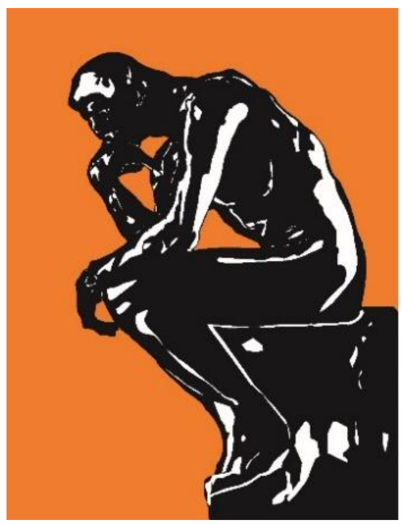

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"[…] we are not such good problem solvers for simple reasons: it is hard to define a genuine problem."

In "The Problem of a Problem Solver is… the Problem"; *Meandering Sobriety* (2023)

A recent assessment indicates that even the Paris Agreement targets of limiting warming to well below 2°C—and ideally 1.5°C—above pre-industrial temperatures are insufficiently safe. Within a warming range of 1.5 to under 2°C, six climate tipping points are likely to be triggered. These include the melting of Greenland and West Antarctic ice sheets, the die-off of low-latitude coral reefs, widespread abrupt permafrost thaw, and a sudden collapse of part of the subpolar gyre in the North Atlantic (Armstrong McKay et al., 2022). Based on consolidated data from six international monitoring datasets, the World Meteorological Organization confirmed that the global temperature was already 1.45 ± 0.12 °C above pre-industrial levels (1850-1900) in 2023 (World Meteorological Organization, 2024). Meanwhile, the National Oceanic and Atmospheric Administration reported record-high CO_2 levels in March 2024 (Milman, 2024). Reducing atmospheric CO_2 has thus become more urgent than ever to avoid passing these tipping points and mitigate the severe impacts of climate change.

Many high-tech methods, such as Carbon Capture and Storage (CCS) technologies, have been proposed as crucial tools in the fight against climate change (Wennersten et al., 2015). The launch of Climeworks' Mammoth carbon capture plant exemplifies a major step in high-tech climate mitigation efforts. With a capacity ten times larger than the company's previous plant, Orca, Mammoth in Iceland is designed to extract carbon dioxide from the atmosphere and store it underground (Limb, 2024). Projects like Mammoth and Orca are part of a growing global trend to address climate change through advanced technological approaches. Another controversial example is a project backed by Bill Gates, which proposes spraying non-toxic calcium carbonate ($CaCO_3$) into the atmosphere to block some sunlight and thereby cool the Earth (Cohen, 2021).

Nevertheless, not to say the risks associated with audacious methods like Gates's project, CCS technologies themselves face significant uncertainties, raising doubts about their effectiveness and long-term sustainability. A primary concern is the high cost of these projects, both in capital investment and operational expenses, due to complex design requirements and high customization needs (Cameron & Carter, 2023). The Orca plant alone, designed to capture 4,000 tonnes of CO_2 annually, costs $10–15 million to construct—a hefty price tag for most nations, not to mention the even larger Mammoth plant's costs (Climeworks, 2024). While Climeworks has not disclosed Mammoth's removal cost per tonne, it aims to bring technology costs down to $400–600 per tonne by 2030 (Limb, 2024).

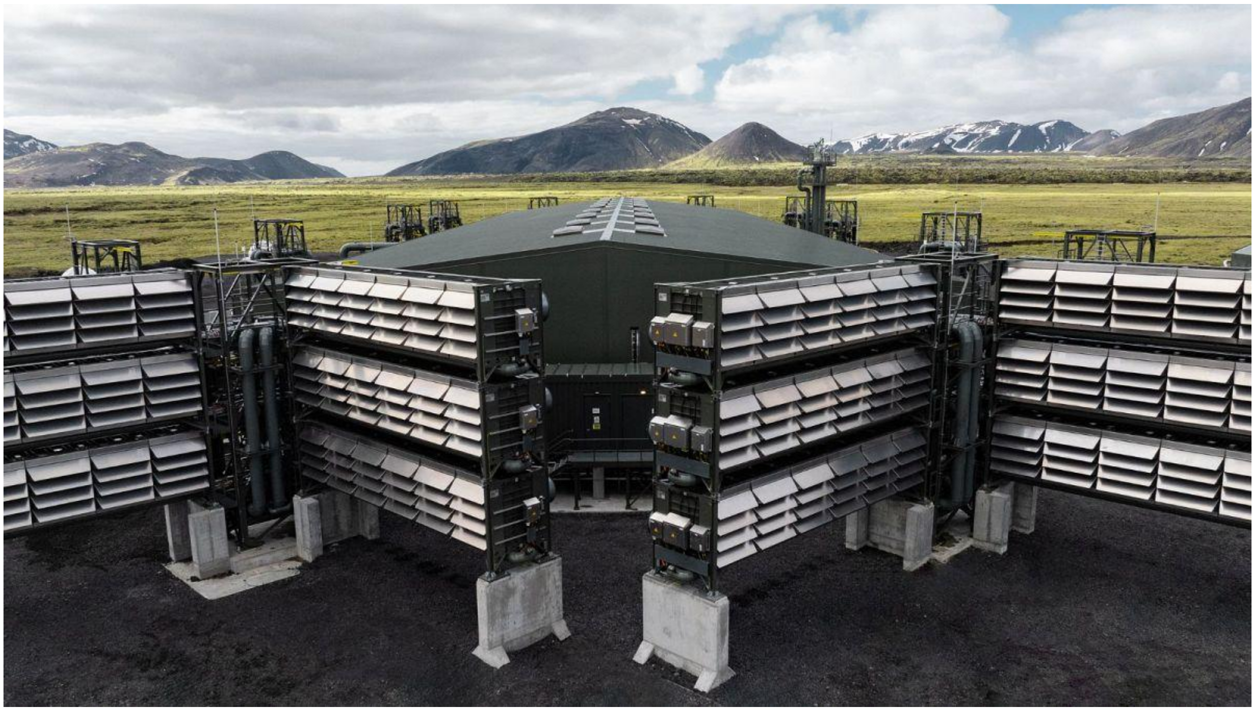

Figure 1. Inside Iceland's massive direct carbon capture plant —the largest of its kind in the world (Climeworks, 2024)

Concerns also exist over stored carbon's stability, as it must remain safely underground for centuries to prevent leaks back into the atmosphere (Mahjour & Faroughi, 2023). CCS projects may emit carbon during construction and operation. While Climeworks' Mammoth and Orca plants operate within Iceland's Hellisheiði geothermal park, harnessing Iceland's low-GHG geothermal energy, most countries lack such low-carbon energy sources. Currently, despite the rapid rise in wind and solar energy, fossil fuels still make up roughly 82% of the global energy mix (Ritchie, 2021). According to a recent IEA report, current oil and gas use would require capturing or removing 32 billion tonnes of carbon to limit global warming to 1.5°C—an endeavor that would require constructing many Orca-sized plants, each costing $10–15 million (Limb, 2024). Apparently, this is economically unfeasible. Additionally, policy, regulatory, and economic uncertainties have caused many CCS projects to fail; over 80% have ended unsuccessfully (Abdulla et al., 2020).

As humans search for high-tech solutions to combat climate change, a recent natural event hints at the possibility of working with nature. Rare floods recently swept across the Sahara Desert, one of the driest places on Earth (Paddison, 2024). In September 2024, torrential rains in parts of the desert turned barren areas green. This unusual weather was caused by an extratropical storm that brought substantial rainfall to the region, raising water levels to heights unseen in decades. Satellite images showed flooded areas and vegetation sprouting in normally dry sandy regions (Gilbert, 2024). In places like Morocco's Iriqui National Park, even dried-out lakes were revived (Ferrari, 2024).

Although reforesting the Sahara might sound far-fetched, historical studies show that this desert was once much greener, supporting diverse plant and animal life (Armstrong et al., 2023). Using natural restoration methods like tree planting and sustainable water management could offer a more balanced solution for addressing both local environmental challenges and the global climate crisis, as well as other mutual benefits: creating rich habitats, improving biodiversity, capturing carbon, and supporting local livelihoods.

Figure 2. Buildings along a lake in the desert town of Merzouga were flooded by heavy rains on October 2, 2024. (Paddison, 2024)

The rare event occurring in the Sahara raises important questions: Are such high-tech solutions truly sustainable? Can the climate crisis be solved more naturally? Why not focus on organic methods—such as afforestation, reforestation, soil restoration, or even re-greening the Sahara? Which path leads to the most sustainable future?

High-tech, expensive, and often experimental solutions, like carbon capture plants or atmospheric dusting, seem to introduce more uncertainties for ecosystems, especially as climate tipping points loom closer. In contrast, working with natural systems—such as forest restoration, sustainable agriculture, and ecosystem rehabilitation—offers a reliable path to addressing climate change, restoring ecological balance, supporting local communities, and strengthening human connections with nature (Minx et al., 2018).

Nonetheless, why do nature-based solutions seem overlooked and underfunded while billions are funneled into less effective high-tech approaches? (Cheng, 2024; UNEP, 2023). According to the Intergovernmental Panel on Climate Change (IPCC), even if CCS reaches its full potential, it will account for only about 2.4% of global carbon mitigation by 2030 (IPCC, 2023). Investing billions in CCS perpetuates an outdated eco-deficit culture, where industries try to replace nature by planting "artificial trees" to capture carbon (Vuong & Nguyen, 2024a, 2024b). The Institute for Energy Economics and Financial Analysis notes that CCS "is an expensive and unproven technology that distracts from global decarbonization efforts while allowing the oil and gas industry to conduct business as usual" (IEEFA, 2024). Meanwhile, funds for local communities to care for carbon sinks in developing countries are often withheld (Forest Tenure Funders Group & UKAid, 2022).

In sum, as we grapple with climate change, we must increasingly heed nature's lessons and consider the solutions we choose (Vuong et al., 2024). Recent events in the Sahara remind us that nature when given the opportunity, has an astonishing capacity to heal itself. A green Sahara might not be a fantasy but a potential future if we choose to work with Earth rather than against it. The debate between costly and uncertain high-tech solutions versus reliable nature-based approaches continues (Nguyen, 2024; Vuong, 2024). However, failing to recognize the importance of nature-based solutions and to act decisively may leave us exhausted because of investing in less effective measures while the impacts of climate change only grow more severe.

References

Abdulla, A., Hanna, R., Schell, K. R., Babacan, O., & Victor, D. G. (2020). Explaining successful and failed investments in US carbon capture and storage using empirical and expert assessments. *Environmental Research Letters*, *16*(1), 014036. https://doi.org/10.1088/1748-9326/abd19e

Armstrong, E., Tallavaara, M., Hopcroft, P. O., & Valdes, P. J. (2023). North African humid periods over the past 800,000 years. *Nature Communications*, *14*(1), 5549. https://doi.org/10.1038/s41467-023-41219-4

Armstrong McKay, D. I., Staal, A., Abrams, J. F., Winkelmann, R., Sakschewski, B., Loriani, S., . . . Lenton, T. M. (2022). Exceeding 1.5 C global warming could trigger multiple climate tipping points. *Science*, *377*(6611), eabn7950. https://doi.org/10.1126/science.abn7950

Cameron, L., & Carter, A. (2023). *Why the cost of carbon capture and storage remains persistently high*. https://www.iisd.org/articles/deep-dive/why-carbon-capture-storage-cost-remains-high

Cheng, P. (2024). *How investing more in nature can help human, community and planetary health to thrive*. https://www.weforum.org/stories/2024/09/how-pharma-companies-are-investing-in-nature-to-improve-human-and-planetary-health/

Climeworks. (2024). *Orca: the first large-scale plant*. https://climeworks.com/plant-orca

Cohen, A. (2021). *A Bill Gates venture aims to spray dust into the atmosphere to block the sun. What could go wrong?* https://www.forbes.com/sites/arielcohen/2021/01/11/bill-gates-backed-climate-solution-gains-traction-but-concerns-linger/
Ferrari, O. (2024). *Sahara desert hit by extraordinary rainfall event that could mess with this year's hurricane season*. https://www.livescience.com/planet-earth/weather/rain-in-the-sahara-could-be-connected-to-a-calmer-atlantic-hurricane-season
Forest Tenure Funders Group, & UKAid. (2022). *Indigenous peoples and local communities forest tenure pledge annual report 2021-2022*. https://landportal.org/library/resources/indigenous-peoples-and-local-communities-forest-tenure-pledge-annual-report-2021
Gilbert, M. (2024). *An unusual shift in the weather has turned the Sahara green*. https://edition.cnn.com/2024/09/13/weather/sahara-desert-green-climate/index.html
IEEFA. (2024). *Carbon Capture and Storage*. https://ieefa.org/ccs
IPCC. (2023). *AR6 synthesis report: Climate change 2023*. https://www.ipcc.ch/report/sixth-assessment-report-cycle/
Limb, L. (2024). *World's largest air capture plant opens in Europe. Is it really a 'misguided scientific experiment'?* https://www.euronews.com/green/2024/05/09/worlds-largest-air-capture-plant-opens-in-europe-is-it-really-a-misguided-scientific-exper
Mahjour, S. K., & Faroughi, S. A. (2023). Risks and uncertainties in carbon capture, transport, and storage projects: A comprehensive review. *Gas Science and Engineering*, *119*(A), 205117. https://doi.org/10.1016/j.jgsce.2023.205117
Milman, O. (2024). *Record-breaking increase in CO2 levels in world's atmosphere*. https://www.theguardian.com/environment/article/2024/may/09/carbon-dioxide-atmosphere-record
Minx, J., Fuss, S., & Nemet, G. (2018). *Guest post: Seven key things to know about 'negative emissions'*. https://www.carbonbrief.org/guest-post-seven-key-things-to-know-about-negative-emissions/
Nguyen, M.-H. (2024). Natural absurdity: How satirical fables can inform us of a vision for sustainability? https://philarchive.org/rec/NGUNAH
Paddison, L. (2024). *The Sahara Desert flooded for the first time in decades. Here's what it looks like*. https://edition.cnn.com/2024/10/14/weather/sahara-desert-floods-climate/index.html
Ritchie, H. (2021). *How have the world's energy sources changed over the last two centuries?* Our World in Data. Retrieved June 05 from https://ourworldindata.org/global-energy-200-years
UNEP. (2023). *State of finance for nature 2023*. https://www.unep.org/resources/state-finance-nature-2023
Vuong, Q.-H. (2023). *Meandering sobriety*. https://www.amazon.com/dp/B0C2TXNX6L/
Vuong, Q.-H. (2024). *Wild Wise Weird*. https://www.amazon.com/dp/B0BG2NNHY6
Vuong, Q.-H., & Nguyen, M.-H. (2024a). *Better economics for the Earth: A lesson from quantum and information theories*. https://www.amazon.com/dp/B0D98L5K44/
Vuong, Q.-H., & Nguyen, M.-H. (2024b). Further on informational quanta, interactions, and entropy under the granular view of value formation. https://doi.org/10.2139/ssrn.4922461

Vuong, Q. H., La, V.-P., & Nguyen, M.-H. (2024). Serendipity and inherent non-linear thinking can help address the climate and environmental conundrums. https://doi.org/10.2139/ssrn.4768399

Wennersten, R., Sun, Q., & Li, H. (2015). The future potential for Carbon Capture and Storage in climate change mitigation–an overview from perspectives of technology, economy and risk. *Journal of Cleaner Production*, *103*, 724-736. https://doi.org/10.1016/j.jclepro.2014.09.023

World Meteorological Organization. (2024). *WMO confirms that 2023 smashes global temperature record*. Retrieved June 10 from https://wmo.int/media/news/wmo-confirms-2023-smashes-global-temperature-record