What are we hoping to sustain? A Personal Ecology

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I'm listening to Icelandic pianist Vikingur Ólafsson play his arrangement of “The Arts and the Hours” by the 18th century French composer Jean-Phillipe Rameau. And I'm thinking about sustainability.

To be honest, I’ve gone through several phases of rethinking sustainability over the years I’ve been teaching. When I started, I was concerned that the whole topic was bogged down by fuzziness. Under the spell of Ólafsson’s playing, my treatment here will be somewhat unconventional. But I will try to outline one clear (narrow) idea of sustainability before moving to broader thoughts.

In my ecology courses, we work through primordial questions: Why do we eat food? Why do we breathe air? What do plants “eat and breathe”? Where does the biomass of trees come from? Where does this mass go when a tree dies and decomposes on the ground? The answers are surprising to most college students. Energy and carbon flow through all these questions.

When I get to global ecology, we sketch a simple model of the global carbon cycle (Figure 1) and cover the science of climate change that is closely tied to that cycle. The main evidence for human-caused global warming can be summed up as follows: CO_2 is a heat-trapping gas; it is increasing in the atmosphere; the increase is due to humans burning fossil fuels; the planet is warming; the warming is only explainable by human-caused emissions of CO_2 and other greenhouse gases.[1]

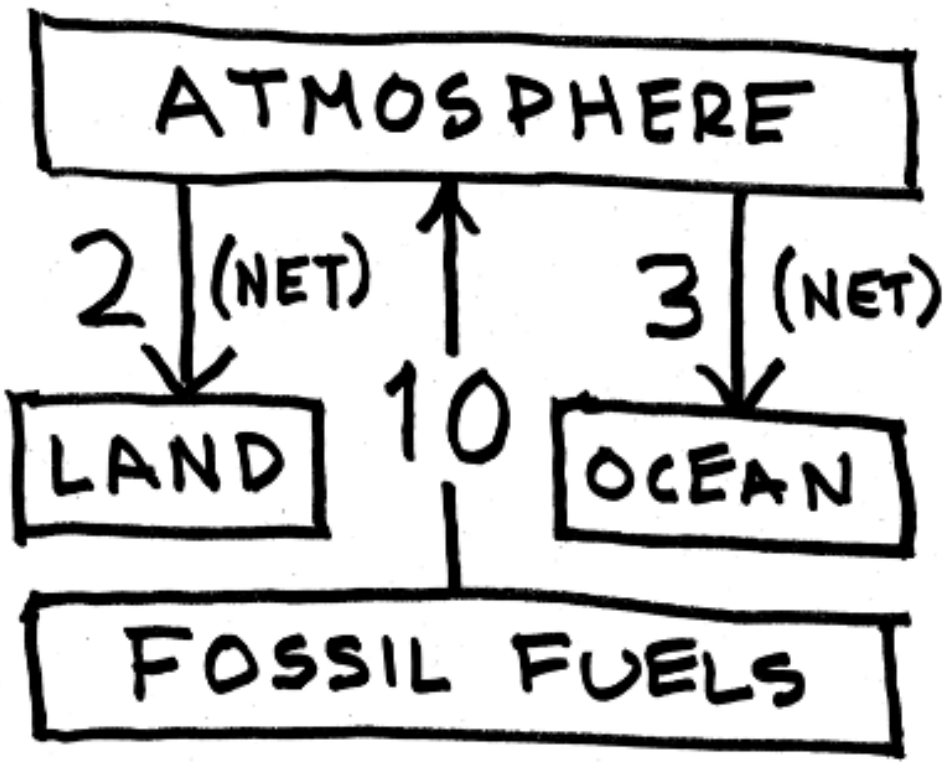


Figure 1. Sketch of the global carbon cycle. Arrows represent "net fluxes" (transfers) of carbon in gigatons of C per year. Flux values are rounded averages for the period 2014 - 2023.[2]

Figure 1 is also the gateway into a quantitative understanding of climate change solutions. Over the past decade or so, we have been emitting CO_2 into the atmosphere at an average rate of about 10 gigatons of carbon per year, while land ecosystems and oceans have captured about 2 and 3 net gigatons of carbon per year respectively. It is easy to see that the rate of emissions is about double the rate of carbon capture, which means CO_2 is increasing in the atmosphere every year. So, our planet has an unstable atmosphere. We are living in a gradually warming world.

Now for one succinct, unfuzzy articulation of sustainability, at least in the narrow context of carbon and climate: Rearrange the numbers in the diagram. There are an infinite number of ways to make *sources* (emissions to the atmosphere) equal *sinks* (total net capture by land and oceans). Sustainability, applied to our atmosphere, requires a balance of sources and sinks, which would produce a stable atmosphere.

The sooner we reach a point where atmospheric greenhouse gases are stable or decreasing, the sooner global temperatures will stabilize. Looking at Figure 1, it is easy to see that stabilizing atmospheric CO_2 involves either increasing the total net uptake rate of CO_2 by land and oceans (sinks) or reducing emissions from fossil fuels (sources). Increasing sinks will likely become more difficult as the planet warms, so a baseline goal is to maintain sinks at current rates. With that approach, Figure 1 shows that global emissions need to be cut roughly in half, probably more if sinks weaken over time. If we hope to draw CO_2 concentrations down, even greater cuts

will be needed. With this basic quantitative understanding at the global scale, we can start to evaluate specific strategies and scale our actions down from the global, to the national, to the community, to the personal.

But now, as a matter of equity, things may get uncomfortable. At the national level, we should compare our average per-capita emissions to other nations. Alternatively, we could ask all highemitting individuals around the world to cut emissions, regardless of their nationality (Chakravarty 2009). If you live in the US, it doesn't matter which approach you take. Our average per-capita emissions are roughly four times the global average, twice the average for a European or Chinese person, and more than eight times the average for a citizen of India or Bangladesh.[3] Almost all of us in the US are high-emitters no matter how you look at it. Accounting for global climate justice, our US national goal must be to reduce emissions by substantially more than 50%.

How can we do this? To understand the relative benefits and burdens of various actions, frameworks like Drawdown (Hawken 2017) or the Wedges (Pacala and Socolow 2004) are helpful. Climate solutions are at hand, and some are rapidly being deployed. Almost all these strategies will require government action so that burdens are shared fairly across society. In 2022 in the US, we passed a climate bill that provided incentives for lowering emissions. In this context, debates about collective vs. personal actions present a false dichotomy. Voting for government action on alternative energy is a personal action *to affect* a collective decision. Taking advantage of those incentives is a personal action *enabled* by a collective decision. The time for personal action in the US is now.

I believe a scientific and quantitative grip can instill hope and action on the climate problem. But science, on its own, is not always a motivator. Likewise, appealing to long-term risks or international justice might not work. Climate-related emergencies are now a regular occurrence worldwide, but there is still no shared sense of urgency. In the US, we are promised inalienable rights: life, liberty, and pursuit of happiness. The shared burdens of acting on climate can always be postponed. Because of this, we live in cognitive dissonance, vaguely aware that our current patterns of energy and resource use are unsustainable, but unwilling or unable to change course.

In 2024, in a talk I gave to teachers in the New York State Master Teacher Program, I showed a video of a childhood friend and professional surfer, Rick Lasch, riding a wave. His movements are graceful, not flashy. In long flowing lines, he coaxes energy out of the wave, carving, rising, coming off the lip, ducking and turning through multiple breaking sections – a long ride. Consider this image from the perspective of human-environment interaction. The wave exists as an independent force of nature. The surfer adds a human dance on top of that – a dance with the pre-human world. The surfer rides the wave, but without exhausting its energy, adding beauty without dominating or diminishing its source. Perhaps this metaphor can hint at new ways to think about our relationship with energy in a time of environmental challenge.

I first saw someone riding an electric surfboard in 2023. No muscle energy required, no need to judge the waves, paddle for the wave, go from prone to standing, or feel the energy of the wave and tap into its wondrous and mysterious power. Tear it up, dude! Running on renewables, an electric surfboard emits no greenhouse gases. It is compatible with the goal of a stable

atmosphere and climate. One might say, *it is sustainable*. But for me, it has no soul and threatens the sustainability of my surfing metaphor.

There are other more direct trade-offs between different visions of sustainability. A recent proposal in the New York Catskills would allow solar farms to produce electricity and use that energy to pump water uphill into reservoirs during the day. The potential energy of the elevated water could then be converted back into electricity again via turbines during the night when the sun is not shining. This clever system would provide renewable electricity 24 hours a day. But it would also entomb several valleys in the Catskills under water and behind concrete dams. The project was killed by popular outcry almost as soon as it was proposed. A complementary example is a proposal to mine the headwaters of the Bitterroot River in Montana to explore for rare-earth minerals needed in many of our computer, electronic, and alternative energy technologies, including batteries for electric vehicles.

I mention these trade-offs not to start a debate, but to point out possible hidden assumptions about what we are hoping to sustain. In the name of sustainability, there is still a risk that we end up doubling down on an unexamined life of consumption: more energy, more technology, more conveniences, more stuff. Personally, I want to keep the valleys of the Catskills undammed and the headwaters of the Bitterroot unmined. I'm willing to use less electricity, even green renewable electricity, to protect places like these and the opportunities they provide for connection to wild and natural things and processes.

I listen again to Ólafsson playing Rameau. On the face of it, music does not seem like part of the natural world. Jazz guitarist Pat Metheny has observed that music seems like something we weren't supposed to know about, as if there are cracks in the universe letting in something forbidden.[4] But we *do* know about music. It comes into the world through our heads, hands, and hearts.[5] Its primary channel is the human voice. There is language for describing music, just as there is language for describing ecosystems. But music expresses a truth with none of the ambiguity of words. Ólafsson's phrases entreat me to feel something deeper and older than modern concerns. Music is not an answer to current environmental problems. But it does address a more eternal question. How do we relate to the mystery of the world? Music's answer: *Add to the Mystery*.

While working on this essay, I decided to take a break, clean up the kitchen, and take out the compost. With the quantitative approach outlined earlier, I could figure out the benefit of composting orange peels instead of tossing them in the trash. Composting might reduce methane emissions from the landfill. It might reduce carbon dioxide emissions by decreasing the waste transported to landfills. But when I head to the compost bin, I realize that what matters is the practice itself. By gathering up the food waste, getting out under the open sky, and spreading and covering the scraps, I'm also stepping outside our lifestyle of economic productivity, where time is money. I pay the compost with orange peels, and I get back time for fresh air, infused briefly with smells of rotting organic matter and buzzing flies.

Like surfing, composting works with the forces of nature. Decomposition is a natural ecosystem process. Of course, it's happening in landfills also. But the landfill is an abstraction. It is a form of de-consciousness, as is our habit of throwing things into the trash. In contrast, composting is a ritual engagement with decomposition. Similarly, owning an EV or putting solar panels on my

roof would have the obvious benefits of decreasing carbon emissions, but would also increase my awareness and engagement with energy. These climate solutions are attractive for ritual, for mindfulness and interactions, for instilling a personal ecology.

As I listen to the piano, I wonder whether there can be a personal ecology related to music. This is more difficult, so I start with a simpler question: What's allowing me to experience this music in the first place? I'm hearing it through Bluetooth speakers, connected to a handheld electronic device made by a company called Apple, running an application called Spotify. I don't understand this technology, which lends itself to the methodology of descriptive ecology. Where am I? What is this stuff? What is going on? I don't think I had ever heard the piece before now. An algorithm suggested it because other people who like this piece also like Bach, Chopin, Elgar, Grieg, and other composers I searched for using the app.

So, did the internet (or AI) enable this experience? Well, yes and no. No, in the sense that this connection was rooted by growing up in a house where this kind of music was played on a piano in our living room. More specifically, this affection was perhaps activated by hearing my sister play at my father's memorial. I can hear my father's piano playing in my sister's piano playing. And I can hear my sister's playing in this pianist from Iceland. The piece itself is reminiscent of Bach, and my father was fond of Bach. Maybe I *have* heard it before, somewhere deep in my childhood. Many other musical experiences in my life likewise play a part in this response.

Going much further back, could anatomically identical humans 40,000 years ago produce a Rameau or a Bach? Bach was part of a huge extended family of musicians. He learned from his uncles. He was eventually supported by nobility and the church. He benefitted from very sophisticated musical instruments that took thousands of years to develop. Somehow, I doubt he ever killed an animal with his bare hands or painted on the walls of caves. But he was indebted to that past, as we all are. There is a cultural stream of consciousness that brings music out of a deeper human history.

This descriptive ecology of music is necessarily exploratory, inductive, and unfinished. But it suggests that connecting with a piece of music grows from a complex personal and cultural history that is only superficially enabled by the digital technology we're immersed in today. I value having access to this music, but more important is the consciousness of its presence and origins – the phrasing and touch of the pianist, the creative vision of the composer, the cracks in the universe adding to the mystery. The act of making and recording these observations about music is also a manifestation of consciousness. We don't want to become unconscious, nonconscious, or even less conscious. Should consciousness be a sustainability goal?

Other observations follow from these meditations. In 2024, the Apple company released an advertisement depicting a massive hydraulic press crushing an artist's studio that includes a piano, a drum set, a guitar, paints and sculpting materials, including a clay sculpture of a human figure. After it's all crushed an iPad emerges, and a singer intones "All I ever need is you." By the same reasoning, I suppose I could crush an iPad under the wheels of my car to liberate all the gifts of human creativity it has appropriated. Sorry, I *don't* need you; I have a guitar.

In fall 2022, I saw a weird triangular thing, lit up and moving across the night sky. A news report said it was a satellite, just one of thousands scheduled to be launched over the next few years, to bring the internet to all the corners of the world. "Don't worry, it's safe!" said the breathless

newscaster. I've seen strange lines of lights crossing the night sky three more times since then: In Bryce Canyon in Utah around 4:00 AM. Again, ironically, during an outdoor presentation on Native American astronomy. And, finally, when I went out with my kids to say goodbye to the winter constellations – Orion, Sirius the Dog Star, and Gemini - setting in the West.

More recently, in the local market, a picture and headline on the front page of the *New York Times* caught my eye. It read, "The Internet's Final Frontier: Remote Amazon tribes of Brazil." The picture showed a young girl, a member of the Marubo tribe, in front of a grass-roofed hut. Looking at the hut and pictures of the village, I feel these people have a lot to teach us about how to live. A grass hut is familiar to me mostly as an image. I'd like to know how to build one. As exotic as the hut is, the young girl strikes a pose that is very familiar - head down, looking at a handheld device. At the time this article appeared, the tribe had had Internet access for eight months. The article ends with a statement from a tribal member: "… going back is no longer an option. … We can't live without the Internet."

After reading this, I found myself wondering, "Does *my* survival depend on the internet?" I wasn't sure of the answer. So, I googled it.

As we lose our awareness of the natural and cultural systems that sustain us, our trajectory becomes one of maximum technology for maximum convenience, with little discussion. But perhaps the bland acceptance that there is "no going back" can raise the question of what we hope to sustain. That question can't be answered until we recognize that adopting new technologies almost always involves benefits that are obvious, and losses that are not.

When it comes to early 20th century technologies such as cars, paved roads, and chainsaws, we *did* have this discussion (Sutter 2009). With the passage of the 1964 Wilderness Act, our country decided to keep these mechanized uses out of some areas of the landscape. The decision not to max out on roads and automobiles was a moment of anti-hubris, a recognition of the deeper implications of Euro-American expansive land use. While wilderness designation does not prevent people from owning a car, it limits where cars can be used by keeping some places roadless. Thus, it preserves freedom to have cars, but also freedom to get away from cars.

A surfer using a surfboard on a wave exhibits the beauty of both using and limiting technology in the context of modern energy use. A hiker with a backpack in a wilderness area does the same for travelling across land in the context of mechanized land use. Are there analogous practices for a world that is always a mere click or swipe away from the ubiquity of cyberspace? [6] The Marubo people have decided to turn off the internet for their entire village during certain times of the day and night. They are hoping to sustain something that doesn't depend on the internet.

In my talks and courses, I often finish by showing a picture of Biosphere 2. Most people don't recognize the building, and many don't know the story. It was an attempt to build a selfsustaining, enclosed ecosystem that humans could live in. Why it failed is an interesting story, but the short answer is: it was a carbon cycle problem.[7]

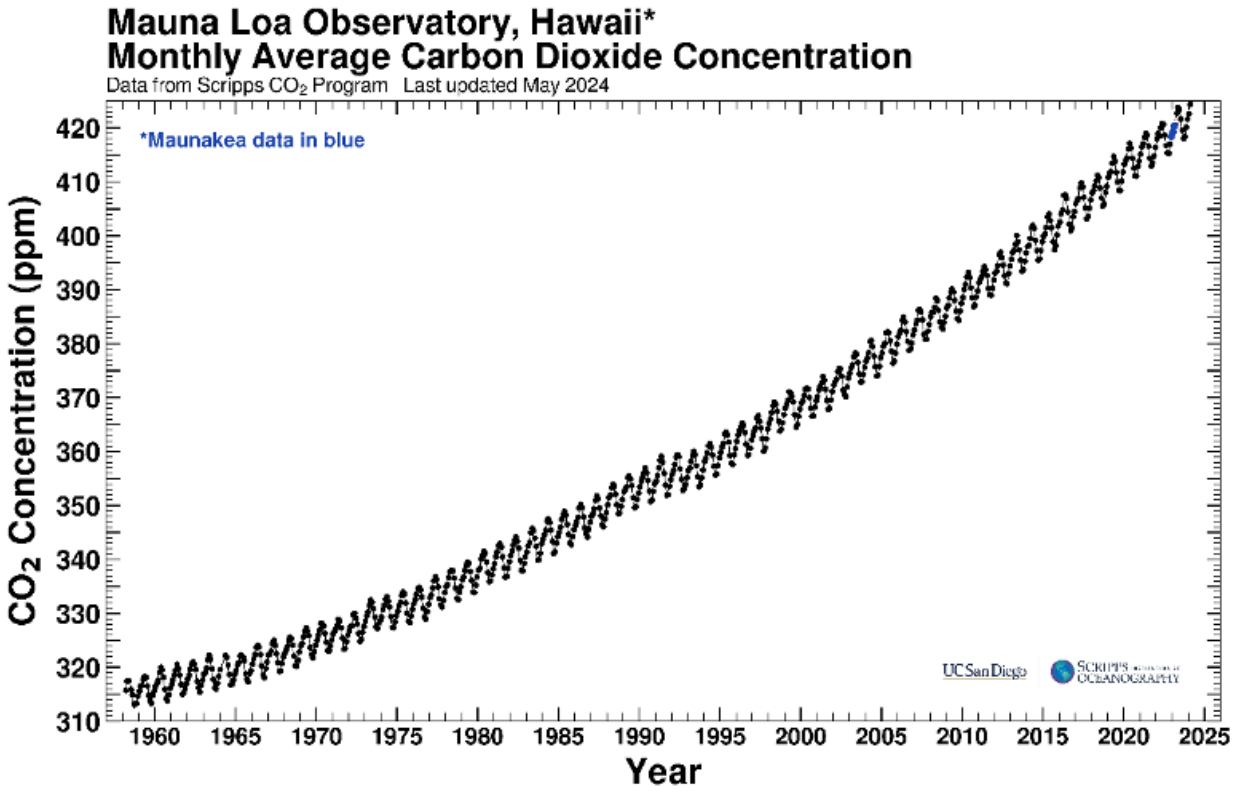
I like to say there are two lessons that we learn from Biosphere 2. The first is self-evident. For the time being we depend on Biosphere 1 (planet earth). This illustrates the importance of environmental sustainability - "life support" - at the broadest level. But the second lesson comes via a thought experiment. Suppose we *are* someday able to build an artificial environment

capable of sustaining human life, an environment maximally designed and controlled by humans for human purposes. Is that the world we want to live in?

I vote against a world that is maximally controlled for human purposes. Instead, I envision sustainability as a dance with natural forces, forces that gave birth to human consciousness and creativity, a stream reaching back to pre-human origins and onward into the future, bountiful with the gifts of stars and waves and self-sustaining wildness, something to revere and be grateful for, a ritual engagement with the beauty and mystery of the earth.

Yes, we must act now to lower our greenhouse gas emissions. But the science of carbon and climate doesn't have to be a message of fear and compulsion. Behind the steady rise of CO_2 in the data from Mauna Loa (Figure 2), there is another, more primordial pattern, the undulating annual cycle of the seasons, photosynthesis in play in spring and summer, respiration unmasked in fall and winter. Driving this pattern is Darwin's entangled bank of plants, singing birds, flitting insects, crawling worms, damp soils, meadows, mountains, forests, deserts and oceans. In all of this, I hear music. And I see my father's hands and fingers at the piano keys.

Figure 2. The "Mauna Loa Record" of carbon dioxide measurements, aka the "Keeling Curve".



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[1] See: https://www.ipcc.ch/report/ar6/syr/summary-for-policymakers

[2] Source: https://essd.copernicus.org/articles/17/965/2025/essd-17-965-2025-discussion.html

[3] Data available online: https://ourworldindata.org/grapher/co-emissions-per-capita

[4] See *Dialogues Between Neuroscience and Society: Music and the Brain* available online:

https://www.youtube.com/watch?v=yhAbNv1gJT8&t=2292s

[5] The phrase comes from guitarist Peter Sprague's album of the same name.

[6] The phrase "ubiquity of cyberspace" comes from Borgmann, 2017.

[7] For a non-technical summary see:
https://dartmouthalumnimagazine.com/articles/biosphere-2-whatreally-happened