The 1,000 Year Ouch

Climate change is real and human-caused — and most of what you know about it is wrong. (And the truth is potentially more hopeful.)

Raz Mason Feb 19 · 14 min read

The deep ocean is already the world's largest carbon sink. Sinking all excess atmospheric CO2 to the depths would add less than 2% to the deep ocean's total. Photo courtesy of vincent desjardins.

How much do you know about atmospheric CO2 residence time?

If you're like most people —from 70% to 93% of people, according to recent research by the University of Washington's Ann Bostrom—you think you know more than you do.

Perhaps you cottoned to the right answer to "the CO2 storage problem" — it's implied in the article title: Many centuries. Most of us (myself included, until I began working last year with Dr. William Calvin to establish the CO2 Foundation) reasonably — but wrongly — imagine excess air-based CO2 to act like air pollution — gone quickly once emissions stop. **We couldn't be more wrong.** If we hand over to nature the responsibility to clean up the current excess CO2 in the air, it will take at least a thousand years. Ignore for a moment that humans, and ever-more-intense wildfires, *continue* pumping out CO2 at prodigious rates… The clean-up can't even start yet.

This report from Yale Climate Connections explains the danger of having even a 10–25% excess CO2 left in the air:

"[W]hile a good portion of warming attributable to carbon and other greenhouse gas emissions would be removed from the atmosphere in a few decades if emissions were somehow ceased immediately, about 10 percent will continue warming Earth for eons to come. This 10 percent is significant, because even a small increase in atmospheric greenhouse gases can have a large impact on things like ice sheets and sea level if it persists over the millennia."

Decades with no improvement in scrubbing CO2 from the atmosphere (let alone the 1,000 years to naturally clear 75–80% of current CO2 excess) would likely guarantee a **catastrophic tipping point with extreme weather** and/or loss of reflective glacial ice.

The biggest danger to humans is not gradual global warming—it's extreme weather tipping points

Surges in extreme weather are already leading to large-scale human suffering and disaster costs. Longer-term effects include hits to agriculture, followed by widespread hunger; reaching a breaking point in the global economy; more people trying to immigrate to climate-secure areas; and armed conflicts driven by resource scarcity. These dangers aren't just in other corners of the world. Over the last ten years or so, **extreme weather has been harming people across the United States, of every political stripe.**

So far, the global community has viewed "climate solutions" with a mistaken pair of glasses. Identifying and acting on **genuine, effective climate solutions will take correcting three major and wrong simplifications.** These are at the heart of our common, but critically important, misunderstandings of excess CO2.

Error #1 — Not understanding that "fossil fuel emissions" is a RATE.

Instead of "fossil fuel emissions," the more correct term is "fossil fuel emissions per year" [or whatever time-frame]. That may not sound like a big change, but…

Assuming they understood the carbon cycle back in the day (a big leap), well-intentioned people talking about strategies to reverse climate change probably didn't want the hassle of "reduce the rate of annual fossil fuel emissions," and thought fewer words would be better. Voila! — "Reduce emissions." Easier to say. *But the consequences of this conceptual short-hand have been disastrous.* **Shortening "emissions per year" to just "emissions" is like claiming "miles per hour" is the same as "miles."**

We know this simplification doesn't work for miles because we use those terms — one referring to rate (mph) and the other to accumulated total (miles) — frequently in our daily lives. **While emissions per year (the rate) and emissions (the accumulated total) may not be as commonly understood yet, ideally they will become so.** Understanding of rate vs. accumulation is critical for building constructive political to roll back extreme weather's destructive acceleration.

Emissions reduction is like turning down the bathtub faucet. Even if we do so, the "full bathtub" problem remains. Photo courtesy of Alena Navarro- Whyte

Not understanding the difference between a rate and an accumulation is like mistaking the **faucet**

(emissions reduction) for **an already-full bathtub** (the CO2 excess in our beleaguered atmosphere). Humans and other present-day species do best within a narrow climate band, like that from our grandparents' time. Right now we are collectively like a baby sitting in an over-full tub, in danger of drowning from extreme weather. Yes, we need to turn off the faucet, though human ineffectiveness and increasing wildfire activity complexify that approach. **Most importantly, given the "1,000 Year Ouch," we need a DRAIN**.

More on drain-building — and the hope in this pursuit —further below.

Error #2 — Believing excess CO2 acts like air pollution.

This first misconception was introduced above. CO2 is bad in overly-large quantities in the air. "Bad" and "in the air" lead the majority of people to conclude that excess CO2 behaves like air pollution — when we ponder it at all. Most of us erroneously assume CO2 will "wash out" of the air or disperse the way exhaust fumes *seem* to when a diesel truck idles nearby (no diss to truck drivers — I've driven long-haul). So we think: "As soon as emissions stop, problem solved — or thereabouts…days to weeks. Months at the most."

This line of thinking has previously led the majority of people concerned with climate change to focus all their/our efforts on emissions reduction. Not only is emissions reduction ***not*** working globally (emissions reached a record high in 2018), but now you know there is a 1,000 year lag time for emissions reduction to be effective. **The "1,000 Year Ouch" essentially nixes emissions reduction as a "climate change solution."**

Wishing doesn't make it so

Excess CO2, when released into the atmosphere, tends to stay there. The amount of CO2 in the atmosphere is a function of the outputs and natural sinks of the **carbon cycle** (here's a NOAA overview; a more complex NASA primer here). For thousands of years, the annual global amount that circulated *out* of the atmosphere — by way of photosynthetic capture in land- and ocean-based growing things, seashells, even rocks — tended to balance the global amount cycled *into* the atmosphere from things like decaying organisms and forest fires — a wonderful, perhaps mystical near-equilibrium that has offered optimal conditions for the diverse plant and animal life, with relatively little variation over the past 10,000 years. Carbon-cycle equilibrium has allowed human life, in particular, to thrive.

The carbon cycle balanced until human ingenuity ushered in the "Industrial Age." Many good things came from that. I love my home with electric light and winter-time heating. Those of us reading on a computer or digital device are beneficiaries of developments bringing much useful, interesting, and pain-relieving technology that serves humans — even though part of the cost is widespread fossil fuel use and more CO2 emissions than the natural cycle can handle. The current situation stands at ~45% over-normal levels of CO2 in the atmosphere, identified as human-added with high confidence. Scientists know this because the carbon isotopes are out of balance.

To say human activity is linked to climate change does not imply humans are bad and wholly suck. Much of our planetary impact has been unintended and accidental — in service of reducing, even if inequitably, human suffering. However, now that science has clearly identified the human role in generating excess CO2, the "You broke it; you fix it" rule applies.

London, April 2014 — Photo courtesy of David Holt

The carbon cycle: So relevant; so little-known

For most of us, awareness of the carbon cycle has not loomed large. The majority of people didn't go through high school recently nor were they/we lucky enough to get science teachers well-versed in the Next Generation Science Standards and the latest climate science (problematic education secret: in most states, no one is ensuring teachers know about climate change). Maybe you *did* go through high school recently, had super teachers, and even took an advanced biology or Earth science course covering the carbon cycle. Even then, you might have been more focused on social drama, for which high school is known, than on locking the carbon cycle into long-term memory. **Most of us are carbon cycle newbies, for good reasons. AND we can ramp up our knowledge (and must, for self-protection).**

In fact, scientists themselves did not resoundingly nail down the "storage problem" of atmospheric CO2 until the last ten years or so. Given the way science works, the ones doing, then communicating, this nailing down were a minority within a minority. Earth and atmospheric scientists make up the smallest cohort of scientists, trailing far behind the number of biologists, chemists, and physicists.

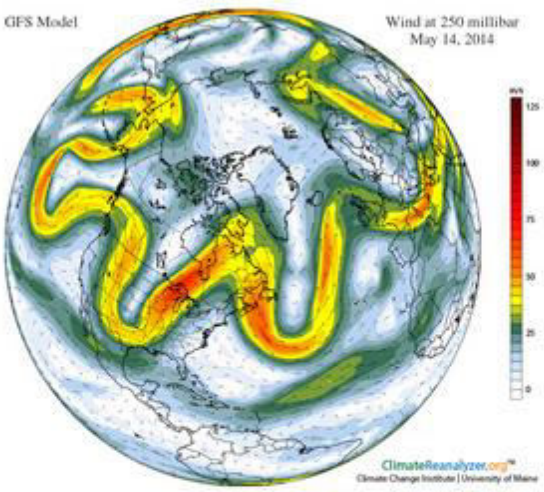
And science rewards people for specializing and working to solve *new* problems. "Publish [new stuff] or perish" still guides academic career progression. Few scientists, except a handful among the established and/or cross-cuttingly gifted, spend their precious career-building time turned toward the public, learning about then explaining how already-discovered science topics form a cohesive tapestry.

So, humans' natural urge to simplification has led to ubiquitous and devastating common assumptions — even among those who already "get" climate change: *"As soon as we stop fossil fuel emissions, problem solved."* **No.**

Not enough, but necessary

On the plus side, the short-hand calculus of "just stop emissions" *has* contributed to necessary public awareness and more numerous socio-political steps in the right direction. We *do* need wide-spread emissions reduction and carbon pricing. **These efforts are essential, but not sufficient.** Remember, left up to natural processes, 1,000 years is the time-frame to scrub 75–80% of current excess CO2 out of the air.

That lingering amount is problematic because even small excesses in natural systems can trigger **tipping points in extreme weather and glacial warming, both driven by ongoing feedback loops**. We seem already to have experienced Arctic warming leading to now-persistent changes in the jet stream: **Slower, longer, and more numerous loops**, which are responsible for a variety of newly-more-extreme weather phenomena.



Changes to the jet stream from global warming now bring ongoing extreme weather.

Graphic courtesy of climatereanalyzer.org

The chain of causality goes like this: Excess CO2 in the atmosphere drove Arctic warming. Evidence indicates that Arctic warming has driven jet stream changes. Jet stream changes are now driving the new extreme weather. The extreme weather (X-Wx if you like, where "Wx" [*wix*] is the meteorologists' traditional abbreviation for "weather") includes billion-dollar floods, windstorms, stalled hurricanes, and two global mega-heatwaves (so far) that each killed more than 50,000 people. Jumps in X-Wx emerged in the early 2000's and have stayed high after 2010 — just the last eight years.

In summary, excess CO2 in the atmosphere doesn't wash out like air pollution after a few days. The extra CO2 we already have is causing up-close, personal harm to many of our communities.

Excess CO2 in the atmosphere is nothing to play with.

[Please don't get bummed out; keep reading. Later the tone becomes more hopeful as I explain an unexpected upside that becomes visible once we truly understand the "1,000 Year Ouch."]

Error #3 — Viewing catastrophic climate change as a future problem.

In the US, disasters cost $306 billion dollars in 2017 alone. West Coast wildfires in 2018 killed dozens, cost billions to fight and clean up, and sow seeds of a US lung-damage epidemic. Each year in the US already, 15,000 people die from chronic exposure to wildfire smoke — a number expected to climb as climate change-driven wildfires worsen.

Looking up, I confess to having found it easy to imagine Earth's atmosphere as big enough to disperse whatever humans throw into it. But when seen from afar, the thinness of Earth's atmosphere is clear:

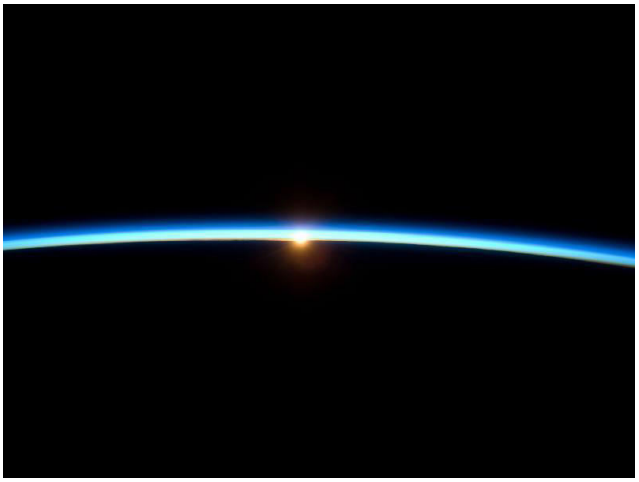


Photo taken by the crew of the International Space Station. Photo courtesy of NASA.

This thin blue line, which humans treat like a global sewer, is all the wiggle-room we have. It's not enough.

And… No more wiggle-time

Extreme weather is already happening, and has been, big-time, for the last eight years. Our propensity to look at catastrophic climate change as a problem "coming up," vs. already upon us, is a cognitive distortion made worse by the non-ear-catching threat of a temperature rise to 1.5 or 2 degrees Celsius above pre-industrial values. That small increase doesn't send shivers of fear into the ordinary person.

So let's leave aside fractional *future* increases. ***Already, these days,*** a climate change-driven cold air intrusion from changes to the jet stream could ruin the year's fruit harvest —while hardly budging the average annual temperature reading.

In addition to the issue that dangers of extreme weather (X-Wx) are now hitting broad swaths of the world, most of us don't respond effectively to vague future threats. Perhaps, like me, you know it's better to eat right and exercise to avoid future health problems — yet still find yourself falling short. Rather than focusing on a nebulous and not-so-scary future, we are more productively motivated, then more strategically influential, when responding to problems already here: X-Wx. Extreme weather impacts include droughts, increased wildfire danger, floods and hits to agriculture from too much rain, the peril of bigger and longer-lasting hurricanes, killer heatwaves, and even more "snow-maggedons," when weather systems get blocked by outsized jet stream loops and drop extra moisture (taken up by a warmer atmosphere) as snow.

The solution — Climate restoration

Coming to grips with unsettling facts and figures like those above about the duration of our problem, types of extreme weather, public health threats, and disaster costs can, paradoxically, be good news. They help us see the problem is *here* — **and now it's time to go to work**.

Understanding the "1,000 Year Ouch" and how thin our emissions-laden atmosphere is helps the answer become clear: **Clean it up.**

"If you don't know where you're going, any road will get you there." The opposite is also true. When we identify a positive destination based on our fundamental values, all kinds of energy, focus, and commitment can be unleashed to help drive where we ***want*** to go.

What would success look like on the climate front? I favor this description from the Foundation for Climate Restoration:

"Our vision is giving our children the same safe & healthy climate our grandparents had."

The risks from tipping points and feedback loops are mammoth. Instead of the current atmospheric CO2 concentration of 410 parts per million (ppm), **a good target is 300 ppm**. Getting clear on our desired destination is simple: Be compassionate, be responsible. **Take action that shows we love the other living things that share the world with us —and our children and grandchildren.**

Even some climate activists are getting discouraged by the lack of progress in and prospects for reducing the rate of annual emissions. **Climate restoration is a mind-shift** that allows us to move from dispiritingly running after a bus that has already left the station (runaway global emissions) — to starting to drive the bus by being focused on positive, constructive action to remove excess CO2 — the heart of the problem — in service of what and whom we love.

Climate restoration is the notion that the human response to catastrophic climate change is composed of **three interlocking strategies**, starting with the most obvious but least immediately impactful, and ending with the least obvious (the point of this article), yet most impactful:

- **1. Leave it in the ground.** Continue the wholesale switch to renewable forms of energy, which are more cost-effective anyway.
- **2. Reduce the rate of annual emissions**, while continuing to work through challenges such as: understandable human fear and sadness; actively unhelpful (even ultimately to themselves) lobbying by some in a doddering fossil fuel industry; more forest fires that raise emissions, driven by drought and insect damage (tree-destroying insects love warmer climates); and cognitive distortions such as those described in this article.
- **3. Finally, remove excess carbon dioxide from the air**. Carbon dioxide removal technologies (CDRs) — also sometimes known as negative emissions technologies (NETs) — are a thing, although this technical/scientific field is still in its infancy. Carbon dioxide removal technologies (CDRs) are designed to **pull excess CO2 out of the air**. They are the needed **drain**. Some projects and proposals are land-based, some ocean-based. Some work via upping rates of photosynthesis and storing away the by-products; others use chemical transformations to create things like limestone aggregate or fuel oil. Some types of CDRs that could be helpful have likely not yet even been thought of — the field is still that under-funded and new. **Carbon dioxide removal technologies need to be more widely and comprehensively designed and researched (with special attention on minimizing negative side-effects), then prototyped, evaluated, and deployed.**

Next steps

We humans, especially those of us in the "developed" world who can bulk up our political capital, are not victims of a future over which we have no control. We can, instead:

- Get active on **social media** about climate restoration — sharing that there are, and should be more and better reality-based "climate solutions" that tackle the big problem of lingering CO2: #RestoreClimate, #BuildCDRs
- **Tweet/message/email our favorite journalist to cover climate restoration.** We need a deployment of **carbon dioxide removal technologies (CDRs)** that is big (able to pull 500+ gigatons of carbon (GtC) from the air —40 GtC/year when fully deployed), quick (within 20 years, to protect global climate from extreme weather), and sure-fire (immune to economic collapse and terrorism) with attention to the fewest side-effects, and an eye toward social justice and our obligations to future generations. #RestoreClimate, #BuildCDRs
- **Tell one elected representative** about the "1,000 Year Ouch." This link gets you started through the **CO2 Foundation's Countable portal**, which can automatically send comments to your elected officials, and gives phone numbers to their offices. The first call may be nervous-making, but staffers *want* to hear what "we the people" care about. Contact national leaders, yet even state and local leaders need to know how the CO2 storage problem makes massive, public-interest funding for research and deployment of carbon dioxide removal technologies (CDRs) necessary — ones that are big, quick, and secure enough. *Don't let people complain about cost unless they're happy with ongoing annual disaster price tags of $306 billion*. In the US, we're good at throwing massive amounts of money at anything labeled "national defense." This is.
- **Put investment dollars** into market-driven prototype solutions that might be scalable up to high-impact projects. The common good is at stake — we need massive government action — but private industry can get it

started. Dr. Calvin's favorite approach is ocean-based upwelling and downwelling — here's a firm prototyping it. Folks at the Foundation for Climate Restoration support several good projects and, with added capital, would expand support to the rest of their short list. The flavor of the emerging CDR field can be found in this **Manylabs list of climate and carbon removal programs** in the Bay Area.

- **Communicate with everyone that there is hope**. Yes, the global community and we personally will encounter challenges, perhaps even disasters. Through realistic, responsible, and constructive action we *will* be better prepared to thrive in the midst of them, and to protect the people and world we love.

[**Adaptation** and **resilience** are big parts of the picture, too. Please follow me to learn more.]