



The Fatal Flaws of Neoclassical Economics – Climate Change and Beyond

Richard Nolthenius, PhD

Earth Futures Institute UCSC, Cabrillo College Astronomy

First, Before LAUNCH... I urge you to get Educated by a Wide Range of Resources...

- [My talks at EFI](#), some condensations are included here today.
- [Nate Hagens' "The Great Simplification" podcast](#). Beyond excellent!
- Excellent Economics: [Steve Keen](#), [Josh Farley](#) on [Ecological Economics](#), also Bill Reese, Herman Daly...
- ["Planet Critical" podcast](#). Also excellent in many ways
- [DeCouple podcast](#). Also has many great episodes
- My Astro 7 Course: "Planetary Climate Science", which includes far more than the physical science; Policy, techno-solutions, geoEngineering, psychopathologies, climate economics/PolySci. [All my Presentations and materials are free and open to the public](#)

Neoclassical Economics: Our Dominant Western Economic/Policy Paradigm

- **Their Self Definition:** *“Neoclassical economists believe that a consumer's first concern is to maximize personal satisfaction, also known as utility. Therefore, they make purchasing decisions based on their evaluations of the utility of a product or service. This theory coincides with rational behavior theory, which states that people act rationally and independently when making economic decisions.”* (source: [Investopedia](#))

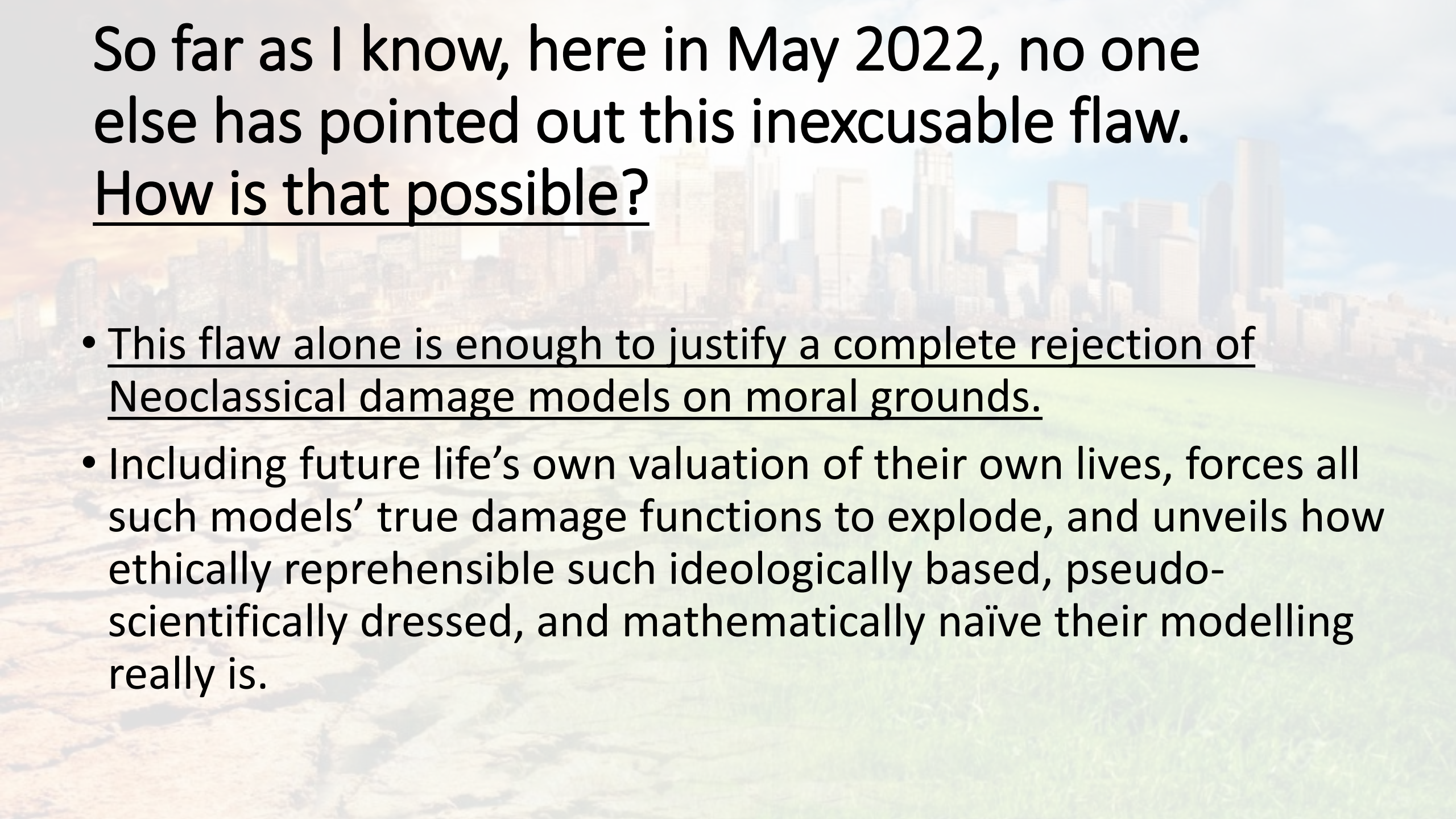
A Far Deeper Deconstruction of Actual In-Reality Neoclassical Economics...

- ... is being done by Economics PhD, now rebel and fearless analyst of all things Economic – Prof. [Steve Keen](#)
- I highly recommend you listen to his many talks on YouTube, digest his books, his presentations, and his podcast “Debunking Economics”.
- His de-construction of [DSGE](#) Economics in regards to climate damage should be required for all Economics majors. [Here’s a starter](#)
- Far too much for me to more than pick a few high points here.



Fatal Flaw #1: And the most morally reprehensible of all - Nordhaus assumes future generations' valuation of their own welfare deserves no consideration in determining civilization's optimal Utility

- Instead, it is only our valuations of their future that matter in his and other Neoclassic econ modelling. And even that value is discounted away at their preferred steep rates of **3-5% annually**.
- These correspond to our valuing, in 2017, the value of our grandchildren's year 2100 at only **8.6% - 1.7% of their 2017 value**.
- **I suggest these economists confront this reality by having an honest heart-to-heart with their grandchildren, tonight, and confess to them how little they value their grandchildren's future.**
- How can this possibly be ethically justified? It cannot. It is sociopathic.



So far as I know, here in May 2022, no one else has pointed out this inexcusable flaw.
How is that possible?

- This flaw alone is enough to justify a complete rejection of Neoclassical damage models on moral grounds.
- Including future life's own valuation of their own lives, forces all such models' true damage functions to explode, and unveils how ethically reprehensible such ideologically based, pseudo-scientifically dressed, and mathematically naïve their modelling really is.

Nordhaus and other Neoclassicals only care “*what are future generations worth to ME? Now, today, to me?*” (and even that, is done poorly).

- Any proper damage function must apply zero discount rate to future Utility.
- Future generations don't get to vote on what climate and what kind of Earth we leave them with.
- We must therefore act to be their protectors, not the object of our looting.

Fatal Flaw #2: People in fact generally do NOT act “Rationally” in favor of their actual Utility

- Nobel Economics winner (not an economist, which is good) [Daniel Kahneman \(psychologist\) showed this convincingly.](#)
- People every day ruin their lives with drugs, mass shootings, irrational voting, obesity-induced eating, etc...
- People every day are lured into self-destructive behavior by the very corporations that are the employers of Neoclassical Economists, and who hire psychology experts to produce reprehensible manipulative advertising to accomplish this.

Fatal Flaw #3: Neoclassical economists ignore energy's importance to economic production

- Economists calculate Utility starting with the [Cobb-Douglas Production function](#). Its inputs are Capital, and Labor as fractions of the economy's GDP. That's all.
- Energy? The energy sector of the economy is just a few percent in terms of GDP, so it's almost negligible in deriving Production, they say: This is ridiculous!
- [***"Labor without Energy, is a Corpse. Capital without Energy, is a Statue"***](#) – Steve Keen.
- Great Truths come in 3's (Newton, Kepler, etc?) So I'll add the 3rd: **"Capitalism without Energy is a Wet Dream"**
- Keen [points out](#) Cobbs-Douglas needs to include Energy as the prime independent variable to Labor and Capital, just for starters. Too much to go into in this talk. I strongly recommend you get his [The New Economics](#) for details, especially if you are majoring in Economics.
- I point out too, that Labor is needed to CREATE the machinery of Capital, so even before considering energy, the assumed independence of Labor and Capital in Cobb-Douglas is seen to be absurd.

Fatal Flaw #4: Discounting future Civilization

- A mathematical icon in Neoclassical economics is “[Hotelling's Rule](#)”
- Briefly: How do you maximize the financial return from exhausting the use of a non-renewable resource?
- *“**Hotelling's rule** defines the net [price path](#) as a function of time while maximizing [economic rent](#) in the time of fully extracting a [non-renewable natural resource](#). The maximum rent is also known as **Hotelling rent** or **scarcity rent** and is the maximum [rent](#) that could be obtained while emptying the stock resource. In an efficient exploitation of a non-renewable and non-augmentable resource.”* (Wikipedia)

Applying a discount rate to returns makes some sense for an individual

- ... because an individual has a finite lifetime over which to enjoy the resource, and because individuals can better enjoy a resource when young and healthy, and less so when old.
- But even here, is a fully self-actualized (*i.e.* rational) human being really completely uncaring of the very future he is helping create, beyond his lifetime? Do Neoclassical economists even understand the value of the basic moral and humane concept I'm describing here? Apparently not.

A background image showing a city skyline at sunset or sunrise, with warm orange and yellow light reflecting on the water in the foreground. The skyline is composed of various skyscrapers and buildings.

In fact, discounting makes NO sense in the maximizing of Utility for civilization as a whole

- Because Civilization HAS no “Death Date” (we hope, Neoclassical economists notwithstanding).
- In fairness, at least a few economists recognize this problem of “fat tails” of climate catastrophe, and how they make discounting unsupportable.
- Discounting in a macro econ (Civilization) context needs to be commensurate with odds of an asteroid extinction or supernova: vanishingly tiny

Fatal Flaw #5: Damaged self worth (even if repressed) is perhaps the greatest casualty of following the climate policy advice of Neoclassical Economists

- The damage inflicted on Civilization by exhausting finite resources by one generation of finite-lived people – is reprehensibly immoral
- And whether recognized by economists or not, this behavior is a major wound to the experienced self worth (repressed or not) of those who inflict this on future life on Earth.
- **It is perhaps the ultimate unrecognized, externalized cost of all costs, as it demotivates and degenerates civilization, ultimately perhaps into savages.**

Cloud Physicist Tim Garrett confronts questionable macroeconomics with the rigors of falsifiable testing in Science ([Garrett \(2014\) “Is Macroeconomics a Science?”](#))

- My answer to Garrett’s rhetorical title question is: **No.**
- Neo-classical Economics is instead closer to a Religion.
- ...an ideology built on faith that, among other flaws, that no matter what problem we cause, innovation, price changes, and substitutability will always allow continual growth in civilization, and, in practice, GDP is the marker to optimize.
- As I show in my EFI talk “[The Thermodynamics of Civilization](#)”, innovation only makes the final payment on a finite planet much worse.

Fatal Flaw #6: Morally Corrupt Behavior

- **Example, acting as the academic veneer of authority to amoral policy advocates.** Stated delicately by a well-known, and high stature within his field, economist...
- *“...We macroeconomists work within an environment of pressure and influence from our governments and societies. While few are willing to recognize or admit the existence of those pressures or the influence of those pressures on our own work, a clear understanding of trends in macroeconomic research is not possible without recognition of the influence of the intellectual, societal, and political environment within which the research is conducted”.*

– Economist William Barnett

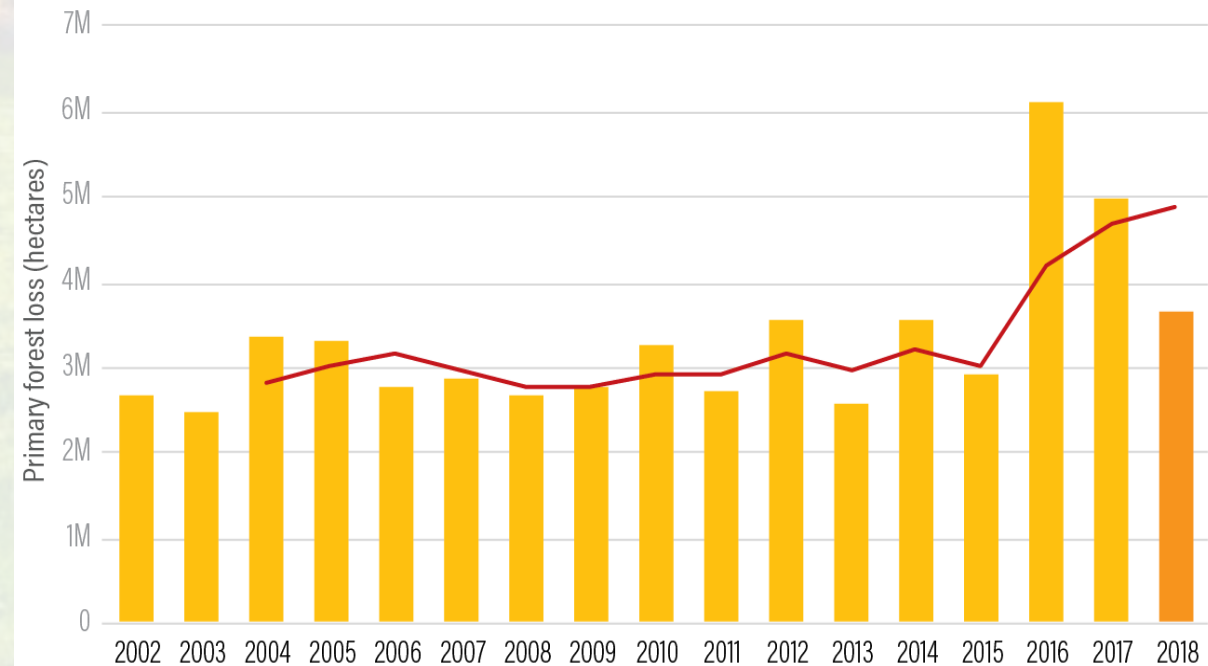
Contrary to Neoclassical Theory - Paying people to be moral actually reduces their moral behavior...

- “Motivation Crowding”
- Studies show when you pay people to do what they otherwise feel is a morally or socially proper thing to do, you rob them of the experience of moral motivation, and turn their actions instead into a monetary maximization exercise.
- But since the most profound internal joys come from honorable actions and behavior, you scramble their moral experience and lower their self-regard, which only further accentuates bad behavior.

Climate Example: Paying tropical countries to NOT cut down their rain forests...

- ... worked for only a short time – and after their moral honoring of Nature was usurped by money, we see renewed de-forestation at unprecedented rates.
- Morally compromised people then behave immorally

Tropical Primary Forest Loss, 2002–2018



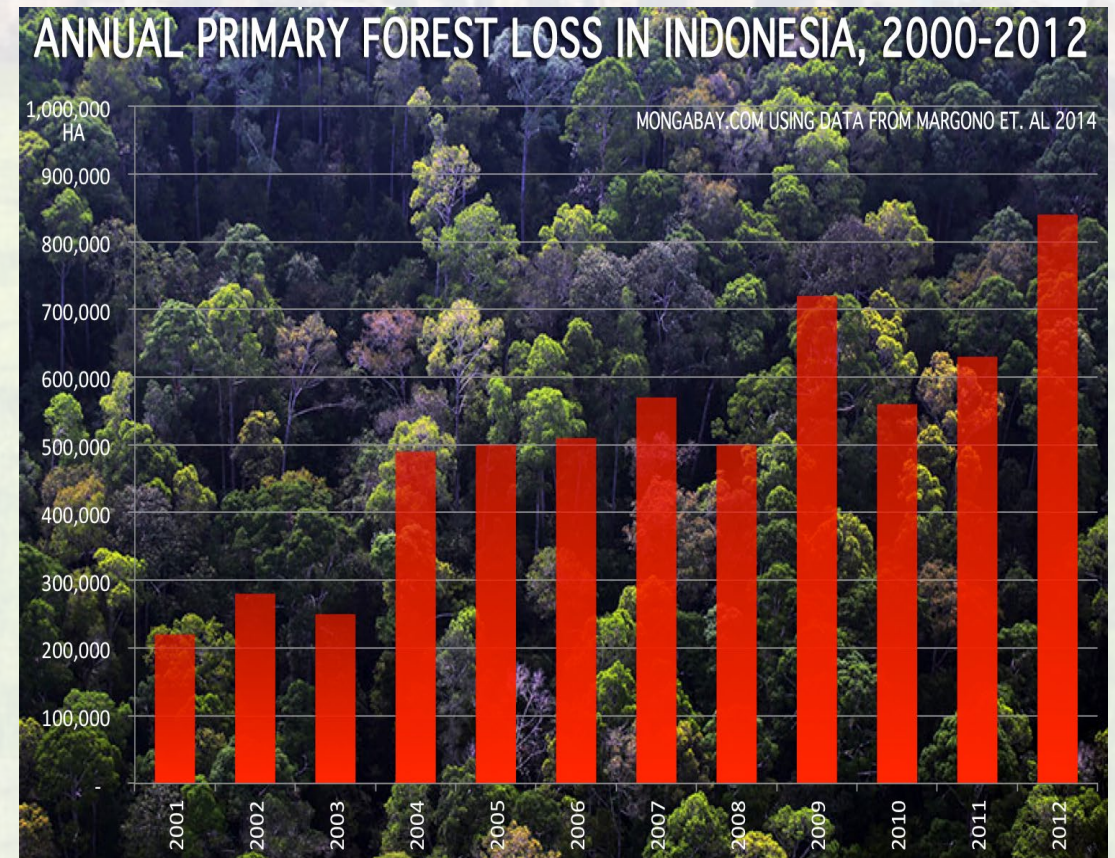
— Three-year moving average. The three-year moving average may represent a more accurate picture of the data trends due to uncertainty in year-to-year comparisons. All figures calculated with a 30% minimum tree cover canopy density.



WORLD RESOURCES INSTITUTE

Univ. of Vermont Ecological Economist Joshua Farley: A [lively interview](#) with many insights into the fatal flaws of capitalist markets and Neoclassical Economics...

- **Example:** The Minister of Finance for Malaysia, [couldn't wait to chop down his rainforest](#), because the forest grew at only ~2.5%/year but if he converted the trees into money, he could grow it at ~9% per year in the stock markets.
- And so, that's exactly what Malaysia (and Brazil, Africa...) are doing.



Does Studying Economics Breed Greed?

Even thinking about economics can make us less compassionate.

Posted October 22, 2013



In 1776, Adam Smith famously wrote: “It is not from the benevolence of the butcher, the brewer, or the baker, that we can expect our dinner, but from their regard to their own interest.”

Economists have run with this insight for hundreds of years, and some experts think they’ve run a bit too far. Robert Frank, an economist at Cornell, believes that his profession is squashing cooperation and generosity. And he believes he has the evidence to prove it. Consider these data points:

Left: [Grant \(2013\)](#)

Economic models are deeply connected to the ideology, politics, and ethical grounding of the economic modelers. Their Utility functions reflect this.

Therefore: Should we really be relying on these economists to guide our treatment of future life?

Less charitable giving: In the US, [economics professors gave less money to charity](#) than professors in other fields—including history, philosophy, education, psychology, sociology, anthropology, literature, physics, chemistry, and biology. More than twice as many economics professors gave *zero dollars to charity* than professors from the other fields.

More deception for personal gain: Economics students in Germany were [more likely](#) than students from other majors to recommend an overpriced plumber when they were paid to do it.

Greater acceptance of greed: Economics majors and students who had taken at least three economics courses were [more likely than their peers](#) to rate greed as “generally good,” “correct,” and “moral.”

Less concern for fairness: Students were given \$10 and had to [make a proposal](#) about how to divide the money with a peer. If the peer accepted, they had a deal, but if the peer declined, both sides got nothing. On average, economics students proposed to keep 13% more money for themselves than students from other majors.

Whether by learned behavior, or self-selection for this profession, traditional economists exhibit heightened psychopathologies. Sample at left from [Grant 2013](#).

Embedded links are below
[Frank *et al.* 1993](#)
[Frank and Schulze 2000](#)
[Wang *et al.* 2013](#)
[Carter and Irons 1991](#)

Many more insights are in the [article](#).

The tragedy is in the breeding of self-debasement – the very antithesis of any properly defined Utility

- Economists give a Utility value of precisely ZERO to the value to self of honesty, integrity, love of all life on this unique planet, the actual, vs. postured virtues that give life meaning and passion.
- In paper, after paper, after paper, after paper.... in Academia.edu, and ResearchGate, I see their Abstracts begin by a claim of maximizing Utility, but quickly “Utility” is redefined as money. GDP. As if “spending” is the hallmark of actual human well-being.
- History shows how false this notion is, in human tragedy after tragedy.

Self respect is essential to motivate our drive to produce genuine value for the world

- Our actual self-respect (vs. delusional posturing) is damaged by endorsing the discounting away of the future damages we're causing, merely for our own immediate gratifications.
- Psychologists know (e.g. [Branden 1981](#)) that self respect is essential for motivation. It is so powerful, we feel driven to fake it if we don't possess it honestly.
- Our brains were designed to do non-contradictory identification and integration. Self-sabotaging of that design feature requires continuous ENERGY to be at war with our very Nature.
- **Maintaining self-delusions requires real, continuous, caloric, biological ENERGY, and as delusions pile on, gets more and more exhausting to maintain (see [Nolthenius](#)). This can end tragically.**

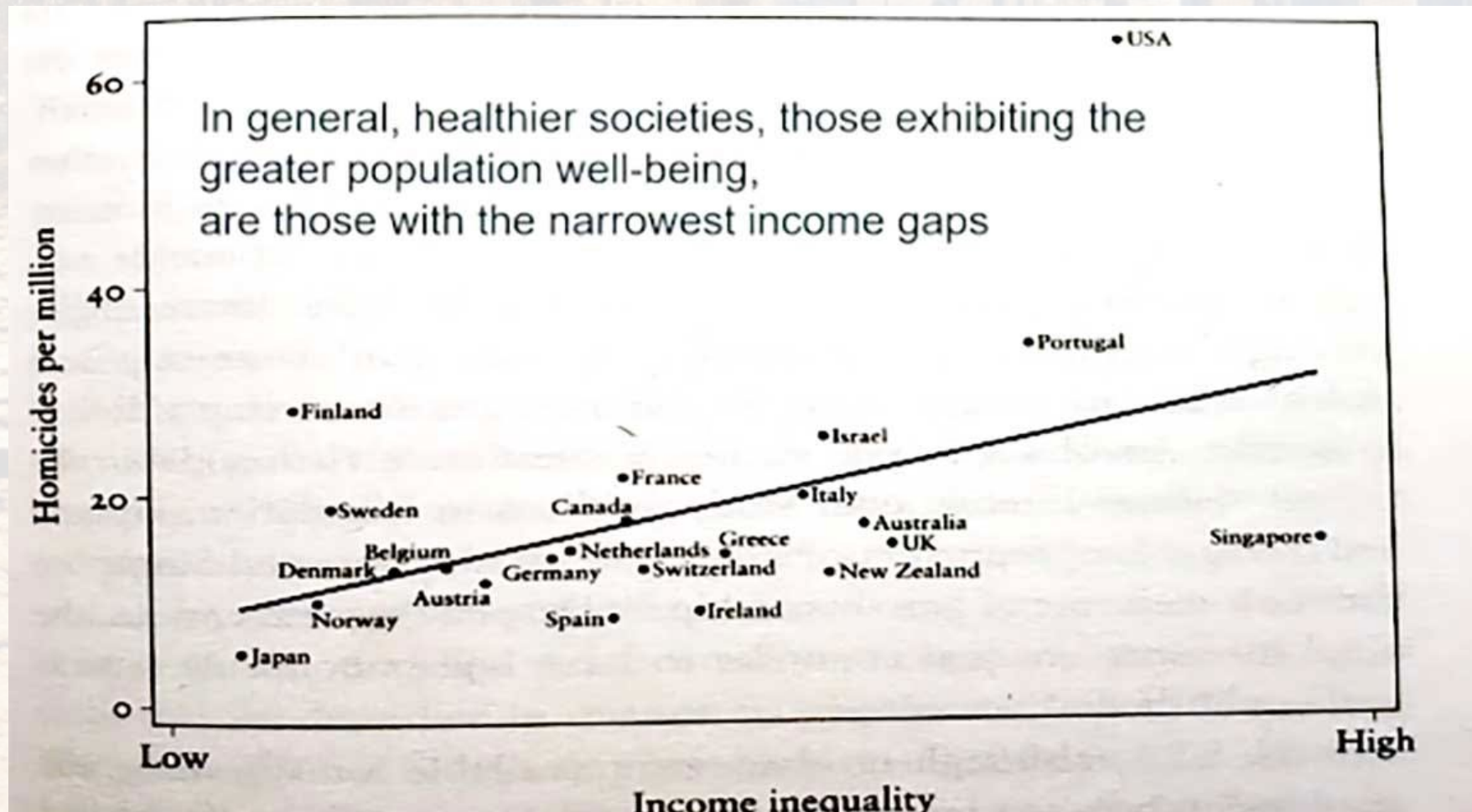
“Economists are the most insular and non-interdisciplinary of the social sciences” – and proud of it (Farley, citing [Fourcade *et al.* 2015](#))

- [Fourcade *et al.* 2015](#), from the sociology viewpoint, did a fascinating study [“The Superiority of Economists”](#) (title intended tongue-in-cheek).
- *“You are only supposed to follow certain rules. If you don’t follow certain rules, you are not an economist. So that means you should derive the way people behave from strict maximization theory”* (quote from an academic economist, cited from Fourcade *et al.* 2015)
- I can attest personally, that economists fight against anyone not a True Believer who attempts to publish anything related to economics, especially if it takes physics and climate science seriously while doing so. I’m not alone in this frustrating experience.
- As example, see the next slide...

This [WikiPedia Entry](#) I created on “The Garrett Relation” (I’ve since re-named the [Power/Wealth Relation](#)) in 2020...

- ...on the insightful work of cloud physicist Tim Garrett.
- My intent was to stimulate a wider conversation on how robust and future-predictive this relation might be. I deliberately included a section “Criticisms”, as any good Wiki should, for this purpose. I seeded initial criticisms and rebuttal responses.
- Then? Two economists pressured a particular Wiki policeman *“We never heard of this guy. He’s probably just a confederate of Tim Garrett. We could demolish this, but why bother? Just get rid of this article”*.
- To my shock, this wikipedia employee never contacted me, never investigated to verify these empty *ad hominem* charges, never answered to my pointing out to him the actual truth. He simply unpublished the article: Fact is, I’ve never met Tim Garrett, the article was my own idea, not Garrett’s. Garrett and I have only exchanged a few emails, never talked on the phone. I’m no “confederate”. And the economists, once they accomplished their mission, never “demolished” anything.
- I saved a copy of [the Wiki article here](#), for you.

Neoclassical Economists' policy claim to be maximizing Utility. By increasing inequality, they do the exact opposite: Here, rising Inequality (given by national Gini coefficients) goes with rising homicide rates.



We ask: Are insular, turf-guarding, dogmatic economists well-suited to solving the Human Dilemma that their pro-growth policy advocacy has created?

The Emergence of Global Systemic Risk

Miguel A. Centeno,¹ Manish Nag,¹
Thayer S. Patterson,² Andrew Shaver,³
and A. Jason Windawi¹

¹Department of Sociology, ²PIIRS Global Systemic Risk Research Community, ³Woodrow Wilson School, Princeton University, Princeton, New Jersey 08544;
email: cenmiga@princeton.edu, mnag@princeton.edu, tspatter@princeton.edu, ashaver@princeton.edu, awindawi@princeton.edu



We need them
focused.

Neoclassical
economists are
not properly
focused.

Fatal Flaw #7: Optimizing for GDP within a system of increasingly scarce essential goods incentivizes more scarcity, not Less

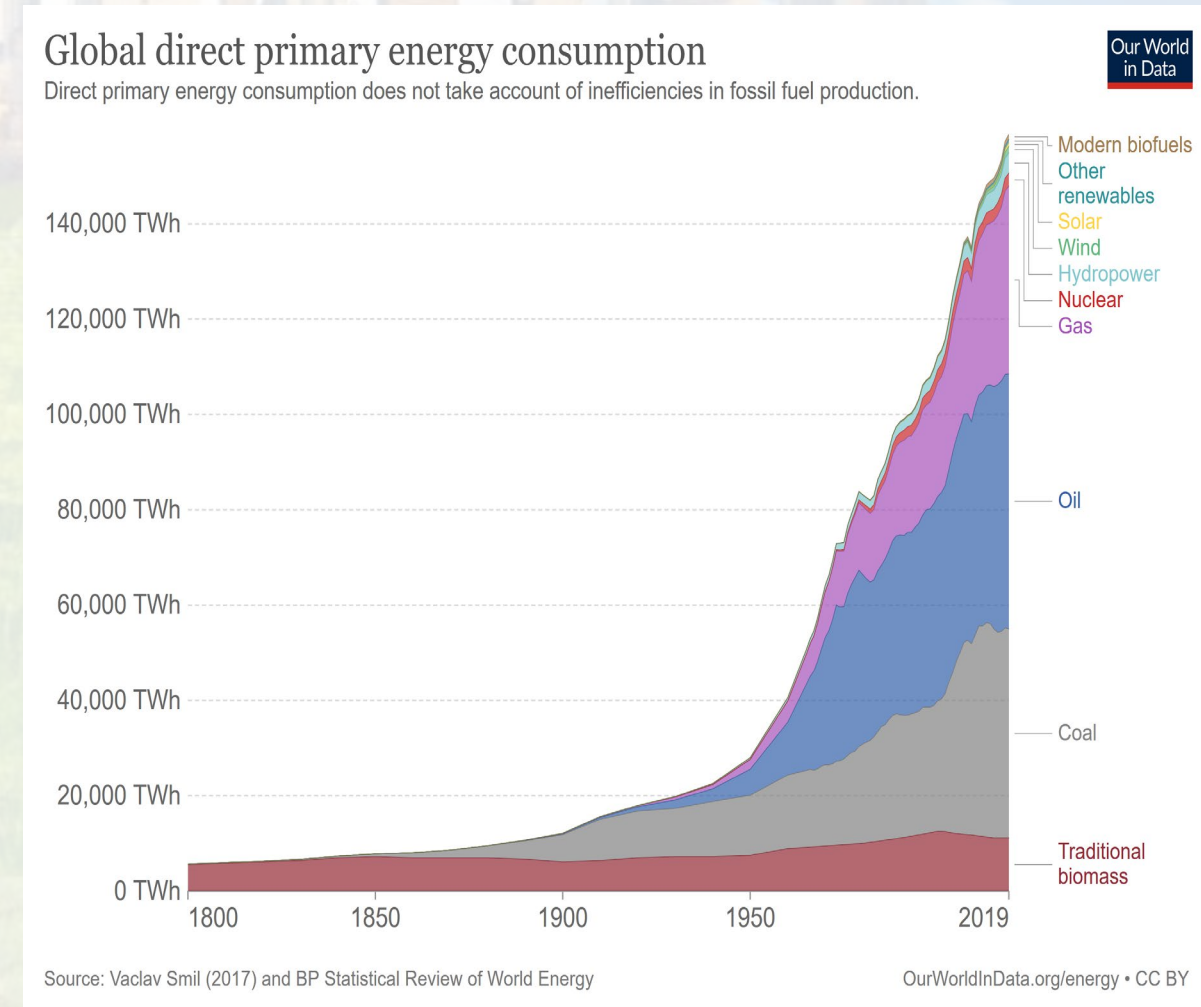
- Why? Because essential goods are price-inelastic. Meaning, their price goes up FASTER than their availability goes down. Example: a 10% drop in availability might mean a 40% rise in prices.
- But GDP rises as (price) x (sales volume). So GDP (and marginal profits) rise with higher scarcity, as the math shows.
- Therefore, the policies which proceed from such models ACCENTUATE inequality, and ACCENTUATE more rapid depletion of natural resources and essentials such as food, water, energy.
- This is the exact opposite of helping present and future total welfare of Earth's life and civilization, the supposed goal of good economics.

Fatal Flaw #8: Neoclassical Economists have a dismal record of making correct predictions

- Consider - even the iconic early 20th century Libertarian economist Friedrich Hayek...
- ...*"Friedrich Hayek made an astonishing admission. Not only were economists unsure about their predictions, he noted, but their tendency to present their findings with the certainty of the language of science was misleading and 'may have deplorable effects'."* ([Guardian 2017](#)). **Posturing as science! This denigrates actual scientists, which I find intolerable.**
- A devastating critique of iconic Neoclassical Milton Friedman's anti-scientific ideology by economist George Blackford ([2017](#) and [here](#))
- Neoclassical economists' continuous failures in understanding and anticipating financial crises are cataloged here ([Keen 2013](#)), and see [here](#) slide #9

Fatal Flaw #9: Self contradictory pricing failure - Fossil fuel energy is priced from the (still small) Cost of Extraction and competitive profit margins, not its true value.

- An \$88 barrel of oil produces the energy equivalent of ~25,000 hours of manual labor, or ~\$500,000 at ~minimum wages for that worker. **No wonder we burn it like there's no tomorrow. It's "free"!** (and at this rate, there may in fact be no tomorrow).
- This incentivizes the most rapid exploitation achievable for the fastest near-term profit growth.
- This behavior stands in sharp contradiction with the claimed nature of Neoclassicals *"They further believe that the price of a product is not dependent upon its cost of production but rather on its "perceived value". (Kaushik 2021 in "What is Neoclassical Economics?")*



Fatal Flaw #10: Neoclassical Economists

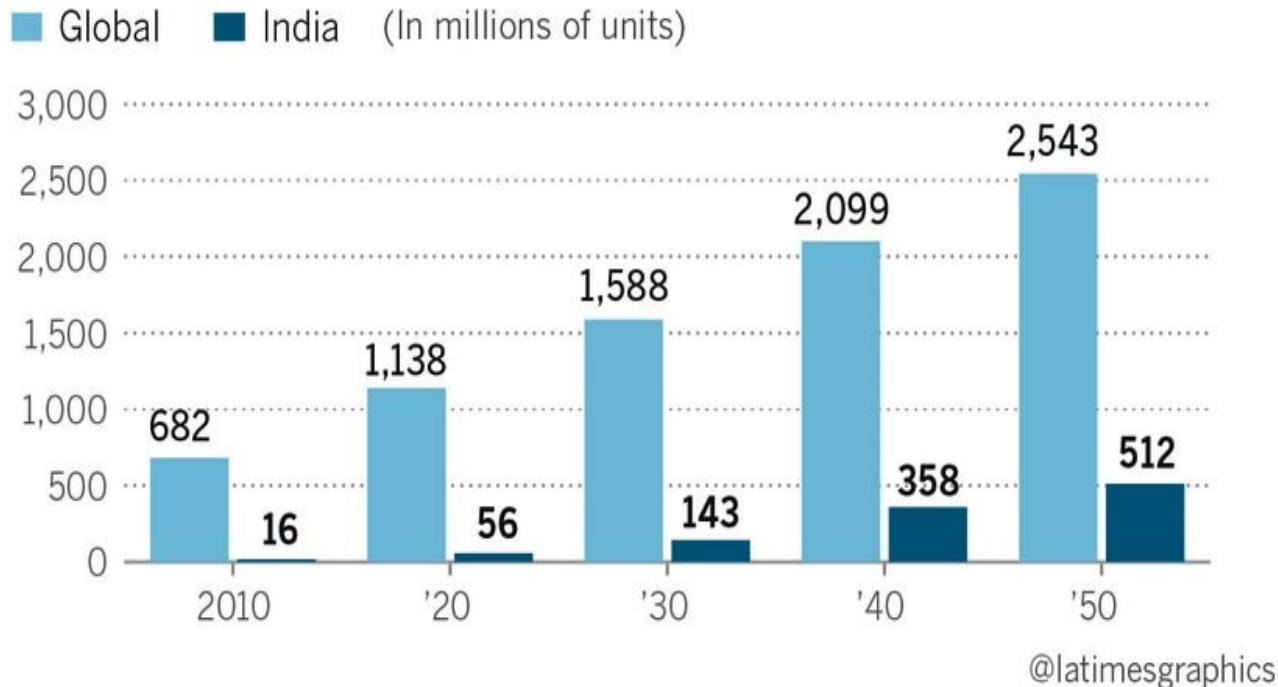
Consider the Environment a “Luxury Good”

- As a luxury good, its value is considered price-elastic. Non-essential. Optional. Should be valued mainly as a pretty view, or a nice vacation spot.
- The environment is considered only a small part of the Great Human Enterprise guided and enshrined by Neoclassical Economics. The truth is opposite. Economics is a small “wholly owned subsidiary of the environment”.
- Mass extinctions happen. Ecology scientists find evidence we’re entering one right now, with plummeting biodiversity. We are not above Nature, we are subjects to Nature.

Example: Global air conditioning rising 3.3%/yr, much faster than global GDP (~2%).

Air conditioner use heats up

Demand in India is projected to drive a global surge in room air conditioners.



(Source: Energy Technologies Area, Berkeley Lab)

- Neoclassical economists, who seek to maximize spending, will presumably celebrate, seeing a steeper positive slope of GDP.
- But is this **real** Utility?... No, it is a repair response to damage (climate damage).
- As such, it is pure inflationary spending. Not a “Real GDP” increase in human well-being.

Focusing now on Neoclassical Economics' travesties against climate science

- The worst offender here is **William Nordhaus** – a Yale economist who is highly influential to policy makers who find his flawed work quite profitable to promote and quote.
- I focus here because, incredibly, they celebrate and promote him for “winning the Nobel Prize in Economics” for his work on climate damage and economic Utility.
- This is a tragedy for our future. Did he win a genuine Nobel Prize?



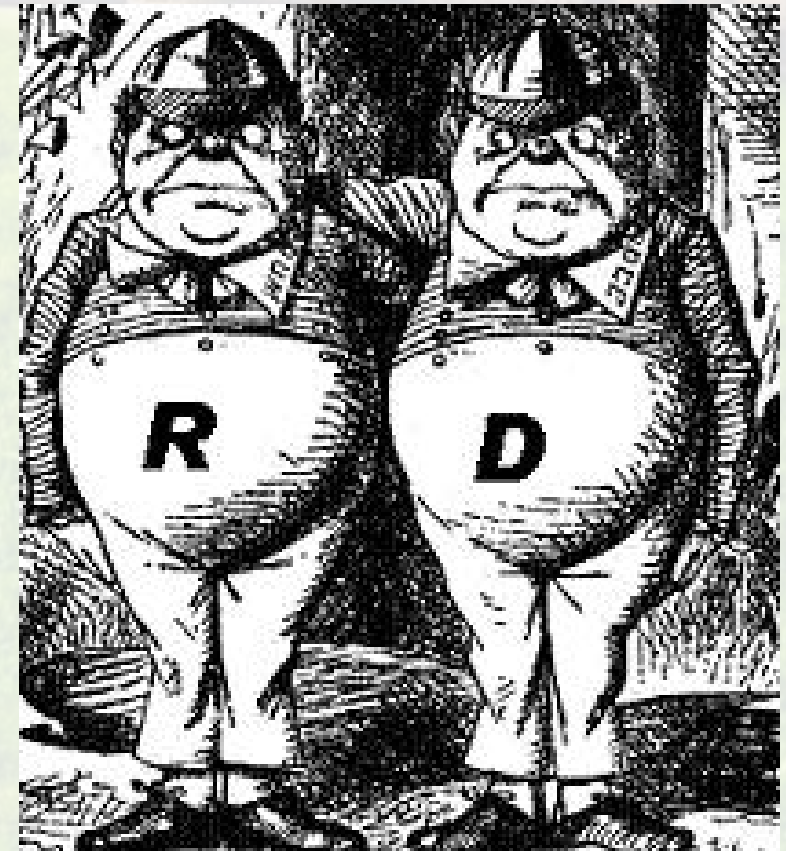
Alfred Nobel, in his wisdom, refused to fund a Nobel Prize for economists

- So, the **Swedish Central Bank** decided to fund a prize they could then smuggle in under Nobel's name.
- The Riksbank in 1968 established the **Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel**
- Alfred Nobel's family members were outraged...
- *Swedish human rights lawyer [Peter Nobel](#), a great-grandnephew of [Alfred Nobel](#).^[40] accuses the awarding institution of misusing his family's name, and states that no member of the Nobel family has ever had the intention of establishing a prize in economics.^[41] He explained that "Nobel despised people who cared more about profits than society's well-being", saying that "There is nothing to indicate that he would have wanted such a prize", and that the association with the Nobel prizes is "a PR coup by economists to improve their reputation".^[40]*

Some sources claim it is the Swedish Central Bank which selects the nominees

- The final recipient, though, is elected from the nominees by the Swedish Academy of Sciences, as with genuine Nobel Prizes
- The nomination selection process is a secret to be revealed only after 50 years.
- But this is pure of [Tweedism](#)...
- Boss Tweed, notorious political controller of New York City in the late 1800's, who said...

"I don't care who does the Electing, so long as I do the Nominating" – Boss Tweed.





This must be the absolute nadir for the reputation of the Swedish Academy of Sciences

- Climate scientists, physicists, and even a few past Nobel Prize economists, are outraged...
- Never has there been a more undeserved Nobel prize.

INET grantee Dr. Eric Weinstein (mathematical physicist by training) on Neoclassical Economics

- *“If you imagine a time when astronomy and astrology are housed in the same department, or chemistry and alchemy sit side by side at a university, such is the situation currently with economic theory. There is a portion of the field that seeks to return dependable conclusions to those who are its patrons. And there’s another portion of the field that is fundamentally focused on getting things right, and understanding how the world works... but this latter, is not the dominant part of the field that we see.” ([source](#) interview)*

Climate scientists' reactions ([quoted here](#) in 2020)

- “For **Michael Mann**, director of the Earth System Science Center at Pennsylvania State University, Nordhaus' ‘heavy social discounting inappropriately down-weights devastating impacts that fall disproportionately on future generations, arguably violating basic ethical considerations’.
- Mann says: “Frankly, such claims absurdly underestimate true costs & damages of business-as usual. They are based on a linear extrapolation of a coupled physical-politico-societal response that is highly non-linear and admits collapse. There IS no economy after civilization collapse...”



- “Many climate scientists are now calling for the focus on economy efficiency and incremental change that economists have taken to global warming to be abandoned.
- In a subsequent academic paper based on this lecture, (Nordhaus) stated that “damages are estimated to be 2 percent of output at a 3°C global warming and 8 percent of output with 6°C warming”. This is a trivial level of damage, equivalent for the 6°C warming case to a fall in the rate of economic growth over the next century of less than 0.1% per year.”

From Nordhaus' 2017 "Revisiting the Social Cost of Carbon"

- *"The damage function was revised in the 2016 version to reflect new findings. The 2013 version relied on estimates of monetized damages from ref. [6](#). It turns out that that survey contained several numerical errors ([7](#)). The current version continues to rely on existing damage studies, but these were collected by Andrew Moffat and the author and independently verified (see [Supporting Information](#) for details). Including all factors, the final estimate is that the damages are 2.1% of global income at a 3 °C warming, and 8.5% of income at a 6 °C warming."*
- **Damage of only 8.5% of accumulated 2100 income in a +6C world. That corresponds to a trivial change to annual GDP of only -0.1%. Absurdly small.**
- **In fact, a +6C world will have suffered complete societal collapse into global wars and chaos, with mass fatalities from hyperthermia, famine, and war.**

Example: Nordhaus claims 87% of the economy will be unaffected by climate change, because it is conducted indoors. I find this too absurdly naïve to be an error made innocently. Not by a PhD who knows his powerful influence.

Mainstream Economics Climate Change “data”

- “Data” used by economists concocted to fit pre-existing biases
 - “First, it must be recognised that **human societies thrive in a wide variety of climatic zones**. For the bulk of economic activity, **non-climate variables** like labour skills, access to markets, or technology **swamp climatic considerations in determining economic efficiency**.” (Nordhaus 1991, p. 930)
 - Mistaking climate:GDP data today for impact of climate change as energy levels of biosphere increase dramatically
 - “3% of **United States national output** is produced in highly sensitive sectors, another 10% in moderately sensitive sectors, and about **87% in sectors that are negligibly affected by climate change**... (p. 930)
 - for the bulk of the economy - **manufacturing, mining, utilities, finance, trade, and most service industries** - it is difficult to find major direct impacts of the projected climate changes over the next 50 to 75 years...

Nordhaus thus shows his belief...

- ...that feeding those economic workers from climate crippled agriculture,
- and clothing them from climate crippled natural resources,
- and building their homes and cars and goods from imports from tropical countries suffering devastation as wet-bulb temperatures kill millions and societal breakdown ensues...
- that somehow these facts are only going to be a trivial dent to their experienced “Utility”.
- It is absolutely indefensible, coming from a long tenured Yale professor of Economics.

Nordhaus justifies this with a strikingly fraudulent claim that his Utility fit is consistent with climate scientist Tim Lenton's supposed survey showing "no tipping points" (Lenton is a good scientist, and in fact said the exact opposite).

Mainstream Economics Climate Change "data"

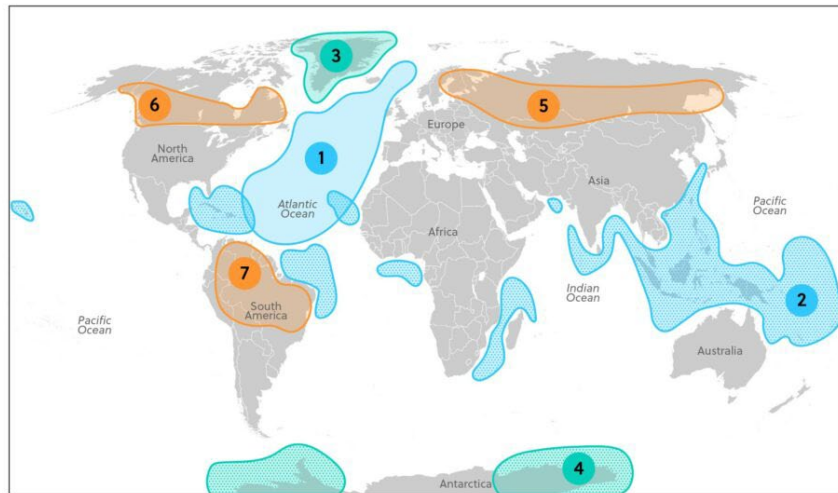
- Nordhaus justifies use of simple quadratic for damages from climate change:
 - "The current version assumes that damages are a quadratic function of temperature change and **does not include** sharp thresholds or **tipping points**, but this is **consistent with the survey by Lenton et al. (2008)**." (Nordhaus & Sztorc 2013, p. 11)
- **Lenton et al.'s actual conclusion:**
 - **"Society may be lulled into a false sense of security by smooth projections of global change.**
 - Our synthesis of present knowledge suggests that **a variety of tipping elements could reach their critical point within this century** under anthropogenic climate change." (Lenton 2008, p. 1792)

Prior blue image-captures are from a [talk](#) by Post-Keynesian Economist Steve Keen in 2020

- Nordhaus claims that climate damages are so low that it's uneconomical to do anything about climate change until +4C is reached.
- This is not from an uneducated freshman undergrad, but from a Yale economist of high profile and policy influence. It's utterly amazing. And to date, no apology has ever been given.
- I don't believe such a claim could happen as a result of sincere academic diligence and proper consultation with climate scientists. This simply cannot be justified in any responsible, ethical way.
- **In fact, he admits his advisors were nearly all economists, and no climate scientists. This behavior is ~universal among Neoclassical economists, who are largely of Conservative political bent.**

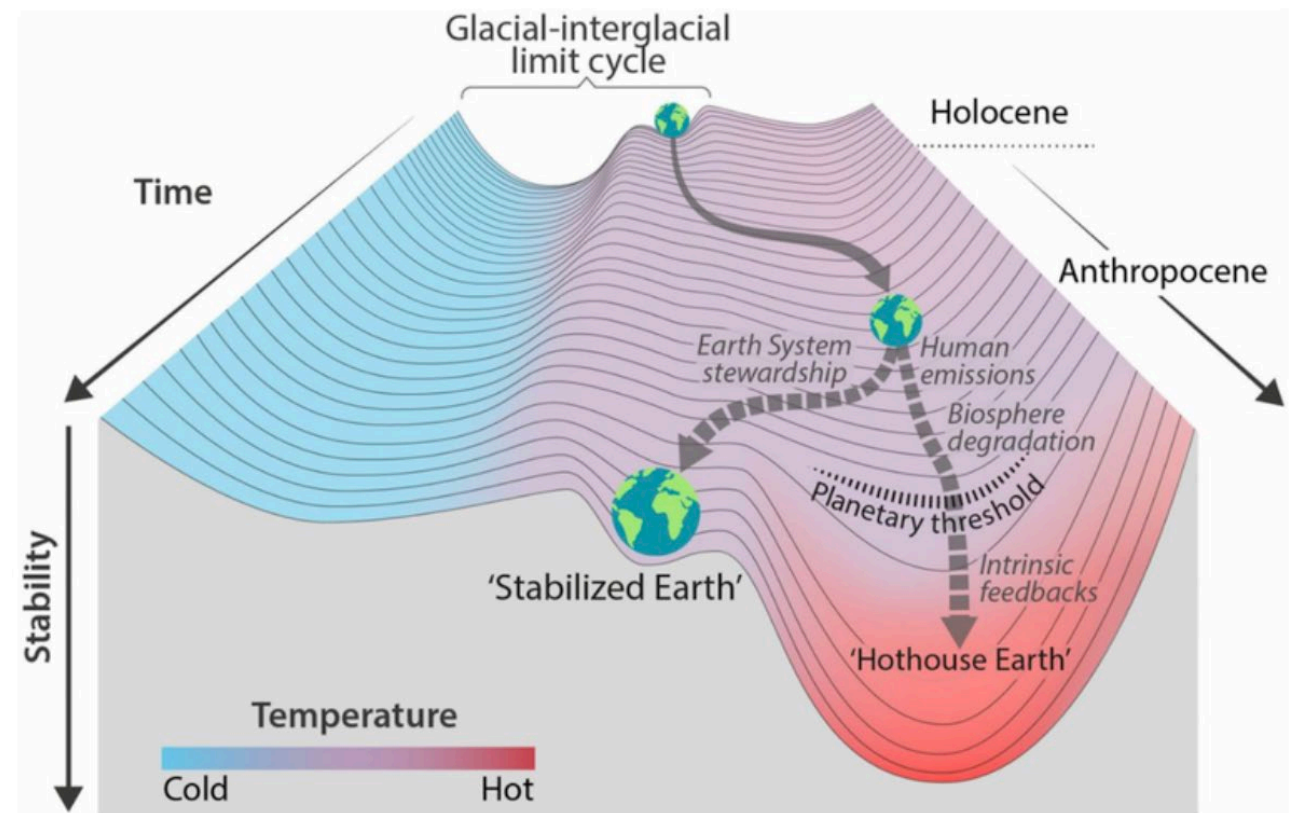
Nordhaus ignores the existence of climate tipping Points. Are they far off and inconsequential? No. They are arriving now. Today. As climate scientists have shown in numerous studies

7 Environmental Tipping Points



- | Sea | Ice | Land |
|------------------------|--------------|---------------------|
| 1 Atlantic circulation | 3 Greenland | 5 Permafrost |
| 2 Coral reefs | 4 Antarctica | 6 Boreal forest |
| | | 7 Amazon rainforest |

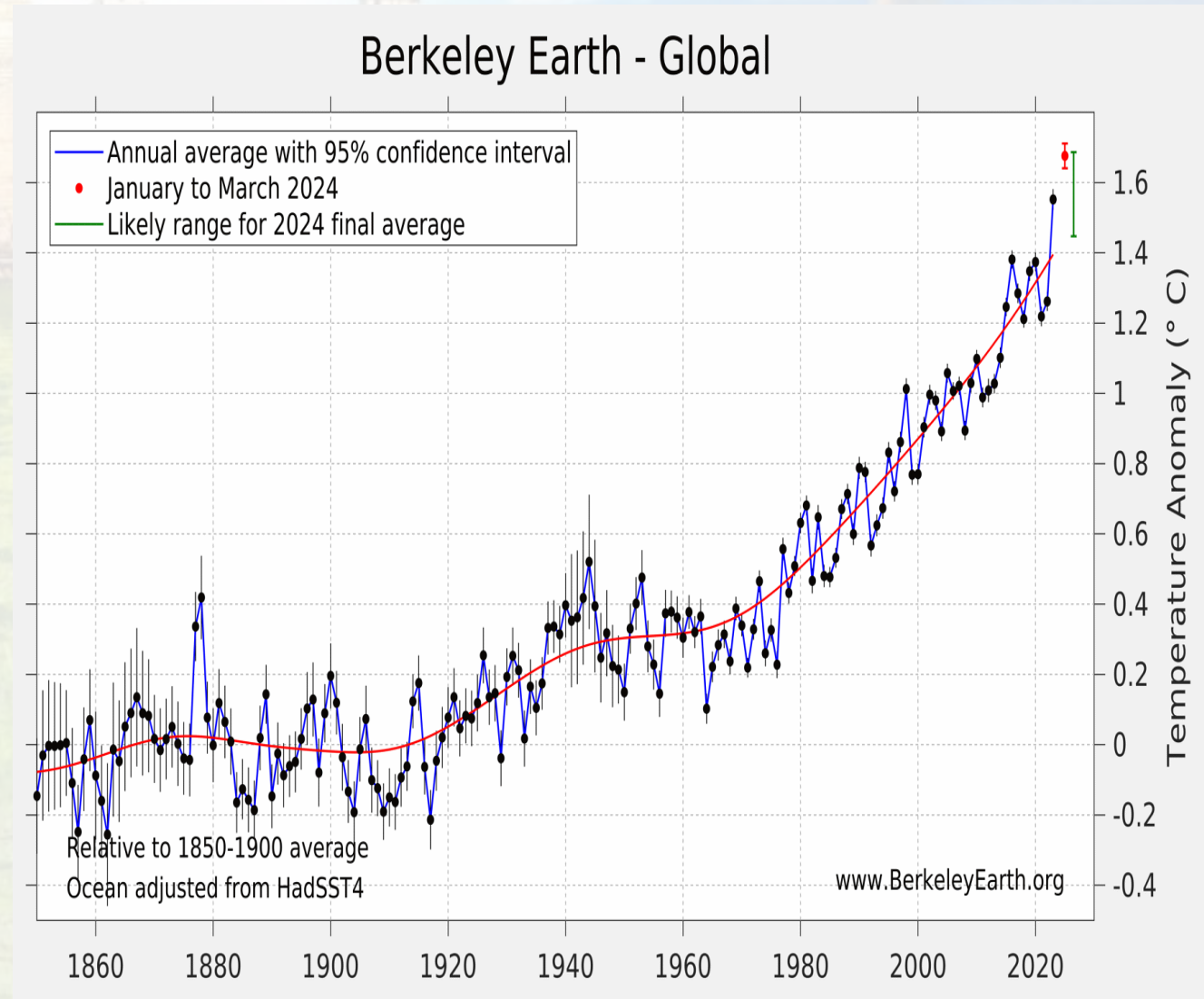
Source: Science.org



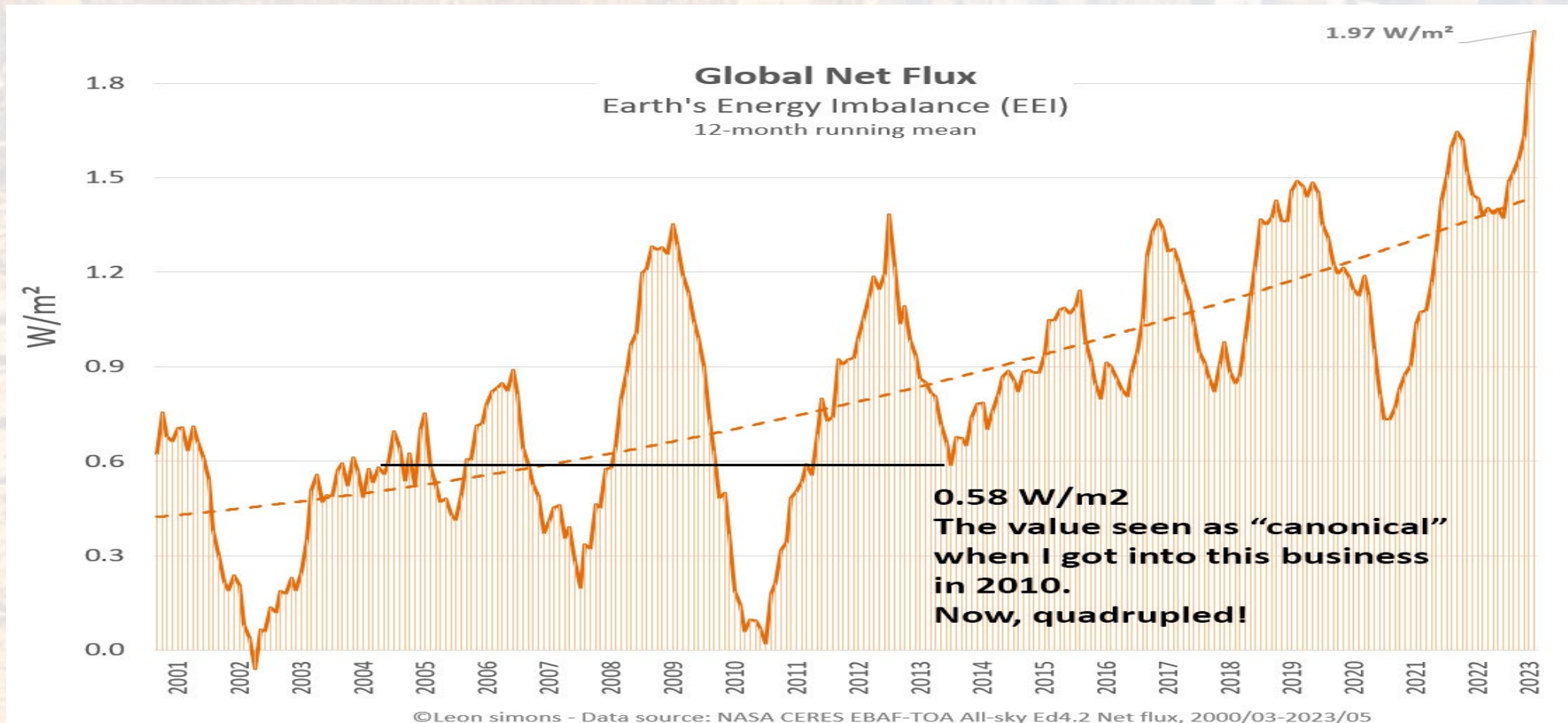
EARTH.ORG

Greenland/West Antarctic tipping point has arrived

- **Pattyn *et al.* (2018)** and discussed [here](#) finds that the tipping points for both the Antarctic (West Antarctic) and Greenland ice sheets is between +1.5C and +2C.
- **Greenland will contribute 25 ft of sea level rise, and West Antarctica another 12 ft.**
- These temperatures are arriving now.
- There's too much existing climate forcing, forcing levels that are only rising, not falling.

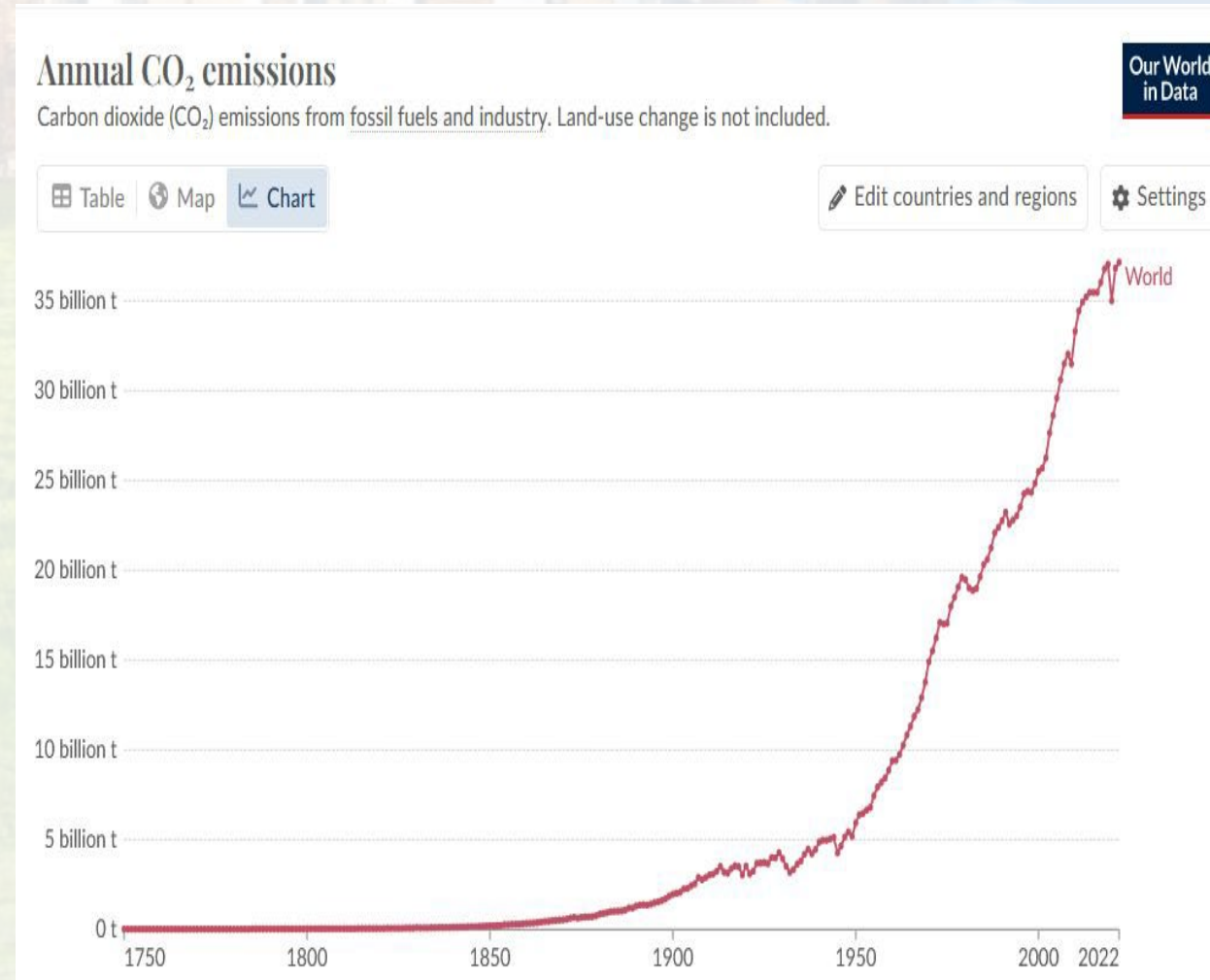


Earth Energy Imbalance (EEI) has skyrocketed. Nearly quadrupled since the '00's level of 0.58 W/M^2 . Cleaner air from laws limiting coal in shipping is a prime suspect. EEI determines the RATE of increase of global temperatures.



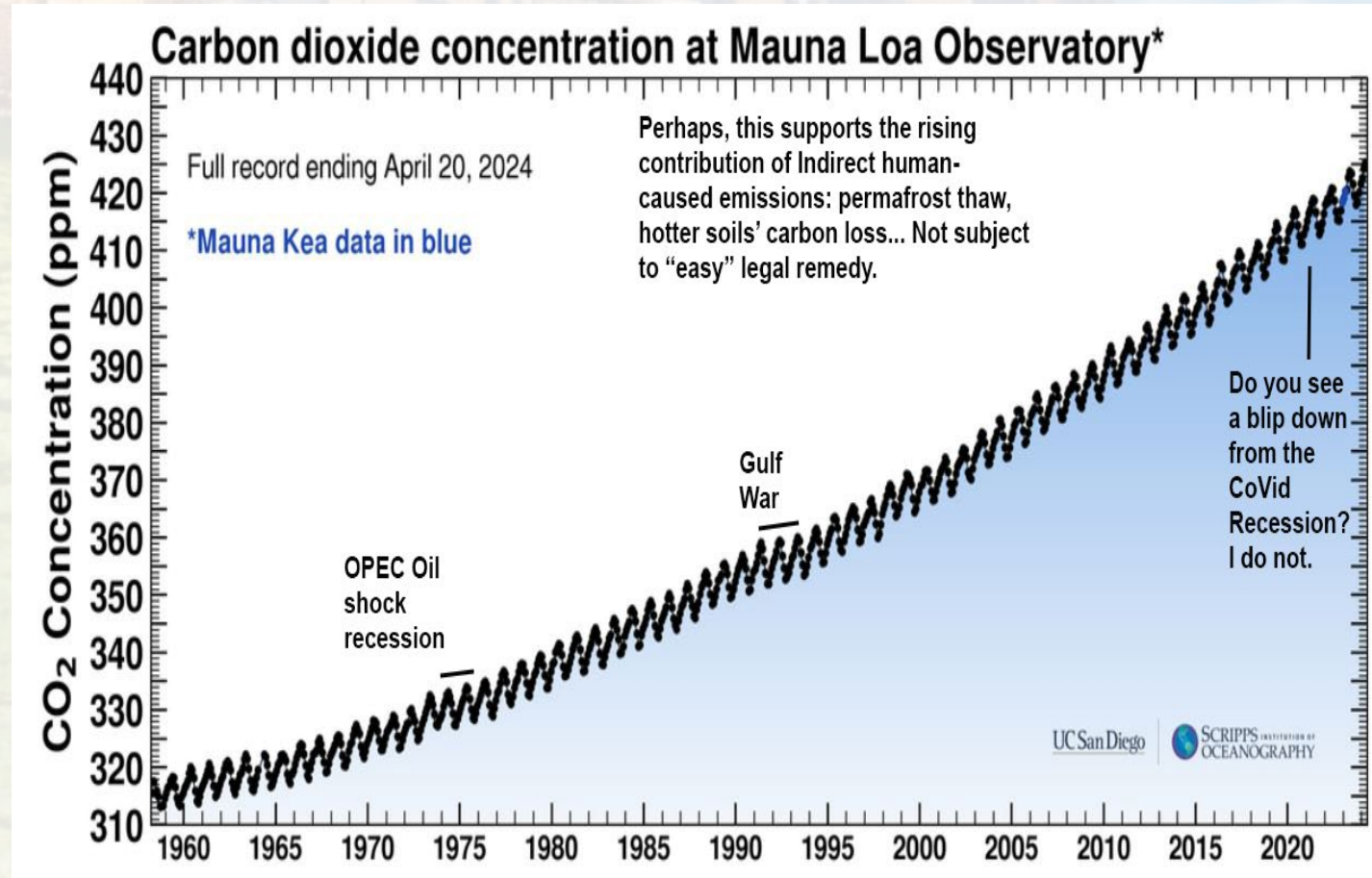
What if we just eliminate direct, legally controllable global human GHG emissions? Won't that solve this?

- No. Not at this point.
- Rising ocean heat absorption, falling carbon absorption by forests, soils, **require active GHG massive re-capture and permanent sequestration.**
- The EEI must go to zero and stay there before temperatures can even just stabilize. Let alone reverse down to tolerable levels. Instead, they are accelerating upwards.
- **Indirect** human caused emissions are **not in the conversation**, as they must be!
- **Example: Note CoVid's steepest drop in direct CO2 emission in a 100 years – do we see it reflected (hopefully) in atmospheric CO2? (next slide)...**



Tipping Points can be irreversible when they are caused by INDIRECT Human Emissions

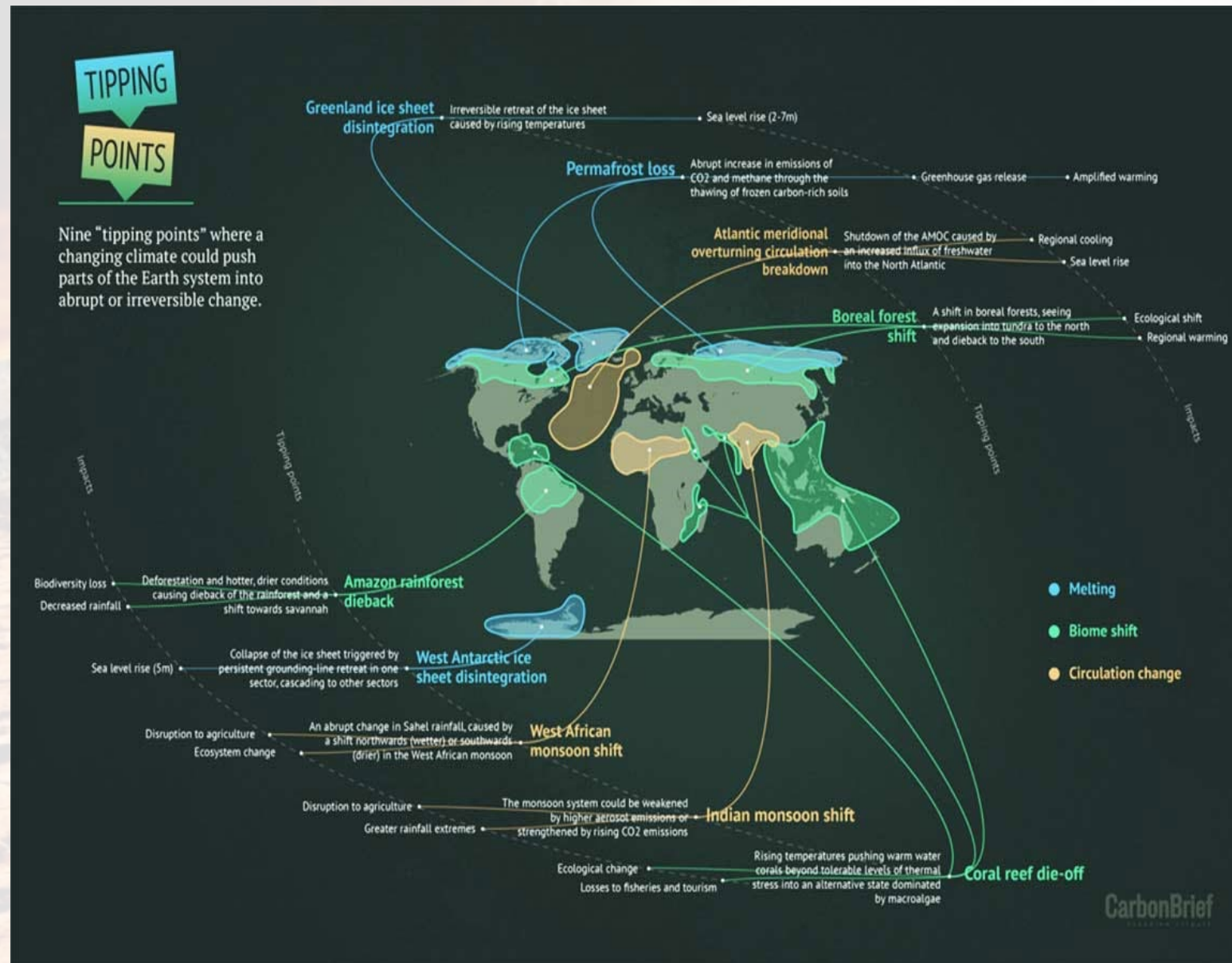
- Very little is talked about this fact, in the “emissions” wrapper word that gets so much play in the techno-optimist community.
- Yet – there is *e.g.* a 44:1 amplification of methane emissions with rising temperatures from all wetlands.
- Katy Walter-Anthony finds methane from permafrost lakes is far higher than IPCC assumes.



Thermokarst permafrost
opaque thaw ponds – They
isolate thawed carbon from
atmospheric oxygen, and
photosynthetic algae, thus
encouraging methane
emitting microbes.

Methane production is
stronger than first thought
([Walter-Anthony et al. 2019](#))





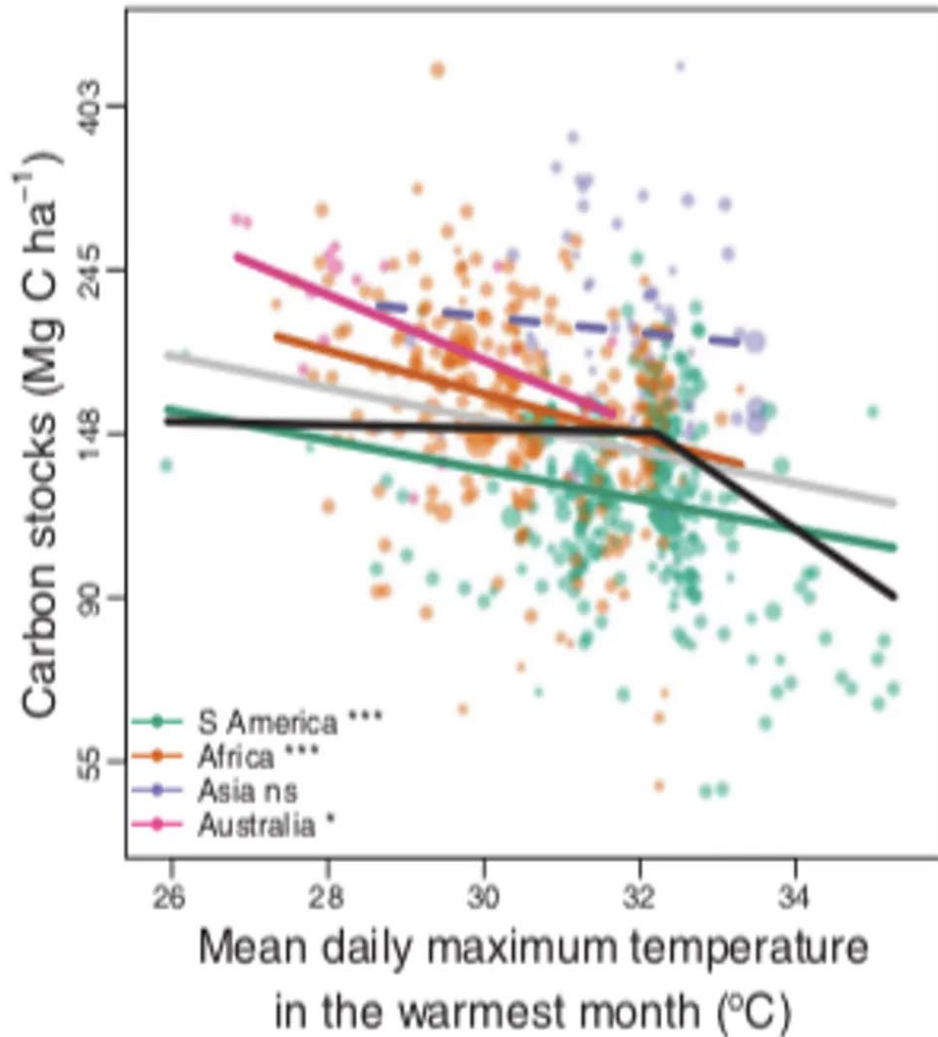
Nordhaus *et al.* Used simple linear, additive, and badly underestimated damage modelling, and ignored tipping points in IPCC models (inclusion vetoed by IPCC Policy people in the Neoclassical camp).

Tipping points are ~Irreversible. Hot House Earth, mass extinctions... may then result.

Consequences will last for millennia. Extinctions are forever. Past mass extinctions did not recover to previous biodiversity levels until 10 *million* years later.

With proper zero discounting – it says “You cannot go there!” – Steven Chu

A New Tipping Point: When avg temperature reaches $T=90^{\circ}\text{F}$ (32°C) in tropical forests' warmest months



- [Sullivan et al. 2020](#) (behind paywall but discussed [here](#)) find that at this temperature, tropical rainforests transition to a state of **steep carbon loss**, as tree growth is stunted and decay amplifies (black curve)
- They point out that this corresponds to a global temperature rise of only **+2C**, which, as we saw, is virtually impossible to avoid at this point.

The Amazon Rainforest tipping point to collapse and become savanna: Evidence says is close - far ahead of predictions.

- The Amazon is already a [net carbon source](#), no longer a carbon sink.

Again, far ahead of predictions from models.



"The Amazon is (now) a carbon source. No doubt,"...

- *...Luciana Gatti, a researcher at Brazil's National Institute for Space Research who led the study, said in an interview with environmental news site [Mongabay](#).*
- *"By now we can say that the budget for the Amazon is 0.3 billion tons of carbon per year [released] into the atmosphere. It's a horrible message." ([source](#))*

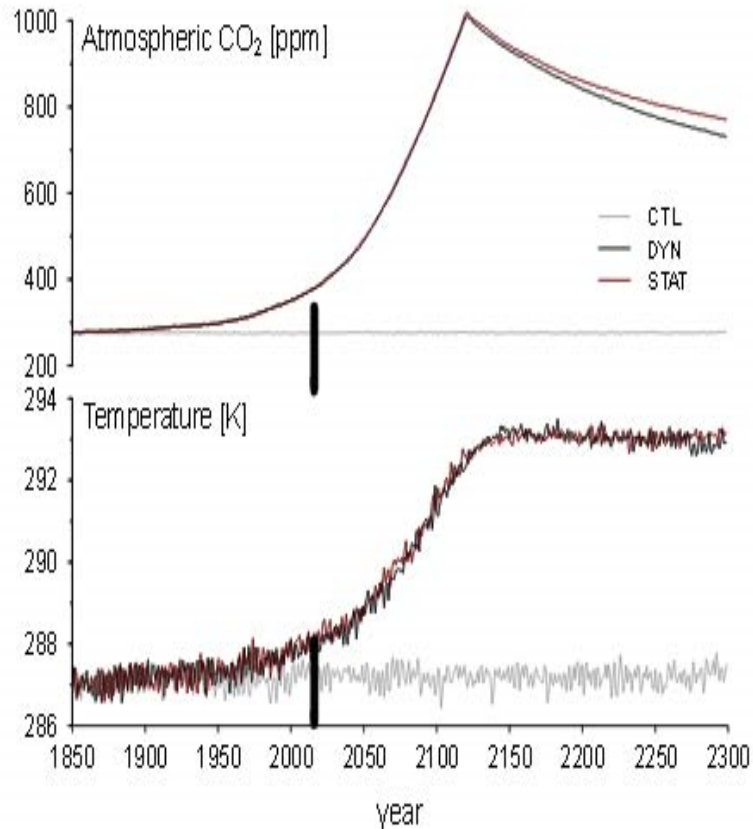


Fig. 2. Time series of annual mean atmospheric CO₂ concentration and global annual mean temperature in the CTL (grey line), the DYN (black line), and the STAT (red line) simulation.

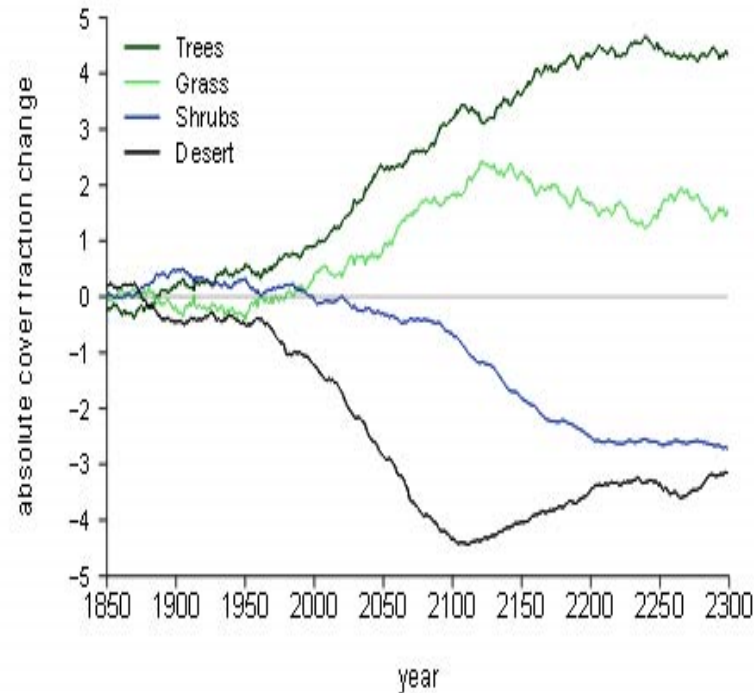


Fig. 3. Time series of changes in absolute global mean vegetation cover (DYN – CTL) in [%]. Forest includes tropical evergreen and deciduous trees as well as extra-tropical evergreen and deciduous trees. Shrubs contain cold and rain green shrubs and grass includes C₃ and C₄ grass.

From [Port et al. 2012](#). CO₂ (top left) drops when all human direct and indirect-caused emissions cease, but not temperatures (bottom left). This work includes the “carbon fertilization effect” of higher CO₂ as plant food. Temperature is a ratchet! We must undo our CO₂ injections if we are to return to a stable climate that ecosystems have evolved to.

Fatal Flaw #11: Nordhaus assumes no hysteresis in the Earth Climate System. False.

- Even within the politically tampered IPCC AR6 - buried inside 1500 pages of the full WG III report, they acknowledge hysteresis in the Earth System.
- Perhaps the Policy People (economists, mostly) did not notice (and then censor) this?
- See next slide...

Irreversible Ice Sheet Loss

- The Antarctic Ice Sheet is at risk of irreversible loss.
- [Garbe et al. \(2020 in Nature\)](#) show that at +2C West Antarctica begins collapse (except, it has already begun), and at +6-9C even East Antarctica collapses
- And with strong hysteresis: Returning to pre-industrial temperatures will not bring it back.
- Why? The dark albedo and altitude feedbacks mean a much **colder** Earth is required to re-start re-icing.

Article | Published: 23 September 2020

The hysteresis of the Antarctic Ice Sheet

[Julius Garbe](#), [Torsten Albrecht](#), [Anders Levermann](#), [Jonathan F. Donges](#) & [Ricarda Winkelmann](#) 

[Nature](#) **585**, 538–544 (2020) | [Cite this article](#)

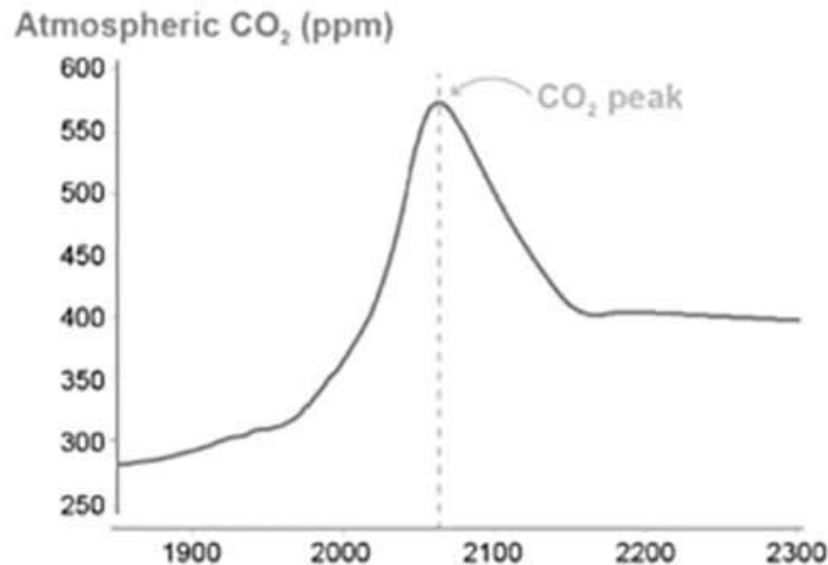
13k Accesses | **44** Citations | **1852** Altmetric | [Metrics](#)

Abstract

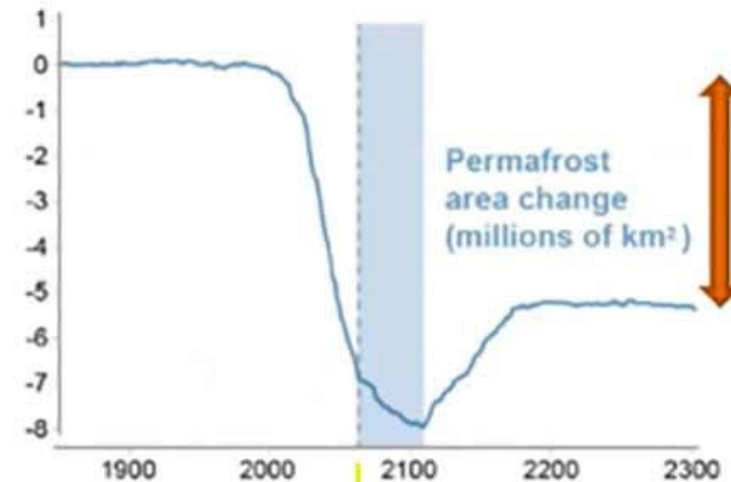
More than half of Earth's freshwater resources are held by the Antarctic Ice Sheet, which thus represents by far the largest potential source for global sea-level rise under future warming conditions¹. Its long-term stability determines the fate of our coastal cities and cultural heritage. Feedbacks between ice, atmosphere, ocean, and the solid Earth give rise to potential nonlinearities in its response to temperature changes. So far, we are lacking a comprehensive stability analysis of the Antarctic Ice Sheet for different amounts of global warming. Here we show that the Antarctic Ice Sheet exhibits a multitude of temperature thresholds beyond which ice loss is irreversible. Consistent with palaeodata² we find, using the Parallel Ice Sheet Model^{3,4,5}, that at global warming levels around 2 degrees Celsius above pre-industrial levels, West Antarctica is committed to long-term partial collapse owing to the marine ice-sheet instability. Between 6 and 9 degrees of warming above pre-industrial levels, the loss of more than 70 per cent of the present-day ice volume is triggered, mainly caused by the surface elevation feedback. At more than 10 degrees of warming above pre-industrial levels, Antarctica is committed to become virtually ice-free. The ice sheet's temperature sensitivity is 1.3 metres of sea-level equivalent per degree of warming up to 2 degrees above pre-industrial levels, almost doubling to 2.4 metres per degree of warming between 2 and 6 degrees and increasing to about 10 metres per degree of warming between 6 and 9 degrees. Each of these thresholds gives rise to hysteresis behaviour: that is, the currently observed ice-sheet configuration is not regained even if temperatures are reversed to present-day levels. In particular, the West Antarctic Ice Sheet does not regrow to its modern extent until temperatures are at least one degree Celsius lower than pre-industrial levels. Our results show that if the Paris Agreement is not met, Antarctica's long-term sea-level contribution will dramatically increase and exceed that of all other sources.

Climate is massive, and nonlinear. So response is slow, and does not return: even after strong CO₂ Removal (CDR), Permafrost (PF) thaw refreezing takes many decades to begin, and then makes only a small partial recovery. This demonstrates **STRONG** hysteresis

Could climate change be reversed by removing carbon dioxide from the atmosphere?



YES, BUT DECADES



After switching on CDR, PF continues to melt for another 40 years before slow recovery

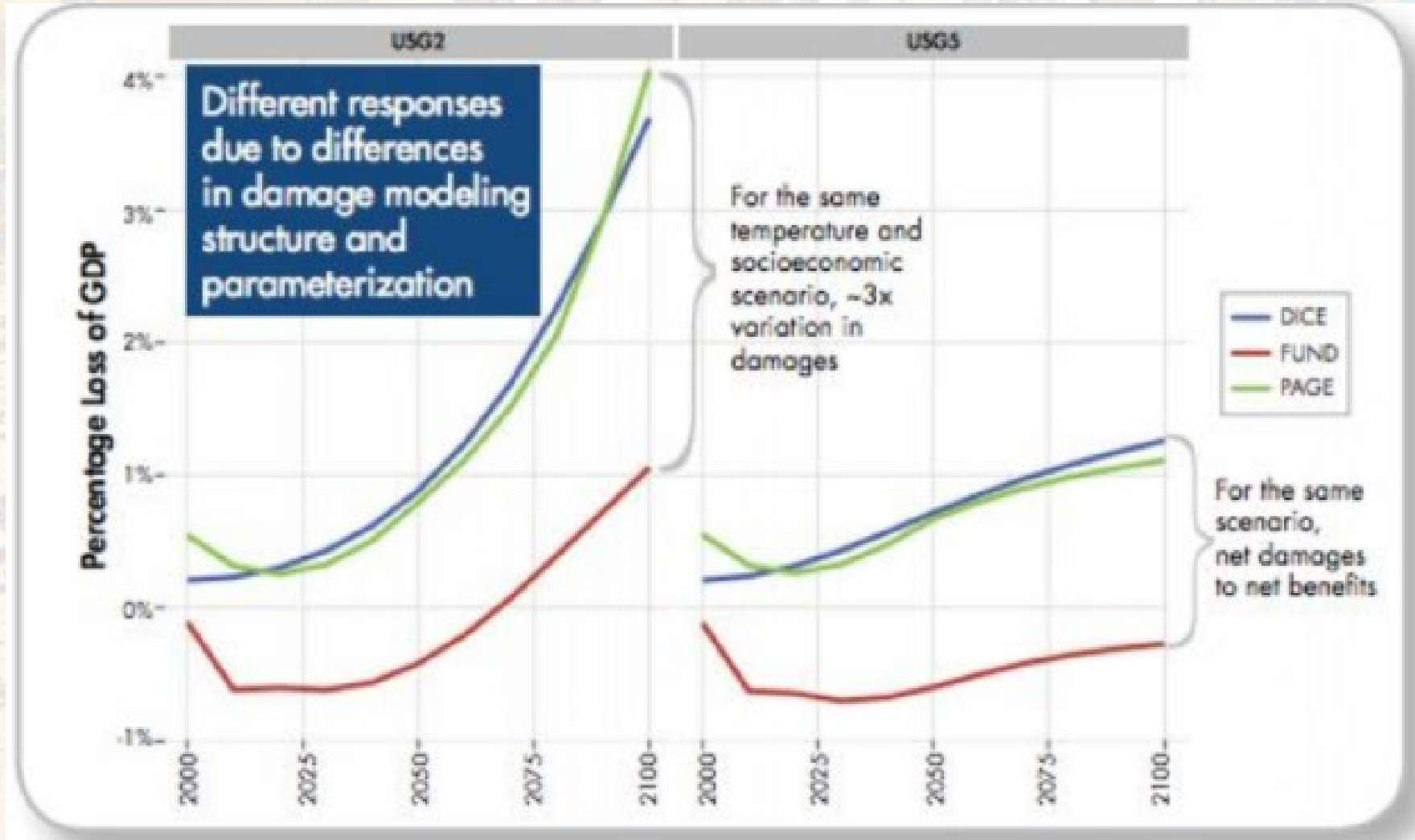
Note the contradiction within IPCC – not mentioned but dead certain in the evidence and the logic...

- The idea of a “Carbon Budget” which was introduced in prior IPCC AR’s, rests on the notion that it doesn’t matter WHEN you add or remove the carbon. Only that it is added or removed (so we politically kick the can down the road further; our kids’ll deal with it).
- The existence of hysteresis, as admitted here in the IPCC AR6’s section within the segment most directly written by the scientists, makes a mockery of the very concept of a “Carbon Budget”.
- Carbon Debts have a loan-shark level of “interest” attached to them:
- **There IS no “Carbon Budget”, IPCC politics notwithstanding.. Please explain this to your can-kicking neighbors and other faculty and students**

So. Given the radical difference between climate scientists' dire assessments and Nordhaus' trivial damage functions, did Nordhaus decide to bring in climate scientists to help update his modelling?

- In fact, he did the exact opposite.
- *“Given this extreme divergence of opinion between economists and scientists, one might expect that Nordhaus’s next survey would examine the reasons for it. In fact, the opposite applied: his methodology excluded non-economists entirely” ([Keen 2021](#)).*

Other Neoclassical [damage functions](#) (Richard Tol's [FUND](#), and [PAGE](#) here) – are as absurd or even more so, than Nordhaus' "DICE" model. Should we waste time we don't have, in trying to patch them? Reject them altogether. It is not "Nobel" prize-worthy to port their cost/benefit discounted Utility equations into climate change policy and long term global sustainability when tipping points exist. It is dangerously stupid.



“It is difficult to get a man to understand something, when his salary depends upon his not understanding it.”

—Upton Sinclair



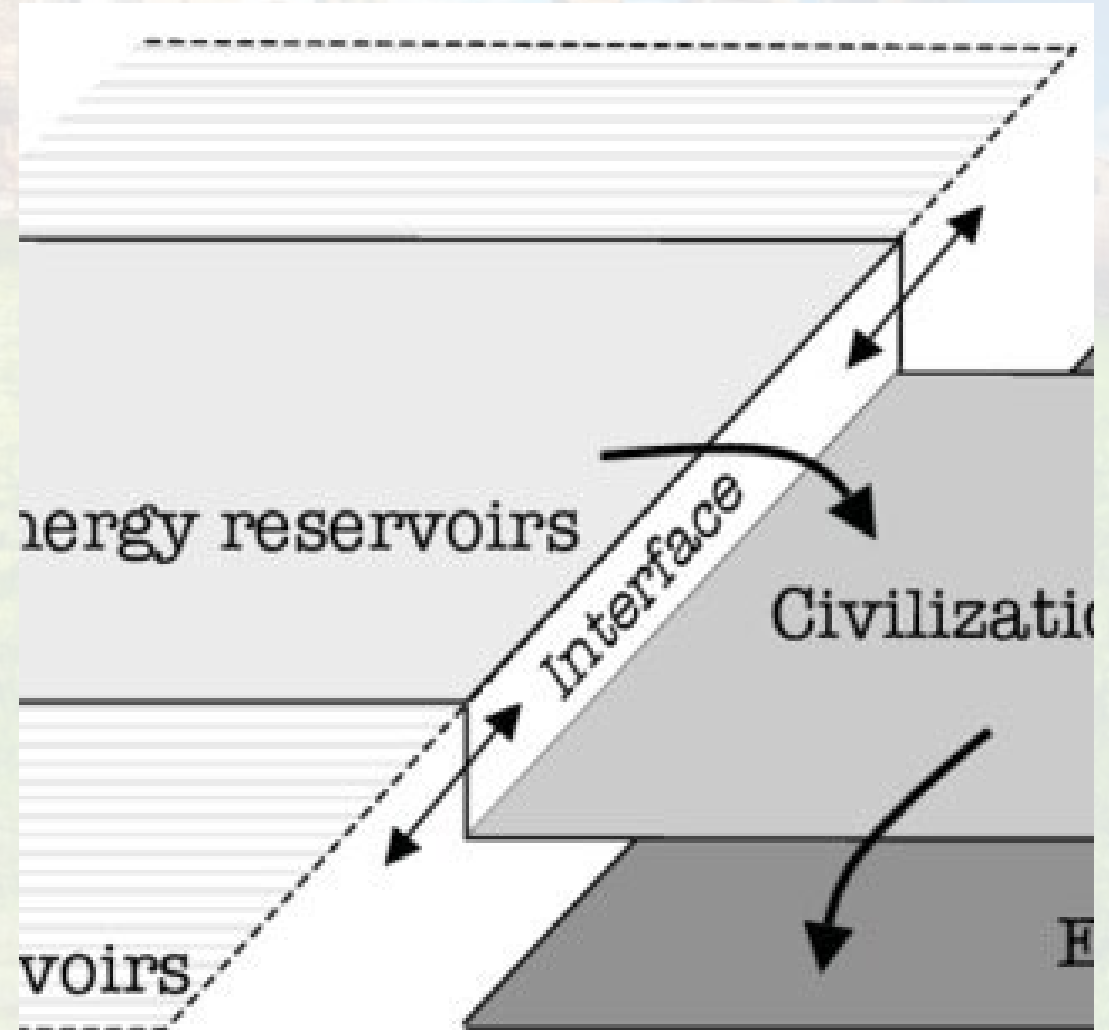
And finally, a last comment on Economic data...

- In my examining relevant economic data, I've never seen confidence limits or error bars given on economists' numbers.
- Yet any assessment of the legitimacy of their claims and conclusions, quantitatively, must crucially include assessing the quality of the data.
- You know? As **scientists do!** Any scientific paper submitted with data that includes no quantitative error analysis will be summarily rejected by the editor before it even goes out to a referee.
- Yet they posture as “scientific”. And their papers get refereed only by similarly tribal economists. Even climate damage papers. What does that say about them?

A Last Segment for This Econ/Climate Talk...

Civilization as a Thermodynamic System

- How Does the universality of Thermodynamics constrain the realism of our climate trajectory, and climate strategies?



First: DOES Civilization Economics Behave Thermodynamically? Yes!

Graphically: the Income distribution for the bottom ~95% follows a perfect Boltzmann-Gibbs function, just as does the energy distribution of molecules. The top ~5% (straight lines at right) fit a power law due to non-economic wealth from asset price inflation.

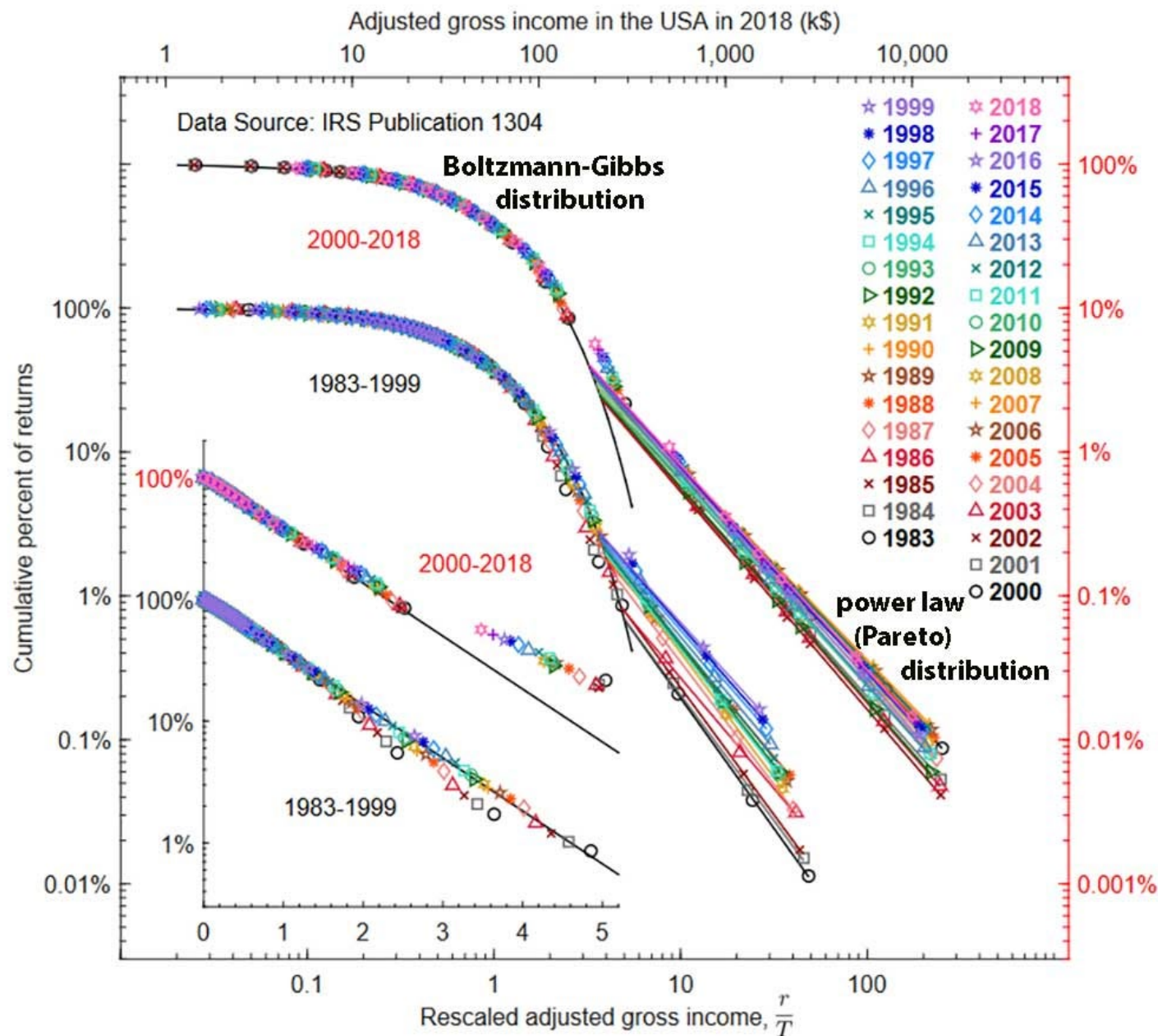


Figure 1. The cumulative distribution function $C(r)$ versus the rescaled income r/T in the USA for 1983–2018. The main panel is in log-log scale, whereas the inset is in log-linear scale.

“If your theory is found to be against the Second Law of Thermodynamics, there is nothing for it but to collapse in deepest humiliation”

- [Sir Arthur Eddington](#): pioneer in the study of General Relativity, and stellar structure and evolution.

So - In 2009, Cloud Physicist Tim Garrett Discovered a Potentially Key Relationship. I call it... The Power/Wealth Relation:

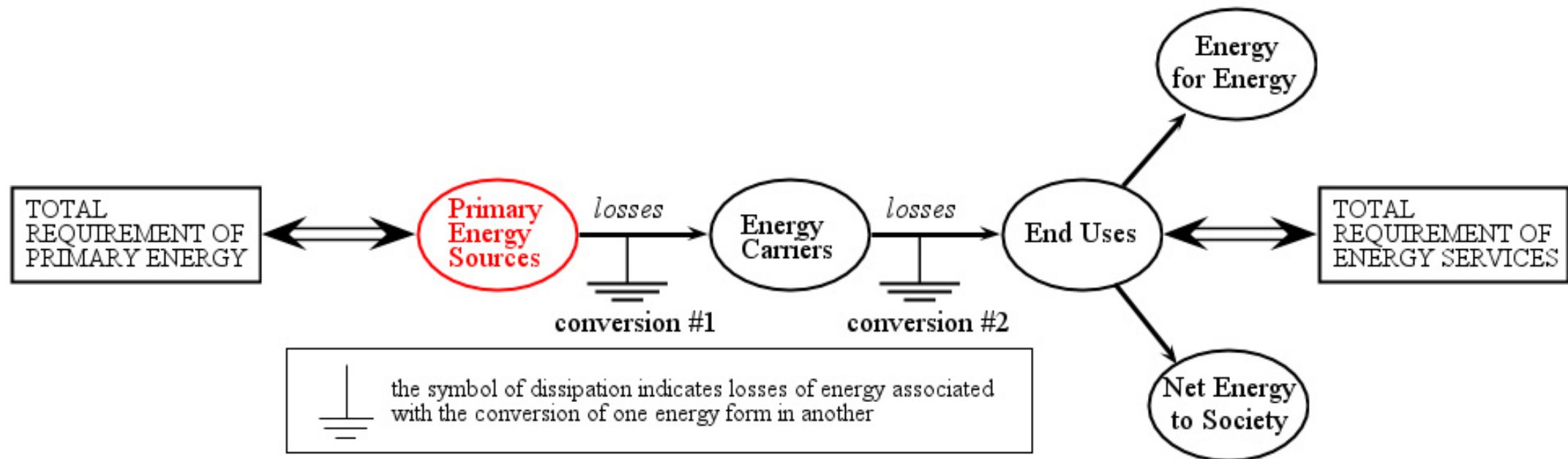
The Current Global Rate of Primary Energy Consumption is Directly Proportional to The Sum Total of All Past Inflation-Adjusted Global Gross Domestic Product (GDP)

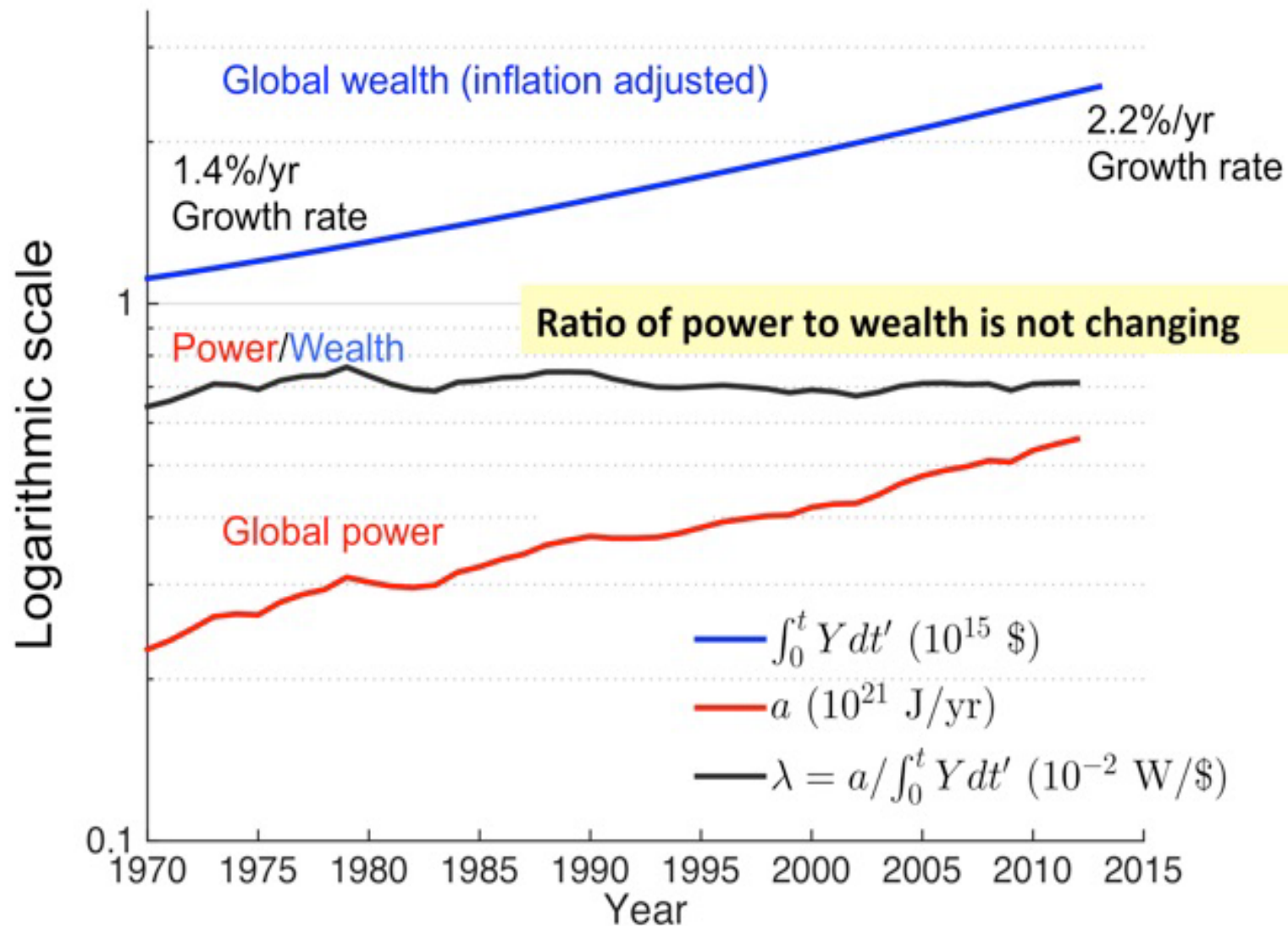
Garrett calls this sum “Wealth”.

(it’s just a short-hand term he chose, don’t over-interpret a personal political/philosophical meaning!)

The Relevant Energy in this Relation is PRIMARY Energy - Energy in Raw Form Provided by Nature, Not Yet Useful Energy!

Looking at promotional graphs which only present our progress in terms of processed energy (e.g. electricity) will be cheery, but unrealistic in true cost.





Current energy consumption rate (power) and total past accumulated Wealth are seen directly proportional; *i.e.* the ratio (black curve) is flat (Garrett 2010)

We add $\lambda=7.1$ mW of new continuous power consumption for every inflation-adjusted 2005 dollar of global GDP ever spent.

Implicit in the observed Power/Wealth Relation is the observational confirmation of what I have come to call “Generalized Jevons’ Paradox”.

- This is distinct from the older, [original formulation](#) by William Stanley Jevons – 19th century British energy economist.
- Garrett has referred to my formulation as a “*more explicitly thermodynamic expression*”
- Most eco-friendly advocates and policy cheerleaders who compose “white papers” and speeches will claim that if we just increase energy efficiency, we’ll make big strides in cutting CO2 emissions.
- **That’s false, both in historical fact, and proper theory.**

Generalized Jevons' Paradox

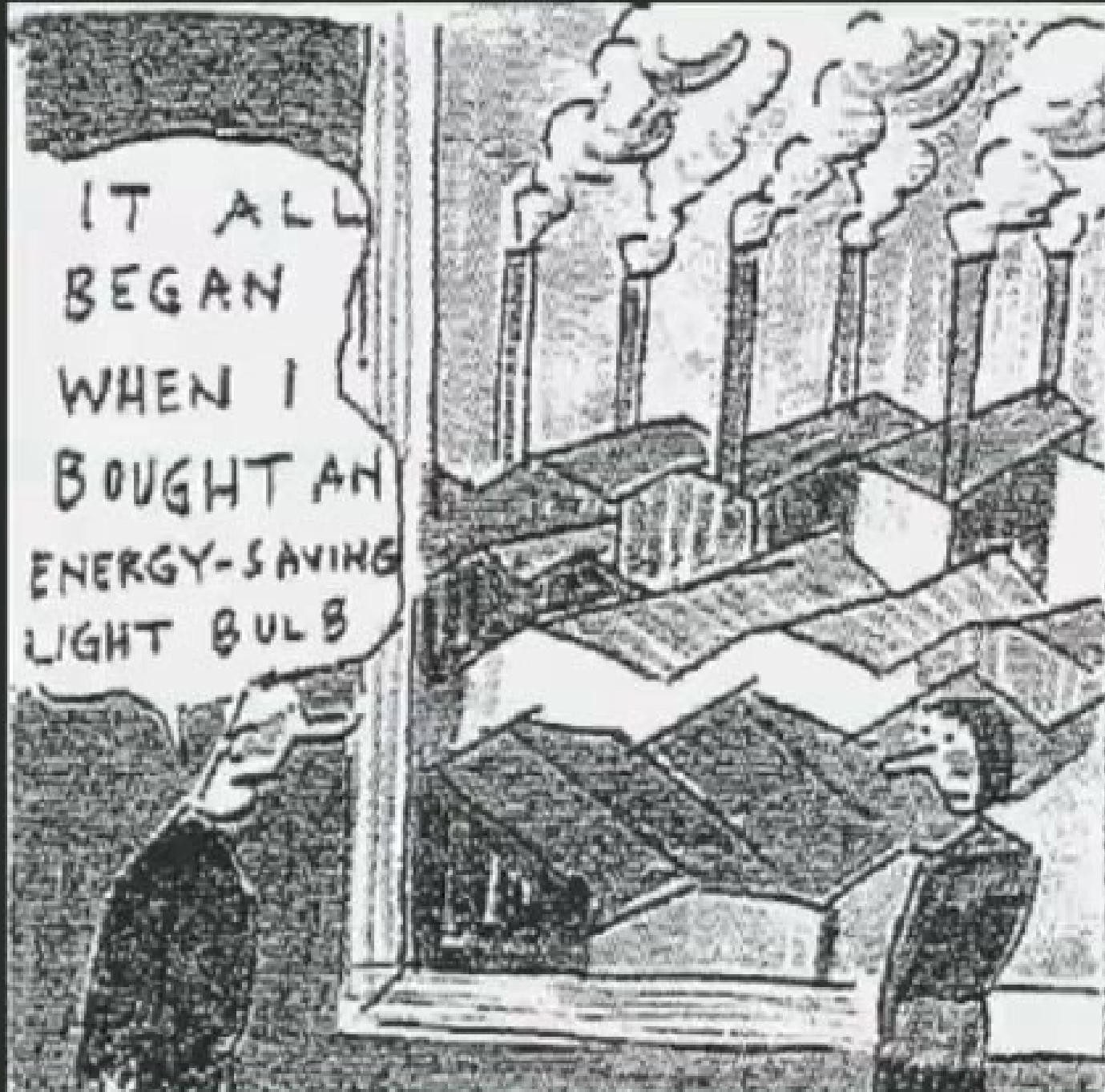
Any increase in energy efficiency will lead to savings. Those savings will not be destroyed but rather they will be spent, and ALL spending requires the ongoing consumption of new energy to support the resulting “civilizing” against decay from the 2nd Law of Thermodynamics, while also expanding our ability to discover and exploit new energy at a faster rate. These combined effects more than offset the efficiency-gained reductions in power. Future global power consumption goes up, not down.

Energy can be usefully split conceptually into several components, in the context of civilization...

- 1. The Gibbs Free Energy (*i.e.* **useful work** which can be done).
- 2. Inefficiency ultimately into waste heat and microscopic randomness).

But the Useful Work itself can be further segregated into 4 categories, in order of civilization's priority, they are...

- 1. The energy needed to tap new energy sources. TOP PRIORITY.
- 2. The energy needed to repair/maintain existing civilization against the 2nd Law decay
- 3. The energy used to power new growth in Civilization
- 4. The energy employed to improve the energy efficiency per \$GDP



Jevons'
Revenge: Prepare
to pay the FULL costs
when you embark on a
global transformation

We invest in energy efficiency only to the extent the cost will be more than compensated by even stronger GDP growth – PROFITS, we insist, drive the world

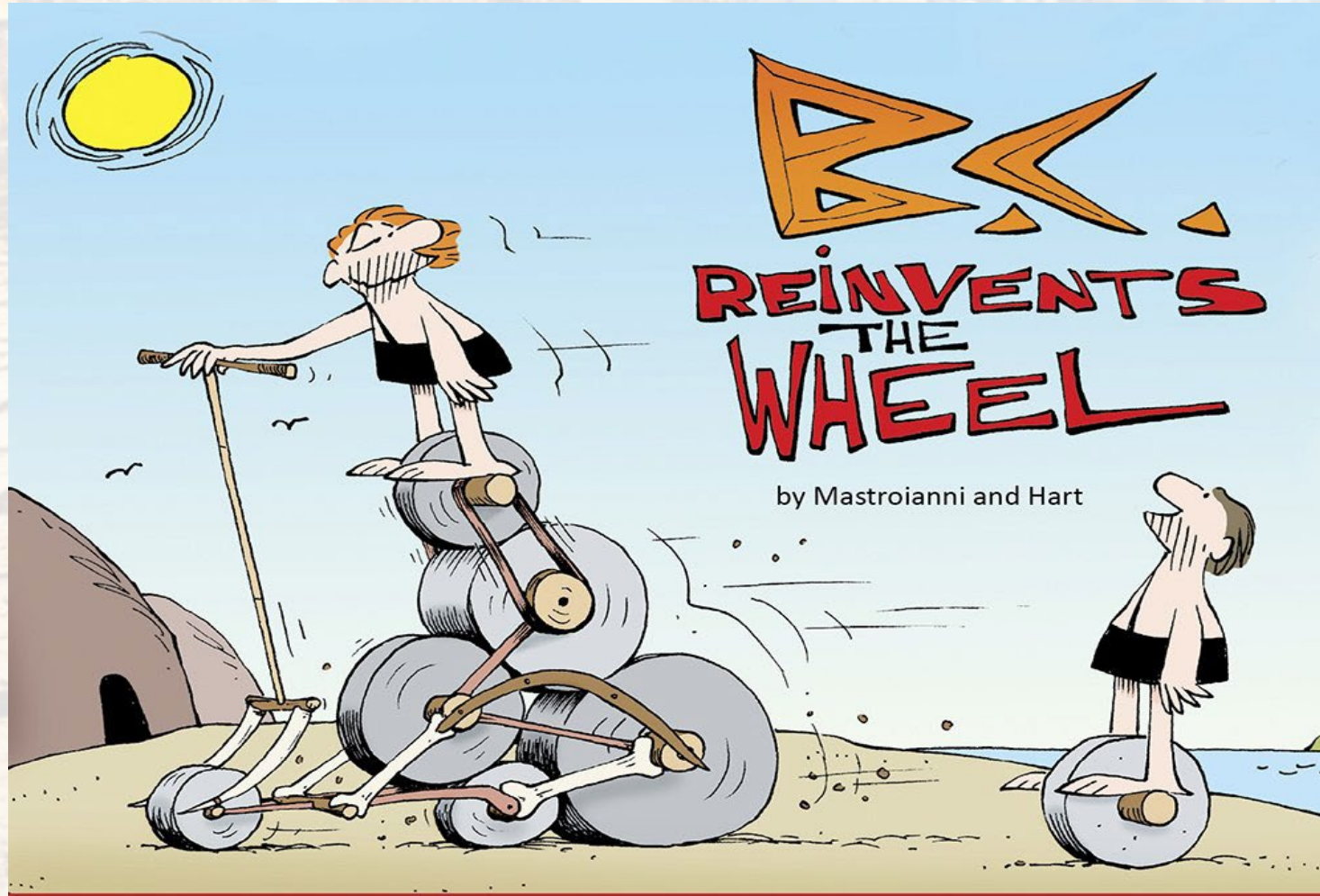
- **Example:** We're globally willing to pay for ~1.1%/year energy efficiency gain ONLY if it will generate an additional ~2.1%/year GDP gain.
- **Profits as the Prime Directive:** guarantees that energy efficiency improvement rates will *never* catch up to the rates of GDP rise,
- ...and that means that we cannot solve our fundamental energy problem by merely pursuing additional efficiency.
- If it doesn't pay, it doesn't get done; under the command of our conventional "Growth Uber Alles" economics paradigm.

I'll take a risk and quote myself here...

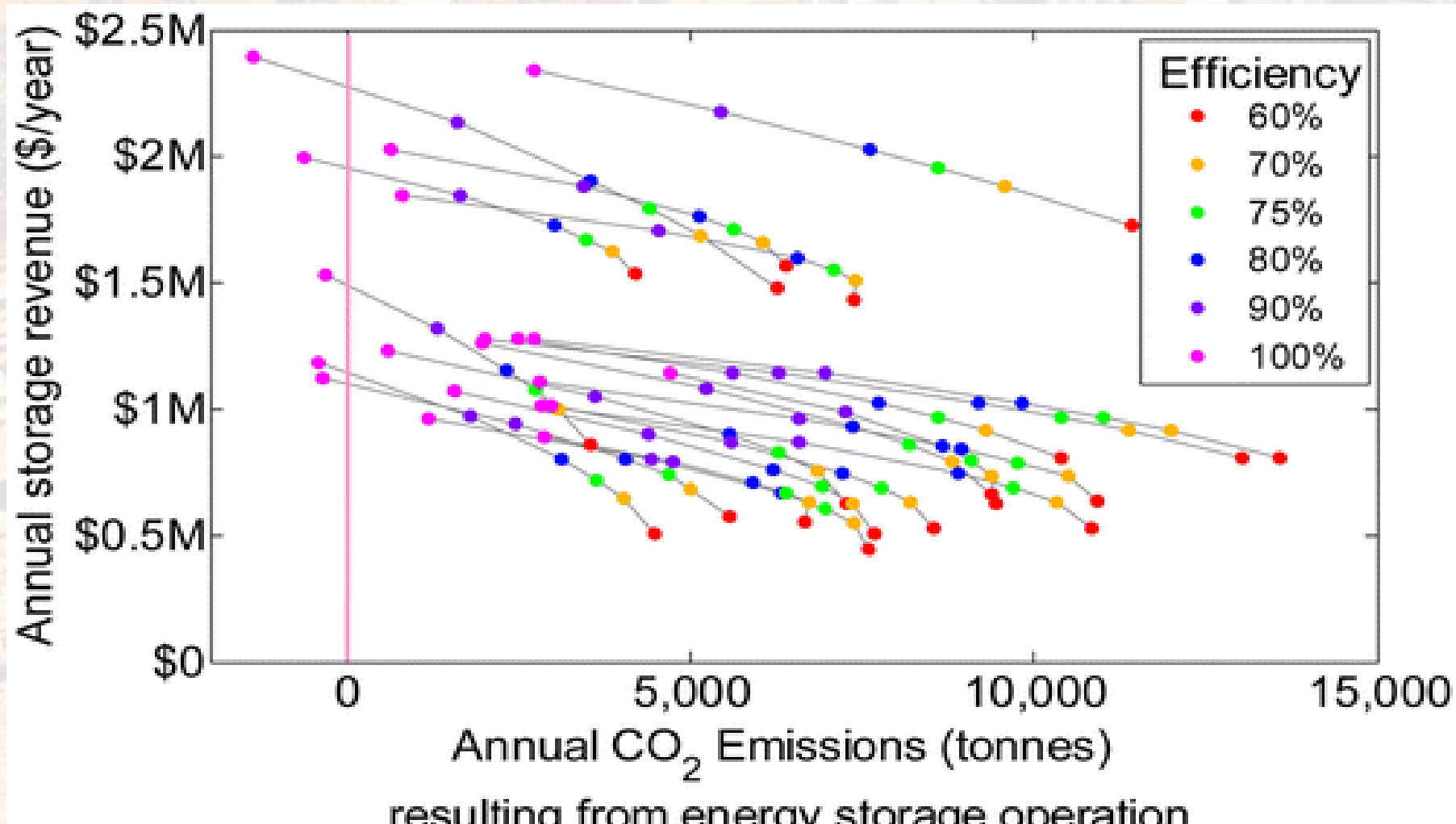
*“Rates of energy efficiency improvement will
~always, year by year, be smaller than the
rates of real GDP gain”*

*“And if annual GDP gains end up being
negative, energy efficiency gains will be even
more negative. It's what short-term profitable
decision-making commands”*

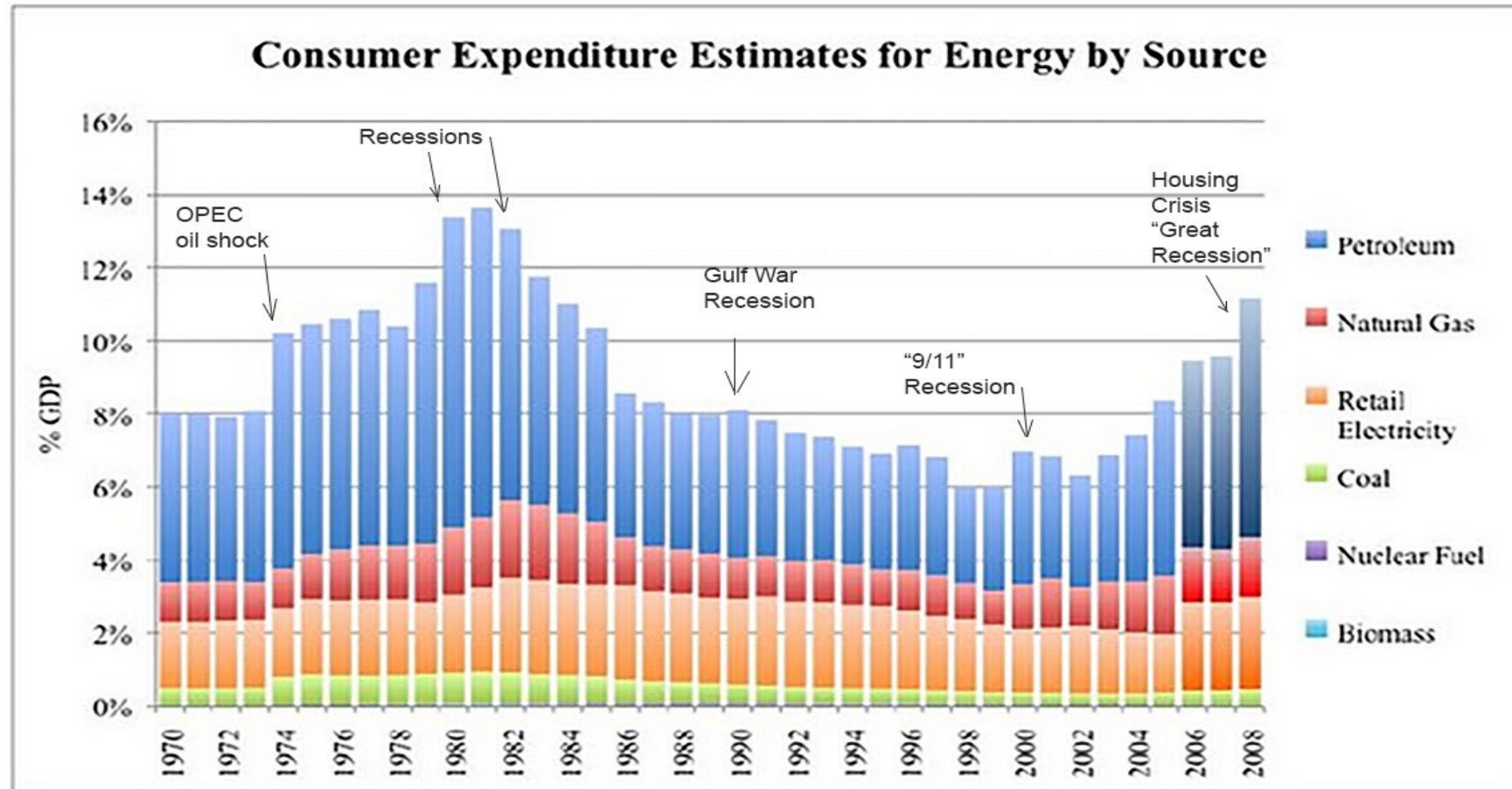
Re-double our efforts at energy efficiency, as economist/policy people claim is the solution? But we've been continually increasing energy efficiency ever since the invention of the wheel. We're "[optimal foragers](#)", as are all animals, seeking to lower our energy spent per unit of economic gain. I argue we're pursuing energy efficiency at the proper rate to maximize short term (discounted) return on investment, and no more.



Energy Storage leads to higher CO₂ emissions (x-axis) in all 20 U.S. grid regions, and only under the assumption of perfect (unobtainable) lossless storage efficiency does it lower emissions, and even then, only in 5 regions ([Hittinger & Azevedo 2017](#)) (purple points, left of 0)



The U.S. is often touted as a great example of energy efficiency and GDP. But note ([Hall & Balough 2009](#)) that every U.S. recession carries not only a worsening of GDP, but an increasing energy consumption per \$GDP, just as the Power/Wealth Relation requires. Globally, Energy efficiency worsens during recessions.



So here is the alarming conclusion...
(perhaps the most crucial point in this part of the talk)

- If the Power/Wealth Relation continues to hold true, and if we enter a long-term recession to pull back within planetary boundaries, it says that we could not (or would not) continue to improve the energy efficiency of global GDP, so that...
- **Energy Consumption rates then Grow FASTER than GDP.**
- Limited Federal Reserve studies are consistent with this (see later).
- **This is a double-bind as we consider the implications of the Power/Wealth Relation to our future.**

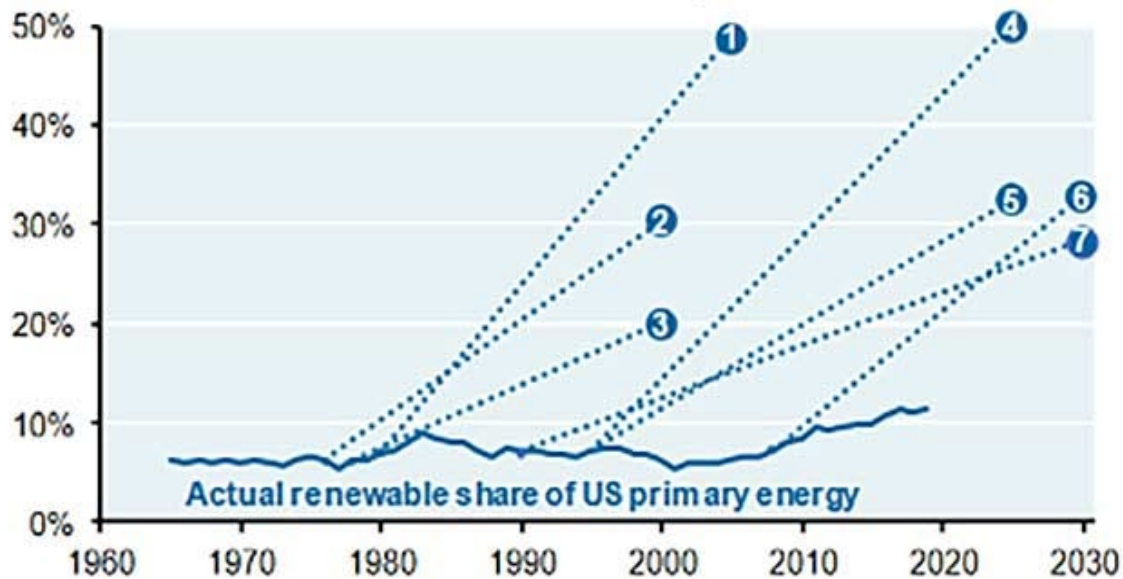
From the annual J.P. Morgan assessment of our global energy situation. The challenge of the 4th Great Energy Transition is continually under-appreciated by the pro-growth proponents (at right). Example: [Amory Lovins](#)

As always, I would like to acknowledge the insights and oversight provided by our technical advisor Vaclav Smil, who has patiently guided my energy journey since this paper's inception 11 years ago. This effort has been one of the most rewarding experiences in my 34 years at JP Morgan.

Overly ambitious forecasts of the 4th great energy transition

Renewable share of US primary energy consumption

Lines start when forecasts were made and end in year of forecast



Source: EIA, listed authors, Vaclav Smil, JPMAM. 2019. Renewables include wind, solar, hydropower, geothermal, biomass, wood and waste.

- ① Physicist Bent Sorensen
- ② Amory Lovins, Rocky Mountain Institute
- ③ Carter Administration (solar only)
- ④ Clinton Presidential Advisory Panel
- ⑤ Intergovernmental Panel on Climate Change
- ⑥ Google 2030 Clean Energy Plan
- ⑦ National Renewable Energy Laboratory

In 2020, Mark Jacobson (Stanford) forecast 80% by 2030

Another Example: 2017 - the First Commercial Air Capture CO2 Installation



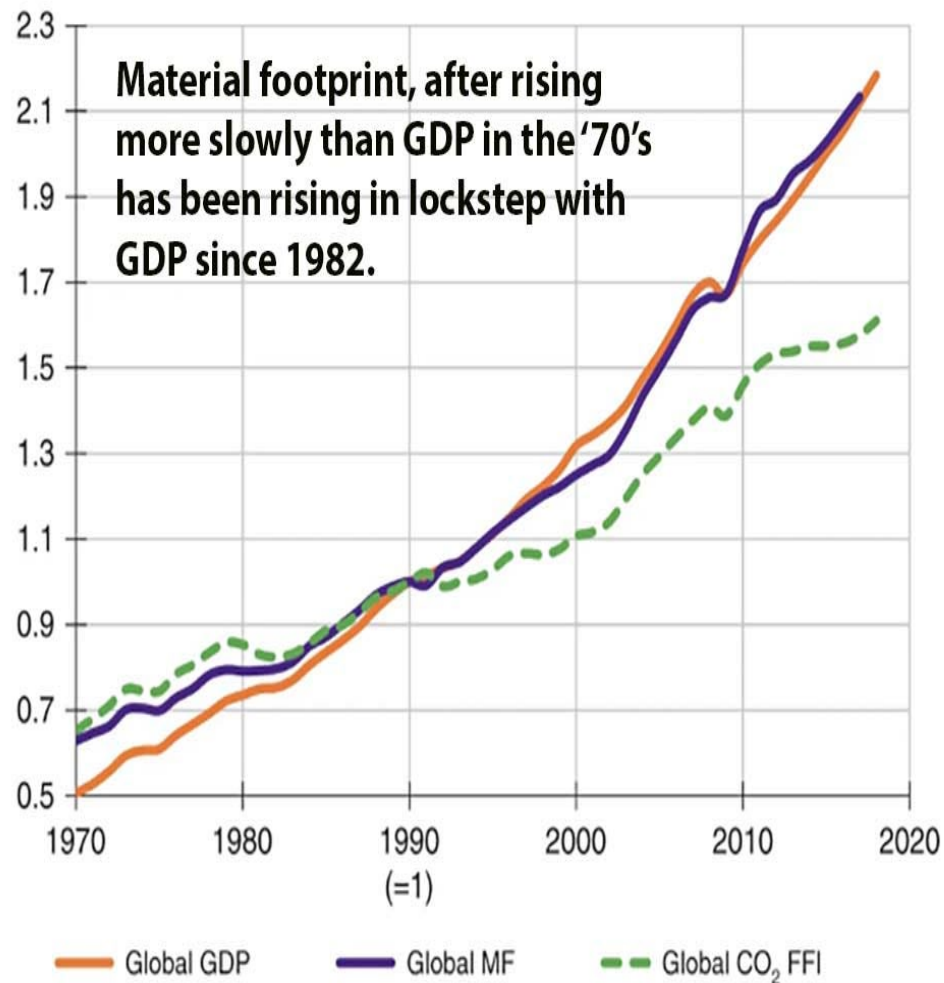
...By Climeworks, Inc. in Switzerland. (The CO₂ is sold for fertilizer, not sequestered). Estimated \$400/ton CO₂ to capture and \$20 to sequester, except feasibility of climate-scale sequestration is highly speculative at present.

Their stated plan is to build 250,000 of these air capture plants by the mid 2020's. If they succeed, that would capture 1% of our current emissions.

It is now near the mid '20's... and they've, in fact, built not 250,000. They've built 18.

Fig. 1: Relative change in main global economic and environmental indicators from 1970 to 2017.

From: [Scientists' warning on affluence](#)



Shown is how the global material footprint (MF, equal to global raw material extraction) and global CO₂ emissions from fossil-fuel combustion and industrial processes (CO₂ FFI) changed compared with global GDP (constant 2010 USD). Indexed to 1 in 1990. Data sources:

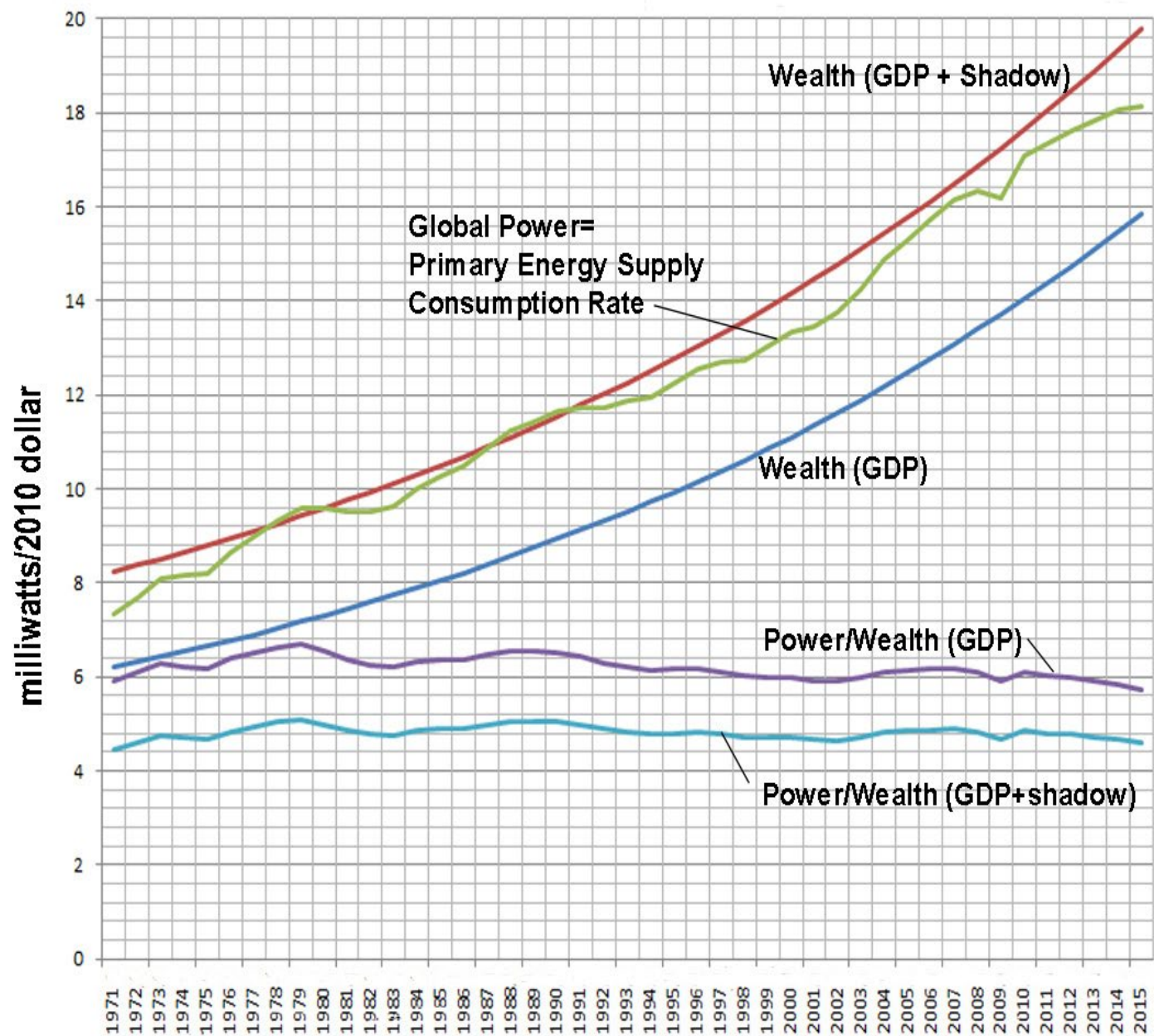
<https://www.resourcepanel.org/global-material-flows-database>, <http://www.globalcarbonatlas.org> and <https://data.worldbank.org>.

Materials? Global Material Footprint Since 1982

...is in perfect proportion to global GDP.

If solar/wind will be our energy sources, expect this trend to worsen as energy storage's materials add in.

the *“de-materialization of the economy”* is a convenient, but complacency-inducing, [myth](#)



My deeper work on the Power/Wealth Relation: Using total spending (light blue, includes the “shadow economy”) is actually even flatter than Garrett’s which uses only published “real” GDP alone (purple).

Both red and light blue curves include inflation adjustment using MIT’s [Billion Prices Project](#).; A better inflation gauge

Conclusion: the Power/Wealth relation remains well supported, observationally.

But Theoretically? We Still Do Not Have a “Proof” the Power/Wealth Relation Must Hold Indefinitely

- I think about this problem. I don't have a solution. Yet.
- However, as Garrett himself points out in a private communication – the size of the Civilization/Climate system and the resulting time-scale for change, argues that inertia will likely carry forward this validity for some time into the future.

Yes, This All Seems Pretty Demoralizing

- What response should students have?
- First – Action is the antidote to Depression...
- Learn. Digest. Understand these climate facts and don't just be seduced into Hopium schemes by promoters who are after your dollars.
- Then TEACH your friends and associates, so they are vaccinated against the promoters as well.
- You can't solve a problem whose dimensions you don't yet understand.



NASA Scientists Join the Resistance.

Perhaps you
should too. We
may not win, but
join the battle
honorably. With
true human values
on your side

Now – If We Have Time...

- A look at Techno-GeoEngineering Schemes
You're being marketed to support by
promoters seeking Carbon Offset \$\$...
- (if no time, I'll take questions now)