THE NEW CLIMATE SCIENCE AND CIVILIZATION. IS HUMAN NATURE COMPATIBLE WITH SOLVING CLIMATE CHANGE?

DR. RICHARD NOLTHENIUS

CABRILLO COLLEGE ASTRONOMY

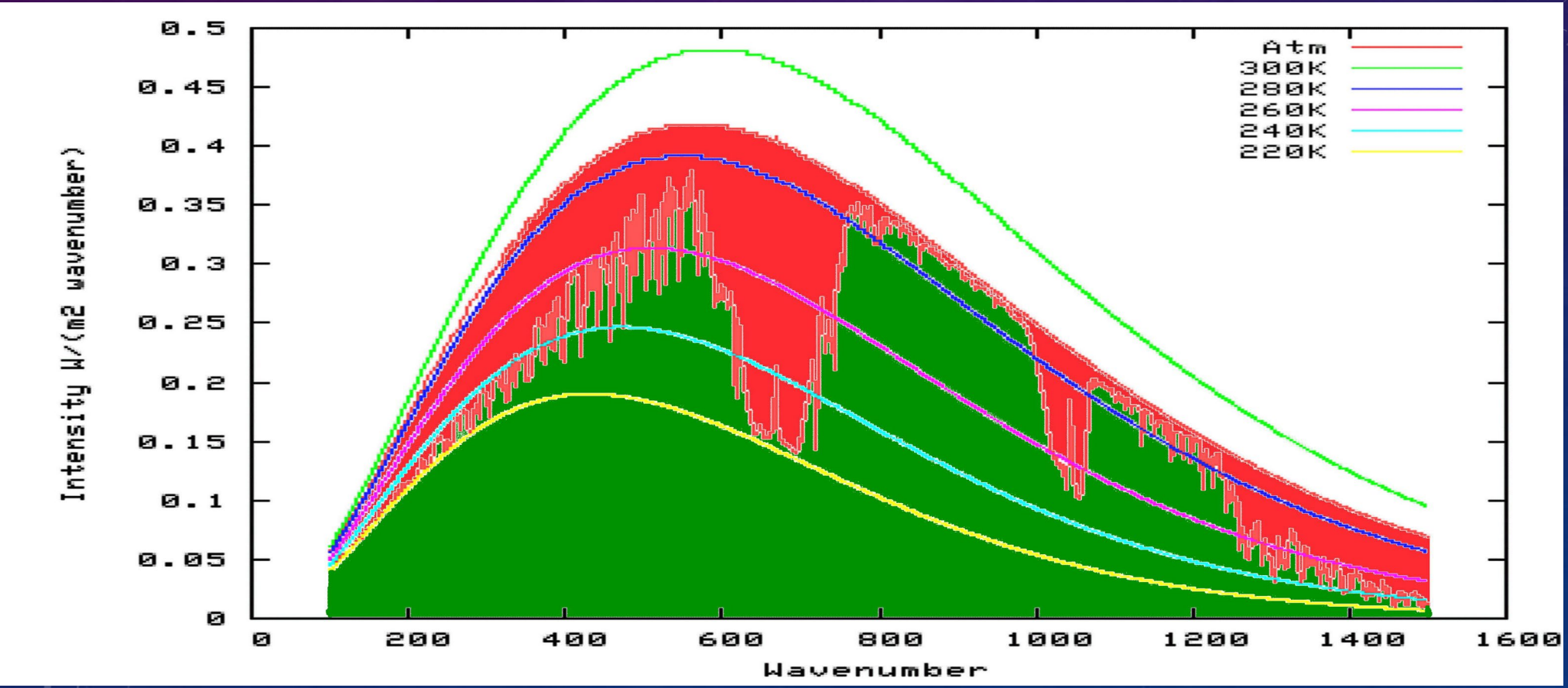
CLIMATE SCIENCE ADVANCES: SIGNIFICANT, AND DIRE, SINCE THE LAST IPCC AR5. YET, THE OLD CARBON BUDGETS AND POOR ASSUMPTIONS KEEP GETTING RECYCLED BY POLICY PEOPLE.

- **New Knowledge Advances**:
- ---Civilization as a thermodynamic system
- --- Indirect carbon emissions, and changing ECS
- ---The nature of the human animal and how we were shaped by evolutionary biology

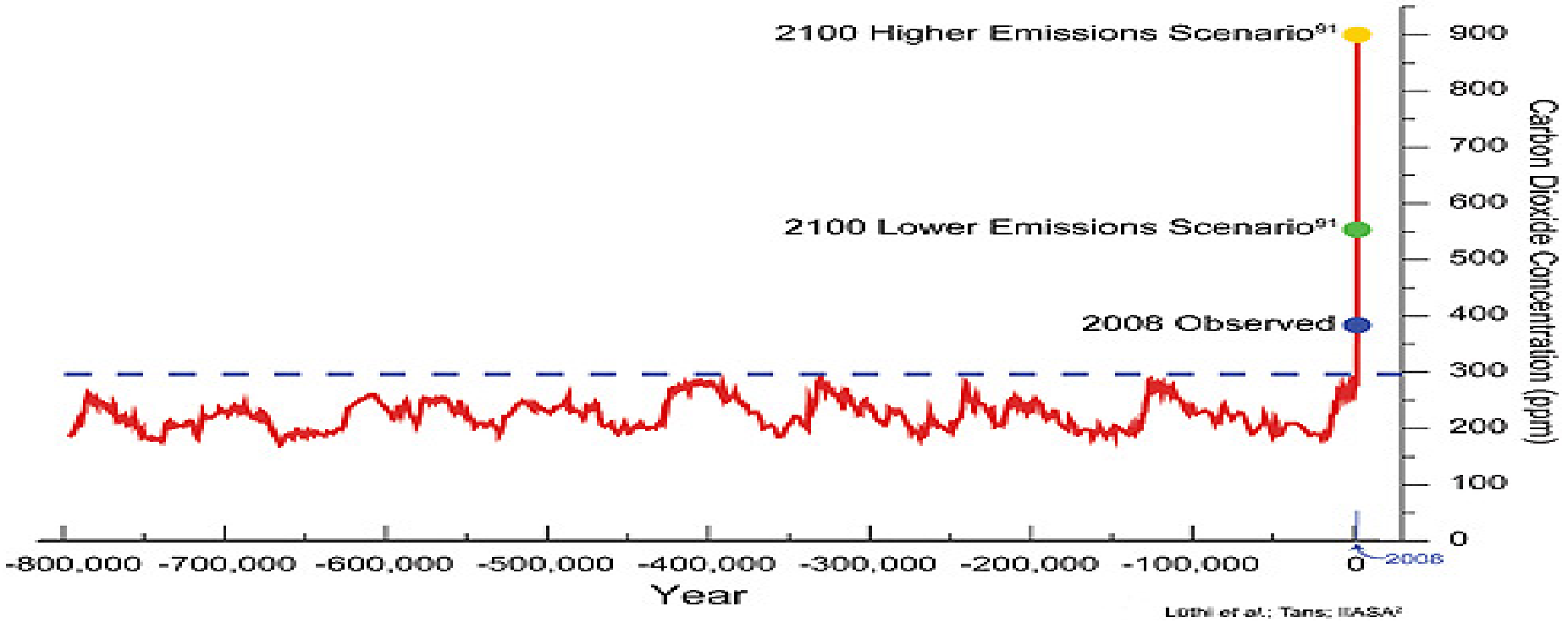
WE'RE TEMPTED WITH FULL COLOR PICTURES OF A BEAUTIFUL CARBON-FREE ENERGY WORLD….

- But the laws of physics and biology/psychology constrain our choices and our future.
- Is it possible for actual humanity to achieve these dreams, given the laws of human nature, and the facts of our 2021 climate world?
- That's what we'll explore here…

BASICS: WHY DOES OUR EMISSIONS OF CO2 CAUSE TEMPERATURE CHANGE? BECAUSE CO2, AND ALL NON-DIATOMIC MOLECULES, ABSORB AND SCATTER THE OUTGOING INFRARED RADIATION THE EARTH MUST SEND BACK OUT TO SPACE IF TEMPERATURES ARE TO BE STABLE

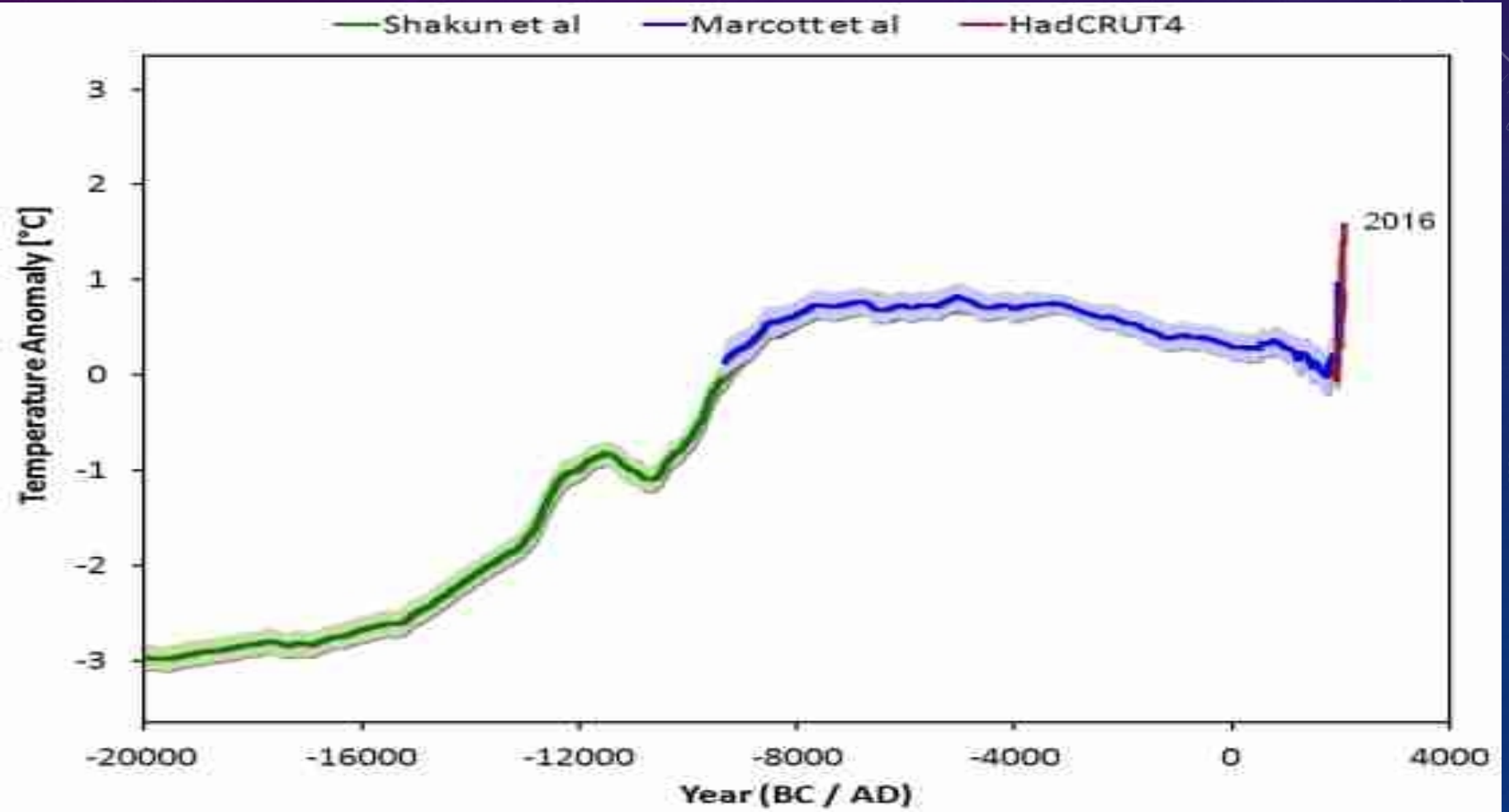


ATMOSPHERIC CO2 IS RISING AT UNPRECEDENTED RATES. EXTINCTIONS HAPPEN WHEN CHANGE IS TOO FAST FOR THE SLOW GENERATIONAL GENETIC CHANGES TO ADAPT TO.



Analysis of air bubbles trapped in an Antarctic ice core extending back 800,000 years documents the Earth's changing carbon dioxide concentration. Over this long period, natural factors have caused the atmospheric carbon dioxide concentration to vary within a range of about 170 to 300 parts per million (ppm). Temperature-related data make clear that these variations have played a central role in determining the global climate. As a result of human activities, the present carbon dioxide concentration of about 385 ppm is about 30 percent above its highest level over at least the last 800,000 years. In the absence of strong control measures, emissions projected for this century would result in the carbon dioxide concentration increasing to a level that is roughly 2 to 3 times the highest level occurring over the glacial-interglacial era that spans the last 800,000 or more years.

THE PAST 20,000 YEARS OF TEMPERATURE. THE HOLOCENE (BLUE) PERIOD OF STABLE TEMPERATURES IS WHAT ALLOWED STABLE COASTLINES, STABLE RAINFALL PATTERNS, STABLE INFRASTRUCTURE SUPPORT SYSTEMS. SO HOMO SAPIENS COULD CLIMB OUT OF THE CAVES AND BUILD THE CIVILIZATION THAT IS NOW IN PERIL. TEMPERATURE IS RISING AT AN UNPRECEDENTED 0.2C PER DECADE



NEXT KEY: NATURE DEMANDS WE MEASURE OUR CLIMATE-INDUCED TEMPERATURE CHANGE FROM THE PRE-INDUSTRIAL BASELINE, IN ORDER TO PROPERLY MEASURE CLIMATE SENSITIVITY TO CO2, AND ITS CONSEQUENCES

- But we are continually misled on what that baseline is.
- Whether deliberate or not, this serves the political purpose of encouraging a complacent public; a public believing that the Paris +1.5C and +2C targets can still be reached within the political / economic paradigm the policy people are employed by.
- Scientists know, and widely acknowledge in private, that those targets are impossible. Lately, it's gotten worse…

TWO MAJOR MIS-COMMUNICATIONS TO THE PUBLIC ON GLOBAL TEMPERATURES…

- **#1 – How Temperature is Plotted**. The best temperature data set is the GISS data. Unfortunately, they chose to plot their graphs as temperature differences ("anomalies") from the 1951-1980 average, yet the media continues to report graphed numbers as if they were temperature rises above the "Pre-Industrial Baseline". Cleary wrong!
- **#2 – The True Pre-Industrial Baseline is not being acknowledged.** Even the actual, older, scientist-adopted Pre-Industrial Baseline (1880-1910 average) is known to be wrong. CO2 emissions then were already as high as 10% of what we emit today. Clearly this is not true Pre-Industrial.
- **Let's fix these mis-communications!**

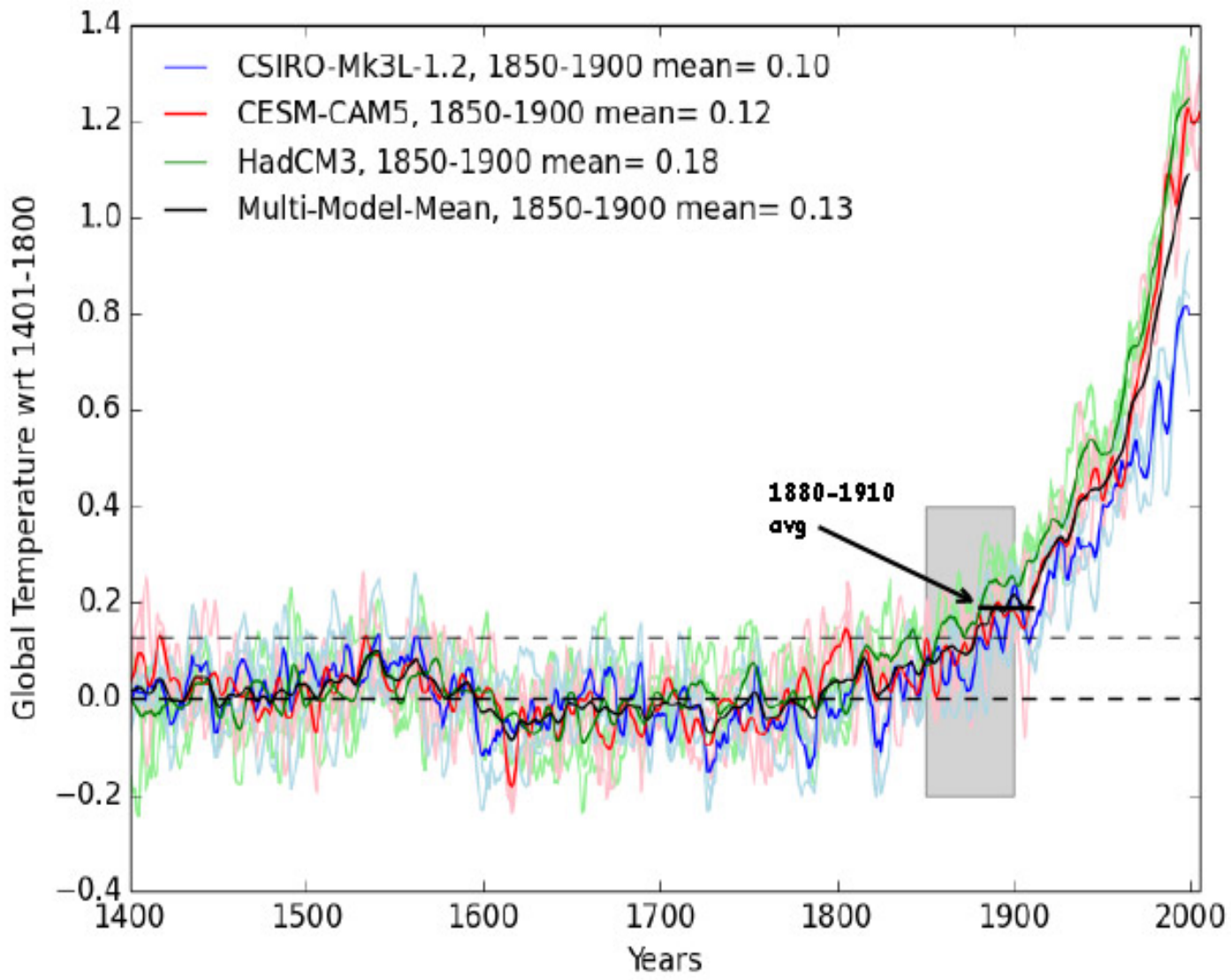


Fig S1- Temperature response to Greenhouse Gas forcing Global mean temperature for three models, smoothed by a 5-year running mean, details given in table S1. Bold coloured lines model means, light coloured lines individual ensemble members. Black line multi-model mean. 1851-1900 highlighted by grey box. Mean for this period shown in legend for the different models and multi-model mean for this period is highlighted by a horizontal dashed line.

USING IMPROVED PALEO DATA AND CLIMATE MODELS, SCHURER, MANN *ET AL.* 2017 DETERMINED A PROPER PRE-INDUSTRIAL TEMPERATURE BASELINE.

YOU SEE AT LEFT IN 2000 WE WERE ALREADY +1.2C ABOVE, AND IN 2020 OVER +1.4C ABOVE.

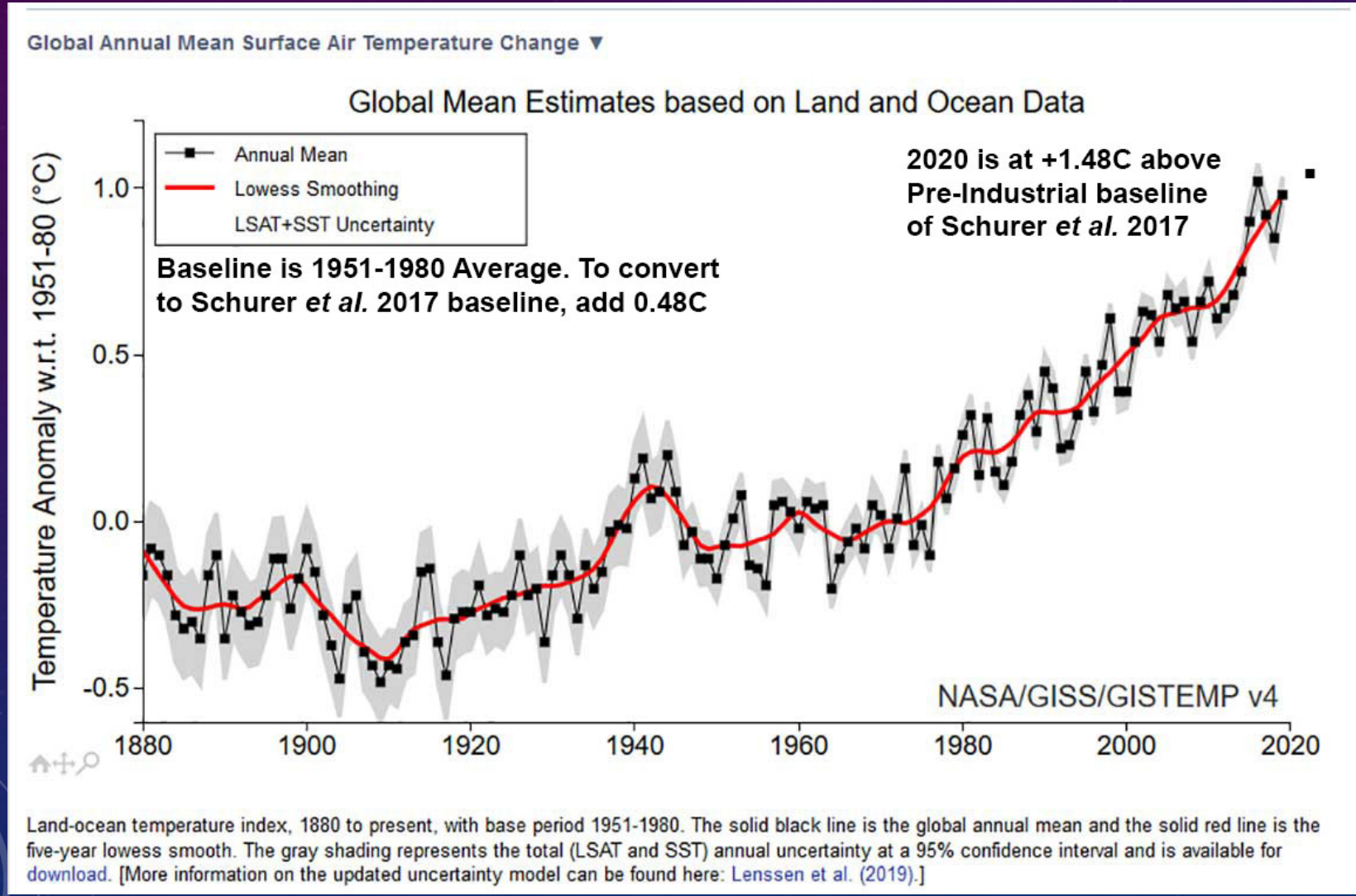
PLEASE, MY LISTENERS - DISREGARD THE ROSY BUT FALSE REPORTINGS OF WHERE WE ARE TODAY. IT'S WORSE.

IN 2021, WE'RE ALMOST AT +1.5C

HOW TO KNOW THIS? IT'S STRAIGHT FORWARD TO TAKE THESE GISS TEMPERATURES FOR EACH YEAR SINCE 1880, DO THE AVERAGES, AND DETERMINE THE CALIBRATIONS TO APPLY BETWEEN DIFFERENT ADOPTED BASELINES. THE RELEVANT ONE TO CORRECT THE PUBLISHED GISS GRAPHS, IS THE LAST ON THIS LIST…

GISS Calibration from (first baseline) – to – (second baseline)	Correction to Apply
(1951-1980 Average) – to – (20th Century Average)	Add 0.025 C
(1951-1980 Average) – to – (1880-1910 "Pre-Indus")	Add 0.254 C
(20th Century Average) – to – (1880-1910 "Pre-Indus")	Add 0.28 C
(1880-1910 "Pre-Indus") – to – (Schurer *et al.* "Pre-Indus")	Add 0.2 C
(1951-1980 "Pre-Indus") – to – (Schurer *et al.* "Pre-Indus")	Add 0.48 C

GISS GLOBAL TEMPERATURE SINCE 1880. MUST ADD +0.48C TO Y-AXIS TO BASE THEM RELATIVE TO THE SCHURER, MANN *ET AL.* (2017) PROPER "PRE-INDUSTRIAL" BASELINE. SMOOTHED RED CURVE: +1.48C AT CLOSE OF 2020



THE CLIMATE FORCING DUE TO OUR GHG'S IS NOT ONLY RISING, THE GROWTH RATE OF RISING IS ITSELF RISING (FROM HANSEN *ET AL.* 2017).
CLIMATE FORCING RISE RATE BY GHG'S HAS RISEN AN ALARMING 50% IN JUST 13 YEARS, AND ACCELERATING. THIS IS DRAMATIC EXPONENTIAL GROWTH

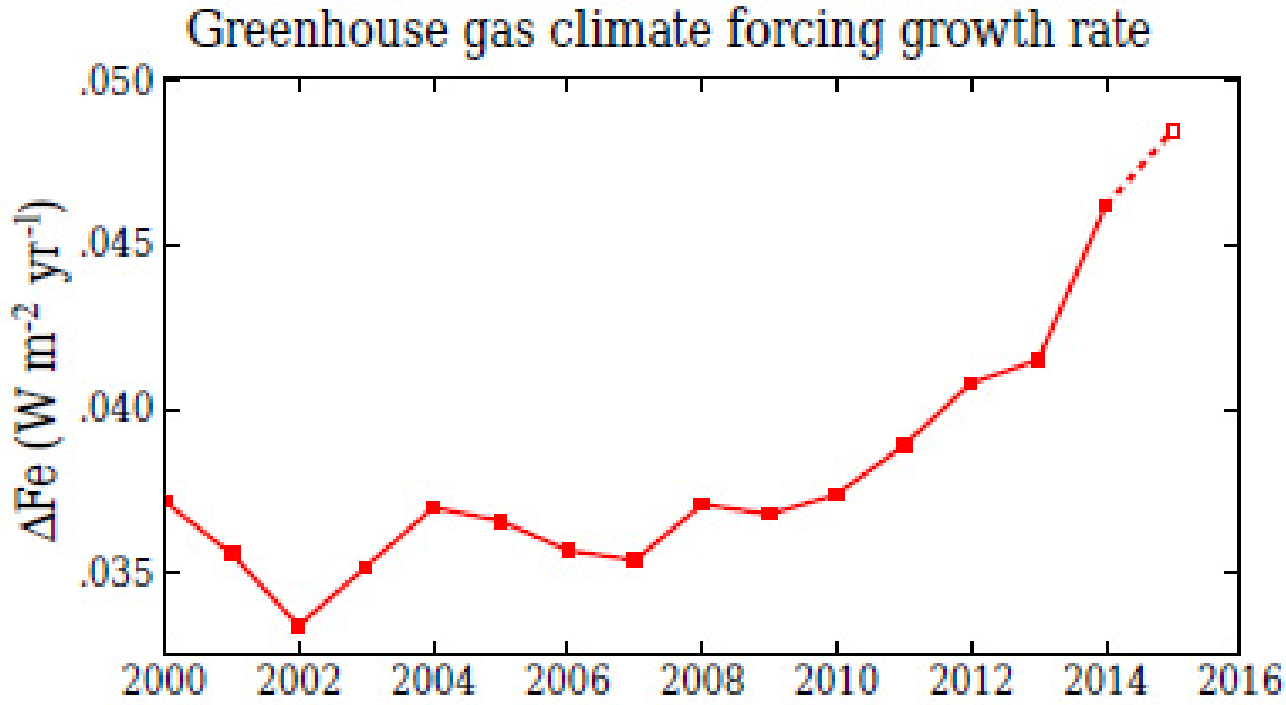
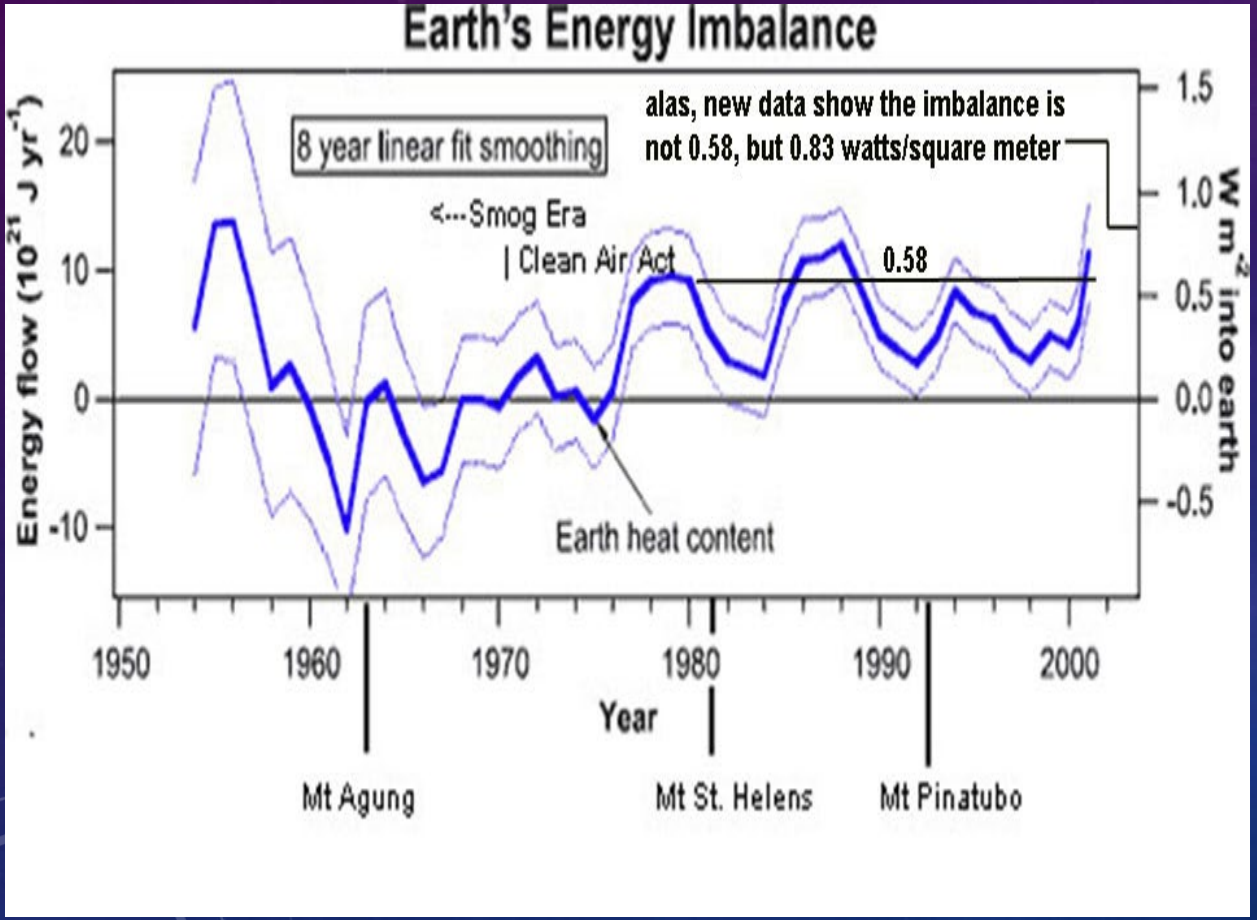


Figure 14. Recent growth rate of total GHG effective climate forcing; points are 5-year running means, except for 2015, which is a 3-year mean. See Fig. 8 for individual gases.

MYTH: IF WE JUST STOP EMITTING CO2, THE EARTH WILL HEAL, RIGHT?

NO. CLIMATE CHANGE IS NOT LIKE OTHER ENVIRONMENTAL DAMAGES…

WHY NOT? IF ATMOSPHERIC CO2 COULD GO DOWN, WHY WOULDN'T TEMPERATURES GO DOWN TOO?

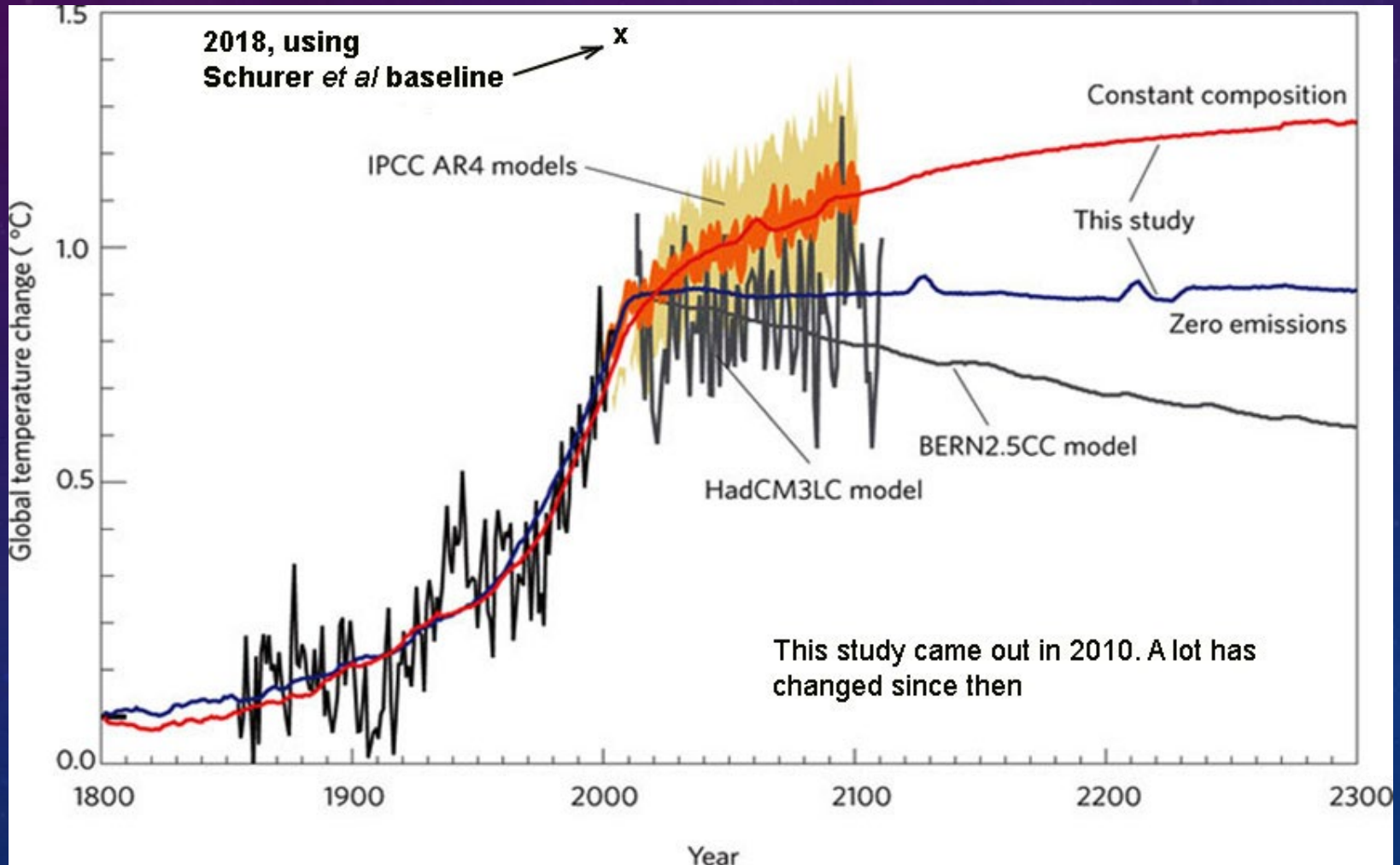


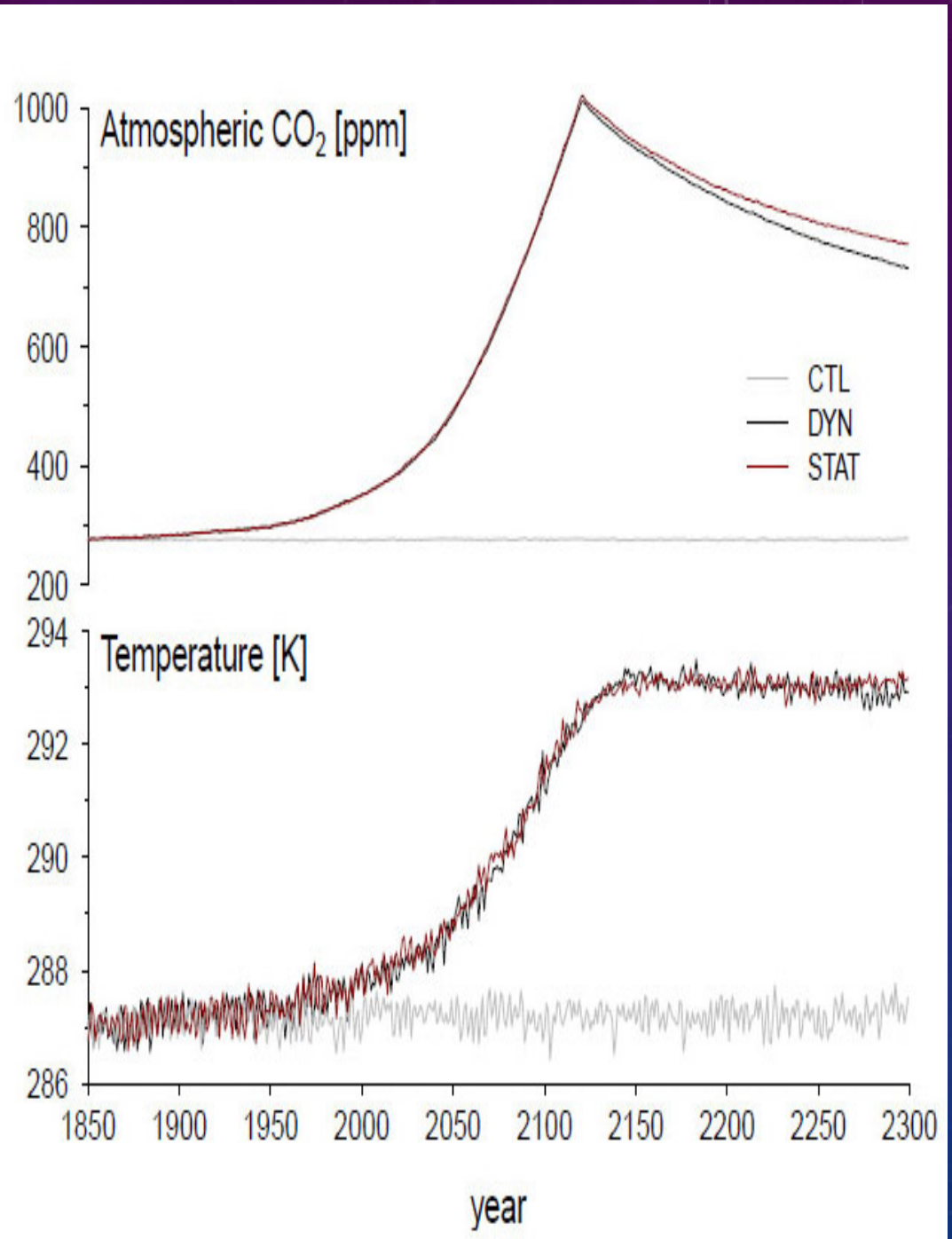
- First: Because temperatures are being "forced" and like a heavy iron skillet suddenly put on a hot stove, it takes time to come up to final equilibrium temperature. Big systems take longer: Rising CO2 prevents equilibrium from being achieved.
- We are out of "radiative equilibrium" by 0.83 watts/sq meter - We have not yet manifested the temperature rise "in the pipeline" that will come even if there were no more additional CO2 forcing.

SECOND: THE OCEAN HAS ABSORBED 93% OF OUR GREENHOUSE HEATING, AND THAT IS A VAST HEAT BATH

- If all that heat had instead remained exclusively in our atmosphere -> Surface Temps **+70F hotter**, and Earth would already be a dead planet
- The ocean has a thermal capacitance 700 times larger than the atmosphere.
- So *"The Ocean Giveth (absorbing our GHG heating) and the Ocean will then Taketh Away (give that heat back)".* And thus *"As ye sow, so shall ye reap".*
- Lower atmospheric CO2 will try to cool the atmosphere, but the excess heat from the ocean will just flow back to the atmosphere if the atmosphere tries to cool at its natural rate.

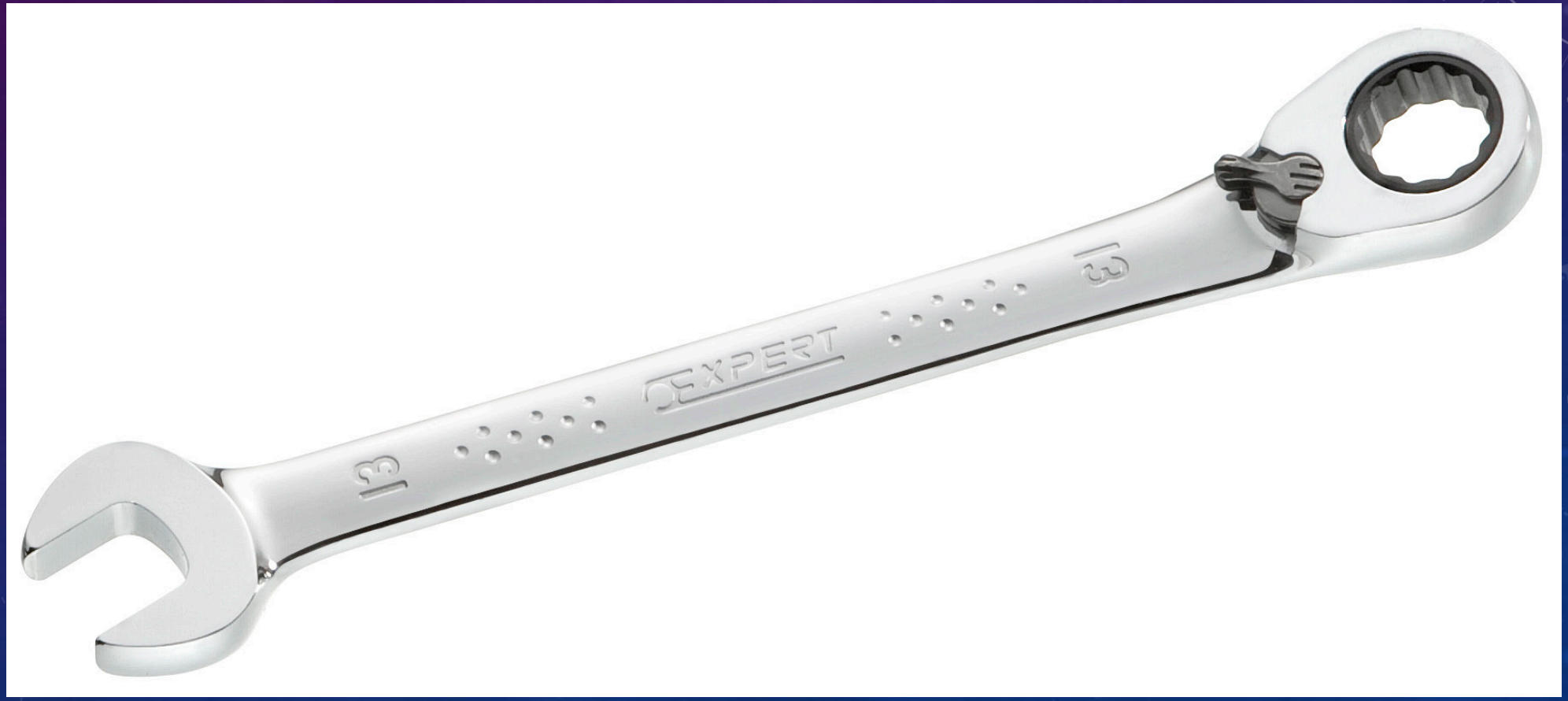
EVEN AT ZERO TOTAL EMISSIONS –DIRECT HUMAN CO2 EMISSIONS AND INDIRECT HUMAN-CAUSED EMISSIONS FROM NATURAL SOURCES – STILL, TEMPERATURES DO NOT GO BACK DOWN. NOT FOR 10'S OF THOUSANDS OF YEARS (MATTHEWS AND WEAVER 2010). ASSUMES ECS=3C





SOLOMON *ET AL.* (2009) FIRST SHOWED THIS. LATER STUDIES CONFIRM. HERE, FROM PORT *ET AL.* (2012): EVEN WITH CO2 ABSORPTION BY PLANTS AND TREES **TOO OPTIMISTICALLY (2020 STUDY I'LL QUOTE LATER) QUANTIFIED**, STILL, TEMPERATURES DO NOT GO BACK DOWN AFTER ALL CO2 EMISSIONS END (HERE ASSUMED IN THE YEAR 2120). IF YOU END ALL EMISSIONS: (DIRECT BY US, PLUS INDIRECTLY HUMAN-CAUSED)– TEMPERATURE CHANGE HALTS (IF ECS=3C)… BUT IT DOES NOT REVERSE.

TEMPERATURE IS A RATCHET. IT ONLY GOES UP, OR IT STAYS THE SAME. IT DOES NOT GO DOWN THROUGH NATURE. IT WILL HAVE TO BE FORCED ARTIFICIALLY DOWN THROUGH MASSIVE, RISKY AND HIGHLY EXPENSIVE GLOBAL GEO-ENGINEERING SCHEMES

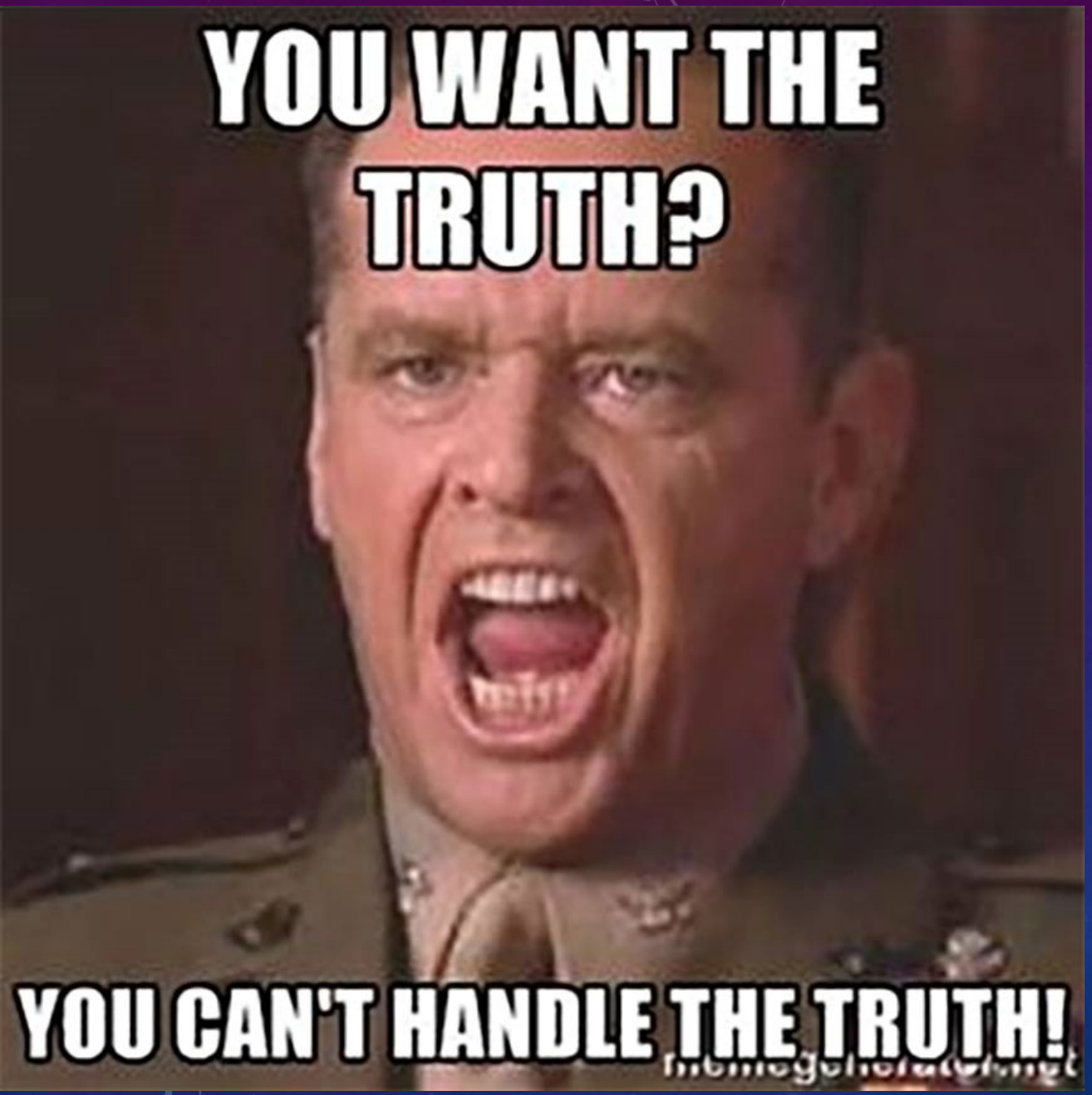


A PUZZLING INTERVIEW WITH MICHAEL MANN – BE CAUTIOUS WITH POPULAR PRESS RELEASES!

- I very much respect and admire the science from Michael Mann. And, I sympathize with the terrible stresses he's been put through by militant climate denialists. But I completely disagree with his position that the public needs to be protected from dire climate science else they'll shut down emotionally and do nothing. I believe that your credibility as a climate speaker rests entirely on how straight and honest to the scientific publications you are. When you are seen to be manipulating people, regardless of the reasons or well-meaning motives, you've lost credibility and that can be tragic because it's very difficult to get it back. I worry about this with Mann.
- In an interview with Mann on "60 minutes", published 2 days after I gave this Zoom lecture, the upshot title is "Cutting emissions to zero CAN halt climate change in our lifetimes" and that doesn't EXPLICITLY disagree with anything I've presented in this talk. I see nothing in this press release that is factually wrong if you take the words literally and narrowly… and yet, this is terribly misleading to the public. See next slide.

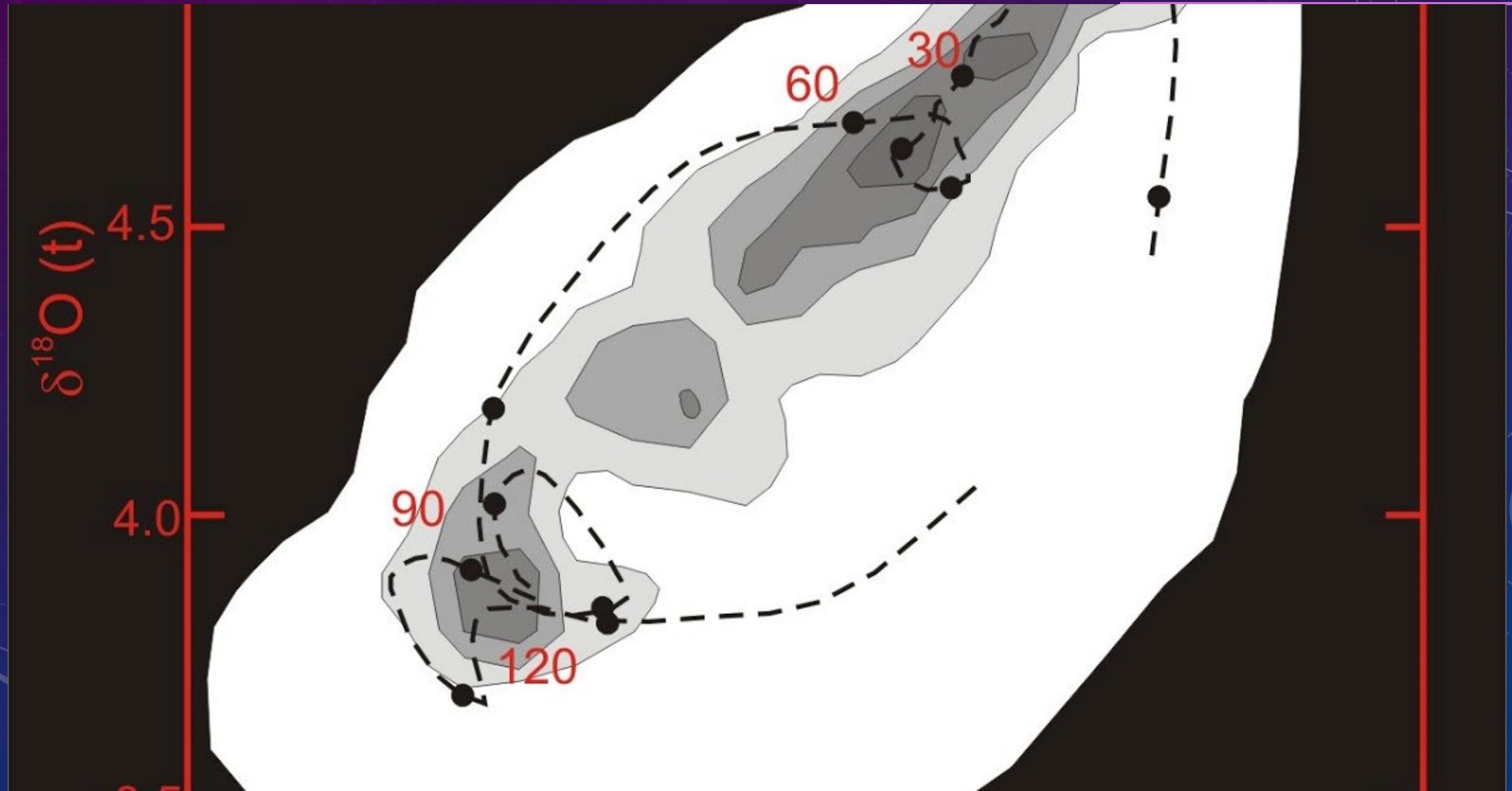
NOTHING NEW. WE'VE KNOWN FOR OVER A DECADE THAT ENDING ALL EMISSIONS WOULD STOP TEMPERATURE RISE IMMEDIATELY. REVIEW MY IMMEDIATELY PREVIOUS SLIDES

- There is nothing new, nor, taken narrowly, incorrect in the statement. So what's the problem?
- --- It leads the public to infer that ending all human emissions is **ending all emissions**. It ignores the indirect emissions which I'll document with published science later in this presentation.
- --- It must be assuming that ECS = 3C, which is now strongly suspected by the latest climate models and paleo data to be far too low (again, see later in this Presentation).
- --- And worst, it clearly must assume that the tipping points of the permafrost carbon feedback, and Greenland and Antarctic melt triggering the shutdown of the global ocean current system should be neglected. Yes, ending "all emissions" would "halt temperature rise climate change"– but we can only control OUR emissions, not *e.g.* the Permafrost's which is already too hot, for example. And ending all emissions "within our lifetime" is clearly far too late to save us from crippling temperatures that will continue to melt the permafrost and cause additional indirect emissions, as we'll see.
- Unfortunately, there's no scientific studies linked in this article to see explicitly what assumptions were made. But my chief complaint is that THERE IS NOTHING NEW to the title claim!
- So why is it hyped as a game-changing sign of hope? I can think of only one motivation – the desire to bend the truth in service of cheering people up; to DO something about climate change rather than sink into despair and do nothing. Did they consider that, as David Wallace-Wells and I believe, Truth may motivate them to rise to the occasion instead of more can-kicking down the road? It looks like not.



I BELIEVE THAT SELLS PEOPLE SHORT. I BELIEVE WE MUST ASSUME THEY "**CAN** HANDLE THE TRUTH!" BECAUSE IF THEY **CAN'T**, AND YOU ASSUME THEY'RE ONLY WILLING TO DO LITTLE THINGS THAT ARE INADEQUATE AND DON'T QUESTION ETERNAL GROWTH, THEN WE'RE DOOMED ANYWAY. THE PLANET IS FINITE, AFTER ALL

COMPLEX DYNAMICAL SYSTEMS HAVE COMPLEX SYSTEM "SURFACES IN PHASE SPACE". PERTURB THE SYSTEM ENOUGH, AND IT TRANSITIONS TO AN ENTIRELY NEW PLACE OF SEMI-STABILITY. CLIMATE IS AT RISK



HOW DOES THIS HAPPEN?

- Through “amplifying feedbacks”…
- Climate change forces something to change… that change leads to that force being even stronger, taking the system further, amplifying the forcing yet again…

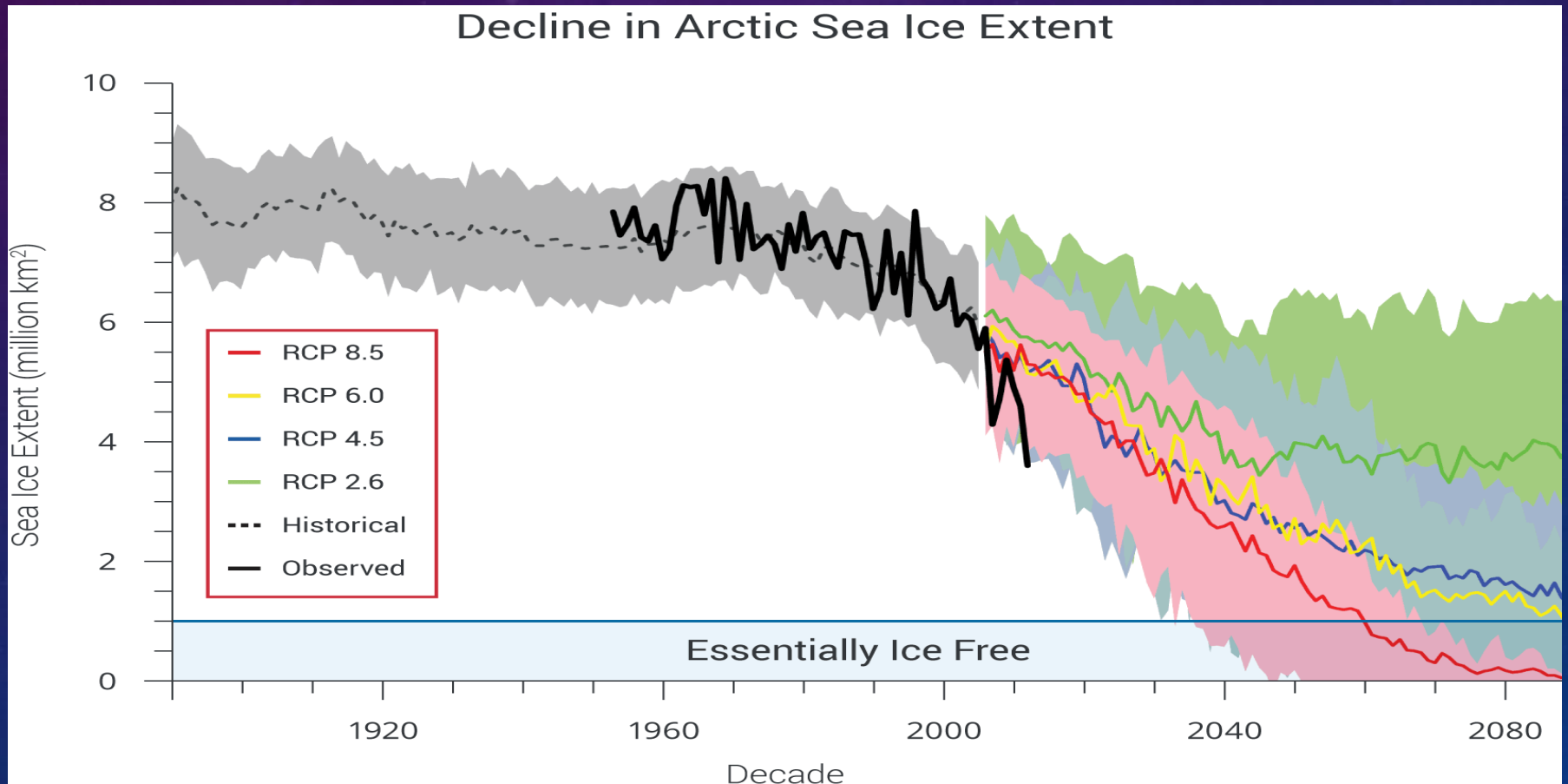
THE STRONGEST AMPLIFYING FEEDBACK IS FROM WATER VAPOR

- Hotter air will hold more water vapor before it saturates and rains out.
- But H_2O is itself a Greenhouse Gas!
- Hotter -> higher humidity -> higher Greenhouse forcing -> hotter -> higher humidity -> etc.

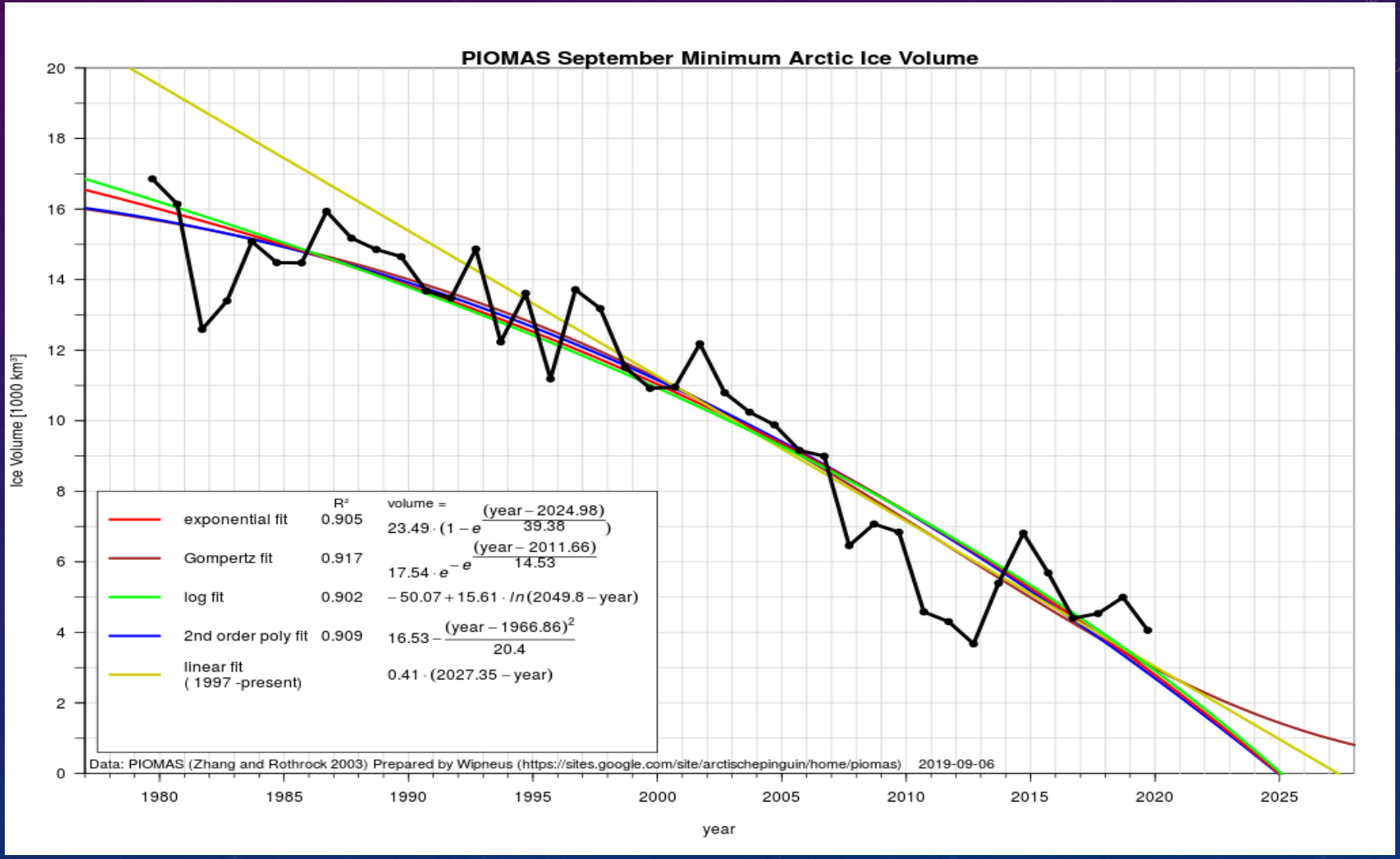
JUST +1C RISE IN TEMPERATURE MEANS THE AIR CAN HOLD FULLY 7% MORE WATER VAPOR

- This humidity effect doubles the temperature rise that CO2 alone would cause.
- The next time a climate denialist tries to tell you it's not our CO2 that's the real problem, it's water vapor – you tell them that it is OUR CO2 which is CONTROLLING water vapor in our atmosphere. Because CO2 does NOT rain out.

AN EASIER FEEDBACK ILLUSTRATES THE POINT. ARCTIC OCEAN ICE IS RAPIDLY DISAPPEARING, THE DARK OCEAN ABSORBS 90% OF SUNLIGHT. ICE REFLECTS ~90% . DISAPPEARING ICE WARMS THE ARCTIC MORE, LEADING TO FASTER MELT AND MORE DARK OPEN OCEAN… OBSERVED REALITY IS WORSE THAN THE WORST IPCC MODELS. CLOUD CHANGES OVER THE ARCTIC COMPLICATE THIS, BUT ARE BELIEVED TO ONLY MAKE HEATING WORSE (GARRETT 2020 TALK)

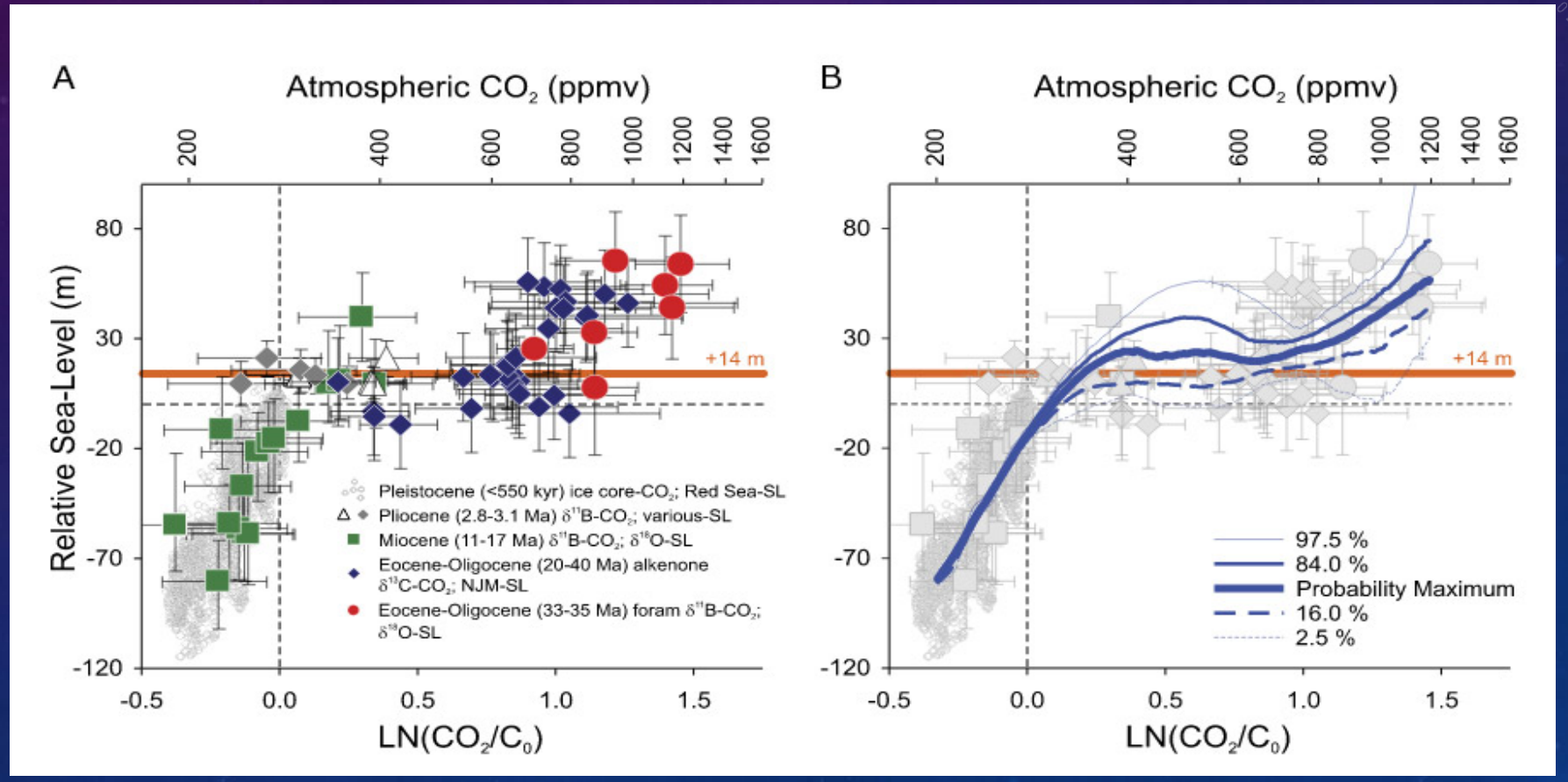


THE ARCTIC OCEAN IS ONLY A FEW YEARS AWAY FROM LOSING ALL OF ITS SUMMER ICE (GRAPH HERE IS ICE VOLUME, MEANING ICE MASS).

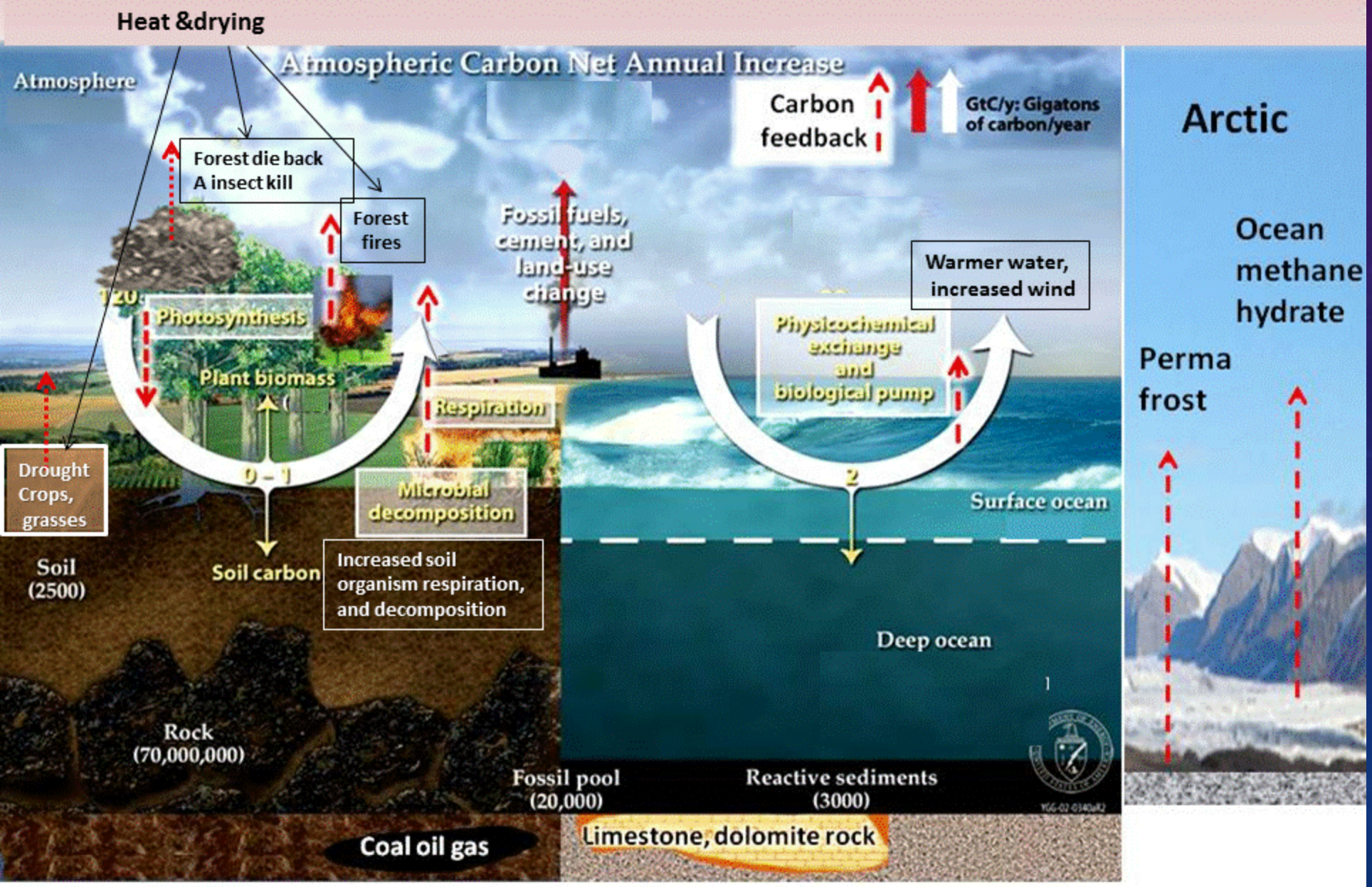


HOW HIGH WILL SEA LEVEL RISE?

FOSTER & ROHLING 2013 - PALEO CLIMATE SHOWS THAT 400 PPM CO2 LEADS TO FINAL SEA LEVEL RISE OF ~24M (80 FT) ABOVE TODAY'S, AND CONCLUDE *"OUR RESULTS IMPLY THAT TO AVOID SIGNIFICANTLY ELEVATED SEA LEVEL IN THE LONG TERM, ATMOSPHERIC CO_2 SHOULD BE REDUCED TO LEVELS SIMILAR TO THOSE OF PRE-INDUSTRIAL TIMES."* THAT MEANS REDUCING IT FROM TODAY'S 415PPM BACK TO ~280 PPM.

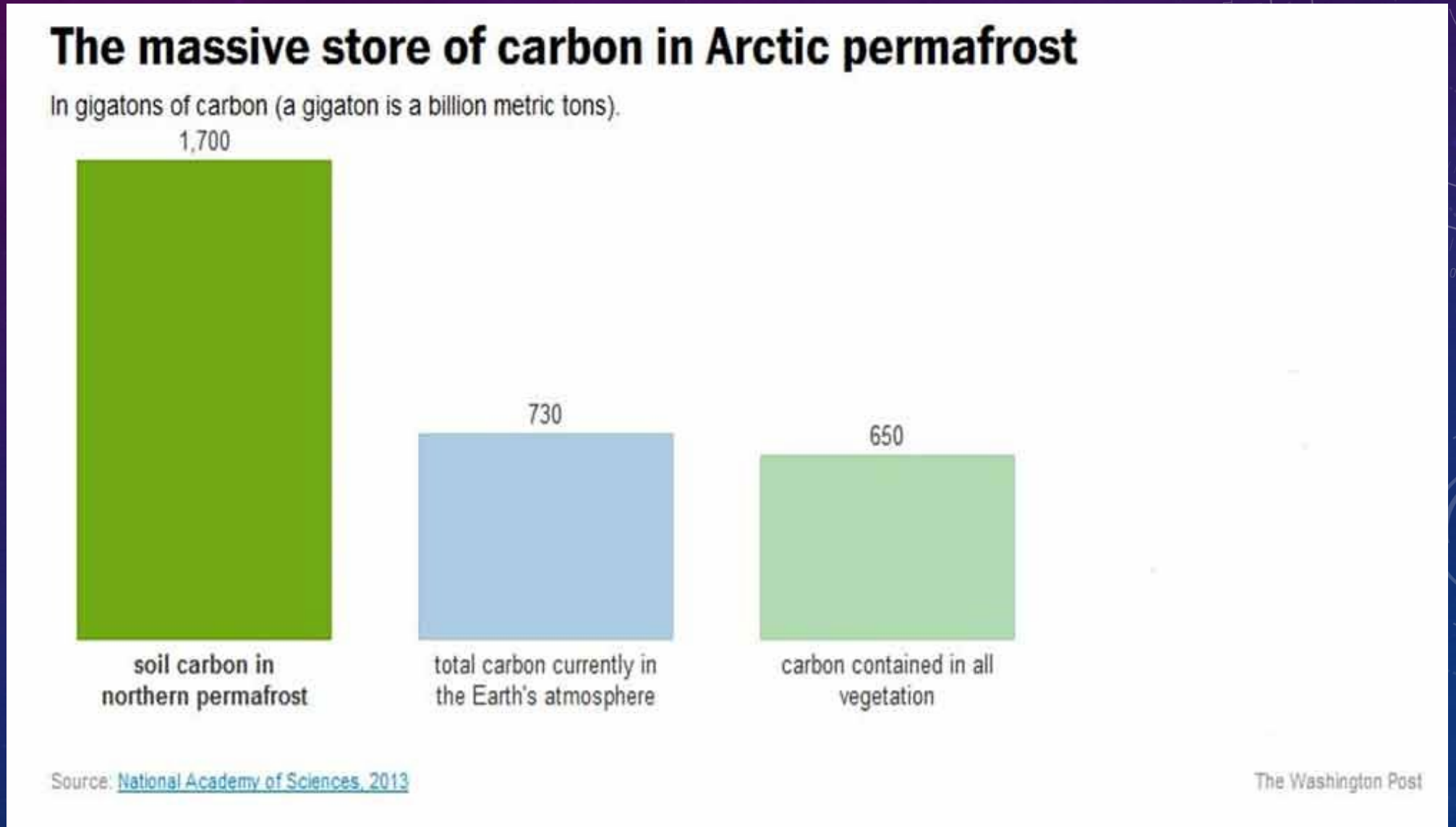


Climate system sources of +ve (bad) carbon feedbacks caused by global warming



HERE ARE JUST SOME OF THE AMPLIFYING FEEDBACKS…

AS THE FUTURE UNFOLDS – INDIRECT HUMAN-CAUSED CARBON MAY COME TO DOMINATE TOTAL EMISSIONS

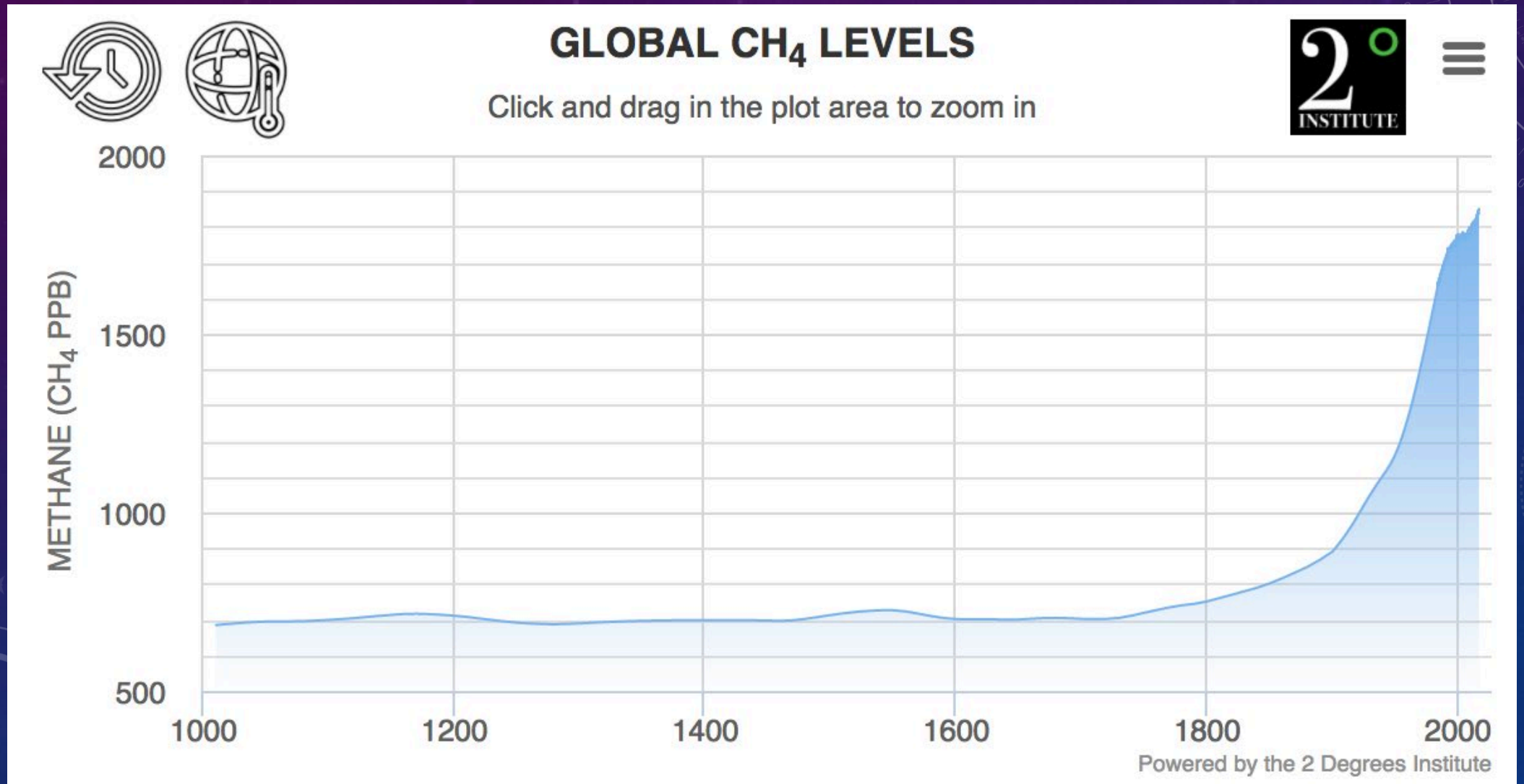


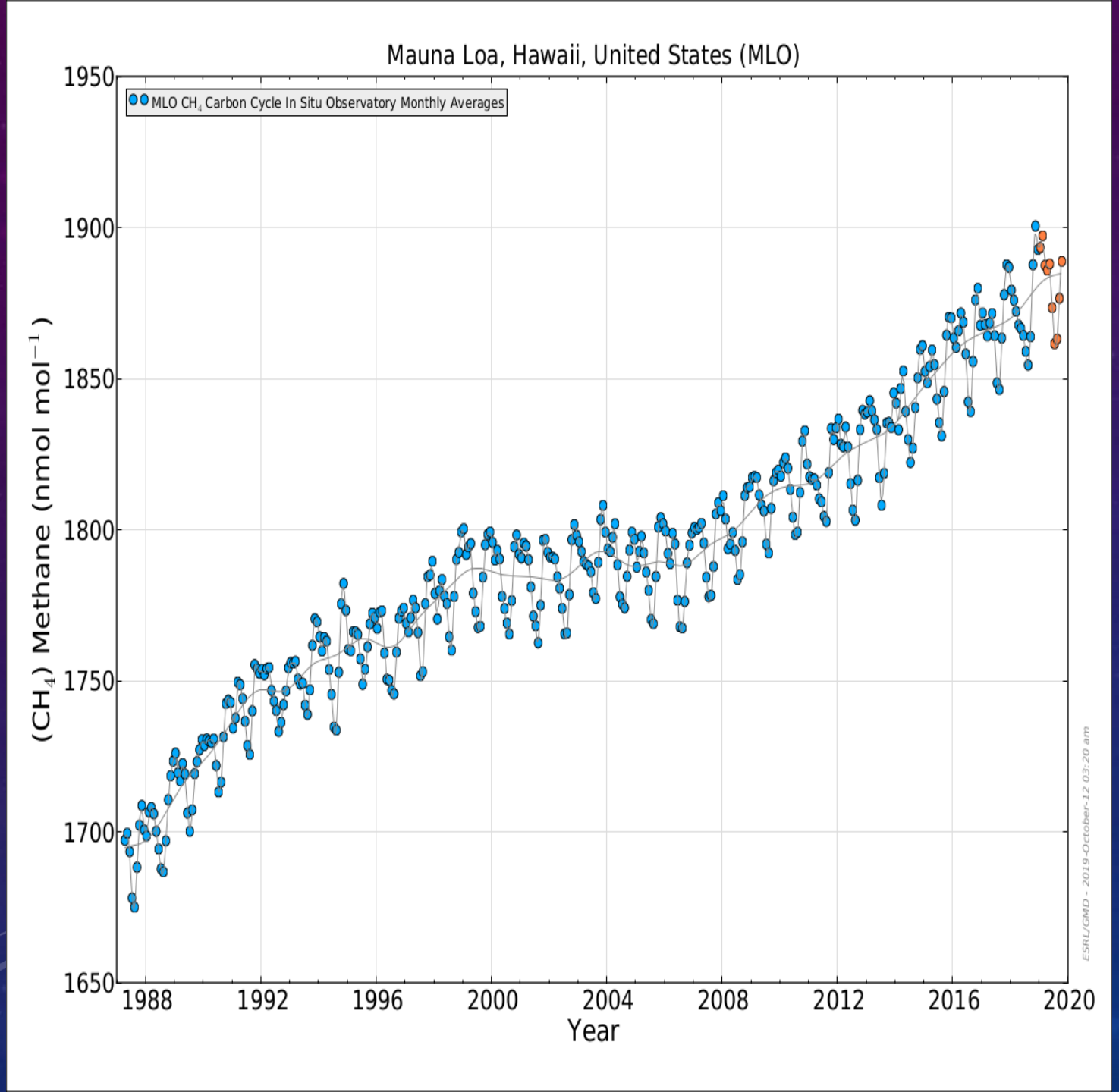
A POWERFUL FEEDBACK JUST BEGINNING NOW - MELTING PERMAFROST CREATES THAW PONDS, CUTTING OFF PREVIOUSLY FROZEN CARBON FROM ATMOSPHERIC OXYGEN, STIMULATING ANAEROBIC MICROBES TO CONSUME THE CARBON AND PRODUCE METHANE INSTEAD OF CO2.

METHANE ABSORBS EARTH'S OUTGOING INFRA-RED RADIATION ~100X MORE, PER POUND, THAN CO2.

- Its "Global Warming Potential GWP" is ~100, on a few year time scale.
- The good news is that methane oxidizes once it's in the atmosphere, with a half-life of 8-12 years depending on whether it is in the tropics (faster), or in the Arctic (slower).
- But the bad news is….

WE'RE CAUSING THE EMISSION OF METHANE AT RATES FAR FASTER THAN IT CAN DECAY: IT'S RISING EVEN FASTER THAN CO2, ALMOST TRIPLED SINCE PRE-INDUSTRIAL DAYS. SO FAR, ARCTIC EMISSIONS ARE STILL MINOR, BUT RISING RAPIDLY

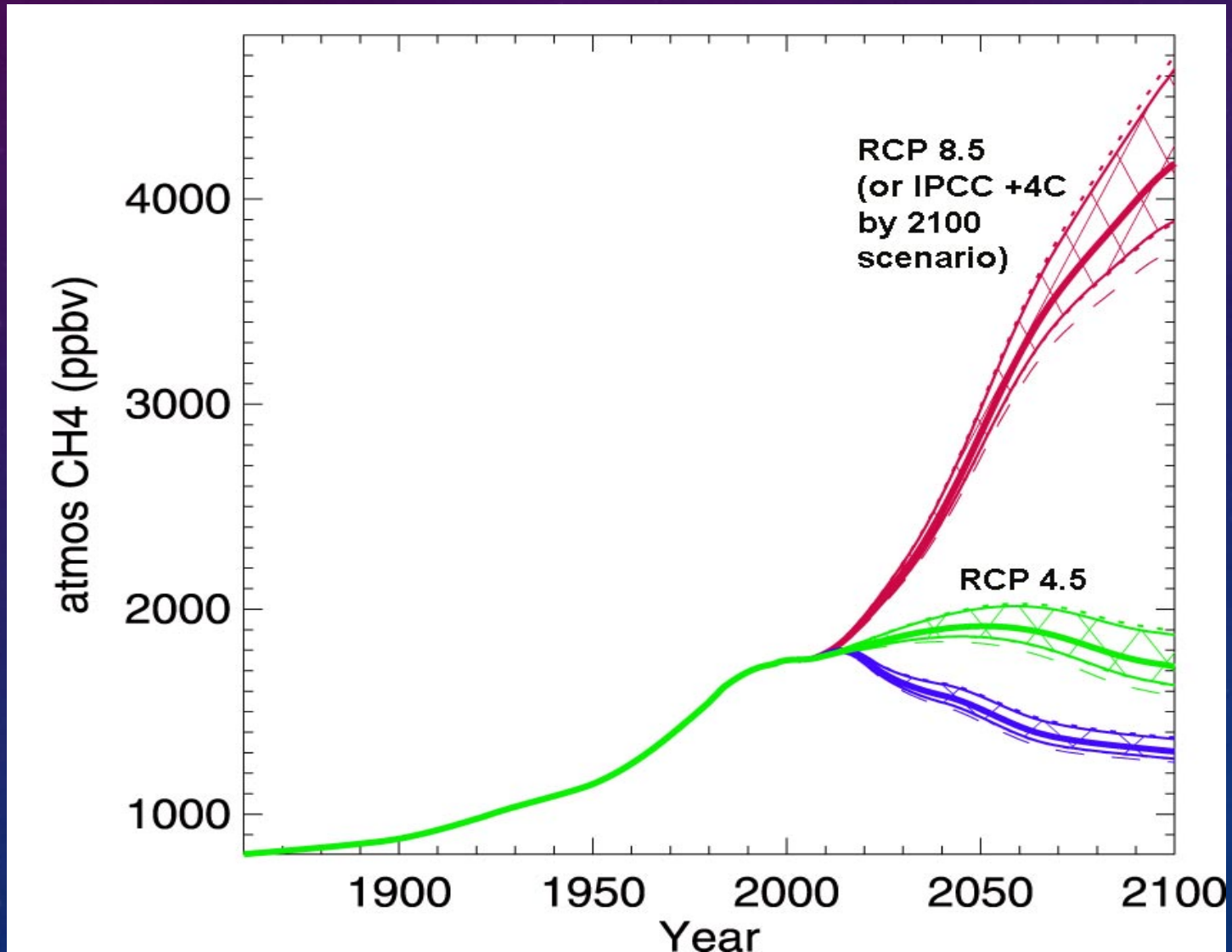




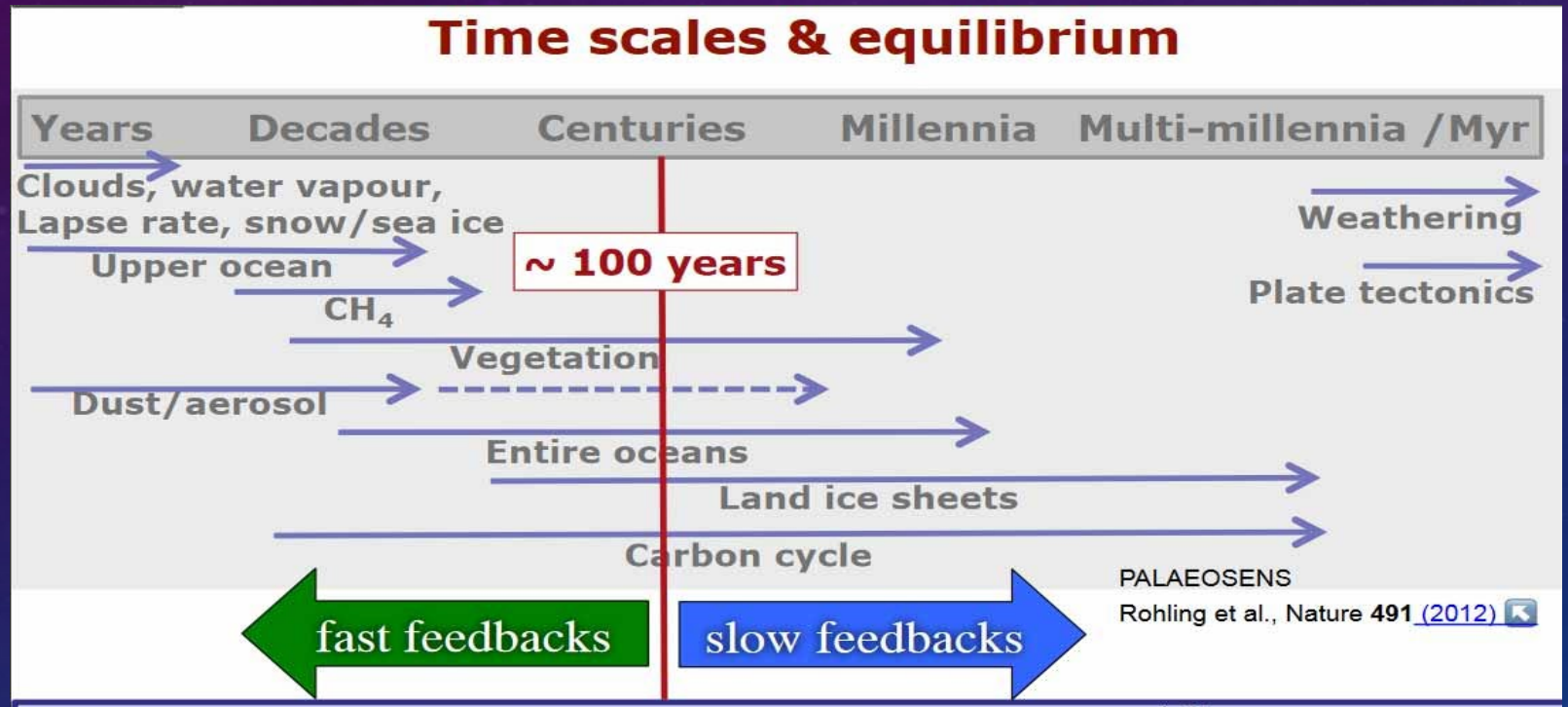
12% RISE IN JUST THE PAST 30 YEARS.

METHANE SOURCES: "FUGITIVE EMISSIONS" FROM GAS PIPELINES, LIVESTOCK, TROPICAL WETLANDS, OTHER AGRICULTURAL SOURCES, RESERVOIRS… AND PERMAFROST THAW

WE REMAIN ON THE MOST PESSIMISTIC SCENARIO TREND FOR METHANE CONCENTRATIONS IN OUR ATMOSPHERE



NEXT KEY: *EQUILIBRIUM CLIMATE SENSITIVITY (ECS).* IT DRASTICALLY AFFECTS HOW OUR FUTURE UNFOLDS. WHAT IS ECS? AND HOW WELL DO WE KNOW IT?



Earth system sensitivity $S^p = S_{[CO_2]} = \frac{\Delta T}{\Delta R_{[CO_2]}}$

'Correct' for slow feedbacks, e.g. $S_{[CO_2,LI]} = \frac{\Delta T}{\Delta R_{[CO_2]} + \Delta R_{[LI]}}$

'Equilibrium' sensitivity S: $S_{forcing,slow} = \frac{\Delta T}{\Delta R_{forcing} + \Delta R_{slow}}$

ECS = "EQUILIBRIUM CLIMATE SENSITIVITY"

- A convenient number to summarize the sensitivity of global average temperature to global atmospheric CO2 level.
- How defined? Take CO2 levels before human interference: 280 ppm. Double that to 560ppm. Now watch temperatures go up and wait till the fast climate feedbacks have pretty much played out, and ask what the new temperature is.
- That temperature change is called **ECS.**

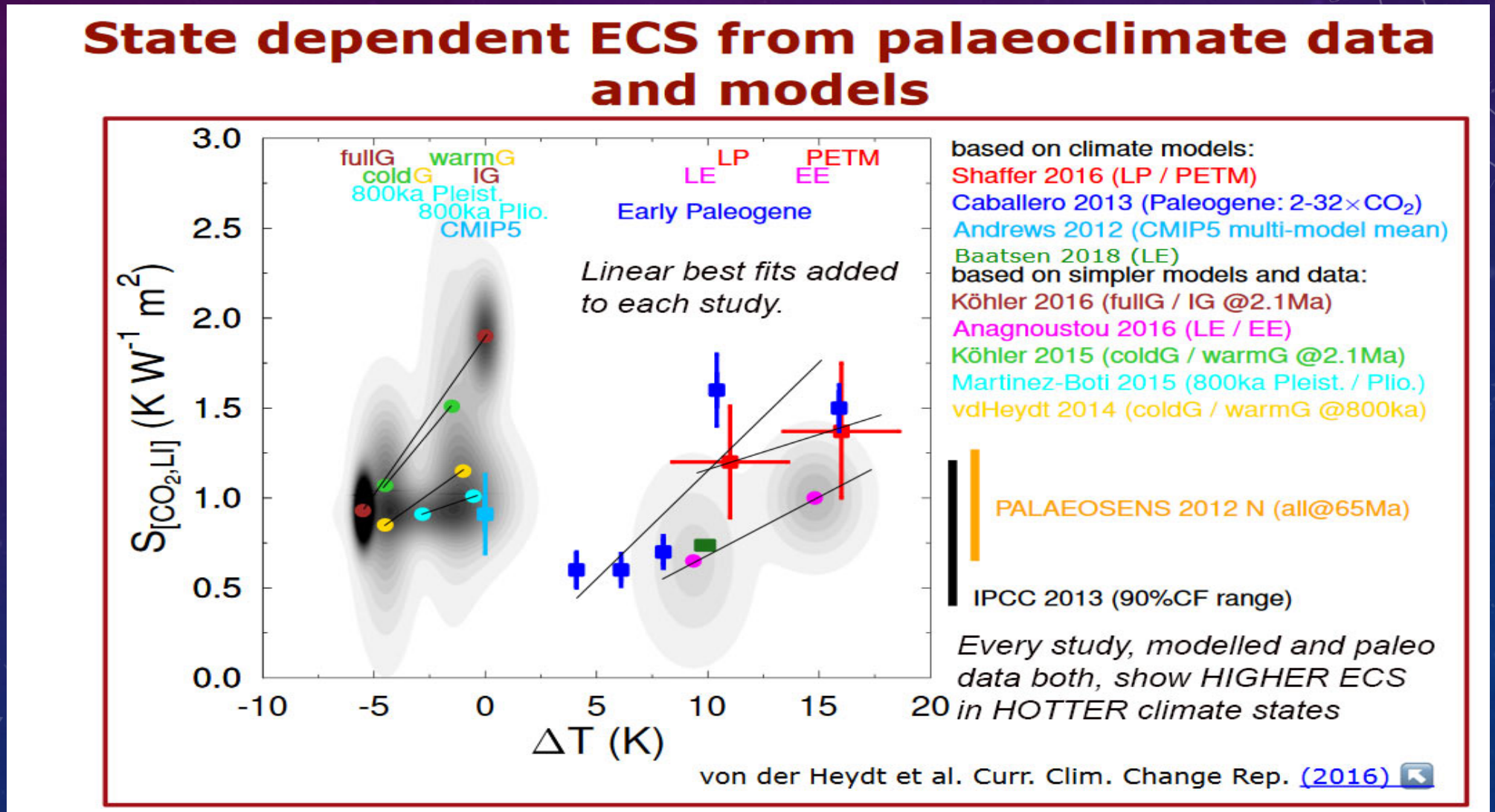
UNFORTUNATELY, TEMPERATURES DON'T REALLY COME TO "EQUILIBRIUM"; THEY CONTINUE UP

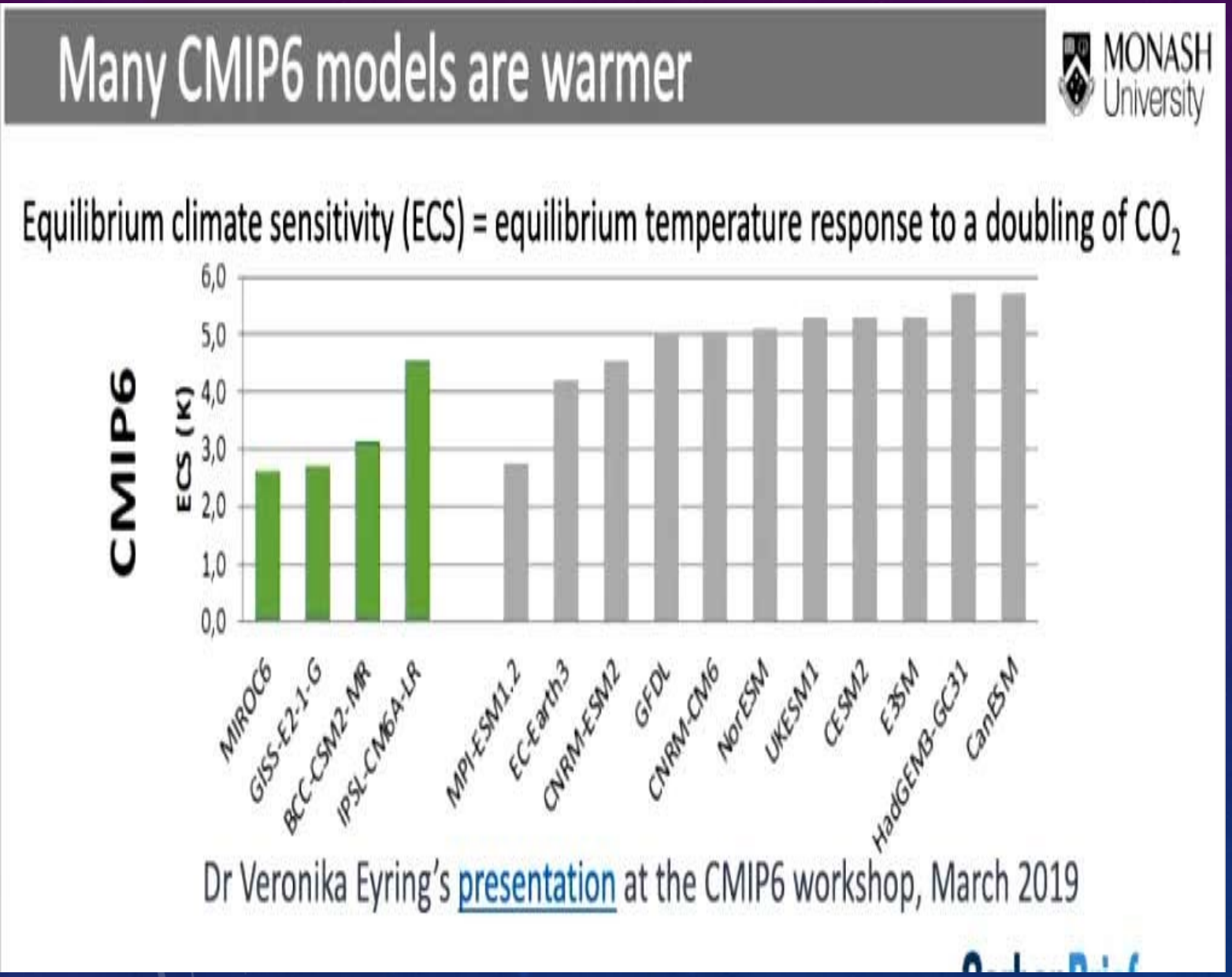
- The slower feedbacks like ice sheet melt and others, continue to raise temperature to about twice as high as ECS alone, over many many centuries or thousands of years.
- But relatively short term (a century or two or three), ECS is meant to be the expectation of what temperatures will come to if we double pre-industrial CO2 concentrations to 560ppm and keep it right there.
- Where are we today? In 2021, we're at 417 ppm, depending on what month you look at.
- We are half way to doubling pre-industrial CO2 today.

IS ECS REALLY A CONSTANT NUMBER IN A WIDE RANGE OF BACKGROUND CLIMATE STATES, AS IS USUALLY ASSUMED?

- If we could treat the Earth as a simple perfect CO2 dominated system, then the radiation transport physics says: approximately yes – pretty much a constant.
- But in the real world? NO.
- Non-CO2 heat forcing that is indirectly induced by CO2, and non-linear feedbacks, mean that ECS actually goes up as temperatures rise. The evidence is new, and it's strong, but not yet in long term climate models.

ALL PALEO STUDIES I'VE FOUND SHOW *ECS* IS HIGHER WITHIN HOTTER BACKGROUND CLIMATE STATES. THIS SUMMARY GRAPH FROM THE REVIEW BY VON DER HEYDT (2016) SHOWS THAT ALL BEST-FIT LINEAR TRENDS HERE HAVE AN UPWARD SLOPE: HOTTER CLIMATES HAVE HIGHER ECS VALUES.





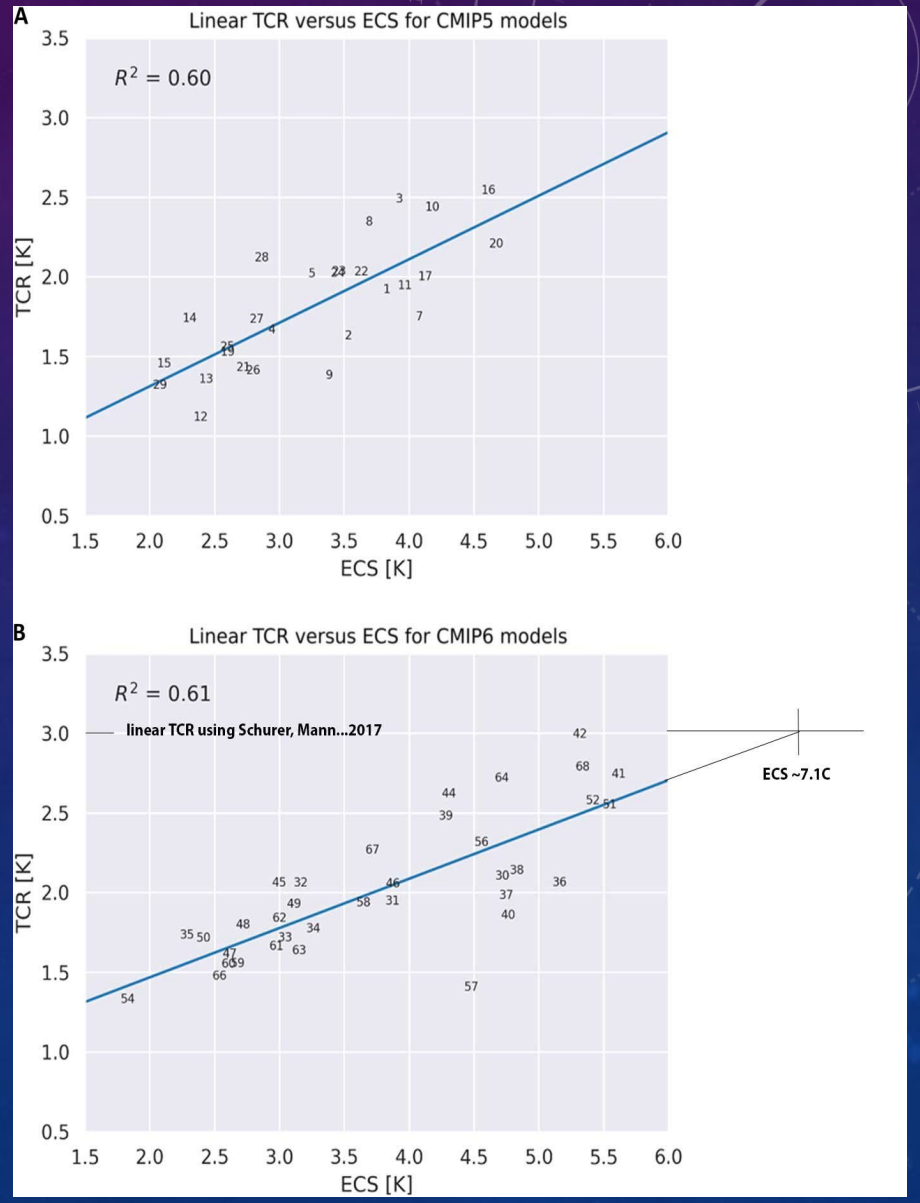
FRIEDRICH *ET AL.* 2016, AND INDEPENDENTLY, NOW, THE LATEST AND MOST DETAILED LARGE SCALE CLIMATE MODELS – THE **CMIP6** MODELS – DONE BY THE MAJOR GLOBAL MODELLING CENTERS, SHOW

ECS =~ 5C.

NOT THE **3C** OF PAST ASSUMPTIONS.

ONE CAN ARGUE CMIP6 MODELS SUGGEST AN EVEN HIGHER ECS OF 7C, USING TODAY'S TEMPERATURE DATA AND THE SCHURER, MANN *ET AL* 2017 BEST DETERMINATION OF TRUE PRE-INDUSTRIAL BASELINE

- **TCR = transient climate response** = the temperature anomaly reached at the time that CO2 reaches a doubling from pre-industrial value (will always be less than "equilibrium".
- Lets assume temperature rises only linearly with CO2 anomaly (very likely an underestimate, since the non-CO2 influences of ice albedo, methane releases are only now beginning very non-linear accelerating rises, and cloud changes are likely to do the same.) Still, let's make that conservative assumption. Today we are 1.48C above the Pre-Industrial Baseline of Schurer, Mann *et al* 2017 at atmospheric CO2 of 415ppm or 49% of the way towards a CO2 doubling (in definition of ECS).
- Then linear trend yields **TCR = 1.48 * (1/0.49) = 3.02C**
- Meehl (2020 Fig 2) shows the trend of TCR *vs* ECS for the current CMIP6 models, and at TCR = 3.02C **yields ECS=7.1C**



SIMILARLY, ZHU *ET AL.* 2019 FIND ECS=6.6C IN THE EARLY EOCENE

- This was 55 million years ago, in “hothouse Earth”, and there was no ice anywhere.
- So ice albedo changes from melting ice caps cannot account for this high ECS. Instead, it is the progressive loss of low stratus clouds(Zelinka *et al.* 2020) (which are such an effective coolant on summer days in Monterey and Santa Cruz).
- And, Bloch-Johnson *et al.* 2020, published just 2 weeks ago, find independently that ECS rises strongly with CO2 concentrations, and only about half is due to the raised temperature effect.

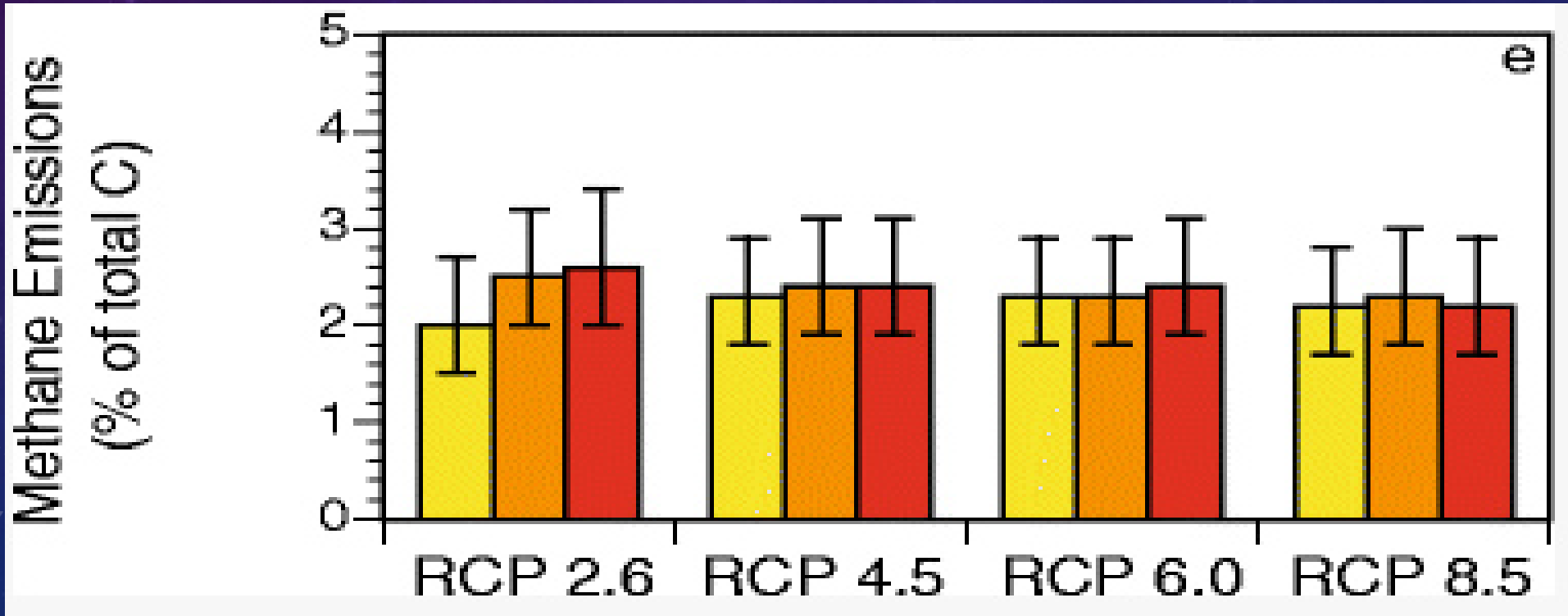
IF ECS IS REALLY +5C PER CO2 DOUBLING GOING FORWARD, THIS DRAMATICALLY ACCELERATES THE PERMAFROST CARBON FEEDBACK, AND WE'RE IN REAL TROUBLE

- MacDougall *et al*. (2012) studied how global atmospheric CO2 concentrations would evolve assuming we stay on our present emissions course until 2050, and then instantly end all human fossil fuel burning.
- The results are striking and concerning.
- Yet they acknowledge, are likely too optimistic; one reason - their U. Vic. Climate Model assumed all permafrost carbon emerges as CO2 (not because it was thought true, but as a simplification to the modelling)

WE KNOW SOME CARBON WILL EMERGE AS METHANE. U. ALASKA'S DR. KATY WALTER- ANTHONY HAS LED THIS OBSERVATIONAL RESEARCH.

SHUUR *ET AL.* 2013 , SURVEYED OF EXPERTS, ESTIMATED 2.3% AS METHANE, REGARDLESS OF HUMAN EMISSION SCENARIO. (BAR COLORS ARE FOR YEAR 2040, 2100, 2300, BELOW).

BUT MORE RECENT STUDIES (E.G. WALTER-ANTHONY *ET AL.)* FIND THIS IS SIGNIFICANTLY UNDERESTIMATED. I'VE JUST LEARNED (JAN. 2021) THAT THE CURRENT BEST ESTIMATE TODAY IS NOT 2.3% BUT 10%.



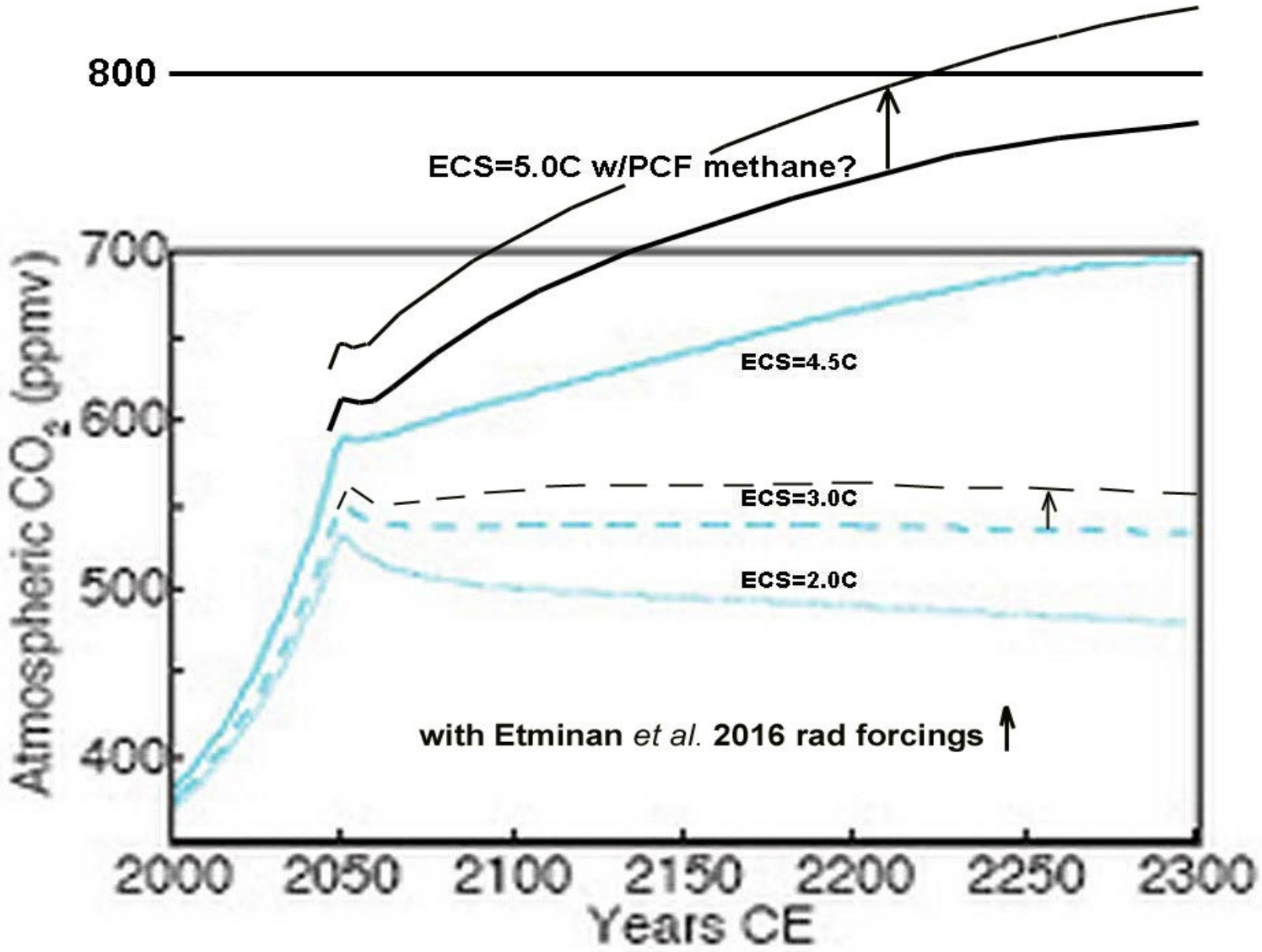
I CANNOT FIND A FULL GLOBAL CLIMATE MODEL SIMULATION INCLUDING ALL THIS LATEST KNOWLEDGE OF PERMAFROST THAW, METHANE, AND NEW FEEDBACKS SINCE MACDOUGALL'S WORK

- So I've made an estimate of how MacDougall's atmospheric CO2e curves would change when methane is included.
- My estimates include…
  -- the high Global Warming Potential of methane, and its decay by combining with available OH-.
  -- the fact the "active layer" is 40% thinner than his first simulations assumed, speeding conduction to the base of the active layer, where permafrost now thaws and begins the process leading to emission.
  -- there is 2x the methane emission we'd thought because there continues (surprisingly) to be emissions all winter (Zona *et al.* 2016), despite freezing at the surface.
  -- and, that the methane and other non-CO2 GHG GWP's had been under-calculated by neglecting short-wavelength spectrum effects (Etminan *et al.* 2016)
- -- they do not include more recent work by Walter-Anthony showing dramatically higher methane when thermo-karst lakes are included (MacDougall did not include these either) – Walter-Anthony 2019 , Lawrence *et al.* 2015 . If included, my black curves would be much higher.
- My black curves (later slide) should only be taken as rough estimates. Uncertainties remain large and a full climate calculation would be better (but still uncertain with today's wide range of thaw emission findings.

THEY ALSO DON'T EXPLICITLY CONSIDER THE GROWING NEW DISCOVERIES OF SIBERIAN METHANE EXPLOSION CRATERS: PINGOS MELTING AND FILLING WITH DEEP METHANE, THEN EXPLODING AND LEAVING LARGE CRATERS.

WHILE THESE DOMES ALONE WOULD HAVE TO NUMBER IN THE 100,000'S TO SIGNIFICANTLY IMPACT CLIMATE, AS OF 2017…

- …Over **7,000 new domes filled with methane** and "are ready to explode", in the Yamal and Gydan Peninsulas alone. **Methane explosion craters continue in 2017**



Shutdown in 2050

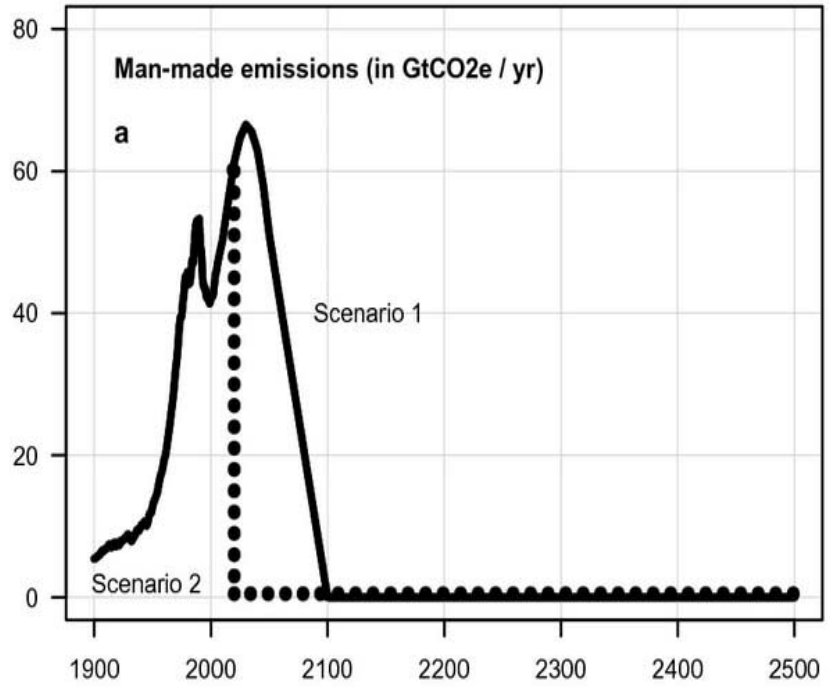
MAYBE BE THE MOST IMPORTANT GRAPH IN THIS TALK…

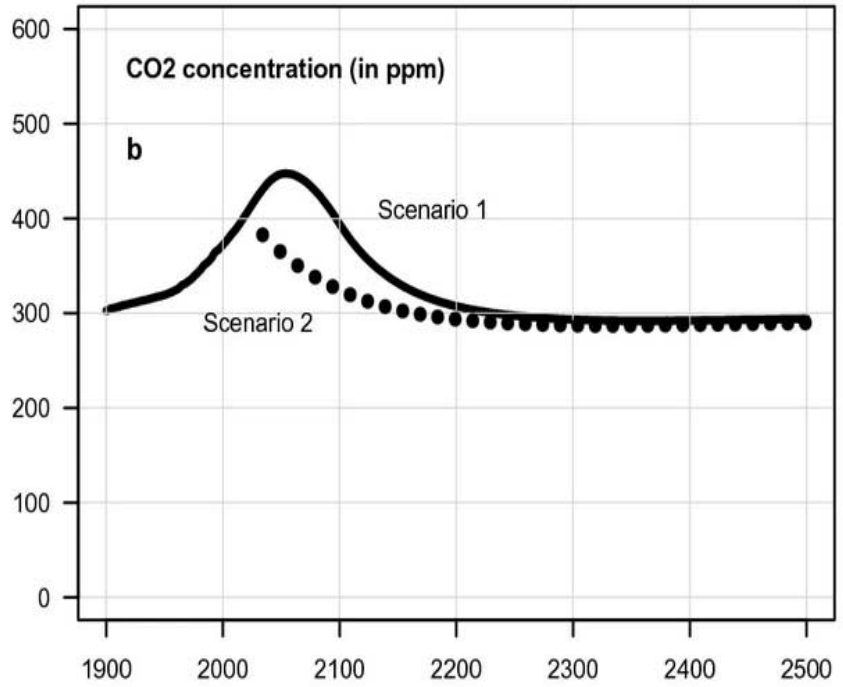
MACDOUGALL *ET AL.* CO2 CURVES IN BLUE, MY ESTIMATED CO2 + METHANE, AS ESTIMATED FROM HIS WORK, IN BLACK. PERMAFROST THAW AND HIGH **ECS** LEAD TO DEVASTATINGLY RISING CO2e LEVELS… <u>EVEN WHEN HUMANS CUT TO ZERO ALL FOSSIL FUEL USE AFTER 2050.</u>

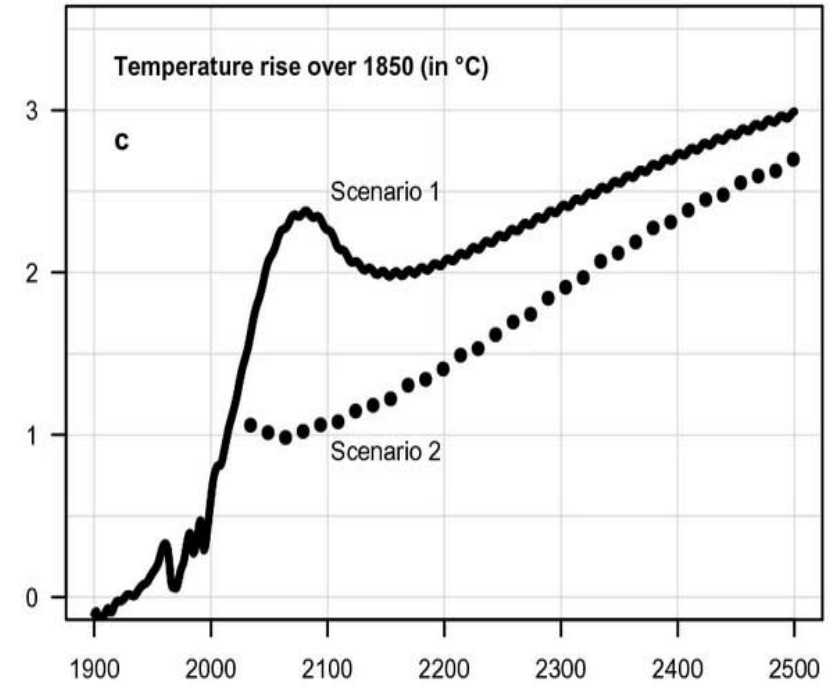
<u>ALAS, THESE CURVES LOOK INCREASINGLY TO BE YET AGAIN TOO OPTIMISTIC…</u>

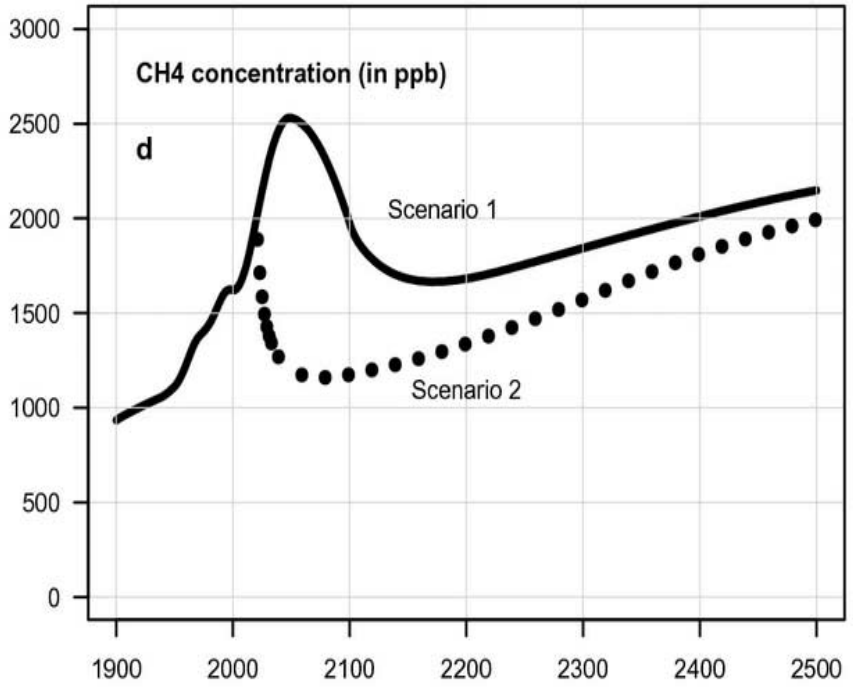
THESE ESTIMATED CALCULATIONS OF MINE ARE ALREADY 2 YEARS OLD, AND MACDOUGALL'S ORIGINAL WORKS ARE 5 AND 8 YEARS OLD. NEWER WORK COULD BE MORE ALARMING

- In the literature search for the work of Randers and Golucke (following slides), Lawrence *et al.* 2015 find 2% of emitted carbon is methane only in dry soils, but is 12% in wet soils such as thermokarst ponds, which Walter-Anthony (2019) and others see to be significant and growing in total area.
- Elsewhere, you'll find IPCC climate models also predict more rainfall in the Arctic for the future.
- In a paper published just 1 month ago, I now see the best estimated methane fraction is not the 2.3% I assumed in the previous graph's estimations, but over 4 times larger: **10% as methane**
- Substituting this into my estimations - I have not done as yet… the results would be significantly worse, is all I will say.





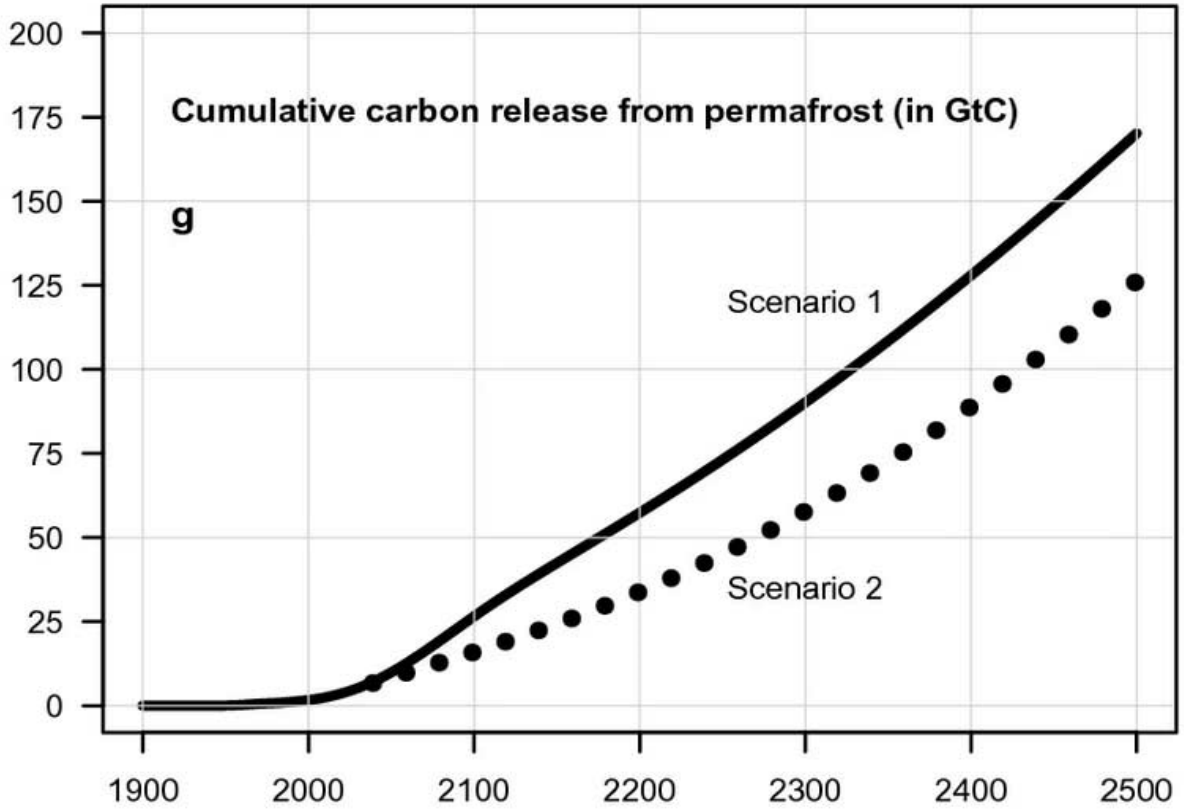


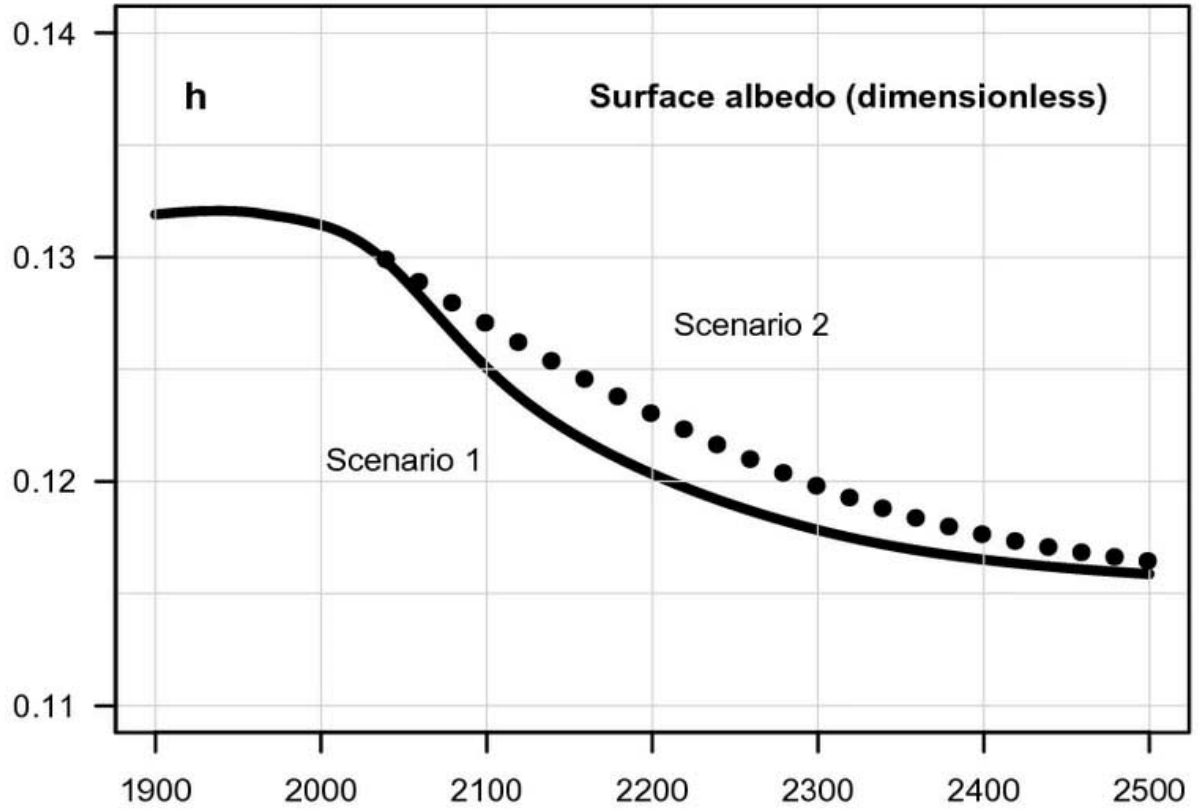


RANDERS AND GOLUCKE (2020) INDEPENDENTLY FIND THE PERMAFROST CARBON TIPPING POINT HAS BEEN CROSSED.

- They find that even if all human emissions halt in 2020, still, after a brief period of slightly decline, the carbon and methane being released from the permafrost cause temperatures to then rise for centuries.
- Falling ice albedo and rising carbon release from the permafrost, drive rising temperatures and resulting water vapor GHG feedbacks.

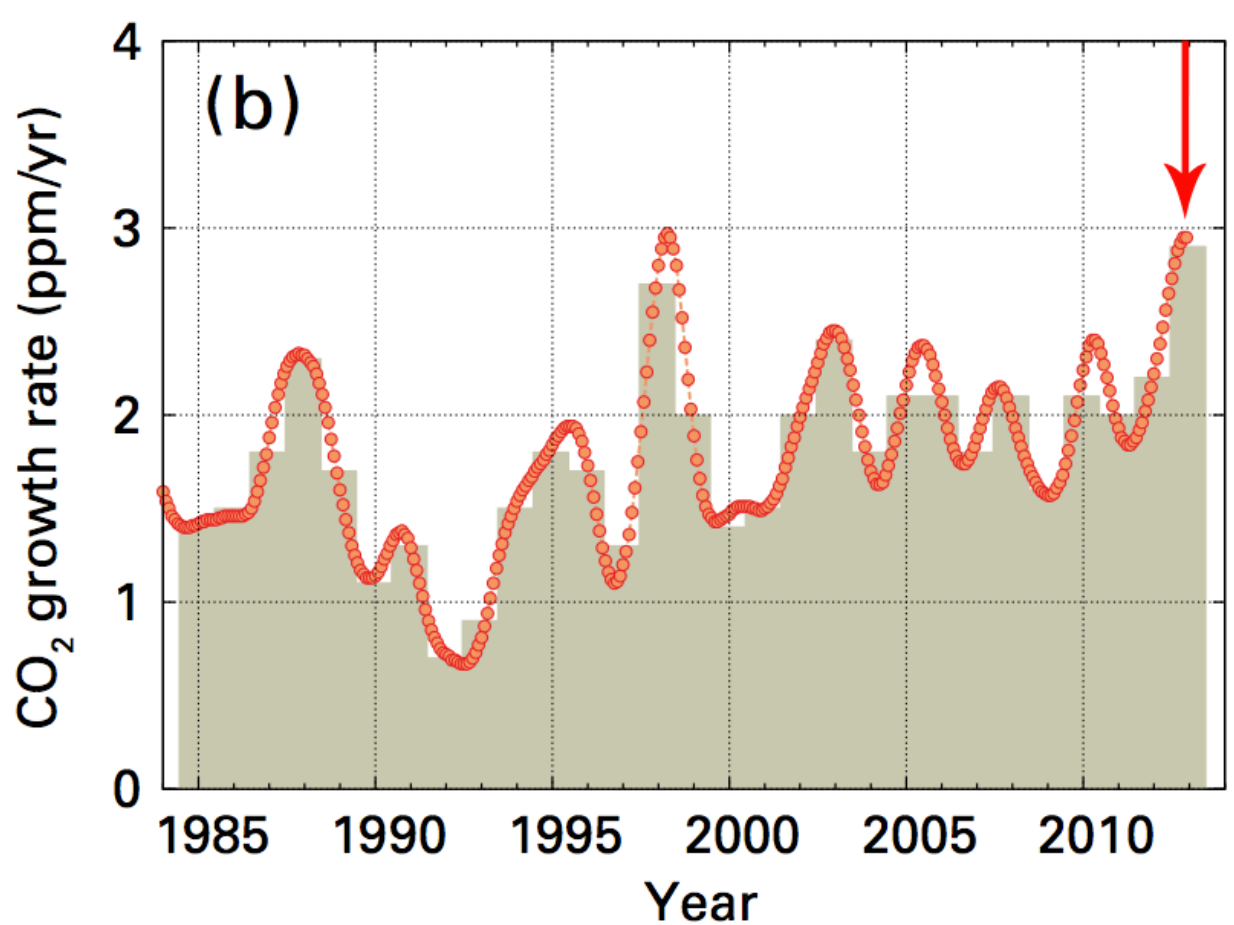
RANDERS AND GOLUCKE 2020 – CUMULATIVE CARBON RELEASE FROM THE PERMAFROST. DOTTED LINE ASSUMES ZERO DIRECT MAN-MADE EMISSIONS AFTER 2020. EVEN BY 2500, THE THAW HAS ONLY TAPPED ~10% OF THE TOTAL CARBON





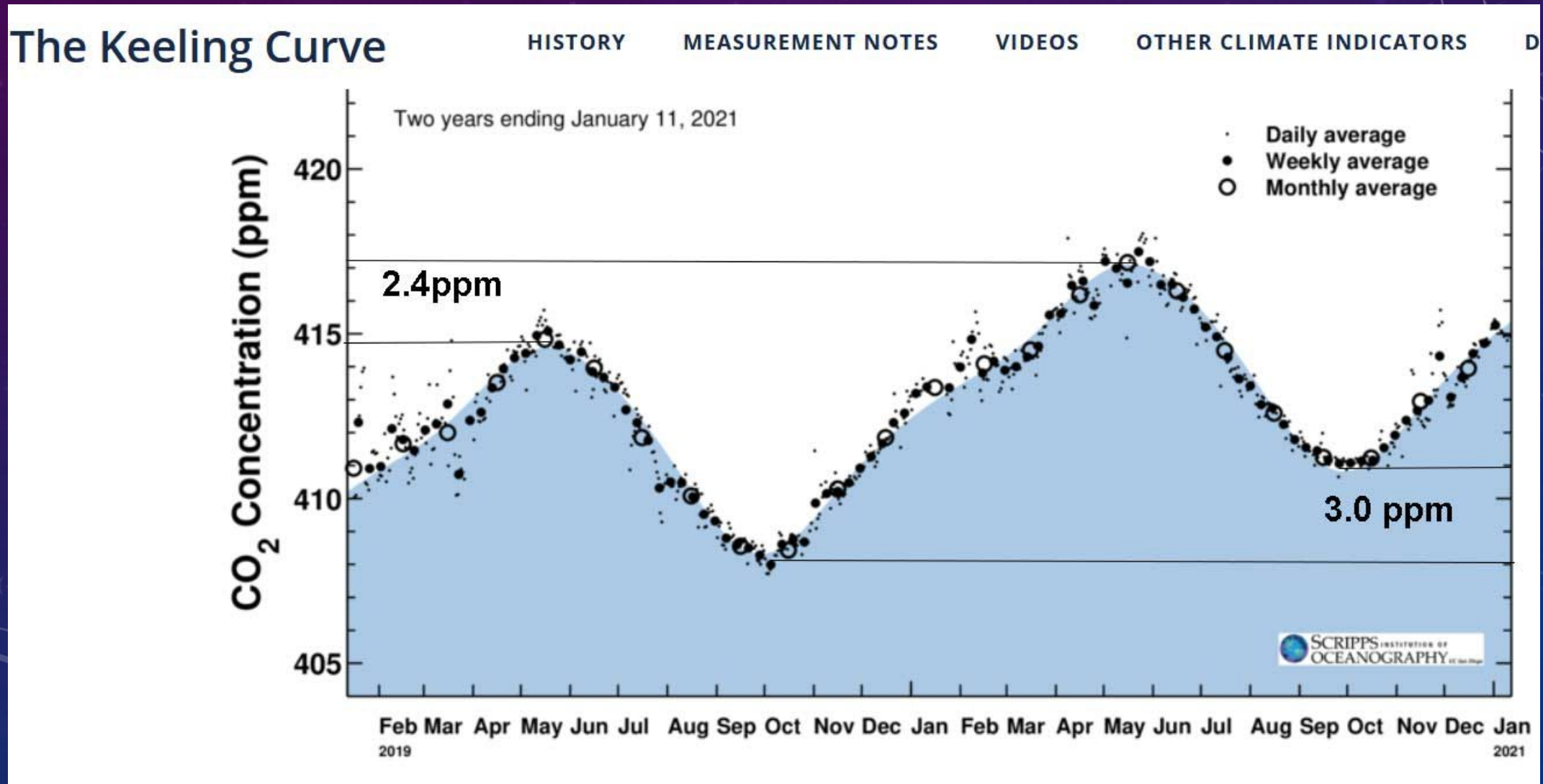
Man-made greenhouse gas (GHG) emissions (**a**), the global average surface temperature (**c**), sea level rise (**e**), and cumulative release of carbon from permafrost (**g**) in two scenarios from 1900 to 2500, generated by ESCIMO. Also shown are the concentration in the atmosphere of CO_2 (**b**), CH_4 (**d**), H_2O (**f**), and surface albedo (**h**). Solid black curves show Scenario 1 where man-made GHG emissions are phased out by 2100. Black dotted curves show Scenario 2 where man-made GHG emissions are cut to zero in 2020. In both cases the global temperature keeps rising for hundreds of years after all man-made emissions have ceased.

ARE WE ALREADY SEEING EVIDENCE OF THIS IN OUR ATMOSPHERIC CO2 RECORDS? ATMOSPHERIC CO2 HAS BEEN INCREASING AT A RATE OF 3 PPM PER YEAR AS OF 2014 THROUGH 2019



- We might expect 2020 to finally show a decline in this growth rate, since globally, reported human CO2 emissions dropped an impressive 7%, at least according to this data. So did the atmospheric CO2 rise rate show any decline?

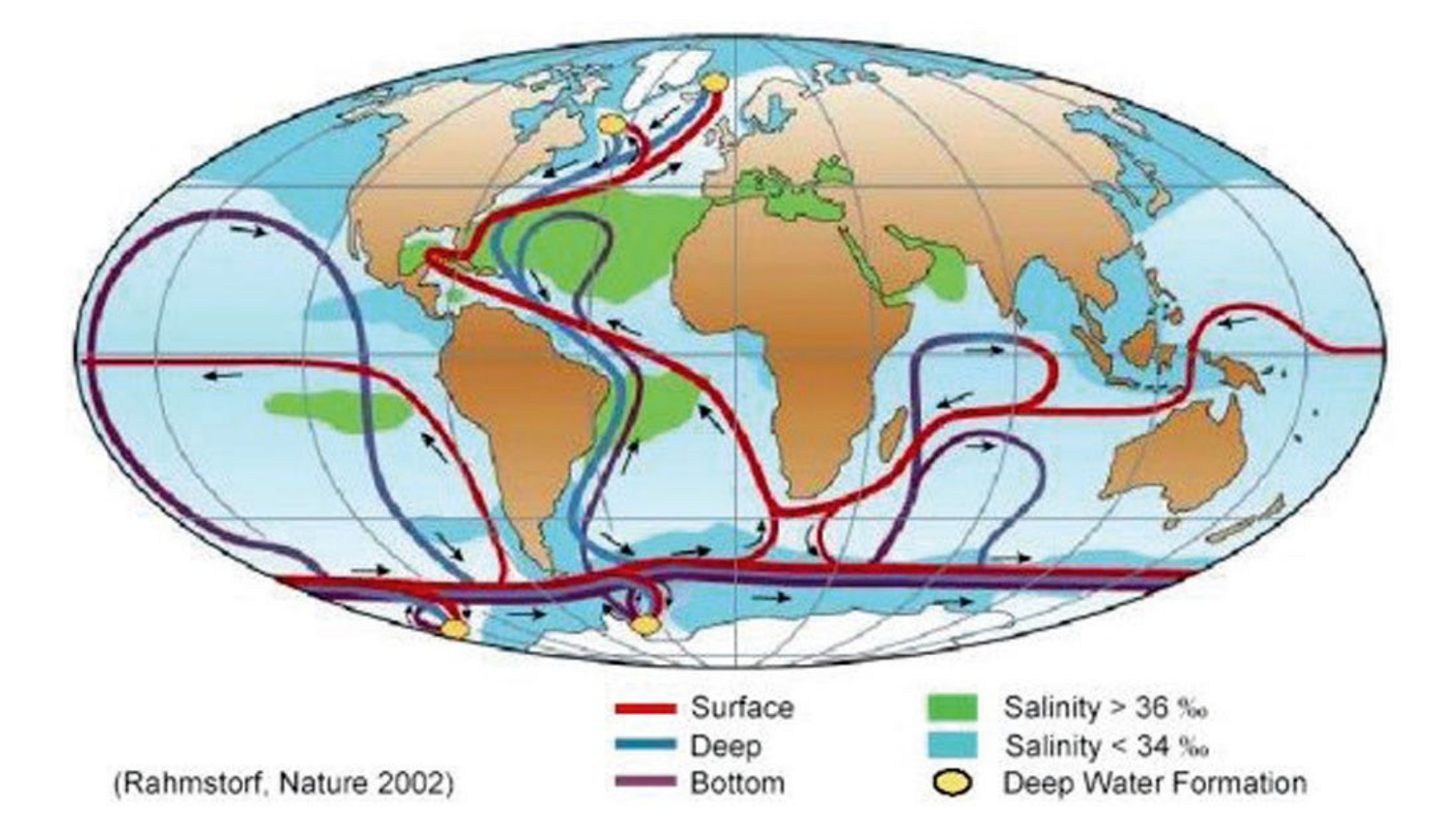
NOT REALLY. THE 2020 SEASONAL MINIMUM IN OCTOBER WAS 3.0 PPM HIGHER THAN OCT 2019'S MINIMUM. THE RATE OF INCREASE OF CO2 HAS NOT DECLINED DESPITE THE WORST ECONOMIC DEPRESSION IN 90 YEARS, A 7% DROP IN CO2 EMISSIONS, AND THE FACT THAT 2020 WAS A LA NINA YEAR. IS IT INDIRECT EMISSIONS? TOO NEW – WE DON'T KNOW YET.



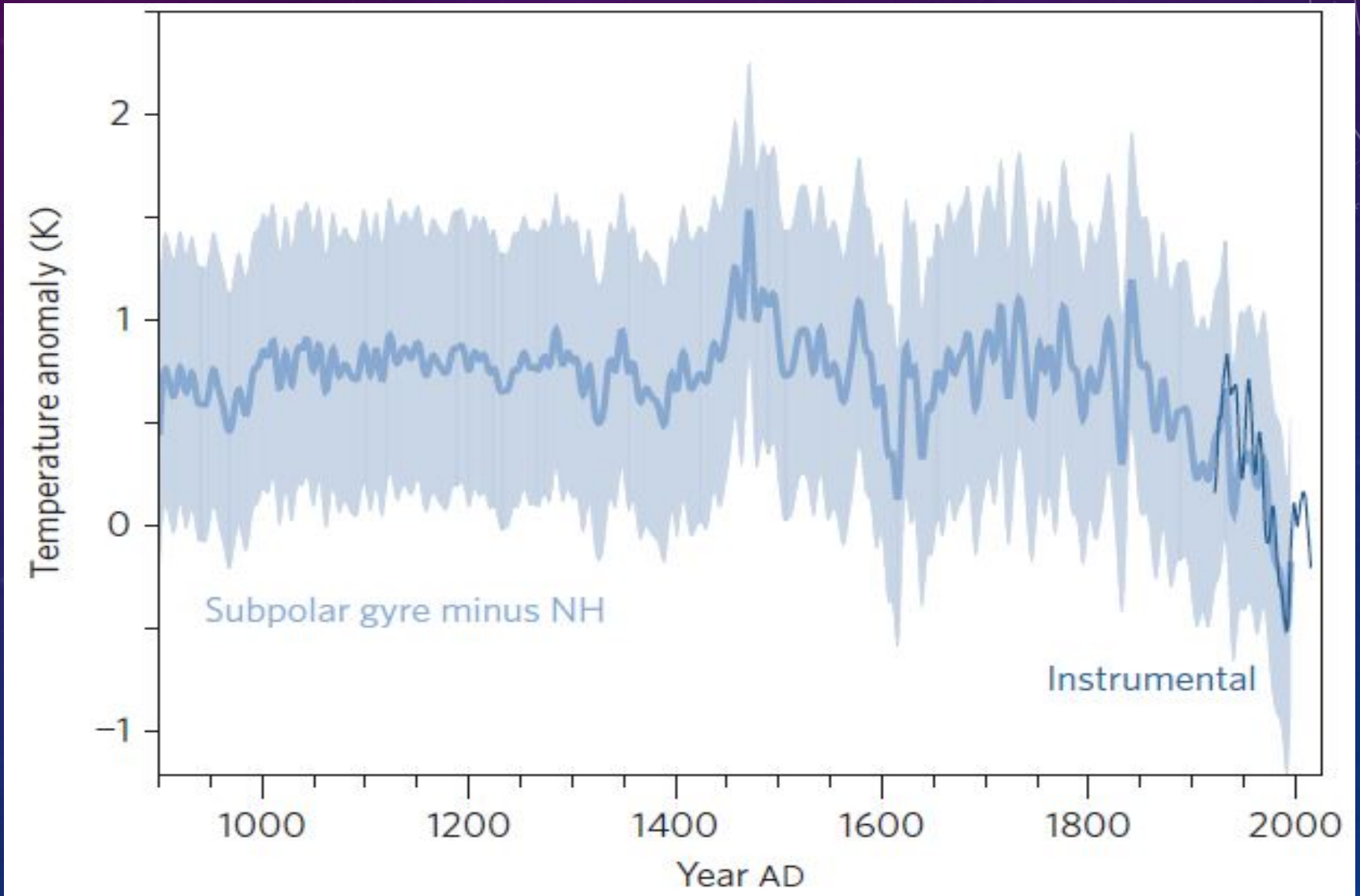
NEXT KEY: SHUT DOWN OF THE GLOBAL OCEAN CIRCULATION. HOW WOULD THAT HAPPEN?

- As Greenland melts, it dumps fresh water - which is lower density and floats over the denser, warmer saltwater - over a wide area around Greenland, preventing the warmer seawater underneath from releasing its heat. So it stays warmer, more buoyant than required to penetrate the thermocline and sink.
- Thus we make a "clog in the pipe" of the global ocean thermohaline circulation.
- The best studied portion – the AMOC – has indeed slowed significantly, and, on current pace, **has a ~50/50 chance of shutting down entirely if global temperatures get to ~+4C above Pre-industrial (Sgubin *et al.* 2017).**

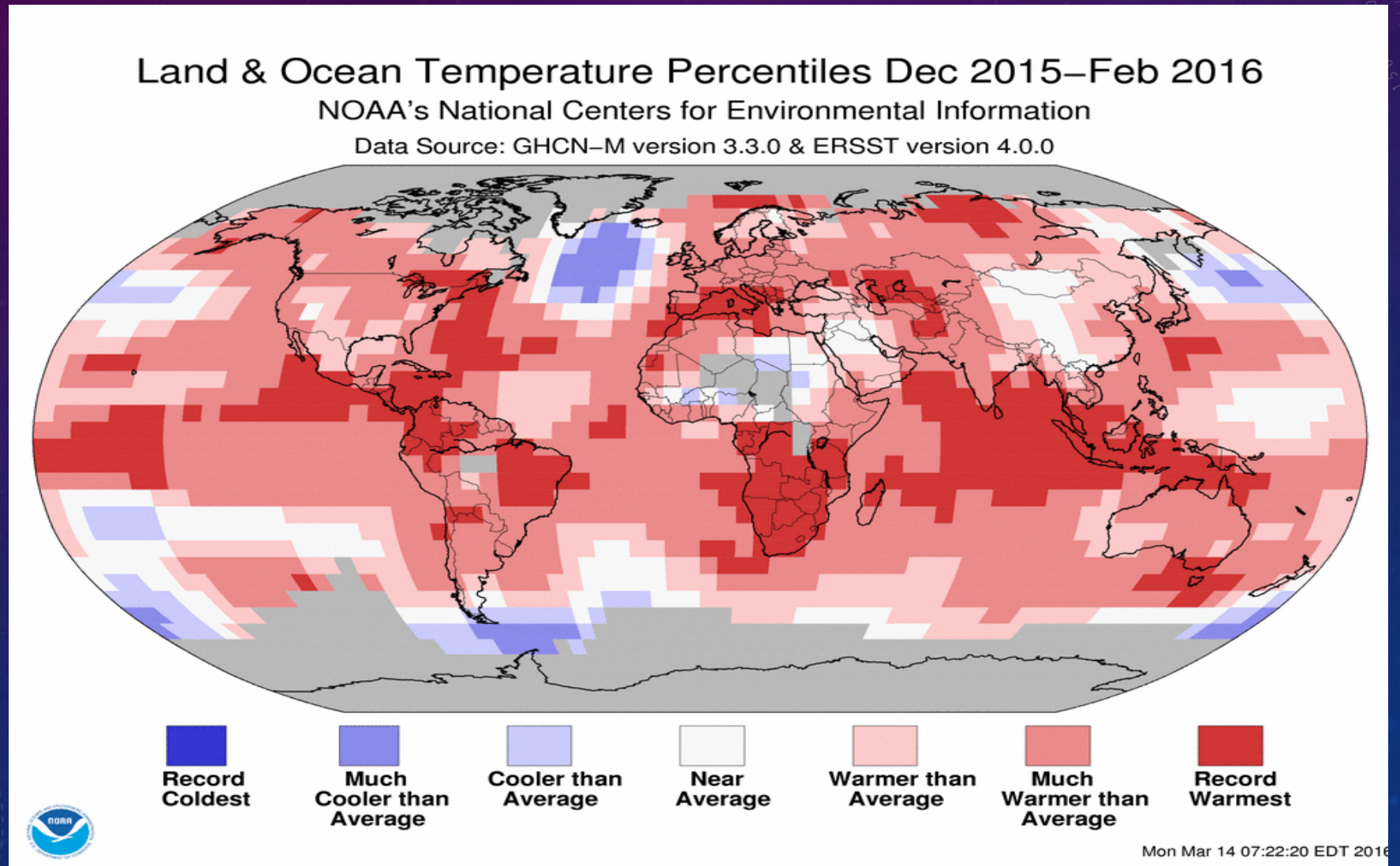
GLOBAL OCEAN CIRCULATION: DEEP WATER FORMS ONLY AT 4 PLACES ON EARTH: TWO ARE OFF GREENLAND, AND TWO STRADDLING THE PALMER PENINSULA IN ANTARCTICA (YELLOW DOTS)



TIME SERIES OF THE TEMPERATURE DIFFERENCE BETWEEN THE SUBPOLAR NORTH ATLANTIC AND THE ENTIRE NORTHERN HEMISPHERE, WHICH IS A PROXY INDICATOR OF THE STRENGTH OF THE ATLANTIC MERIDIONAL OVERTURNING CURRENT. FROM RAHMSTORF *ET AL.* 2014, SEE HERE … CLEARLY THE *AMOC* IS ALREADY WEAKENING.



OBSERVED DATA. COLD PATCH (BLUE) OFF GREENLAND, AND STRADDLING THE ANTARCTIC PENINSULA, WHERE THE LARSEN ICE SHELVES ARE WELL INTO COLLAPSE – COLD CAP OF LOW DENSITY FRESH WATER IS NOW INHIBITING DEEP WATER FORMATION. THE RESULTING INTENSE TEMPERATURE DIFFERENCE BETWEEN COLDER GREENLAND WATERS AND STAGNANT HOT EQUATORIAL WATERS DRIVES "SUPERSTORMS"



THESE ~1,000 TON BOULDERS WERE TOSSED UP TO RIDGE LINES FROM THE SHALLOW OCEAN OFFSHORE DURING THE EEMIAN INTERGLACIAL IN THE BAHAMAS BY SUPER-STORMS, POWERED BY THE SAME *AMOC* SHUTDOWN WE MAY BE INITIATING WITH OUR FOSSIL FUEL BURNING. CAPTION BELOW INCLUDES "CHEVRON RIDGES" … (NEXT SLIDE)

Fig. 1. Two boulders (#1 and #2 of Hearty, 1997) on coastal ridge of North Eleuthera Island, Bahamas. Scale: person in both photos = 1.6 m. Estimated weight of largest boulder (#1, on left) is ~ 2300 tons.

Enormous boulders tossed onto an older Pleistocene landscape (Hearty, 1997; Hearty et al., 1998; Hearty and Neumann, 2001) provide a metric of powerful waves at the end of stage 5e. Giant displaced boulders (Fig. 1) were deposited in north Eleuthera, Bahamas near chevron ridges and runup deposits (Hearty, 1997).

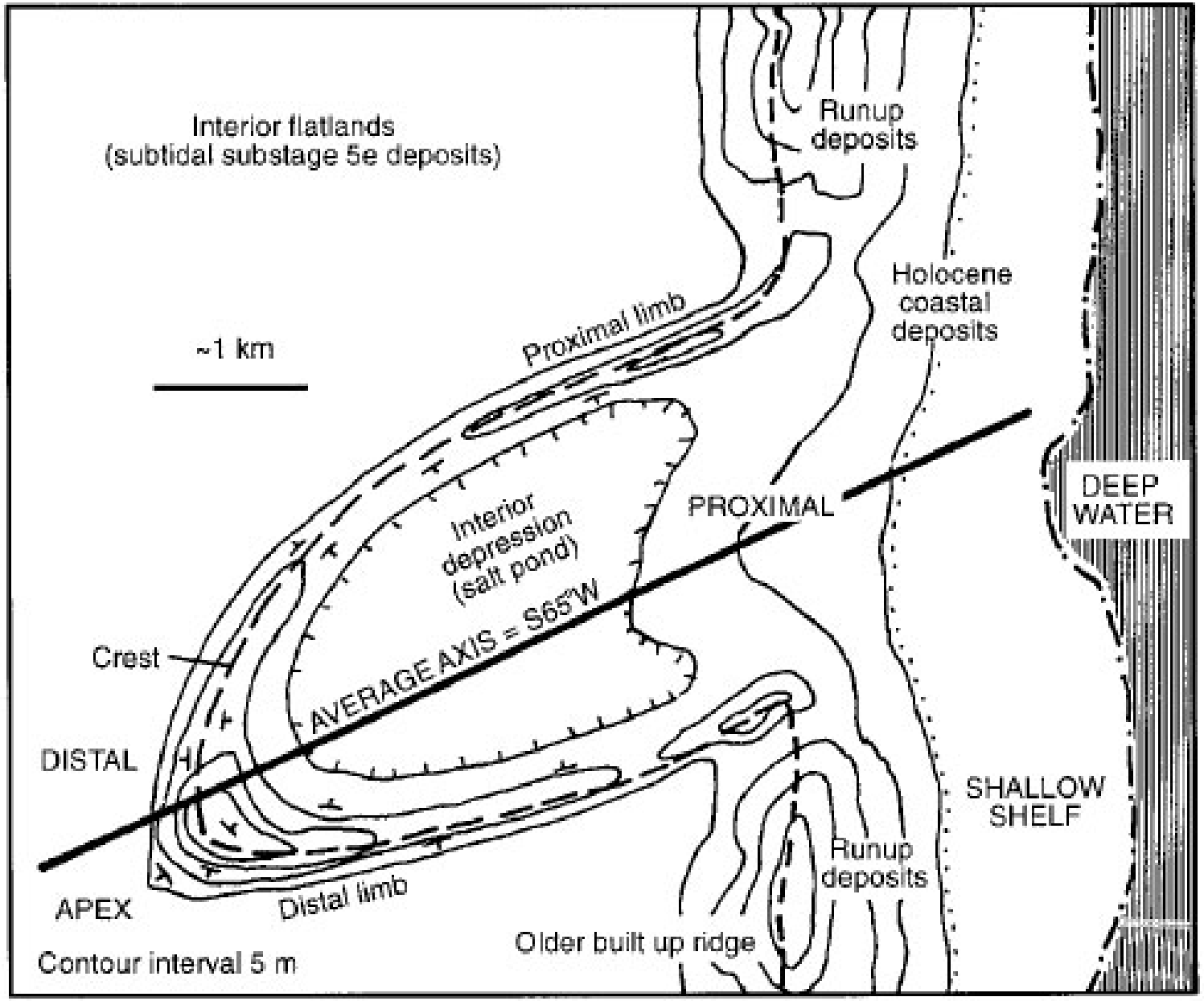
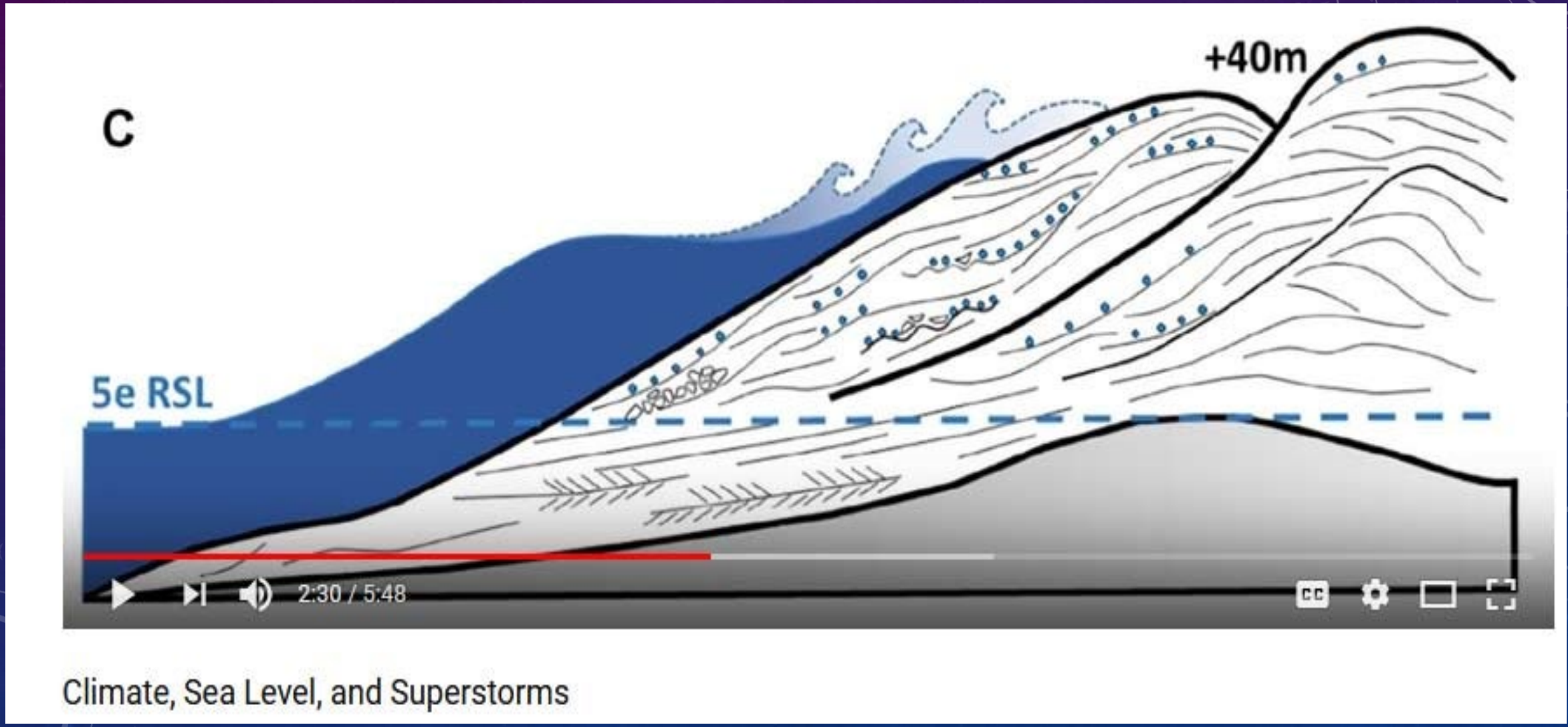


FIG. 1. Schematic map of chevron beach ridge.

GIANT SUPER-STORM WAVES OF THE EEMIAN INTERGLACIAL CREATED CHEVRON DEPOSITS 50 FT HIGH AND 2 MILES LONG, WHEN WASHING BACK TO SEA. THESE ARE ALL ALONG THE NE SHORELINES OF THE BAHAMAS. SOME RUN-UP DEPOSITS ARE AS HIGH AS 43M, REQUIRING WAVES NEARLY ~200 FT IN HEIGHT TO CREATE THEM.

THIS IS WORK BY JAMES HANSEN *ET AL.* 2016, ON WHICH I GAVE A PUBLIC TALK BACK IN 2016.

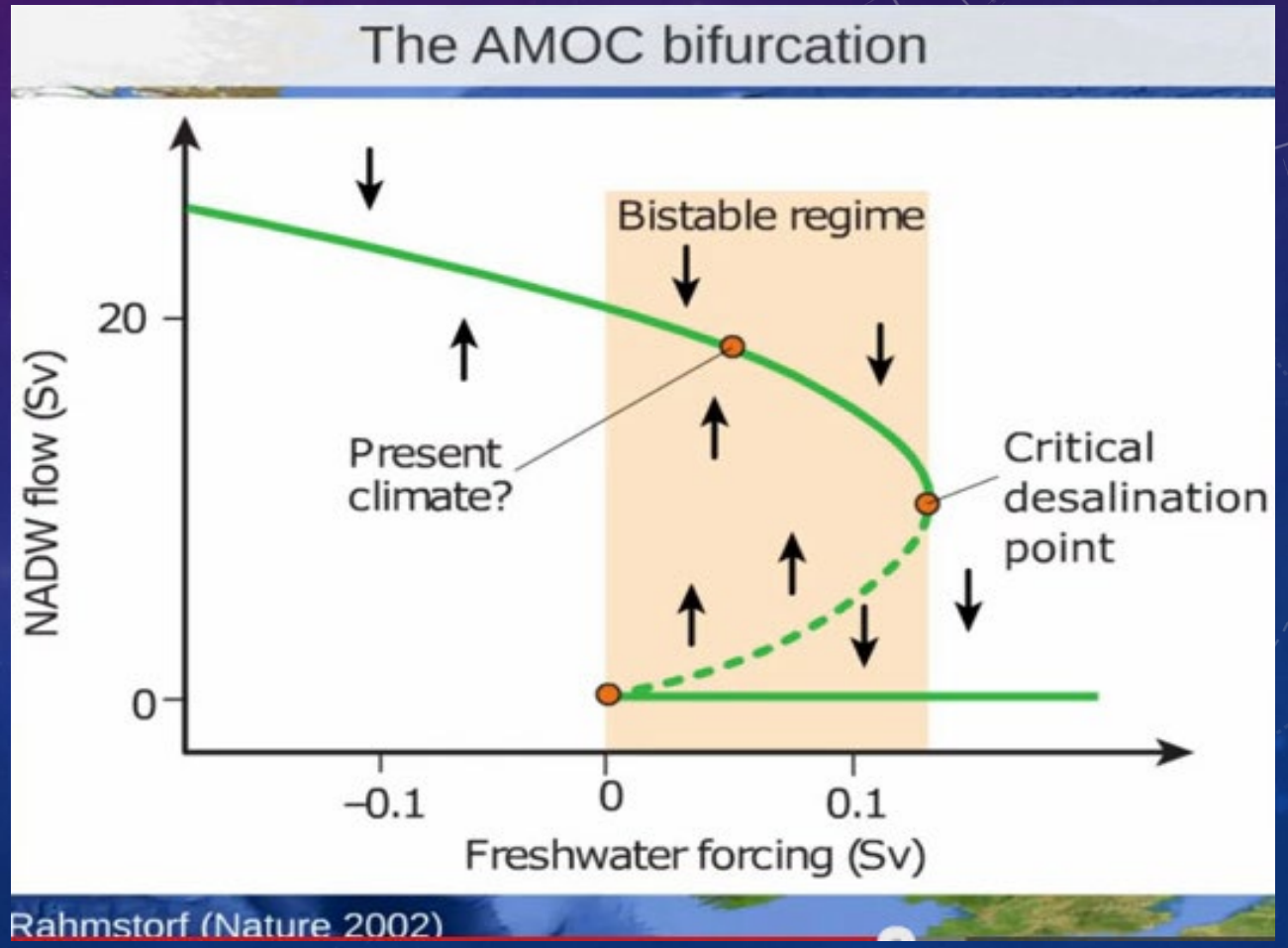
HERE IS A 6 MIN VIDEO ON SUPERSTORMS FROM HANSEN *ET AL.* (2016), FROM YALE CLIMATE CONNECTIONS



REMEMBER THE WAVES IN THE MOVIE *"INTERSTELLAR"?* THAT'S THE RIGHT HEIGHT.

HOW CLOSE ARE WE TO THIS SITUATION? RAHMSTORFF *ET AL.* (2002) SHOWS THE SYSTEM STABILITY TRAJECTORY FOR THE AMOC (ATLANTIC MERIDIONAL OVERTURNING CIRCULATION) – THE BEST STUDIED SEGMENT OF THE GLOBAL OCEAN CIRCULATION

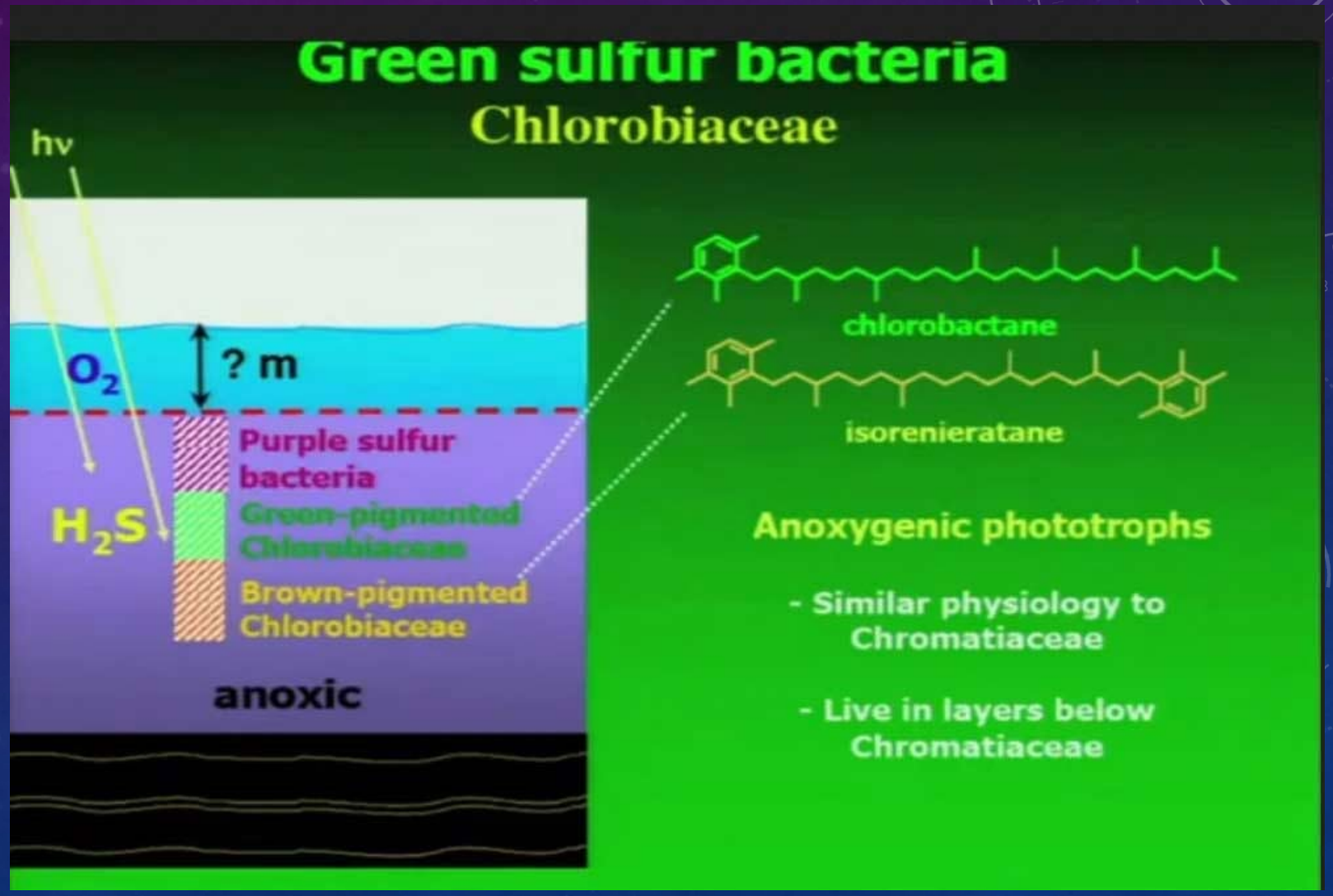
We're already in a salinity regime where there are two stable solutions, one being total shutdown. If melt increases and salinity declines further, a critical desalinization point is reached and the global current shuts down. Then, only drastic re-salinization (re-freezing Greenland) can push it all the way back to a point where the current can resume, and that would take centuries even if temperatures dropped immediately, according to James Hansen.

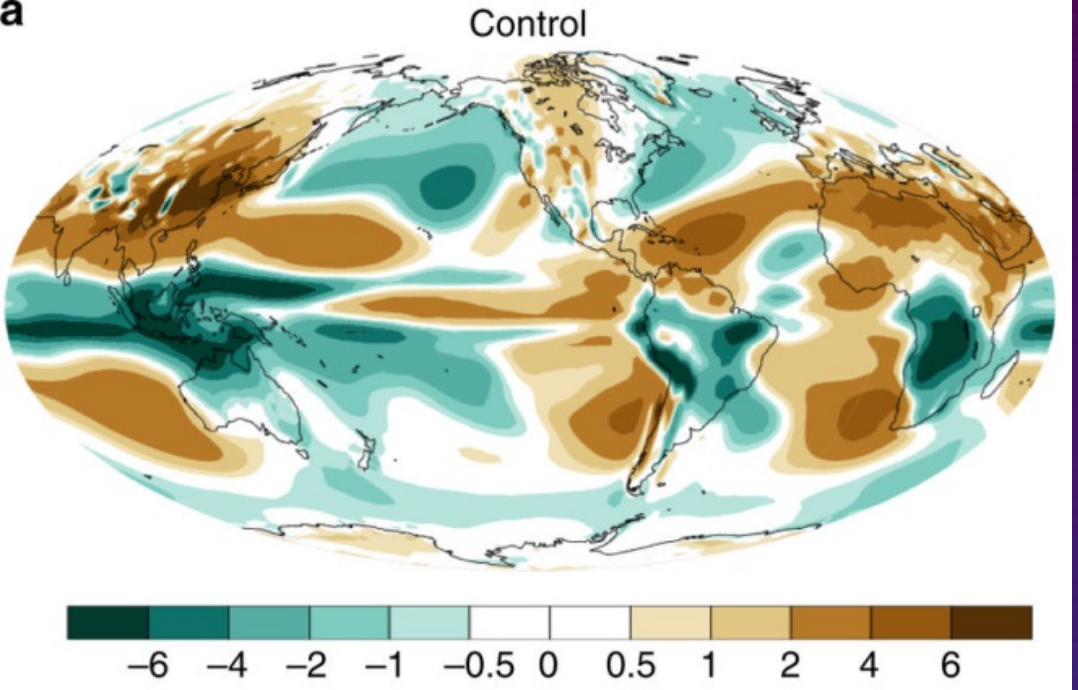


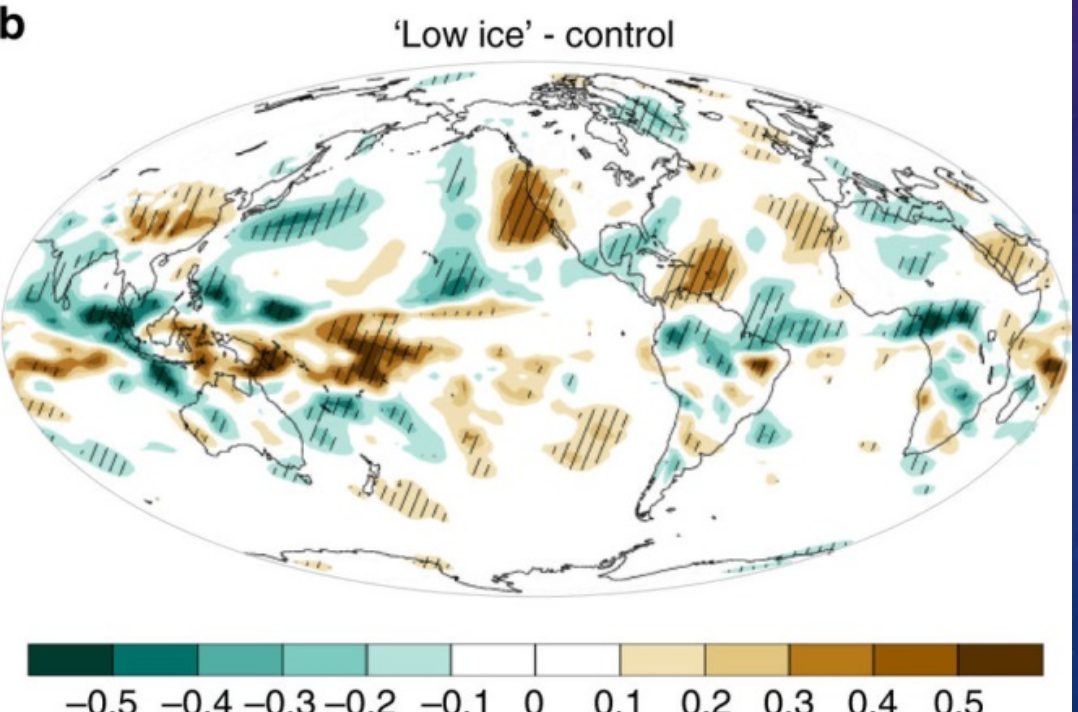
SHUTDOWN OF GLOBAL OCEAN CURRENTS COULD BE CATASTROPHIC TO EARTH LIFE

- Peter Ward finds strong evidence that past intense CO2 episodes (massive volcanism unlike anything seen for millions of years), released CO2 at rates such as we're doing now, and triggered thermohaline ocean current shutdown, cutting off oxygen to the ocean bottom, killing aerobic ecosystems ("dead zones") and stimulating anerobic bacteria which generate hydrogen sulfide (HS).
- However, during the Eemian interglacial, the ocean current did shut down, and we did not experience a hydrogen sulfide mass extinction, so there's hope!

HYDROGEN SULFIDE IS DEADLY EVEN IN TINY DOSES. 200 PPM IS ENOUGH TO KILL MAMMALS. IT'S DEADLY TO MOST LIFE. IT IS NOW IMPLICATED IN 4 OF THE 5 GREAT MASS EXTINCTIONS IN EARTH'S HISTORY.







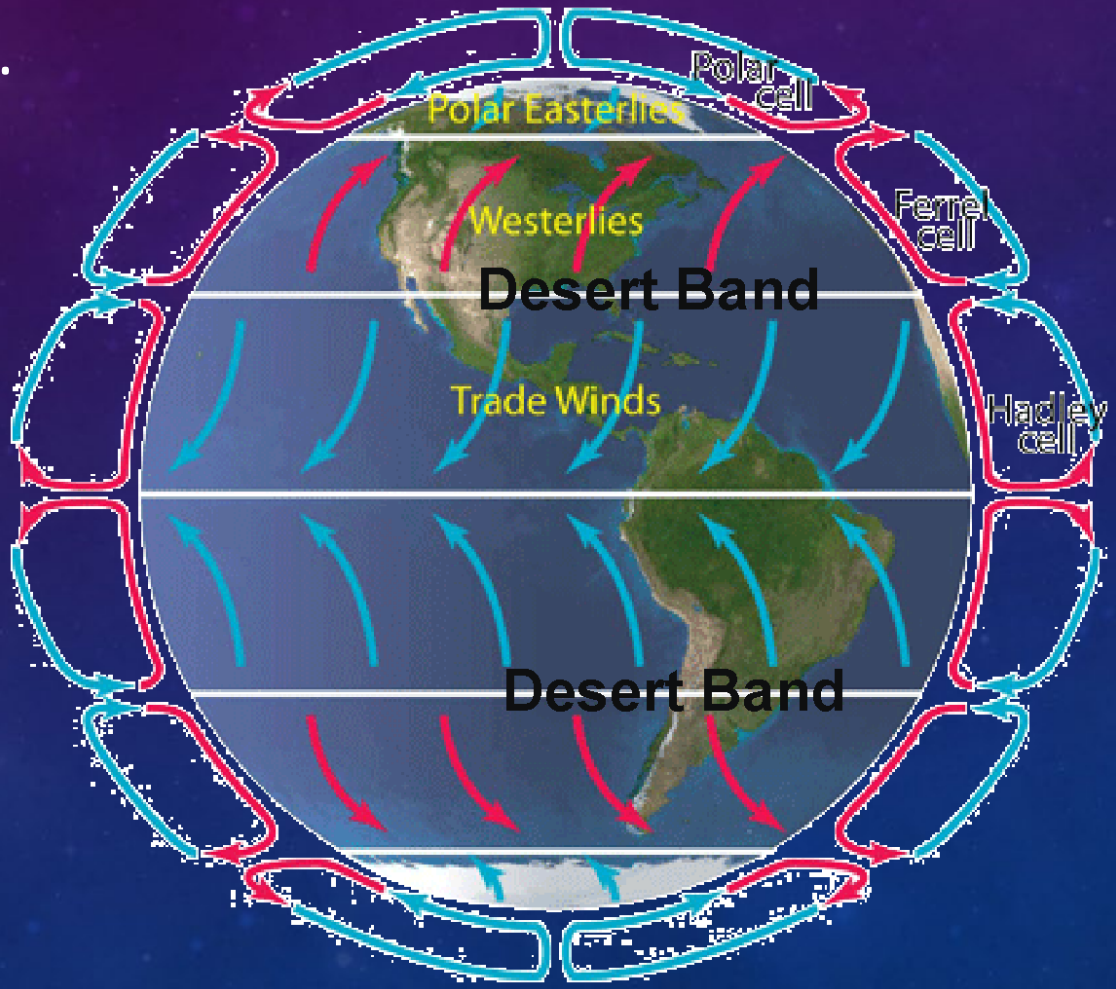
WHAT ABOUT CALIFORNIA'S FUTURE?

CVIJANOVIC *ET AL.* 2017 CONFIRM THE LINK BETWEEN THE LOSS OF ARCTIC OCEAN ICE AND SEVERE DROUGHT IN CALIFORNIA

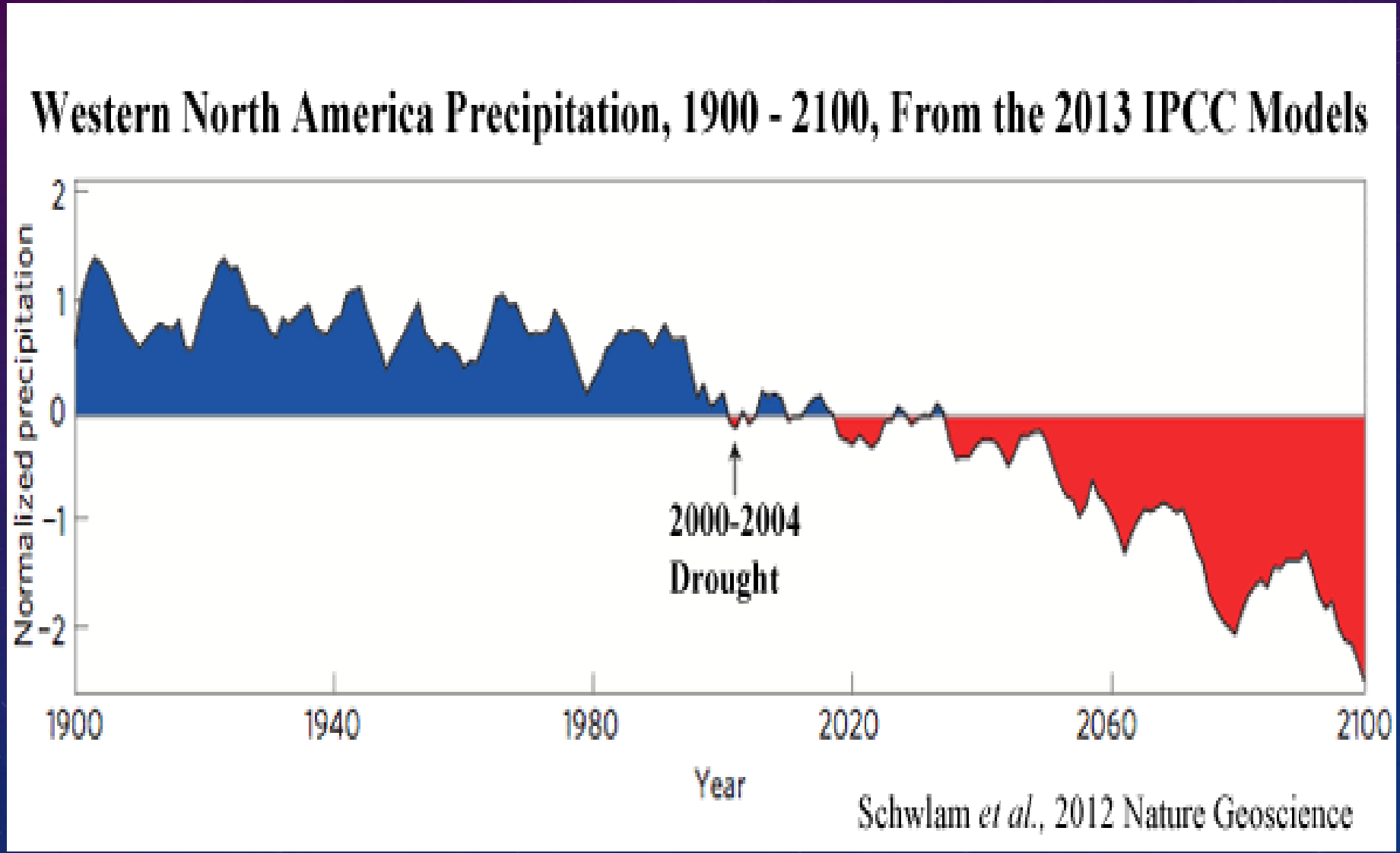
AS THE POLAR CELL WEAKENS AND TROPICAL WARMING RISES, THE DESERT BAND AT ~+30 LATITUDE, IS MIGRATING NORTHWARD 3 TIMES FASTER THAN CLIMATE MODELS PREDICTED, RISING NORTH THROUGH CALIFORNIA

THE RESULT: CALIFORNIA IS THE WORST CONTINENTAL LAND ON EARTH FOR ICE-FREE ARCTIC OCEAN - INDUCED DROUGHT (BOTTOM MAP).

AS THE POLAR CELL WARMS, WEAKENS AND SHRINKS, AND THE TROPICAL HADLEY CELL WARMS AND EXPANDS, BOTH FORCES DRIVE THE DESERT BANDS POLEWARD. CALIFORNIA IS ON THE EDGE OF THE DESERT BAND, AND IT IS MARCHING NORTHWARD.



EVEN IN THE OVERLY CONSERVATIVE IPCC AR5 PREDICTIONS OF 2013, WE SEE WESTERN U.S. DROUGHTS ARE JUST GETTING STARTED. PLOTTED IS SUMMER PRECIPITATION. SCHWLAM *ET AL.* 2012.



SO WHAT DO WE DO?

Perhaps you're thinking – "We'll just re-double our efforts at energy efficiency!"

Policy people and pro-economic growth people constantly promote this.

Alas, for climate, that does not work...

SORRY…. IT'S NOT THAT EASY.

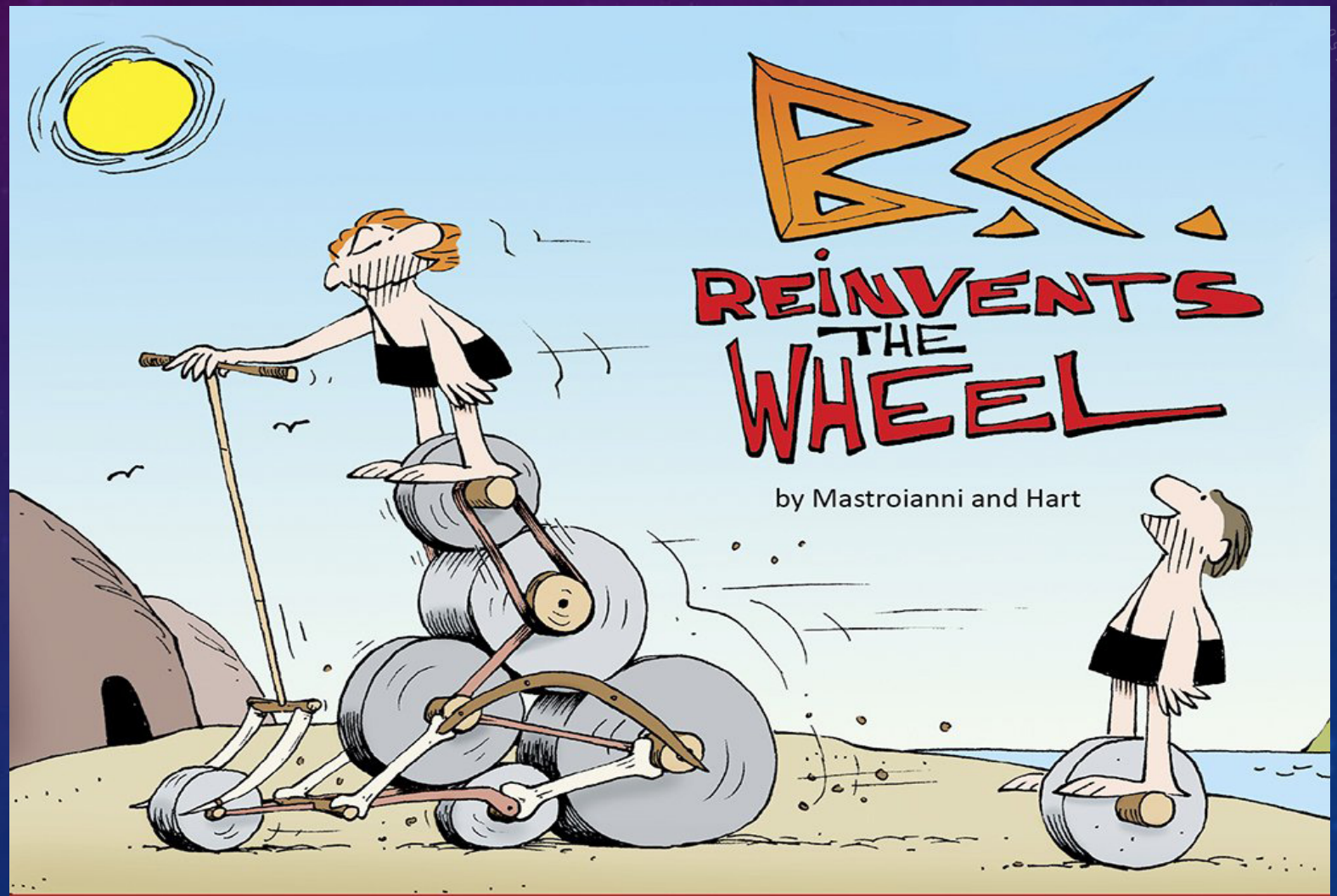
JEVONS' PARADOX

- Original Jevons' Paradox: "Improving the efficiency of steam engines will not result in lower coal use, but in fact to greater coal use." He was correct.
- Pro-growth economists who do not want to face the implications on a finite planet, will narrowly interpret Jevons' Paradox to only the item whose efficiency is being improved, and thereby claim Jevons' Paradox is false and instead there's only a small "rebound" in demand.
- Classic example: double the miles per gallon efficiency of your car, and they claim you won't then drive twice as many miles and thereby eliminate the energy savings. True! You'll probably drive only a little more, but not a lot.
- But this misses the key truth…

THE KEY INSTEAD IS FORMULATED IN WHAT I CALL: GENERALIZED JEVONS' PARADOX

- **"Generalized Jevons' Paradox"** – improved energy efficiencies lead to *savings,* and those savings have been, and will always be, *spent*. And spending forces new continuous energy consumption to support the creations the work paid for. Greater savings also leads to expanded ability, and realization, to access new energy and grow civilization faster.
- Combined Result: Civilization consumes MORE energy, not less, as energy efficiency improves..

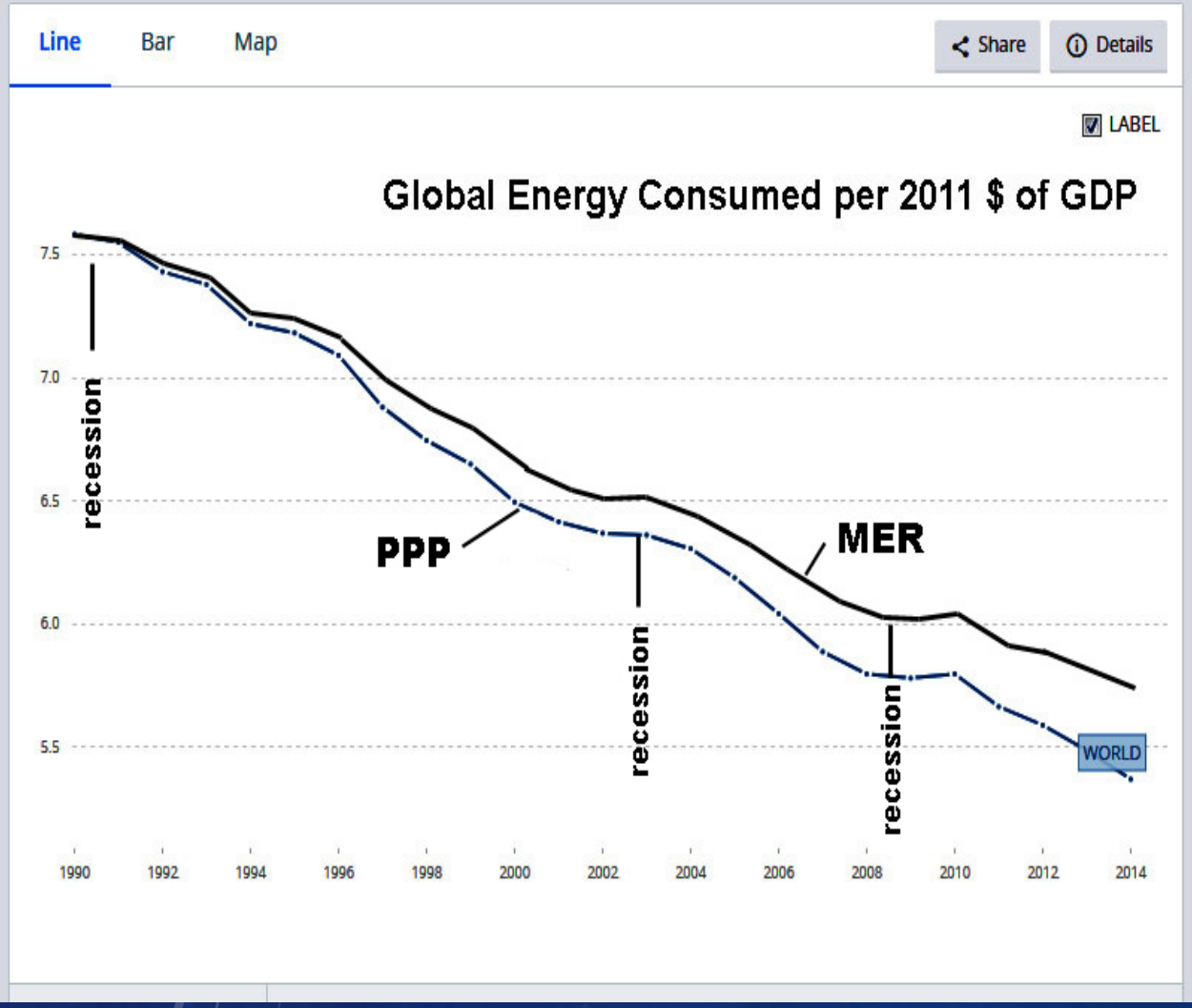
WE'VE BEEN CONTINUALLY AND DRAMATICALLY INCREASING ENERGY EFFICIENCY EVER SINCE THE INVENTION OF THE WHEEL. WE'RE "OPTIMAL FORAGERS", AS ARE ALL OTHER ANIMALS, SEEKING TO LOWER OUR ENERGY SPENT PER UNIT OF ECONOMIC UTILITY GAINED.



Energy intensity level of primary energy (MJ/$2011 PPP GDP)

World Bank, Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework led jointly by the World Bank, International Energy Agency, and the Energy Sector Management Assistance Program.

License: Open



GLOBAL PRIMARY ENERGY EFFICIENCY: STRONG CONSISTENT IMPROVEMENT.

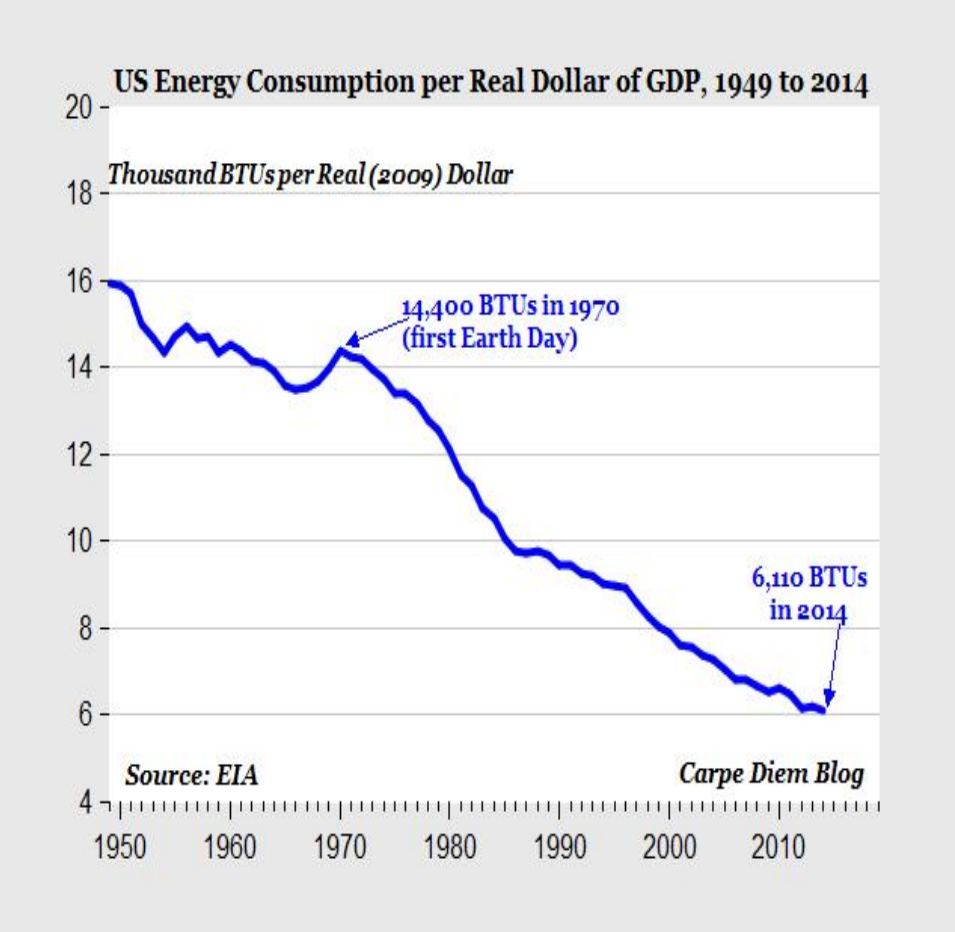
THE CONSISTENT SLOPE ARGUES THAT WE ARE ALREADY PURSUING ENERGY EFFICIENCY WITH AS MUCH VIGOR AS WE CAN MUSTER. THAT'S NO SURPRISE - IT'S A "WIN/WIN" FOR EVERYONE. BUT THAT MEANS – HOW CAN WE HOPE TO DO DRAMATICALLY BETTER AND FASTER? IN FACT...

…ALL BIOLOGICAL SYSTEMS STUDIED, AND INCREASINGLY UNDERSTOOD NOW, CIVILIZATION ITSELF (WHICH PROCEEDS FROM A BIOLOGICAL SYSTEM – US), FOLLOW LAWS DEMONSTRATING OPTIMIZATION OF ENERGY EFFICIENCY.

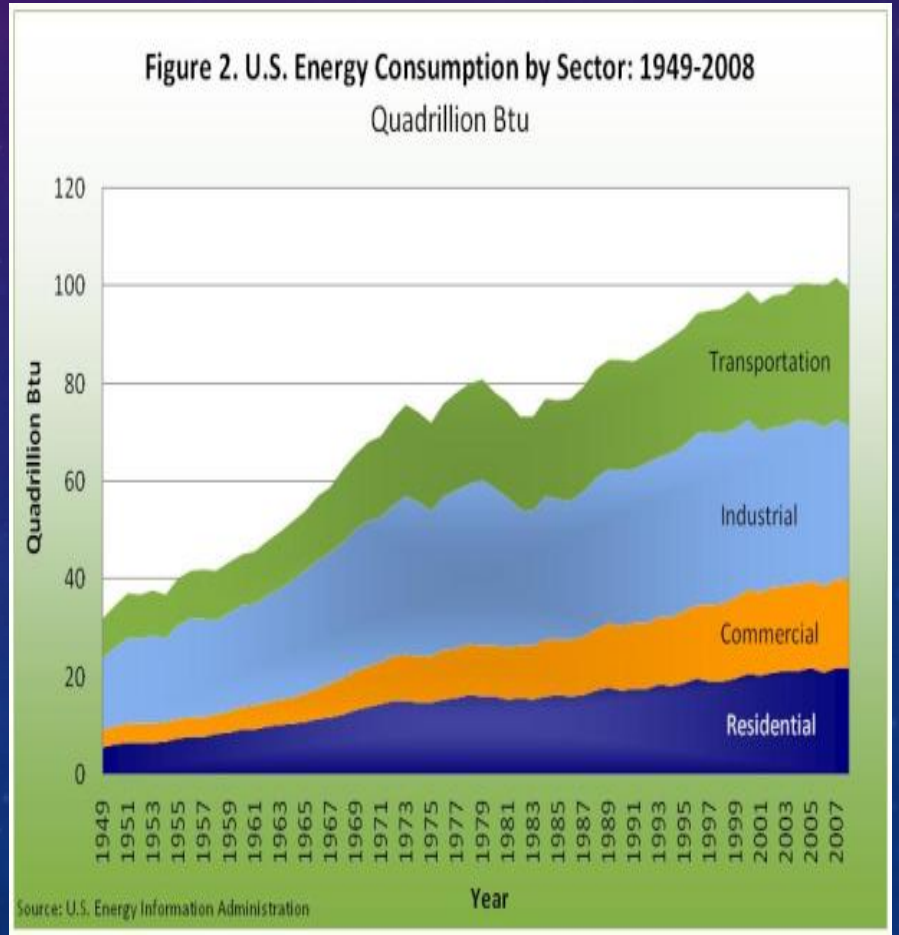
- The beautiful work of Geoffrey West (West and Brown and refs therein, 2005) and collaborators derives why there are impressive scaling laws obeyed by all aspects of biology and civilization (West 2014) studied.
- Biological systems energy requirements are observed to scale with mass as $(\text{Mass})^{3/4}$. Why does this happen? "3" because of the 3 dimensions of space, and the 4 because of the 3 dimensions of space, plus 1. The "1" is due to the fractal nature of networks supporting biological and civilization systems, and the **optimization of energy efficiency** turns that fractal dimension of the networks to their maximum theoretical value, which is "space-filling" and therefore =1.

U.S. ENERGY EFFICIENCY SINCE 1950…

Spectacular 62% increase in energy efficiency! (except during oil-shock recessions of '70-'74). Has it lowered our consumption?...



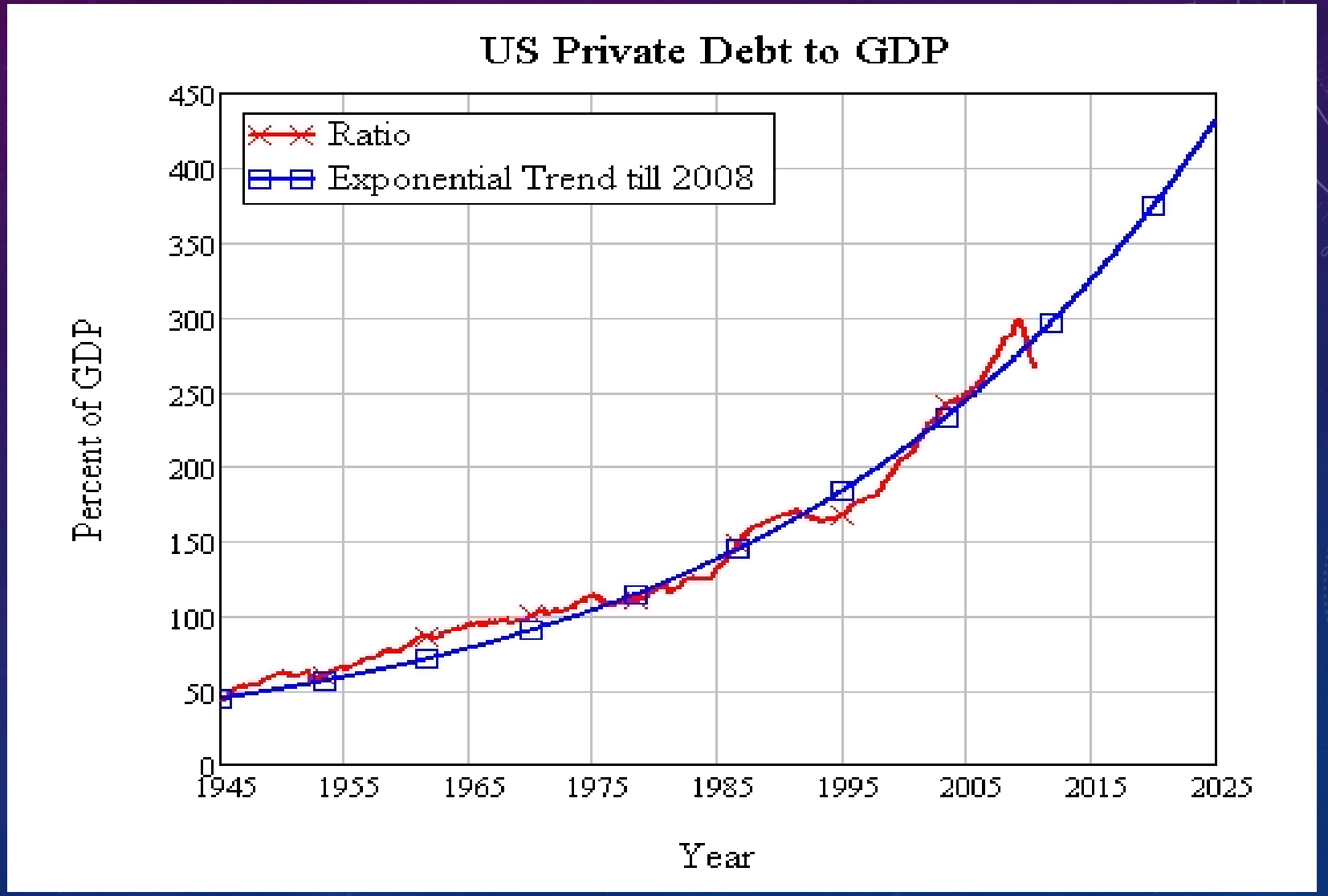
Quite the reverse - Energy consumption is up 300%, even given our off-shoring of much of our manufacturing to China



ECONOMISTS FOCUS ON EXPANDING PROFITS, EXPANDING LIFESTYLES, EXPANDING WEALTH… AND FEEL GREAT ABOUT IMPROVING ENERGY EFFICIENCY

- Unfortunately, climate only cares about the TOTAL energy consumed on this finite planet, not *per capita, and* not per GDP dollar
- …and the implications won't leave future generations feeling so great

WE DO MORE THAN SPEND THOSE EFFICIENCY GAINS. WE LEVERAGE THEM, BORROW FROM FUTURE GENERATIONS, IMPOVERISHING THEM. PRIVATE DEBT IS NOW OVER 350% OF GDP, EXPONENTIALLY INCREASING. (GOVT. DEBT RISING EVEN FASTER).

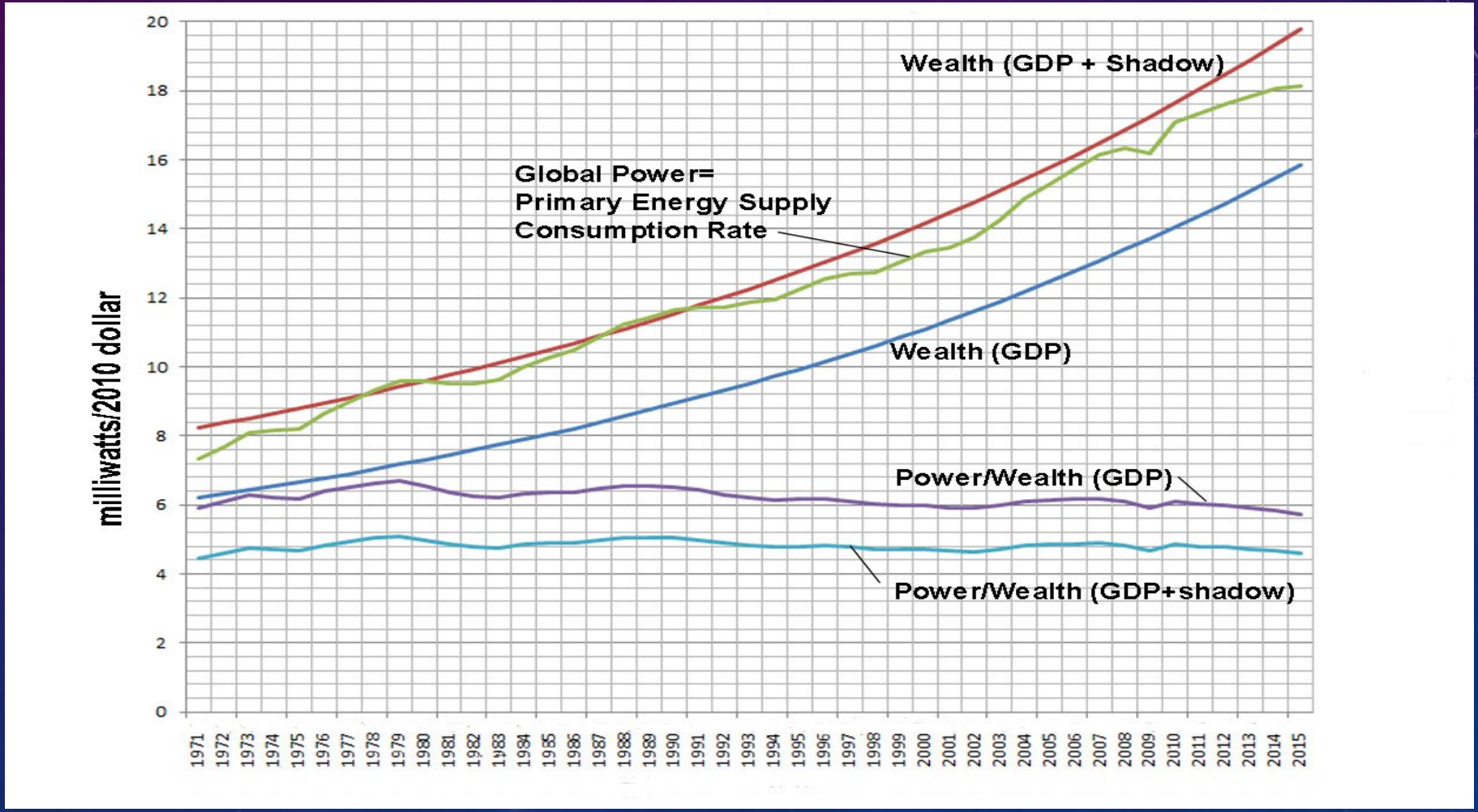


THE GARRETT RELATION

- Cloud physicist Tim Garrett (U. Utah) discovered a fundamental (if it remains true) relationship between Civilization's wealth and its energy consumption rate…

The Global Consumption Rate of Primary Energy is Proportional to the Sum Total of All Past Global GDP, Summed Over All Time.

I'VE EXTENDED THAT WORK BY INCLUDING THE "SHADOW ECONOMY", AND CORRECTED FOR BIASES IN THE OFFICIAL STATED CONSUMER PRICE INDEX AND HENCE THE GDP DEFLATOR WHICH MUST BE USED TO CORRECT FOR INFLATION, AND FIND THE GARRETT RELATION APPEARS CONFIRMED SLIGHTLY BETTER THAN TIM'S ORIGINAL WORK, IN THE HISTORICAL DATA (POWER/WEALTH=CONSTANT. THE BOTTOM BLUE CURVE).



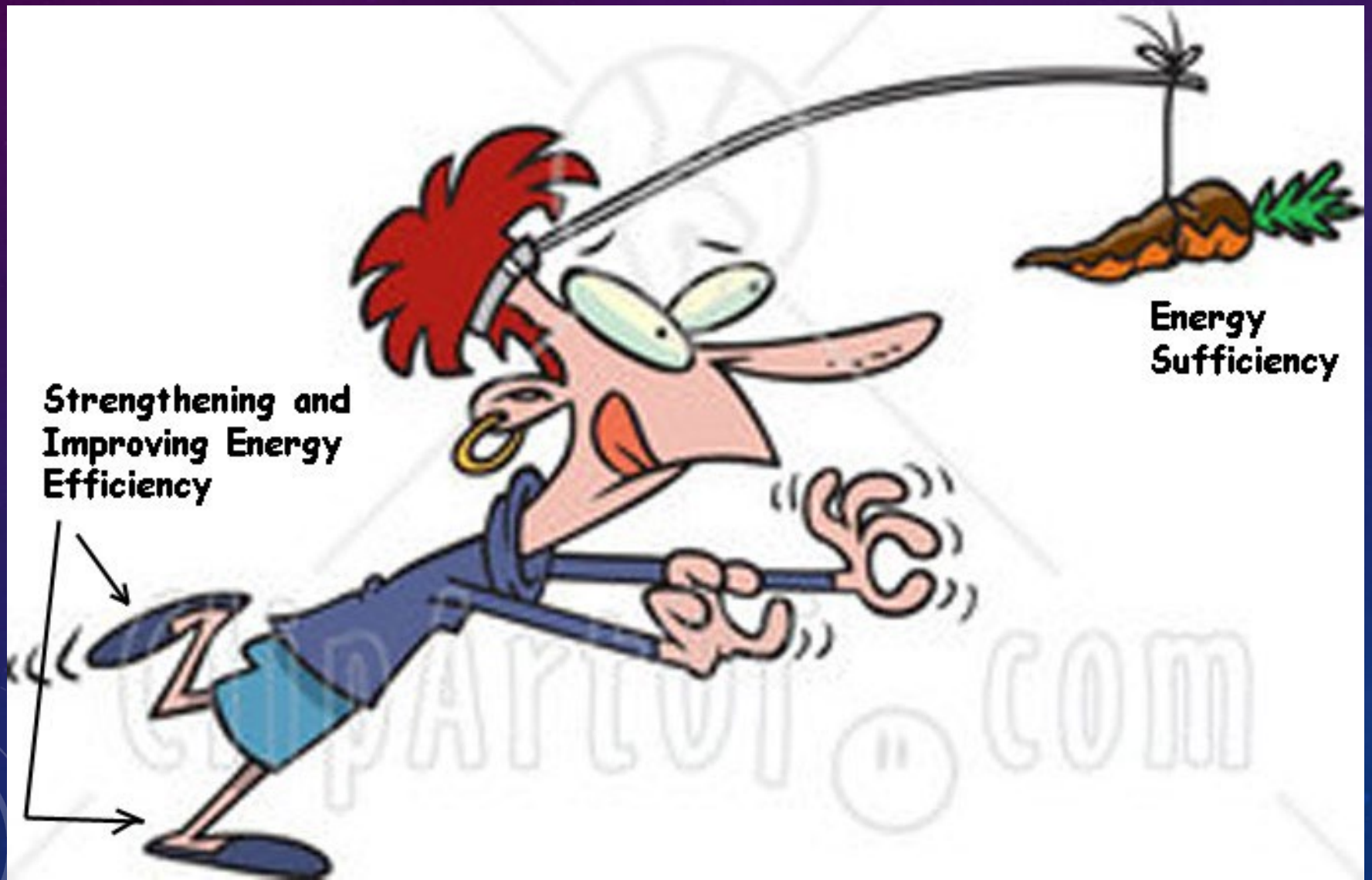
IS THE *GARRETT RELATION* PROVED BY THEORY, AND CAN IT BE RELIED ON TO REMAIN TRUE FOR THE FUTURE? THAT'S TOO STRONG A CONCLUSION FOR NOW; MORE WORK REMAINS. HOWEVER…

- One of Garrett's key insights is that the value of civilization is not in static "things", but instead in the active networks that connect people, and people to their creations. This is supported by West's work cited earlier as well.
- The VALUE is in the networks, the continuous ACTION along those networks.
- Conventional economics ignores this, assigns value to static "things" (capital), and assumes implicitly that energy should be taken for granted. Conventional economics, here, is wrong.

YET ACTIVE NETWORKS INVOLVE FRICTION, AND REQUIRE CONTINUOUS ENERGY CONSUMPTION TO FIGHT THE 2ND LAW OF THERMODYNAMICS (TOTAL ENTROPY ALWAYS INCREASES).

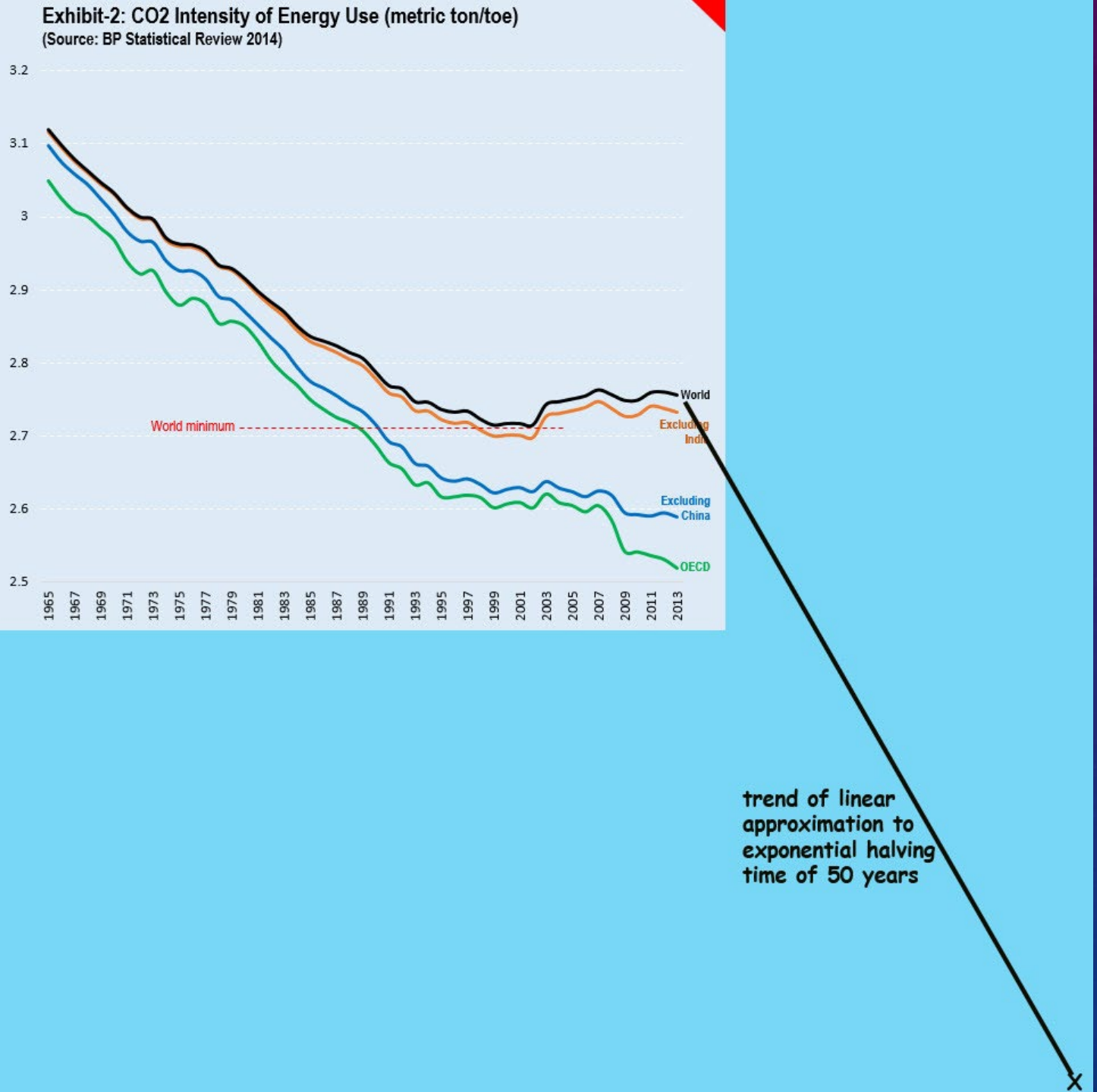
- And, if all energy consumption stops, then all value goes to zero – not just this year's value creation, but all value ever created. That's as close to a "proof" of the relation as we have so far…
- I think the **Garrett Relation's** validity revolves around not just the thermodynamics laws he's identified, but the human nature laws that Nature bred into our motivational drives, and which motivated our success as Earth's dominant species.
- It's an amalgam of 100% certain Laws of Physics, and the more complex laws ruling the rather difficult battle between our forebrains and our hormone-driven desires in the inner battle of the human animal, both individually and collectively.

JEVONS' PARADOX - SIMPLIFIED



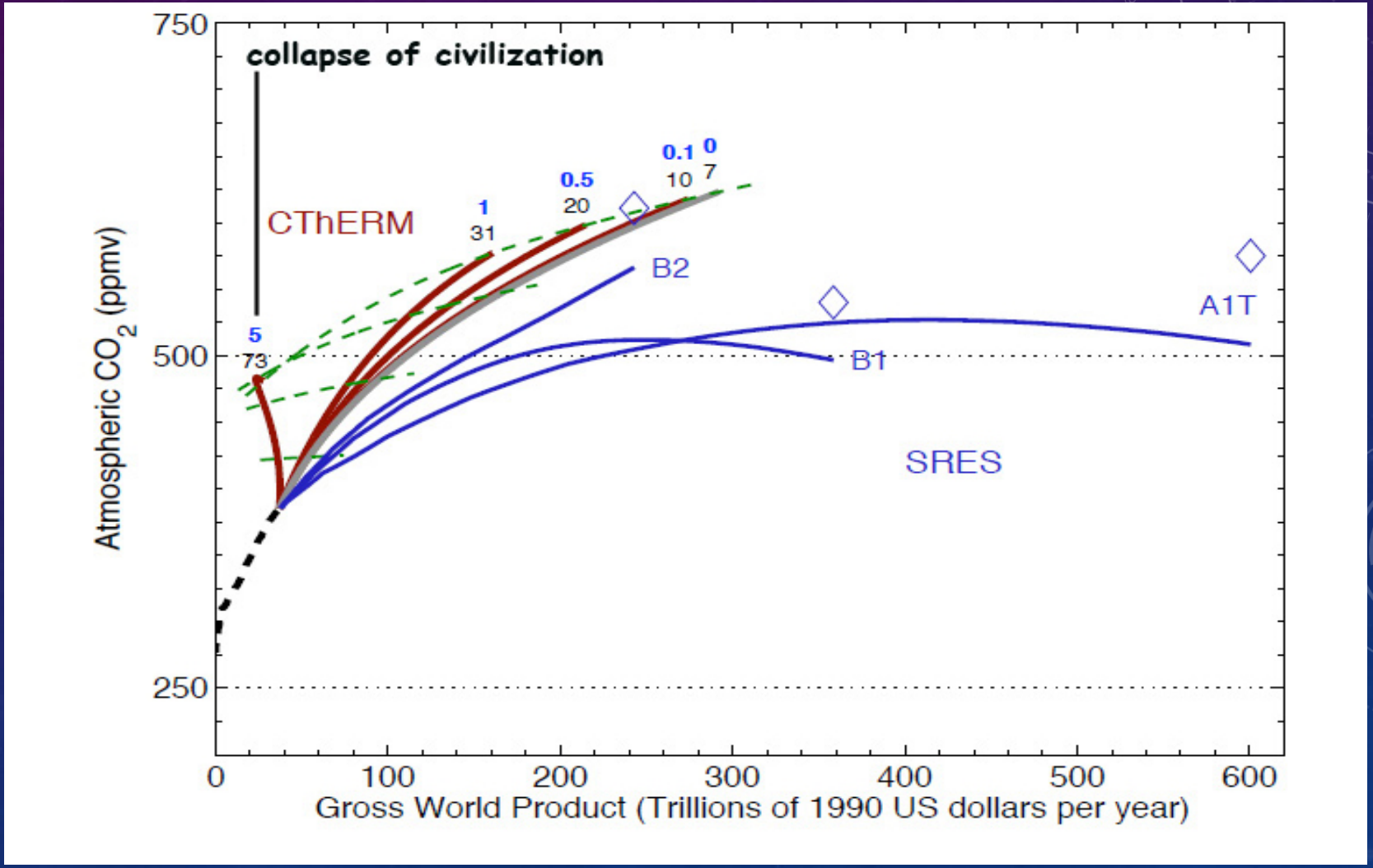
THE TRAGEDY IS NOT WHEN YOU LOSE THE BATTLE FOR SPECIES DOMINANCE… IT'S WHEN YOU **WIN**

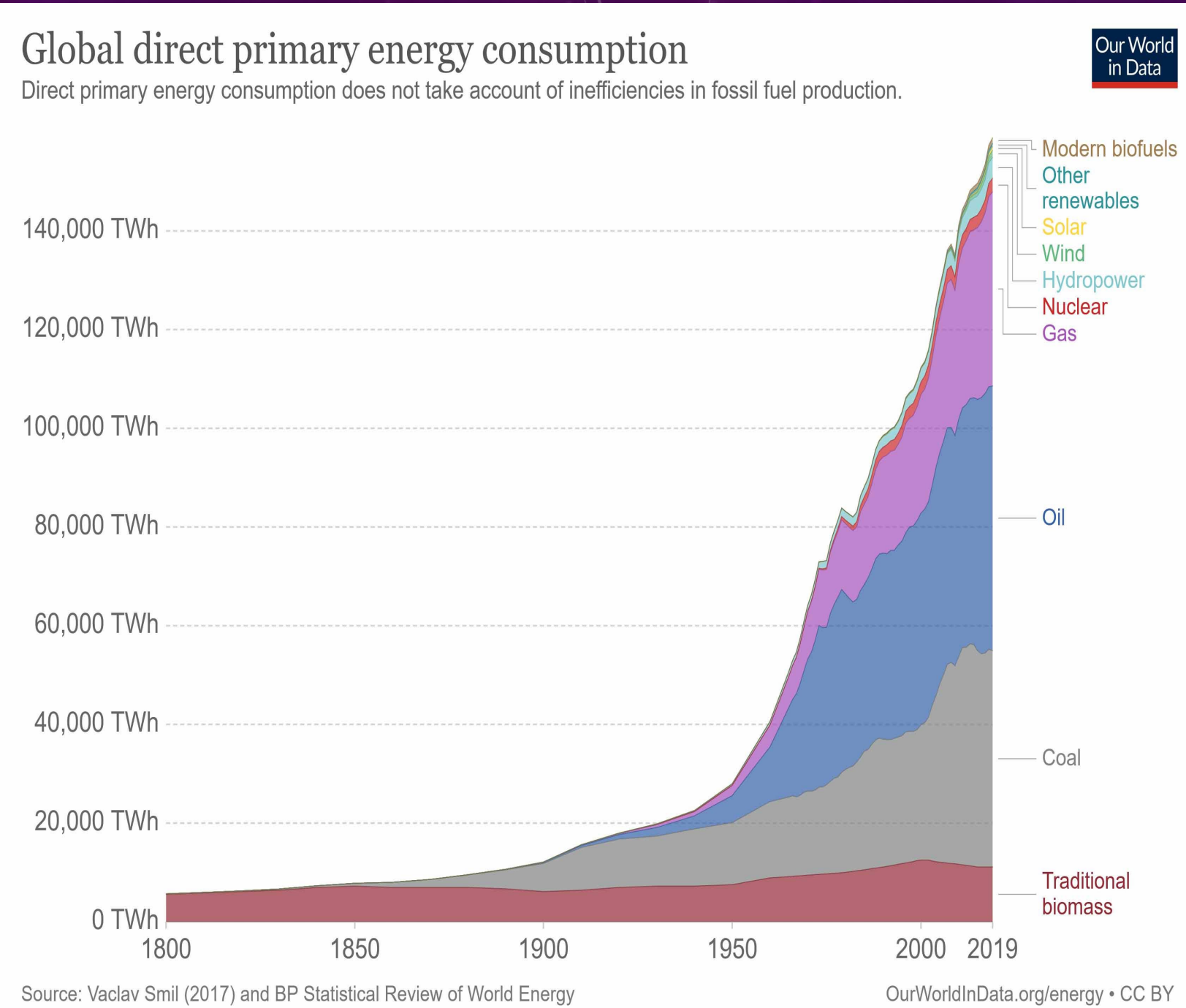
- …when you're a species as powerful and dominant as ***Homo Sapiens.*** When you WIN, then the rest of the planet's life LOSES. And then we lose too. We've arrived at that point. Now. Today.
- The Earth is finite. Desires are infinite, but the Earth and its ability to renew itself are finite and always will be.
- And there are NO OTHER PLANETS that can support more than the tiniest handful of astronaut humans, and at staggering costs.
- Earth is finite. Growth WILL end. Gracefully we'd have hoped, but that looks now to be unlikely.



IMPLICATIONS OF **THE GARRETT RELATION**? FIRST, ASSUME WE STRONGLY DECARBONIZE OUR ENERGY GOING FORWARD; 50% REDUCTION IN CARBON INTENSITY OF ENERGY PER 50 YEARS, GIVEN BY THE LINE SHOWN.

ASSUMING THE GARRETT RELATION, GARRETT'S MODELLING SHOWS ATMOSPHERIC CO2 STILL RISES. HIGHER CO2 CURVES RESULT FROM GREATER RESILIENCY OF CIVILIZATION TO CLIMATE DAMAGE. GARRETT'S INCLUDED ONLY DIRECT ECONOMIC CO2 EMISSIONS; NO NON-CO2 AND NO INDIRECT CO2 EMISSIONS (*E.G.* PERMAFROST, DRYING SOILS, CRIPPLED PHOTOSYNTHESIS…)





THE LUST FOR GROWTH… PRIMARY ENERGY CONSUMPTION CONTINUES TO SKYROCKET, DOMINATED BY GROWTH IN NAT GAS, OIL. COAL IS LEVELING OFF LATELY. RENEWABLES INSIGNIFICANT.

The potential of energy efficiency is largely ignored as the global primary energy system works "a little bit like a bathtub with a leak," Fischedick said.

"We put a lot of energy into the bathtub and at the end there are a lot of losses. We can use one third of the energy but two-thirds is lost," he added.

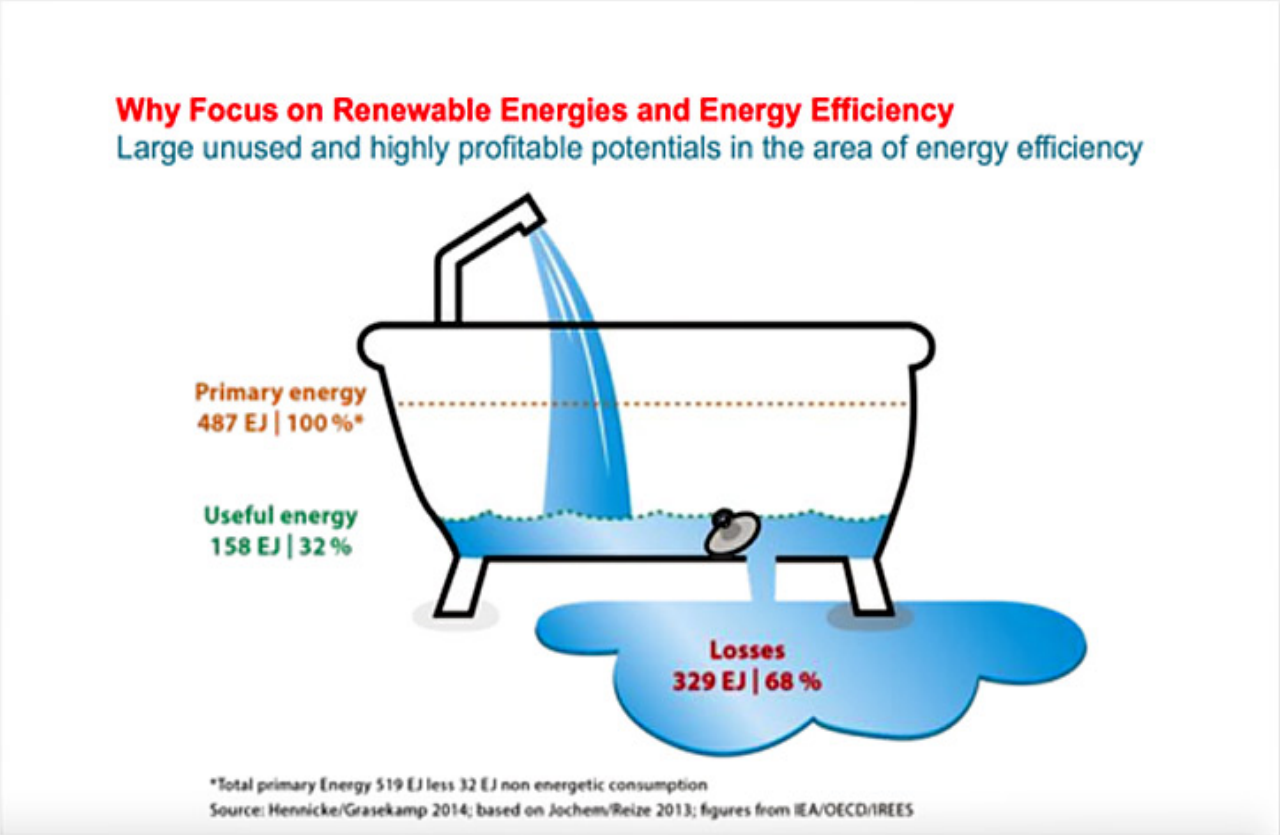


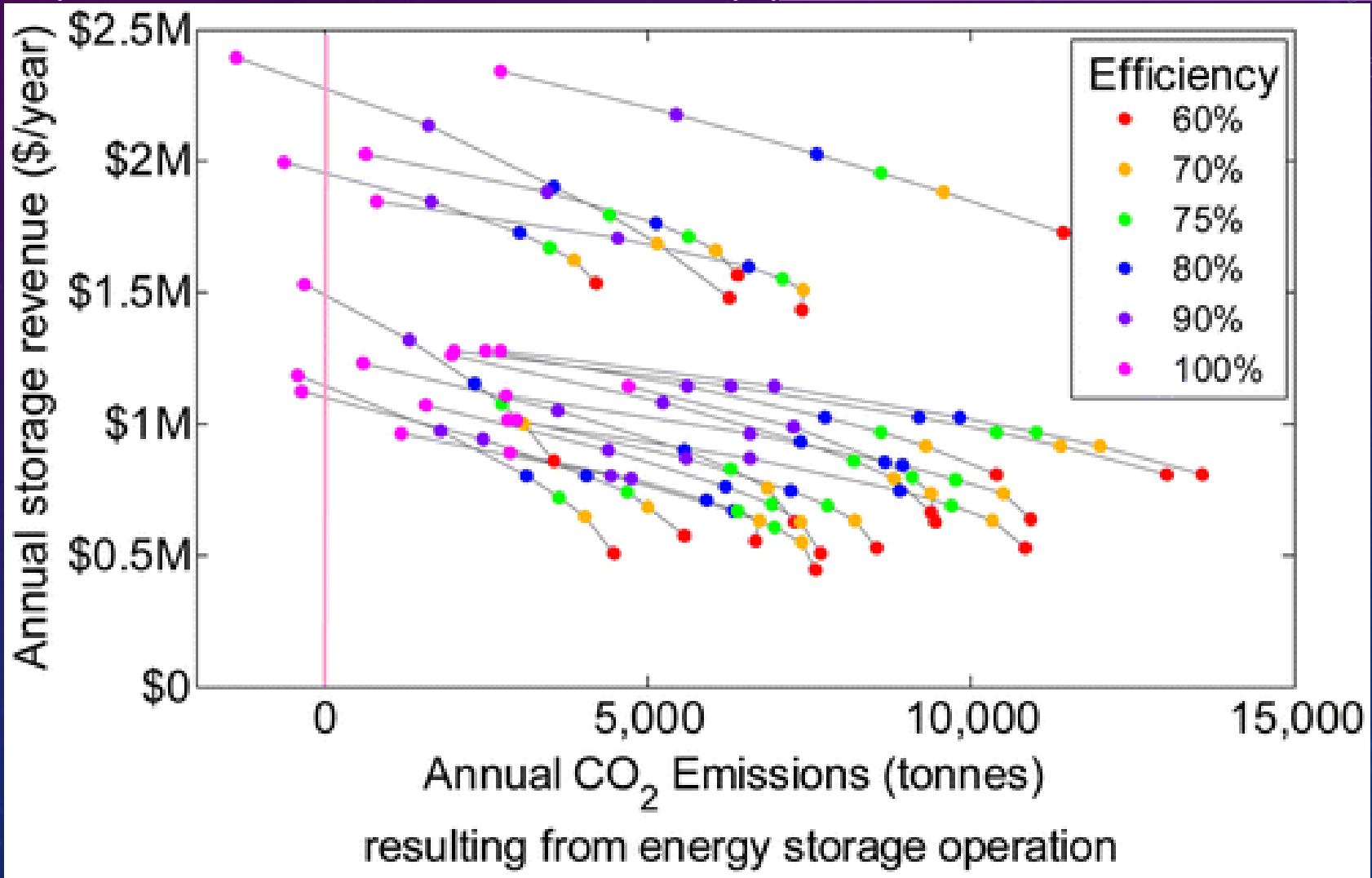
Photo courtesy of Manfred Fischedick

NATURE ONLY GIVES US PRIMARY ENERGY. WE MUST THEN INVEST MONEY, EFFORT **AND ADDITIONAL ENERGY** IN CONVERTING IT TO USEFUL ENERGY. PROMOTIONAL GRAPHS SHOWING IMPROVING ENERGY EFFICIENCY, BUT DON'T CALCULATE USING PRIMARY ENERGY ARE HIDING THE TRUE COSTS.

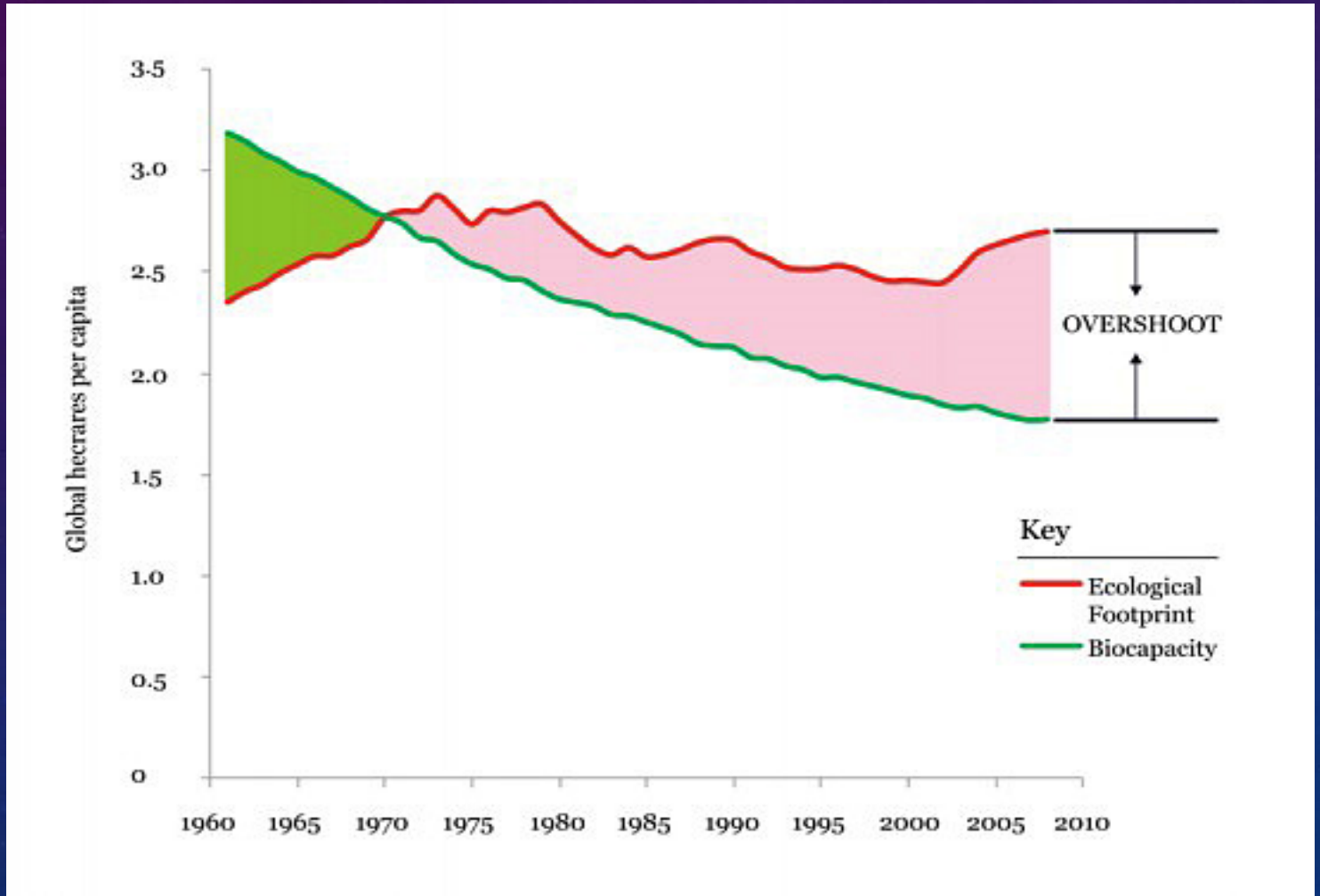
ONLY 1/3 OF PRIMARY ENERGY ENDS UP AS USEFUL ENERGY

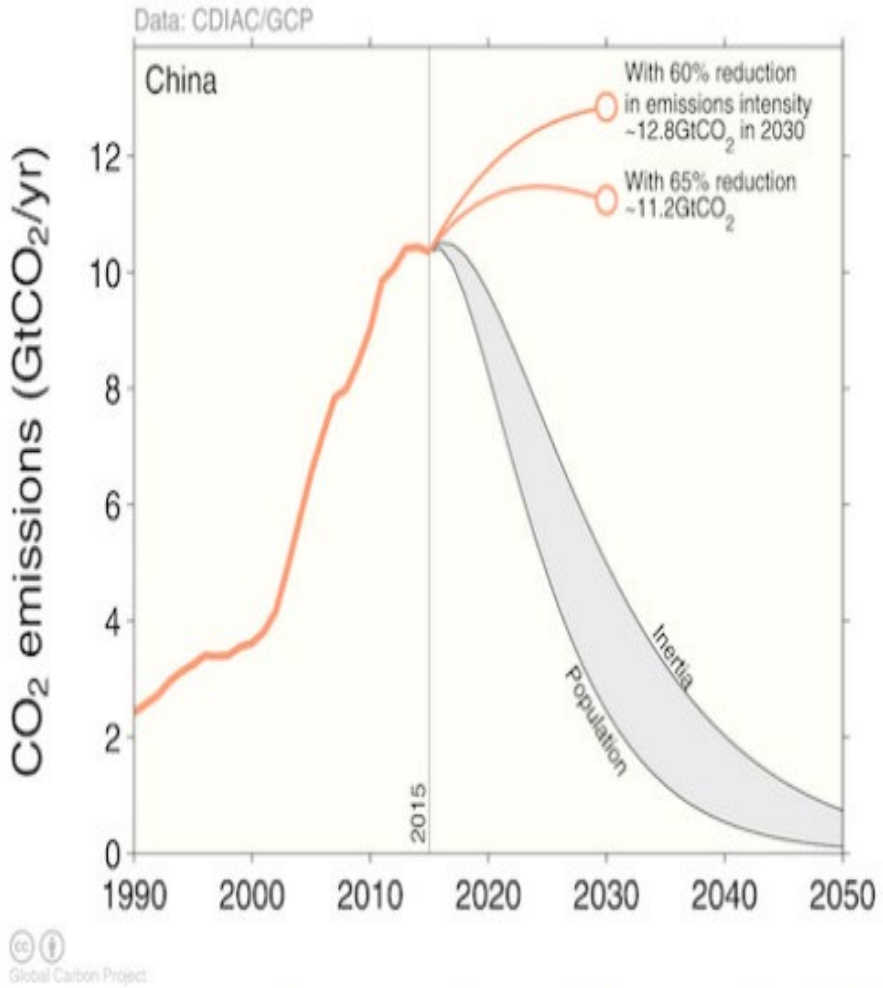
BUT, ENERGY STORAGE WILL SAVE US, RIGHT?

ALAS, ENERGY STORAGE LEADS TO HIGHER CO_2 EMISSIONS IN ALL 20 U.S. GRID REGIONS, EXCEPT ASSUMING PERFECT LOSSLESS (UNOBTAINABLE) STORAGE EFFICIENCY (LEFT-MOST PURPLE POINTS) (HITTINGER & AZEVEDO 2017)



THE RESULTING COSTS TO EARTH ARE HIGH… HUMANS ARE ALREADY USING 1.7 EARTH'S WORTH OF NATURAL RENEWABILITY. THIS WILL END BADLY. WE'RE EATING THROUGH OUR NATURAL RESOURCES "SEED CORN"





The Chinese emission pledge (orange lines after 2015) is inconsistent with the recent slowdown in emissions growth (orange lines before 2015). The grey band shows where Chinese emissions need to go to remain consistent with a 2°C temperature limit. (Source: Cicero)

THOSE MUCH-HYPED PROMISES BY CHINA? READ THE FINE PRINT…

THEY'RE PROMISING TO REDUCE THEIR CARBON INTENSITY ***OF GDP.***

SO, 60% REDUCTION IN EMISSIONS INTENSITY BY 2030 SOUNDS PLANET-SAVINGLY DRAMATIC…

UNTIL YOU CONVOLVE WITH THEIR ECONOMIC GROWTH RATE, AND DISCOVER THEIR TOTAL CO2 EMISSIONS RATES CONTINUE GOING UP AT THE SAME ALARMING RATE AS ALWAYS.

SO WHAT DO WE DO?

- More than stop our growth, we must UNDO the damage we've done.
- It's not enough to just walk away from the planet we've trashed and expect it to heal. We must pull back out the CO2 we added, sequester it permanently, and do it quickly.
- Climate tipping points are being crossed. Now.
- The pubic needs to know the un-sugar-coated truth contained in the science journals. To that end…

ON THE COMING CLIMATE CHANGE…

"…Scientists were not telling the whole truth. Because they were discouraged from telling the whole story, even explicitly told not to do so." (page 4)

- James Hansen, 2019

ACTION #1: IPCC SCIENTISTS SHOULD DIVORCE THEMSELVES FROM THE U.N.

- Continue to issue periodic reports, including the Summary to Policy Makers, but change the rules so…
- --- that only ~90% of scientists need agree on language for it to be approved.
- --- that policy people have NO say in the content of these reports, only the scientists. Exclude policy people from the new organization.
- --- Let policy people deal with the science however they will, but do not force the scientists to put their name on documents redacted, manipulated, and re-worded against their better judgment. Science is not to be “negotiated” for political purposes.

I HAVE RESPECT FOR (MOST OF) THE IPCC SCIENTISTS' WORK IN QUALITY JOURNALS…

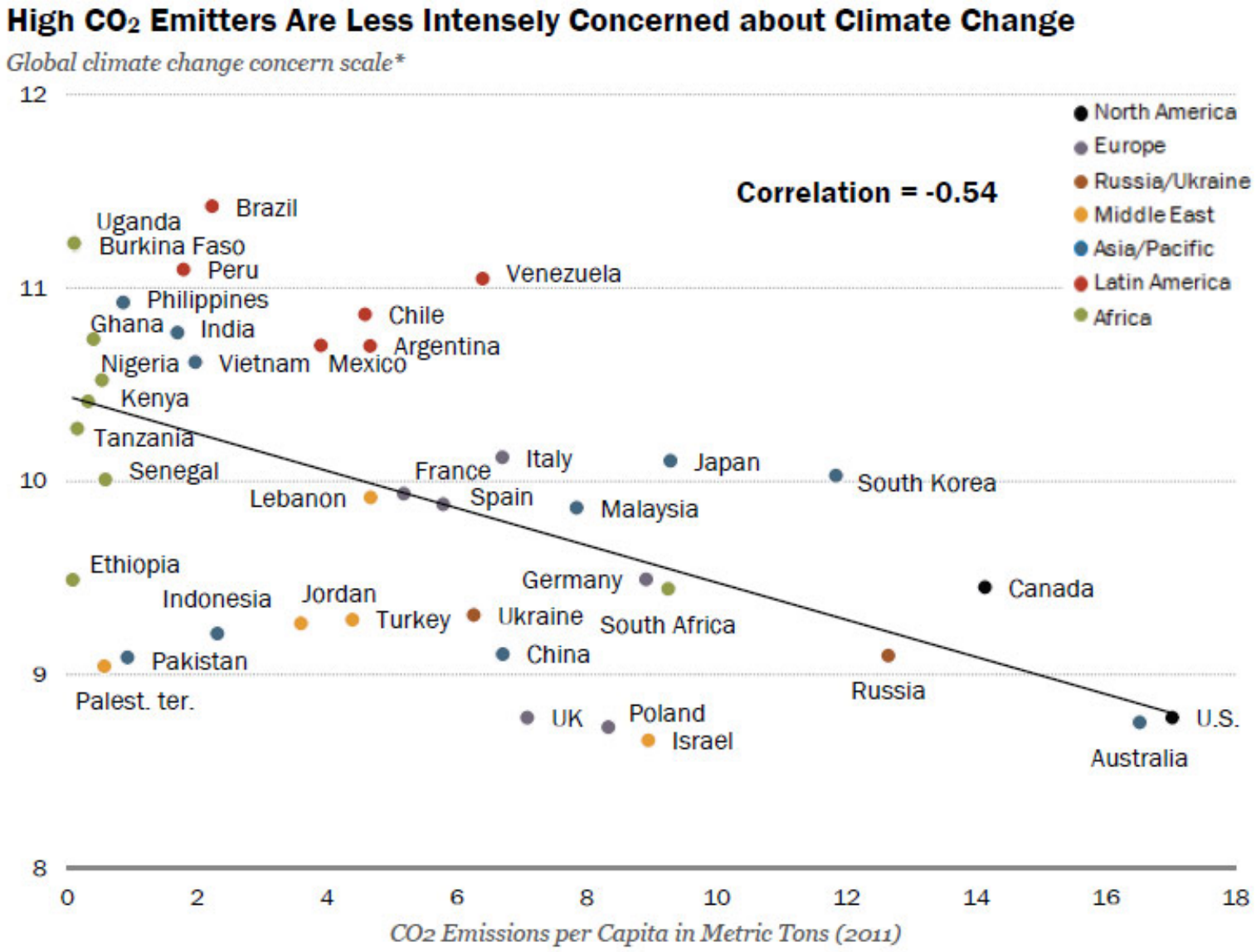
- …but I have little respect for their U.N. overlords who censor the scientists and command what assumptions they must make.
- **The U.N.'s stated goals - choose IPCC members with a *"range of views"* and then insist on 100% agreement from all IPCC policy people, volunteers, and scientists to every word in all publications.**
- They thus insure veto-power for the small minority of industry-sponsored "scientists" together with the larger number of political representatives, whose goals are not scientific openness, but preservation of the economic paradigm that employs them. Yet it was their policies which brought us this tragedy. Thus, we get only the most bland and unthreatening pronouncements from the IPCC.
- And worse – the scientists' name and imprimatur is then on the documents which actually violate the faithful observance of good science. A thousand times worse than if it were just economists and Big Oil's names on the documents.

THE POLITICAL MANIPULATION OF THE IPCC

- More and more scientists are complaining that the latest report, as well as earlier ones, have a “vast blind spot” on the role of the fossil fuel and right-wing sponsored mis-information campaigns.
- *“This is an important barrier to climate action, but it is never addressed,” said Professor Robert Brulle of Drexel University, who* ***has published research on the funding*** ***and influence of climate science denial efforts.***
- *“A large existing literature on this was ignored by the IPCC,” he added.*

THE IPCC: CLIMATE SCIENTISTS WERE LURED INTO THE IPCC; TOLD THE IPCC WAS THEIR OPPORTUNITY TO INFLUENCE PUBLIC POLICY

- But in operation (and intent?), by encapsulating the scientists within the UN mandated rules for "consensus" with policy overlords (the UN is dominated by the most powerful carbon emitters and pro-economic growth countries on Earth – next slide), **the IPCC instead acts as a mechanism to muzzle and neutralize the science**.
- And much worse - it puts the names of the scientists on these documents which are forced to be unthreatening to the economic growth paradigm that rules the politics of U.N. countries.
- This has effectively trumped the message of actual science - Real science; science contained in the peer-reviewed journal papers many of the IPCC scientists authored.



* Concern about global climate change is measured using a three-item index ranging from 3-12, with 12 representing the most concerned about climate change. Respondents were coded as 4 if they believe climate change is a very serious problem; if they think climate change is harming people now; and if they say they are very concerned that climate change will harm them personally at some point in their lifetime. The mean score for each country is used in this analysis. (See Appendix for more details.)

Source: Spring 2015 Global Attitudes survey. Q32, Q41 & Q42. Data for CO_2 emissions per capita from World Bank Data Bank, accessed August 5, 2015.

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THE HIGHEST PER CAPITA CARBON EMITTING COUNTRIES ARE ALSO THE COUNTRIES MOST IN DENIAL, AND MOST MANIPULATING THE IPCC SCIENCE (STOKES *ET AL.* 2015). THE U.S. IS THE WORST OF ALL.

THE MARKET ECONOMIC SYSTEM DEVISED IN THE LATE 1700'S

- Assumes, as explicitly expressed by Milton Friedman (paraphrased here), *Each person pursuing their own perceived selfish interests, best guarantees the well-being of society as a whole*
- No. It guarantees the most ruthless exploitation of the Commons (oceans, air, ice caps, great forests…) by the wealthy, and ultimately impoverishes the Earth that gave us life.
- Why? Because we make our decisions "on the margin", and on the margin, each person's individual choices have NO effect on climate, but have a LARGE positive effect on their personal and family's welfare.
- Hence – the complex system called civilization cascades towards disaster, not because individuals want it, but because it's in very few people's personal economic interest to stop it.

BUT CAPITALISM IS NOT IMMORAL – IT'S AMORAL

- Morality simply doesn't enter the equation, except by a few who believe it's important enough they will sacrifice some competitive advantage to heed it (or, at least enable some "greenwashing" of their ads)
- Brooks *et al* 2016 find that the rate of occurrence of psychopaths among corporate CEO's is fully 21 times higher than among the general population. The same % as found in hardened prisons…. These are the people who nominate and install the politicians whom we get to choose between (look up "Tweed-ism" on that subject)

SO WHAT DO WE DO?

- *We cannot know what to do, until we know what we aspire to”*

– Dr. Nate Hagens. Energy expert and systems thinker on the human dilemma in its widest meaning.

THE MOST SPIRITUALLY, INTELLECTUALLY, AND EMOTIONALLY EVOLVED AMONG US, HAVE SHOWN US…

- That happiness is not to be found by submitting to being a hamster in the consumption cage run by the profit-motivated manipulators of your hormones.
- That the best and most meaningful things in life include:
- -- Appreciating and welcoming the other life on this planet. Not merely as a food "resource", nor as a competitor to be beaten.
- -- Living on a planet of abundance, and in simplicity enough to enjoy your personal growth in knowledge, values, benevolent companionship. That does require a certain level of technological wealth, but not status-driven avarice.
- -- Mastering new knowledge and skills and creating a better world for all future generations.
- This, for me, is what *Homo Sapiens* at their best would be aspiring to.

TO FRAME SOLUTIONS: ALL EFFECTIVE CLIMATE STRATEGIES WILL HAVE ONE OR BOTH OF THE GOALS BELOW:

- #1. Lower the heating of the Earth by the sun ("sunshade" category)
- #2. Raise the ability of Earth to radiate its heat back out to outer space (lower Greenhouse Gas concentrations is the only way to accomplish this)

AND ALL SAFE GEO-ENGINEERING SOLUTIONS SHOULD SATISFY MY TWO CRITERIA BELOW:

- #1: No Hysteresis. Technologies must take the Earth System back from its current dangerous state to its safe climate state along the ~same trajectory as we got here. In other words, with as little hysteresis as possible. You do not go off into profit-hungry schemes that veer the Earth into completely novel directions we only fool ourselves that we understand and could trigger worse effects and even new tipping points.
- #2: Leave the Earth's surface, where ~all life must live, in as pristine a state for all species as possible. No growing a U.S. sized area with weeds to burn and capture their carbon (impoverishing soil). No spreading iron across the open oceans (domoic acid toxic, doesn't sequester carbon), no ideas which change rainfall patterns. No massive use of white paint. No clear-cutting of boreal forests to raise albedo. No trillions of glass beads spread over the ocean. Etc.

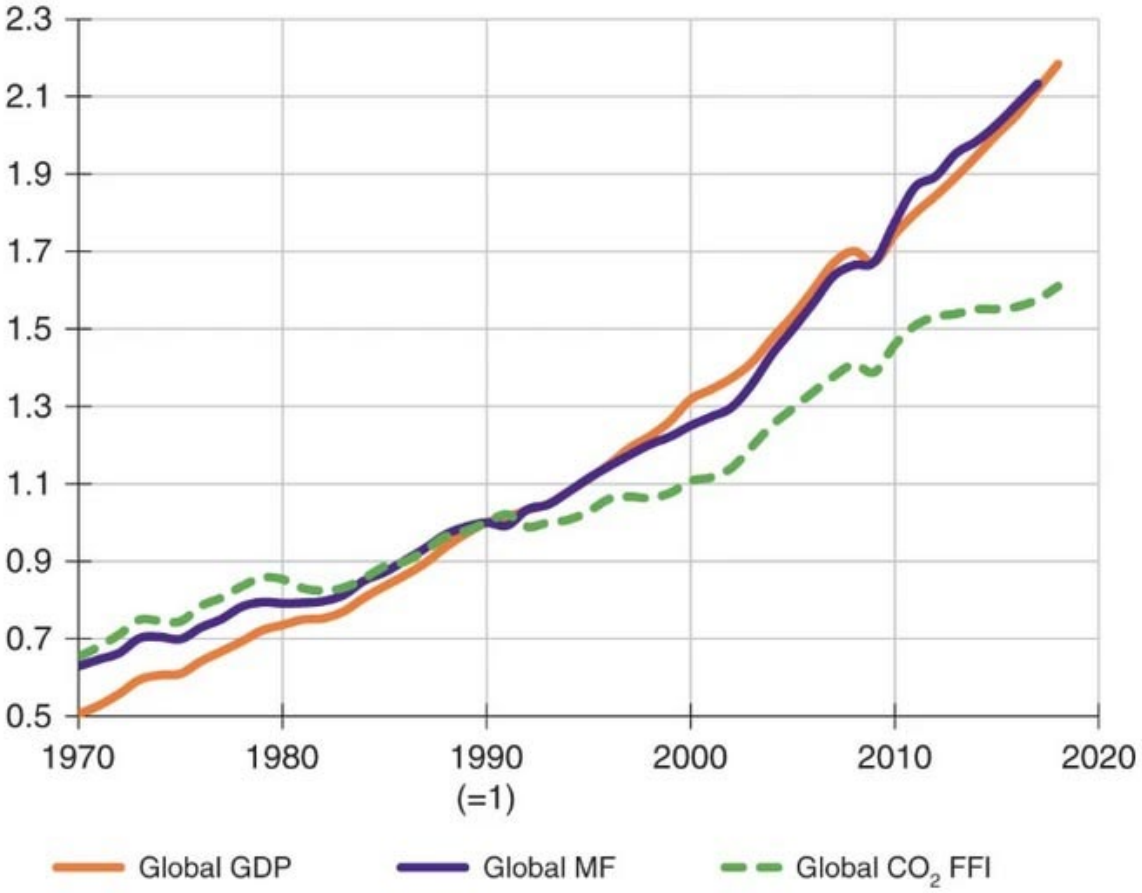
HOW TO GET THERE? FIRST: THE EASY (*I.E.* TECHNO) STUFF (EASY BY COMPARISON ONLY!). WHAT WOULD STABILIZE CLIMATE TO A STATE CLOSE TO WHAT CURRENT SPECIES EVOLVED IN HARMONY WITH?

- Massive capture and underground sequestration of CO2 from existing fossil fuel power plants.
- Massive deployment of DAC (direct air capture) of CO2 (*e.g.* Climeworks) and pumping underground permanently into salt dome and other geologically stable formations, or basalt formations for slow chemical fixing into CaCO3.
- Transform "always-on" energy systems to run mostly on molten salt thorium breeder reactors (MSR, LFTR), which are vastly safer than current nuclear, and have a virtually inexhaustible supply of fuel, and have a tiny footprint on Nature. Solar PV and wind in already-developed areas as "peaker" supplies. Virtually all species need sunlight, but only one can use thorium. Let's use it, and leave sunlight and space to our fellow life travelers. New EIA studies suggest we might also be able to use high grade geothermal power for always-on reliable power with low footprint on Nature. Let's hope so.

CARBON CAPTURE AND TRUE SEQUESTRATION – BEYOND TOUGH… (THERMODYNAMICS CAN BE A HARSH MISTRESS)

- First, I'm highly skeptical of any schemes that merely shuffle the carbon around within the "fast carbon cycle". They take continuous energy to keep going, and when the economics of civilization's decay really take hold, the money will be diverted to survival instead of long term thinking, and all that carbon goes back to the atmosphere.
- So permanent sequestration is required. But at the moment, DAC is strongly counter-productive when powered by our global energy mix (Sekera and Lichtenberger 2020). It will generate roughly 4 tons of CO2 for every 1 ton it sequesters. Powering with solar, wind would take 10x all of the solar and wind energy generated on Earth today (work cited in Levy 2020). Levy also cites that natural CO2 removal schemes are far more available and "cost effective"…. But seems to ignore the indirect CO2 and methane emissions that will make such ideas continue to wither and fail. **Modern nuclear needs to be back on the table.**
- It's very difficult to see any way to succeed which does not include massive reduction in the sheer size of civilization and very rapidly. But that involves Spartan thinking – an impossible political sell.

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



Shown is how the global material footprint (MF, equal to global raw material extraction) and global CO_2 emissions from fossil-fuel combustion and industrial processes (CO_2 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.

RENEWABLES ARE RISING, SLOWLY, BUT THE **GLOBAL MATERIAL CONSUMPTION FOOTPRINT** IS RISING EVEN FASTER THAN **GDP,** AND MUCH FASTER THAN CO2.

MATERIAL MINING FOR DIFFUSE, LOW **EROI** SOLAR PV AND WIND, IS FAR HIGHER THAN FOR MODERN NUCLEAR.

THE ENERGY DENSITY OF THORIUM, IS **1 MILLION TIMES** HIGHER THAN EVEN THAT OF ENERGY DENSE OIL.

GEOENGINEERING: A STOP-GAP TO HALT FURTHER TEMPERATURE RISE WHILE WE PURSUE LONG TERM BETTER SOLUTIONS.

- Re-Ice the Arctic Ocean: Wind-driven pumps operated on the Arctic Ocean to re-ice it in winter, thick enough to prevent melt through during the following summer (Desch 2017). This satisfies both safety criteria. Expensive but affordable and do-able. But better start soon, before winter temperatures are too high and the winter ice is too thin to permit this to work.
- **Sunshade:** Perhaps CaCO3 dust into the stratosphere as a solar reflector? But reflects sunlight only on the $(pi)r^2$ sunny side, while outgoing IR is from the entire $4(pi)r^2$ surface. Rainfall, wind and weather patterns will change – winner and loser countries. Not so safe.

Solar geoengineering may not prevent strong warming from direct effects of CO_2 on stratocumulus cloud cover

Tapio Schneider, Colleen M. Kaul, and Kyle G. Pressel

PNAS December 1, 2020 117 (48) 30179-30185; first published November 16, 2020; https://doi.org/10.1073/pnas.2003730117

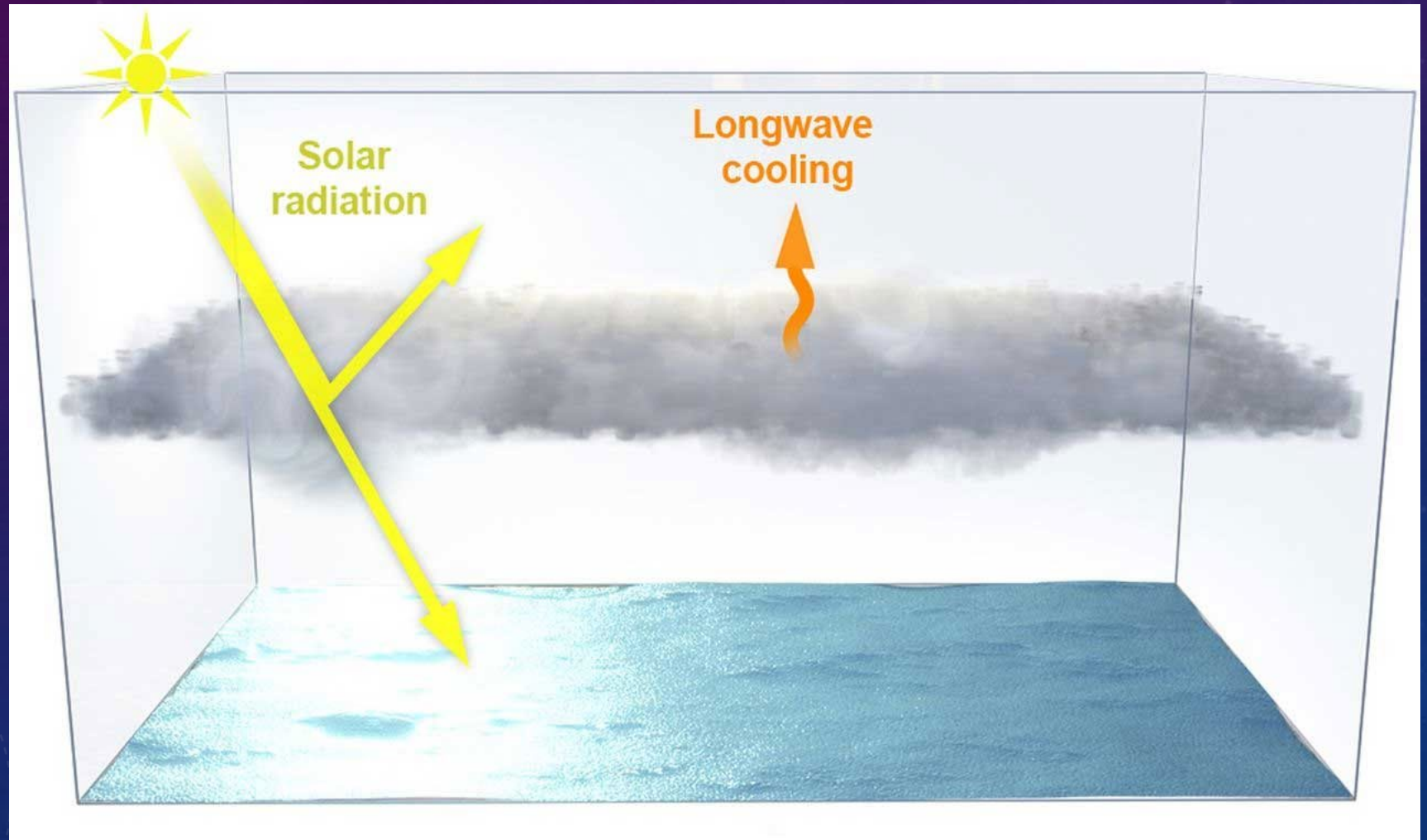
Edited by Kerry A. Emanuel, Massachusetts Institute of Technology, Cambridge, MA, and approved October 7, 2020 (received for review February 27, 2020)

Significance

Solar geoengineering that manipulates the amount of sunlight Earth absorbs is increasingly discussed as an option to counter global warming. However, we demonstrate that solar geoengineering is not a fail-safe option to prevent global warming because it does not mitigate risks to the climate system that arise from direct effects of greenhouse gases on cloud cover. High-resolution simulations of stratocumulus clouds show that clouds thin as greenhouse gases build up, even when warming is modest. In a scenario of solar geoengineering that is sustained for more than a century, this can eventually lead to breakup of the clouds, triggering strong (5°C), and possibly difficult to reverse, global warming, despite the solar geoengineering.

AND WORSE… “SUNSHADE” (SOLAR GEOENGINEERING) IN ANY FORM, YET WHILE LEAVING CO2 IN THE ATMOSPHERE – WILL FAIL

CONVECTION DRIVEN BY RADIATIVE COOLING FROM THE WARM CLOUD TOPS OUT INTO SPACE, IS WHAT SUSTAINS “FOG” (STRATO-CUMULOUS). RISING GHG’S IMPEDE THIS OUTGOING LONG-WAVE IR RADIATION, AND THUS REDUCES STRATO-CUMULOUS CLOUDS.



WHAT ABOUT PLANTING TREES AND COUNTING ON PHOTOSYNTHESIS? NEW SCIENCE SHOWS THAT PROMOTERS' PROJECTIONS ARE FAR TOO ROSY.

- Tropical forests no longer function as carbon sinks, they are now net emitting CO2 at a rate almost equal to the entire U.S. Transportation Sector (Baccini *et al.* 2017) and discussed here.
- We're crippling forests faster than they can sequester carbon.

WORSE: GLOBALLY THE CARBON FERTILIZATION EFFECT (RISING CO2 FEEDING PLANTS BETTER) IS INSTEAD DROPPING DRAMATICALLY

- Wang *et al.* 2020, published just a month ago as I write this – find that global carbon fertilization per unit CO2 in the atmosphere, has dropped a dramatic 43% from 1982 to 2015.
- Nutrient loss, soil moisture loss happen in parallel and may be at least part of the cause, they infer.

SHARE

RESEARCH ARTICLE

Recent global decline of CO_2 fertilization effects on vegetation photosynthesis

Songhan Wang[1,2], Yongguang Zhang[1,2,3,*], Weimin Ju[1,2], Jing M. Chen[1,4], Philippe Ciais[5], Alessandro Ces...
+ See all authors and affiliations

Science 11 Dec 2020:
Vol. 370, Issue 6522, pp. 1295-1300
DOI: 10.1126/science.abb7772

A decline in the carbon fertilization effect

One source of uncertainty in climate science is how the carbon fertilization effect (CFE) will contribute to mitigation of anthropogenic climate change. Wang *et al.* explored the temporal dynamics of CFE on vegetation photosynthesis at the global scale. There has been a decline over recent decades in the contribution of CFE to vegetation photosynthesis, perhaps owing to the limiting effects of plant nutrients such as nitrogen and phosphorus. This declining trend has not been adequately accounted for in carbon cycle models. CFE thus has limitations for long-term mitigation of climate change, and future warming might currently be underestimated.

Science, this issue p. **1295**

Abstract

The enhanced vegetation productivity driven by increased concentrations of carbon dioxide (CO_2) [i.e., the CO_2 fertilization effect (CFE)] sustains an important negative feedback on climate warming, but the temporal dynamics of CFE remain unclear. Using multiple long-term satellite- and ground-based datasets, we showed that global CFE has declined across most terrestrial regions of the globe from 1982 to 2015, correlating well with changing nutrient concentrations and availability of soil water. Current carbon cycle models also demonstrate a declining CFE trend, albeit one substantially weaker than that from the global observations. This declining trend in the forcing of terrestrial carbon sinks by increasing amounts of atmospheric CO_2 implies a weakening negative feedback on the climatic system and increased societal dependence on future strategies to mitigate climate warming.

NOTE THE IMPORTANT CONCLUSION – THAT THE CURRENT CARBON CYCLE MODELS SIGNIFICANTLY UNDER-ESTIMATE THE MAGNITUDE OF THIS OBSERVED GLOBAL CRIPPLING OF THE CARBON FERTILIZATION EFFECT.

SO HOW CAN WE DEPEND ON PLANTS TO SAVE US FROM OUR OWN CO2 WHEN THEY'RE UNDER THIS KIND OF STRESS?

- Maybe GMO new "SuperPlants" with bigger roots? That's the hope of the Salk Institute.
- But I can only wonder – super plants are going to need additional nutrients. Where are the additional soil nutrients going to come from to support these SuperPlants, if we're doing BECCS, or even just watching the global erosion of 1% of our topsoil per year, as now?

SAFE!: THE FIRST COMMERCIAL AIR CAPTURE CO2 INSTALLATION IN 2017

By Climeworks, Inc. in Switzerland. Very small scale, and CO2 is sold for fertilizer, not sequestered. In the next 10 years, their very ambitious goal is build 250,000 of these air capture plants by the mid 2020's. If they succeed, that would capture 1% of our current emissions. Estimate $400/ton CO2 to capture and $20 to sequester, except feasibility of climate-scale sequestration is highly speculative at present.

How expensive is $420/ton? To remove enough CO2 to bring global concentration down to 350 ppm, would cost $26,000 for every man, woman, and child on the planet.

THAT'S THE EASY PART - NOW THE HARD PART: *HOMO SAPIENS.* THE GENETIC DRIVES THAT MADE US A SUCCESS ARE NOW KILLING THE PLANET. AND US.

- The deeper I delve into climate change science, the more clear to me it is merely a symptom of a deeper problem that may be unsolvable, and that mere techno stuff won't overcome.
- Natural Selection breeds species to grow, dominate the competing species for resources, and leave more offspring. This is mediated through hormones and brain chemistry; the brain's reward and desire systems.
- But Nature never bred us for a time when we had over-filled the planet. Our same growth compulsions are now killing us.

CCL MEMBERS TAKE NOTE… THE CLAIM (REMI) THAT YOU CAN GROW THE ECONOMY BY TAXING CARBON IS NOT SUPPORTED

- As energy economics expert Dr. Nate Hagens **points out**, the "revenue neutral" claim makes the mistake of assuming a **$1 tax** on carbon, is the same **$1 value given (dividend) and spent** by someone else. It's not.
- The **price** charged for fossil fuel carbon is less than its **energy value**. "$1 of carbon does ~$100 worth of labor work by the energy content of that carbon." Why so cheap? Competition drives the price of oil down to just above what it costs to mine it, which is far below it's actual value.
- This means that taxing ("fee'ing") $1 worth of carbon from the economy subtracts $100 worth of economic production, while transferring only $1 of spending to whoever gets that tax as a dividend.
- However, Hagens' argument is only valid if you insert the carbon-free energy value, not the brute human labor value, so that would be some mix of solar, wind, and nuclear with correction for the carbon implicit in the construction of those power plants. I don't have that number, it's no doubt somewhere between $1 and $100, and closer to the competitive oil price ($1). Still, 'revenue neutral' strictly speaking, is indeed incorrect.

SO IT'S A HIT ON THE ECONOMY, IN THE END. BUT I'LL ADD….. IS THAT A BAD THING?

- Strong DE-GROWTH of civilization is what is needed to save the future.
- Of course, being honest about this is what is politically un-sell'able and so you don't hear this… even from the supposed good guys in this fight.
- As always, it's the manipulation, the PR, the sales pitch, that drives the promoters. I find it very discouraging, and frankly disgusting, to work in fields so dominated by this sort of thing. I feel inner self crying to run back to pure astronomy.

TECHNOLOGICAL SOLUTIONS? NOT EASY…

- As just one example…
- Natural gas has been touted as a “bridge fuel” to replace coal.
- But the first effect of replacing all coal with natural gas power plants will be a sharp INCREASE in global temperatures, after which temperatures will still climb.
- **Why? Because the aerosols from burning coal COOL the ground beneath them… they both reflect incoming sunlight and also help seed low clouds which also cool climate.**
- That doesn’t mean we should keep coal fired power plants, it’s illustrating how we’ve dug a very deep hole and we will have to dig it even deeper just to try to climb out.

AS ANOTHER EXAMPLE: THE ENVIRONMENTAL COST OF SOLAR PV

- Merely to keep our global annual CO2 emission rate constant, at about 39 billion tons per year, and still keep global growth at its historical 2% per year, will require the equivalent of **11 square miles of solar panels (which is about 20 square miles of solar farm area) be constructed EVERY DAY.**
- That is taking away the habitat and the sunlight needed by all the other life we share this planet with.
- I'd instead advocate **against** utility-scale solar and argue **for** modern molten salt thorium breeder reactors, which have vastly less nuclear waste, and which only needs storage for a few centuries instead of 100,000 years like uranium reactors, and which takes up only 1% of the landscape that solar PV does.
- No other species can use thorium. Let other life have the sunlight and the natural ecosystems' land.

WE HAVE ARRIVED AT A TIPPING POINT IN HUMAN EVOLUTION. **NOW. TODAY.**

- Nature's gift to us – our overpowering mind's ability to out-compete all species for resources, worked well for 6,000 generations.
- But it never bred us for the moment, now, to push back from the dwindling feast on the table. Yet that is what we must do, or face the destruction of perhaps the only intelligently inhabited planet in the Galaxy. Instead, our urges compel us to compete that much more desperately against our fellow humans, and other species.

A 2019 POLL SHOWED THAT 70% OF AMERICANS BELIEVE IN THE REALITY OF CLIMATE CHANGE AND FIND IT "PERSONALLY CONCERNING". **56% BELIEVE CLIMATE CHANGE WILL HARM THEIR FAMILY.** THAT'S A RISING NUMBER. GOOD! BUT HERE'S WHAT'S APPALLING:

YET 70% OF AMERICANS ALSO SAY THEY'RE UNWILLING TO PAY EVEN $10/MONTH TO DO SOMETHING ABOUT IT. 40% WOULDN'T PAY EVEN $1/MONTH.

WILL WE SOMEHOW OVERCOME OUR VERY NATURE, AND CHANGE?

- I’m skeptical. Most people do not change. They cling to their dogmatic attachments. Only when they “hit bottom” and can no longer exert the mental energy drain required by maintaining denial of their dysfunctions, do they find the courage to change, or else end their life.
- So I agree with James Hansen – if it’s to happen, it will have to be by the youth of today. My generation got us INTO this mess and still refuses to do anything meaningful about it.

SO WHAT DO WE DO?

- It may yet be possible to turn things around, even with only a minority of dedicated activists.
- Some studies indicate that as little as 3.5% of a population needs to get fully on board and insistent on change (if that change is genuinely good), for a “tipping point” in cultural change to begin.
- I have thought about this issue for 10 years. My best idea remains the same…

OCCUPY D.C. FOR CLIMATE

- If climate activists, rather than celebrating inconsequential meetings with their congressman, instead got educated using climate science resources such as I and others have assembled, and then internet-canvassed the country to get at least 100,000 people who would commit to going to Washington D.C. for a different kind of demonstration…

- **With images stirring public conscience, the power of media attention can be instantaneous. Witness the Standing Rock Nation standing up to Big Oil**
- **We either deal with climate change, or little else really matters**

OCCUPY DC'S GOAL WOULD BE…

- To nonviolently, peacefully, but with determination, prevent "business as usual" from continuing… by occupying the public grounds outside the Capitol and White House.
- Retain the moral high ground. Stay within your 1st Amendment rights, and if arrested, let it happen w/o resistance. But that's why 100,000+. That's too many to jail.
- It would not be just a weekend feel-good march.
- **It would be to OCCUPY the City, slowing its political "business as usual" to a halt, until congressional leadership publicly spoke to the assembled press and the People with a commitment to pass the legislative requirement outlined in my "K44 Strategies: Policy".**

THE MOST IMPORTANT LEGISLATIVE DEMAND

- A 28th Amendment to the Constitution: *"Congress shall pass no law which violates the life, liberty, and pursuit of humane happiness by future generations, when such violation involves the destruction of the Planetary Commons given by Nature to all: Healthy oceans, climate, the great forests, ice caps, and the atmosphere. These commons shall be left in a stable state suitable for the great ecosystems of the planet which evolved within it, and future generations."*
- (this is my wording. Open, of course, to fine-tune.)

ANOTHER LEGISLATIVE DEMAND: TAX CARBON AT THE SOURCE

- A James Hansen-style tax on well-head carbon. Not an emissions tax, but a source tax on any carbon pulled from the ground or imported across our national boundary. The goal is to de-motivate the MINING of carbon. Because once out of the ground, the reality it that it'll end up mostly in the atmosphere sooner rather than later.
- Only this, has hope of forcing us off Fossil Fuels. Emission taxes are what the fossil fuel industry favors, because they understand how vital and price-inelastic energy is. It has historically only motivated more profits and more domination by the major oil companies, while being "sold" as a "solution". It is NOT (Donnelly 2018). And it makes the poorest suffer the worst costs.
- To "sell" this politically has usually included that the tax be given to all citizens to spend as they please. Alas, this sacrifices some of the pro-climate, pro-environment effect…

CCL'S "DIVIDEND": DR. NATE HAGENS POINTS OUT THE STRONG CLIMATE BACKFIRE

- *"To distribute carbon fees as dividends to the poor as a combinatory climate mitigation and wealth inequality tool, risks a large (carbon) backfire.*
- *The lowest 2 quintiles of our society spend 100% of their income. The top 5% spend only 7% of their income* (RN: the rest going into inflating asset prices, or what is usually called "investments". All spending encumbers new energy consumption to power it – the Garrett Relation).
- *In a world with depleting oil fields (not 1 year view but 10 year view), a carbon fee with the money going to the poor quickly rebounds as a large 'call' on more oil/gas consumption as we are taking abstract wealth (digits in bank) and having them become an immediate call on natural resources"*

There are additional actions described here.

It appears, shows history, not in our nature to make such personal sacrifices for the sake of global society's distant future.

For our individual families? … maybe.

For the world? Only a tiny few are on board for that. But climate is global and climate requires we all make major sacrifices.

INSTEAD, CIVILIZATION HAS A LONG HISTORY OF EMPOWERING, OR TOLERATING THE EMPOWERMENT OF, THE MOST AMORAL AND RUTHLESS OF PSYCHO-PATHOLOGICAL PEOPLE

- …into government, and the high places in Industry (Brooks *et al.* 2016). We let them make the laws we all must live by, and thus the fate of the planet. And this trend has been worsening, in parallel with climate.
- **Are you not amazed at the nearly unbroken record of nations to install the worst among us as our rulers?**
- What does this say about human nature and who we really are?
- I'm afraid my honest judgment remains pessimistic about gracefully solving climate change. High profile scientists like Kevin Anderson, Tim Garrett, and others agree. (But PLEASE: ***prove me wrong!)***

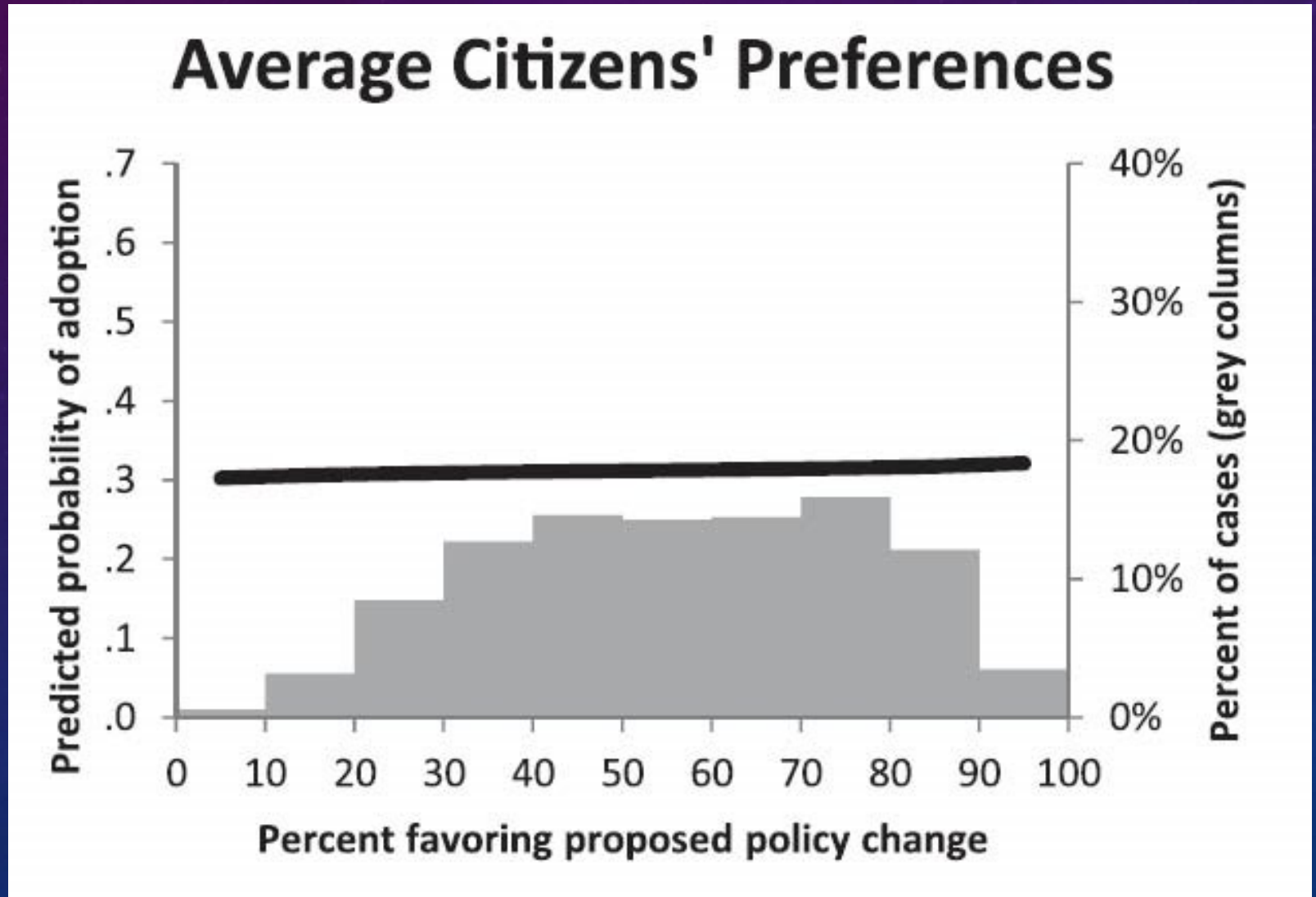
STILL, CAN WE DO IT?
THE EASY PART… VOTE!

- It takes very little time, and compared to everything else, it's extremely easy.
- You might be tempted to think, after what I'll show you, that voting is pointless.
- But refusing to vote, out of pure disgust, is a key reason we had the most disastrous election imaginable in 2016.
- No matter how bad things are getting, we may find, in the words of Han Solo - "It's Worse!" if you let the worst candidates win through your negligence. I vote. You should too.

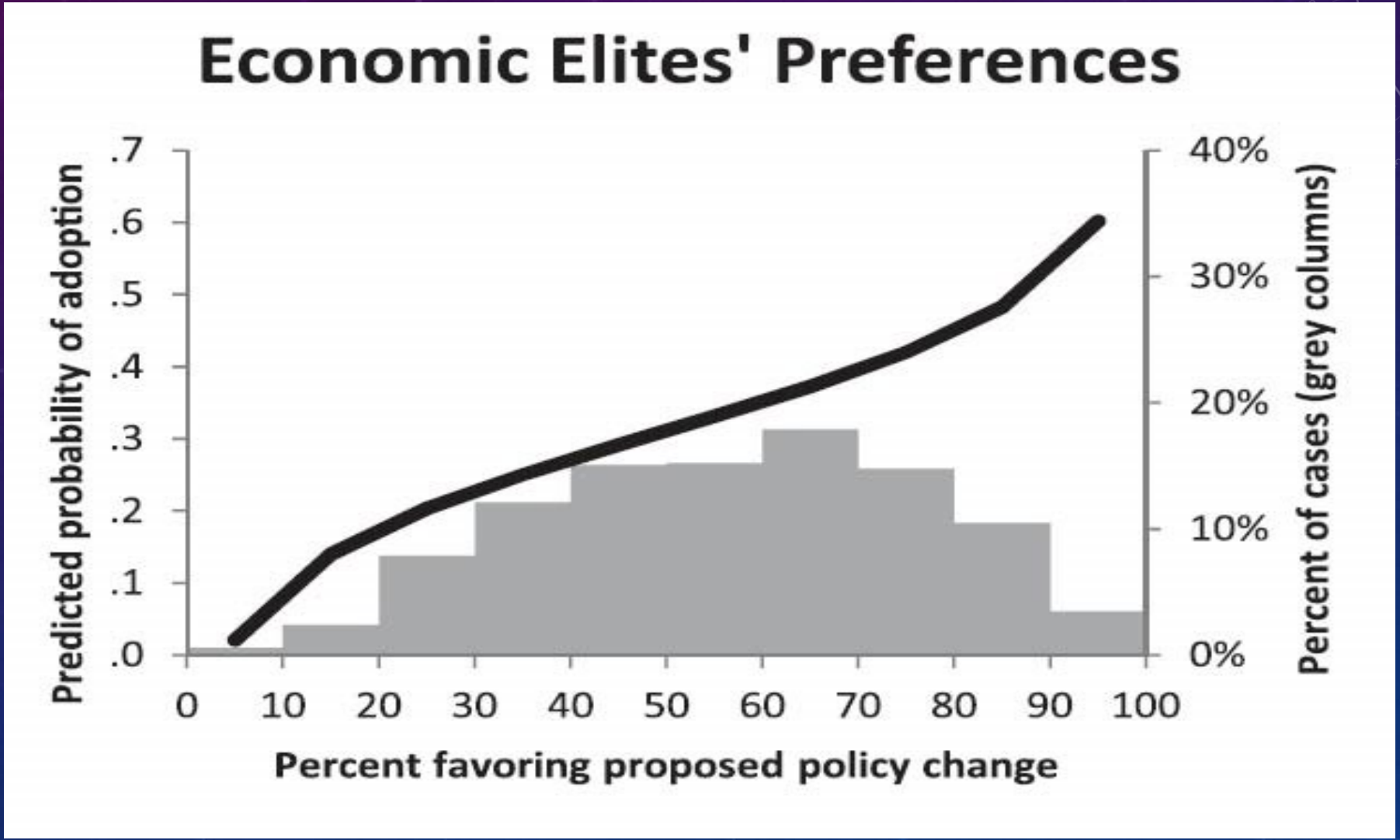
BEYOND VOTING: HOW TO BRING ABOUT THESE POLICIES?

- **The hard evidence proves it is certainly not by politely asking "please", hat-in-hand, of our law-makers once they're in office…**
- Princeton and Northwestern University researchers (**Gilens and Page 2014**) studied the key variables of the 1,779 policy issues contained in all congressional legislation bills with the needed data for their study; all such bills between 1981 and 2002 (most of these years the Democrats held a majority in Congress, where bills originate), and found that **the desires of the average citizen had a "miniscule, statistically insignificant" (i.e. *zero*) correlation with what legislation was actually enacted.**
- **ZERO CORRELATION.**

REGARDLESS OF WHETHER AVERAGE CITIZENS HATED OR LOVED A POLICY PROPOSAL, THEIR INFLUENCE HAD ZERO CORRELATION (FLAT LINE) WITH WHETHER THE POLICY WAS ENACTED (GILENS AND PAGE 2014). THIS IS ARGUABLY THE MOST IMPORTANT GRAPH IN THE FIELD OF POLITICAL SCIENCE. SO WHY VOTE? BECAUSE OTHERWISE "IT'S WORSE!". THE CORRELATION COULD WELL END UP A *NEGATIVE* CORRELATION INSTEAD OF MERELY ZERO.



BUT THE INFLUENCE OF ECONOMIC ELITES CORRELATED ALMOST PERFECTLY (CORRELATION COEFF =0.78) WITH WHAT LAWS WERE ENACTED. (PERFECT=1.00). AND IF THEY HATE A PROPOSED LAW, IT HAS 0% CHANCE OF PASSING (LOWER LEFT)



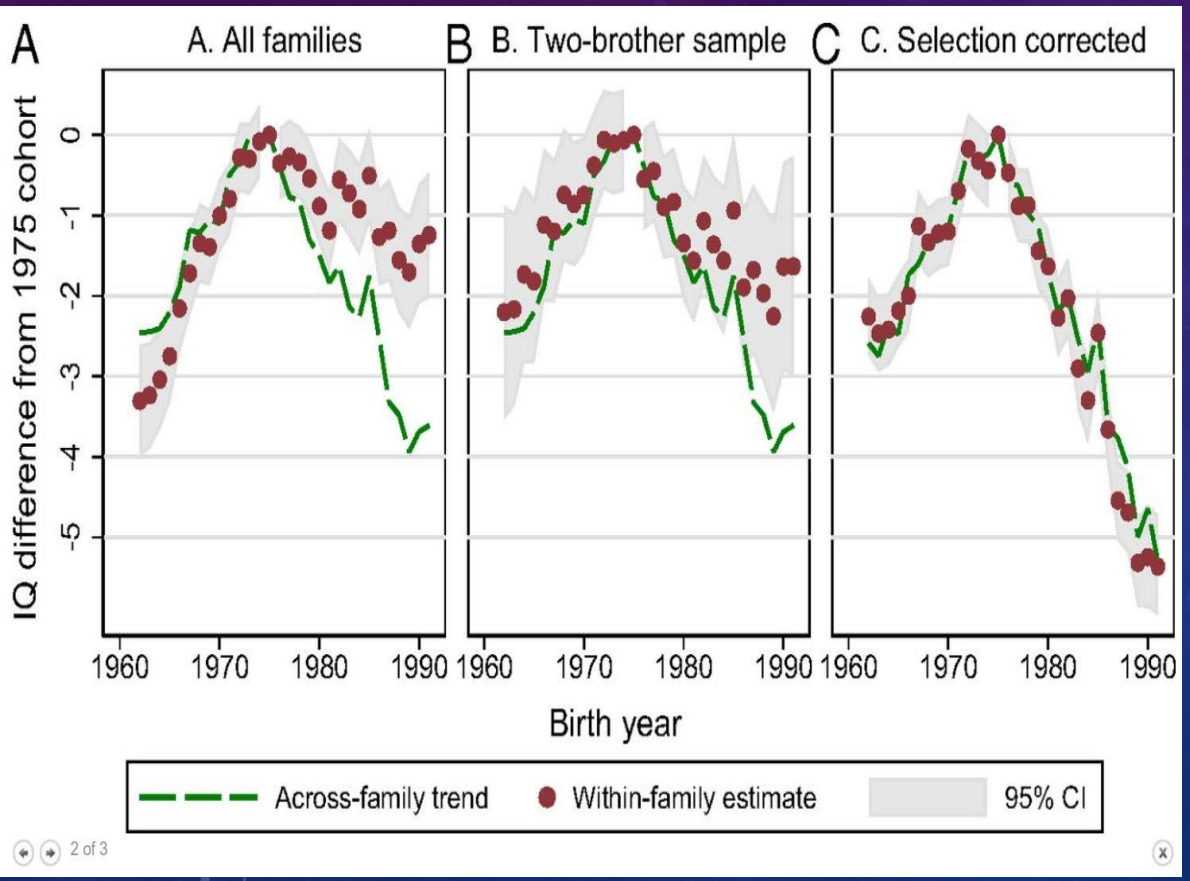
WE MAY REQUIRE OUR GENTLE, AND NOW GROWN UP, 1970’S “FLOWER CHILDREN” PROGRESSIVES TO GET A BIT MORE INSISTENT. GRETA THUNBERG’S GENERATION IS PRETTY JUSTIFIABLY ANGRY THAT IT INDEED SEEMS THEY’LL HAVE TO DO IT ALL THEMSELVES.

“ *'YOU HAVE STOLEN MY DREAMS AND MY CHILDHOOD WITH YOUR EMPTY WORDS,'* CLIMATE ACTIVIST GRETA THUNBERG HAS TOLD WORLD LEADERS AT THE 2019 UN CLIMATE ACTION SUMMIT”

A NEW "OCCUPY DC FOR CLIMATE"… WHY THIS JUST MIGHT WORK…

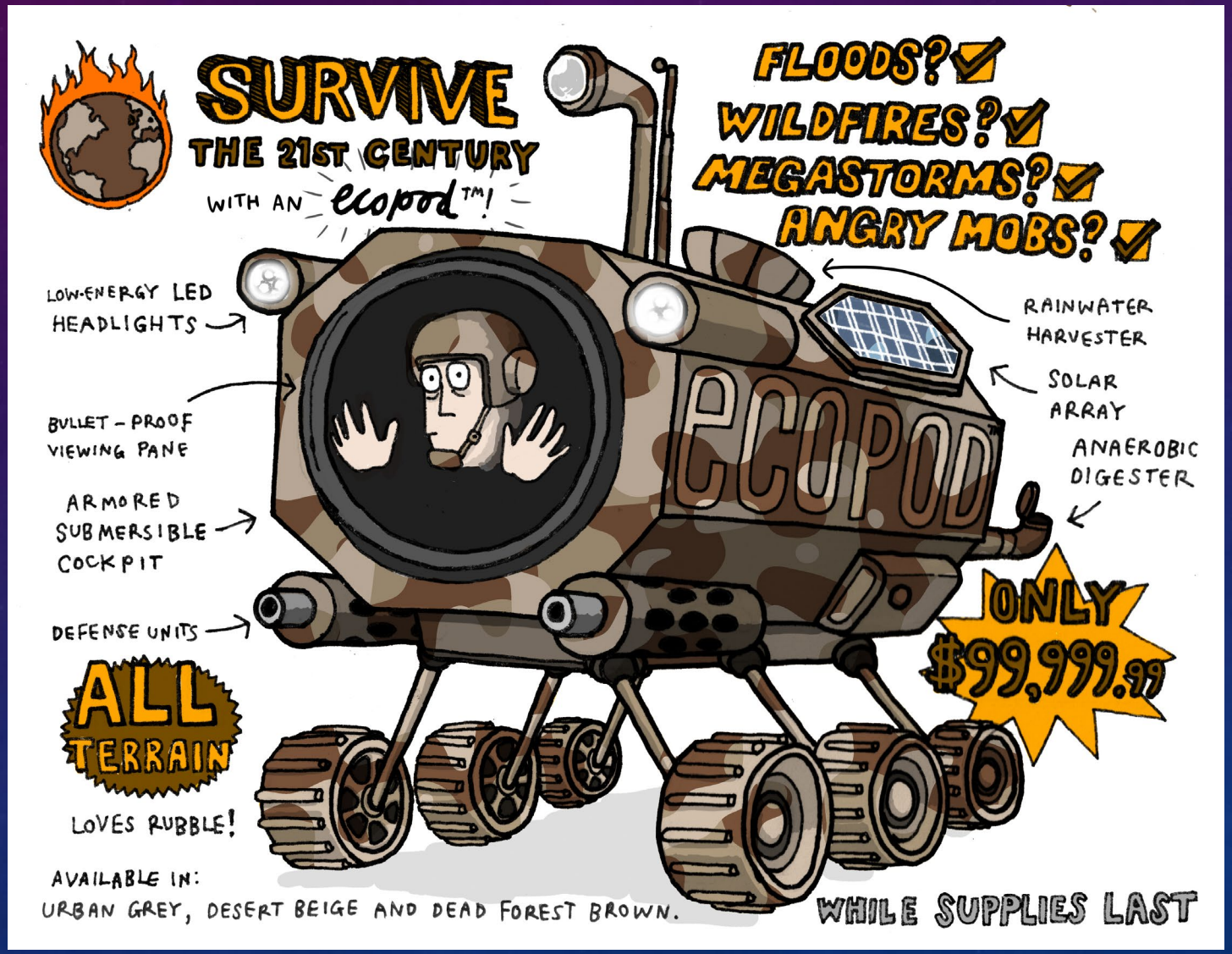
- History shows that nearly all politicians will do what is in their own selfish re-election (and financial) interests.
- So individually they will very rarely stand up against their own Party and its fund-raising machinery. Things have to go off-scale lunatic before they'll even consider this.
- This is one reason why individual meetings with individual congress people have gotten us just talk and no action.
- But when **100,000 to a million** determined citizens are outside their doors are demanding that ALL of Congress enact the future-saving legislation required – **together** they just might decide it actually IS in their best interest to listen and obey the average citizens this time.
- They also just might have somewhere still buried inside, a soul that is longing to do the right thing, but has been too scared. Let's give that soul an easier opportunity to take charge, together with their other Congress people. That requires they ALL be pressured TOGETHER!

THE YOUNG: CAN THEY DO IT? I PRAY THEY CAN



- I'm encouraged by Hansen's "Our Children's Trust" effort, and Greta Thunberg.
- But intelligence scores for younger and younger people (born after 1975) are steeply declining (panel C from Bratsberg *et al*. 2018). Cause: "Environmental effects", not genetics. That leaves a wide range of hypotheses open, from declining education to greater exposure to toxins in early years, to distractability through rampant capitalist diversions, etc.

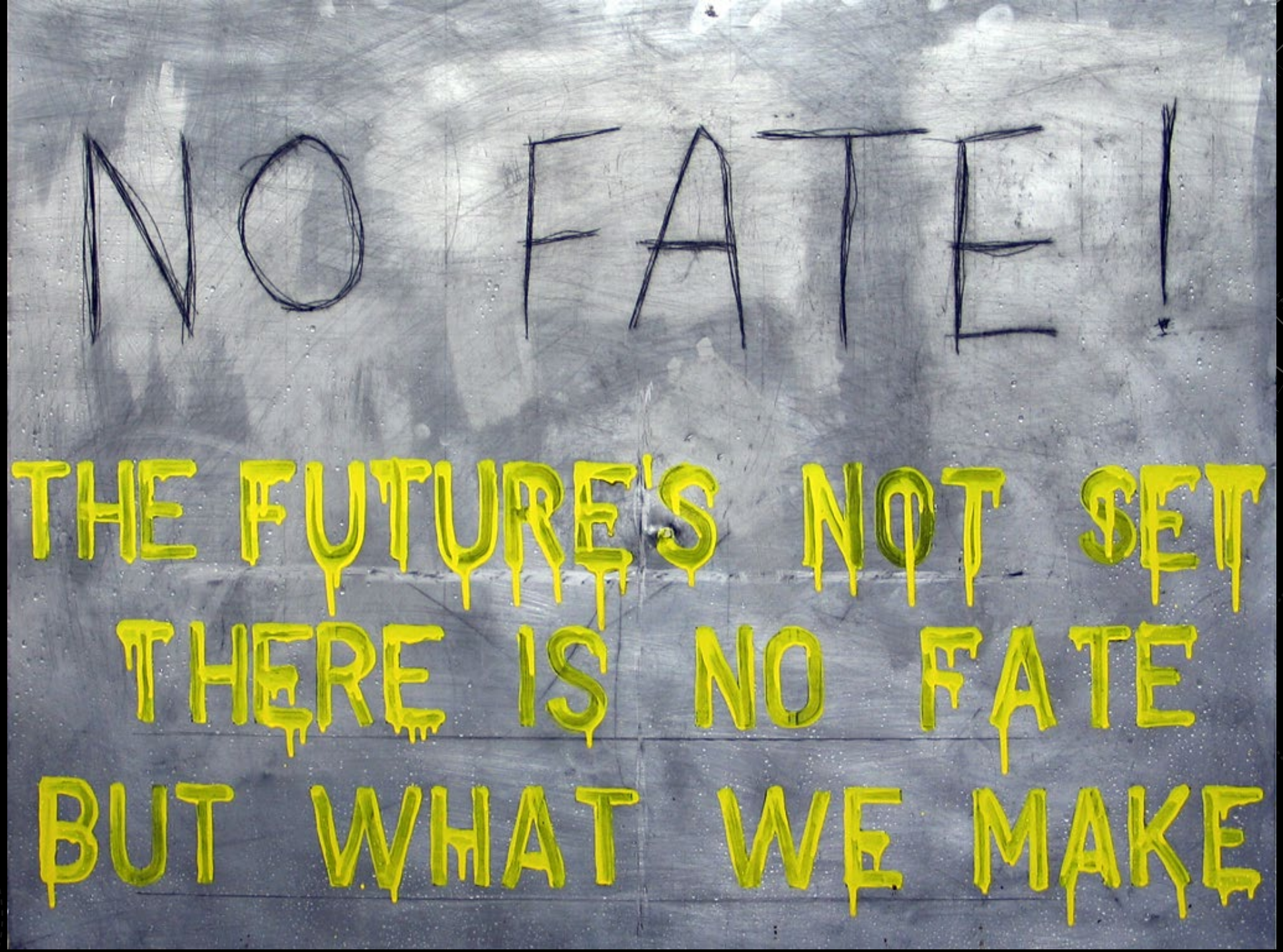
TECHNOLOGICAL SOLUTIONS: I HOPE IT DOESN'T COME TO THIS. (SEE MY K45: STRATEGIES – TECHNOLOGY FOR BETTER)

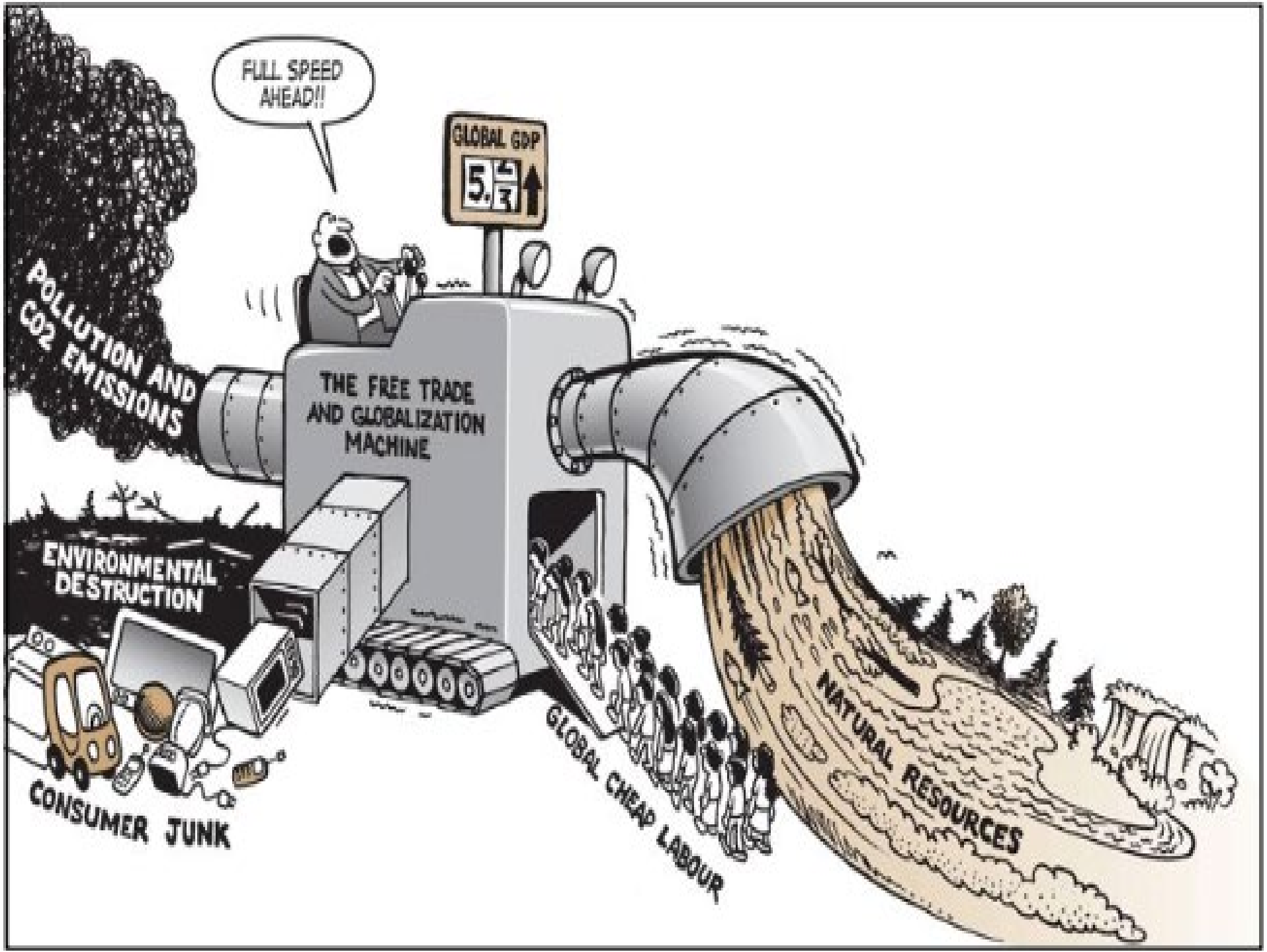


"Yes, the planet got destroyed. But for a beautiful moment in time we created a lot of value for shareholders."

"YES, THE PLANET GOT DESTROYED. BUT FOR A BEAUTIFUL MOMENT IN TIME WE CREATED A LOT OF VALUE FOR SHAREHOLDERS"

NO FATE? MAYBE... BUT:


NO FATE!
THE FUTURE'S NOT SET
THERE IS NO FATE
BUT WHAT WE MAKE



FULL SPEED AHEAD? OR SHOULD WE RE-CONSIDER?