Responding to the Climate Emergency: Technology or Ecosystem based Approach?

William Moomaw

CIERP

January 29, 2020


TICK
TOCK
TICK
TOCK
DON'T CALL IT
CHANGE,
CALL IT CLIMATE
EMERGENCY
#TIMEFORACTION
TIME FOR ACTION
COP25
CHILE
MADRID 2019
UN CLIMATE CHANGE CONFERENCE
acciona

11,000 scientists declare a climate emergency

BioScience

World Scientists' Warning of a Climate Emergency

FREE

William J Ripple ✉, Christopher Wolf ✉, Thomas M Newsome, Phoebe Barnard, William R Moomaw Author Notes

BioScience, Volume 70, Issue 1, January 2020, Pages 8–12, https://doi.org/10.1093/biosci/biz088
Published: 05 November 2019

A correction has been published:
BioScience, Volume 70, Issue 1, January 2020, Page 100, https://doi.org/10.1093/biosci/biz152

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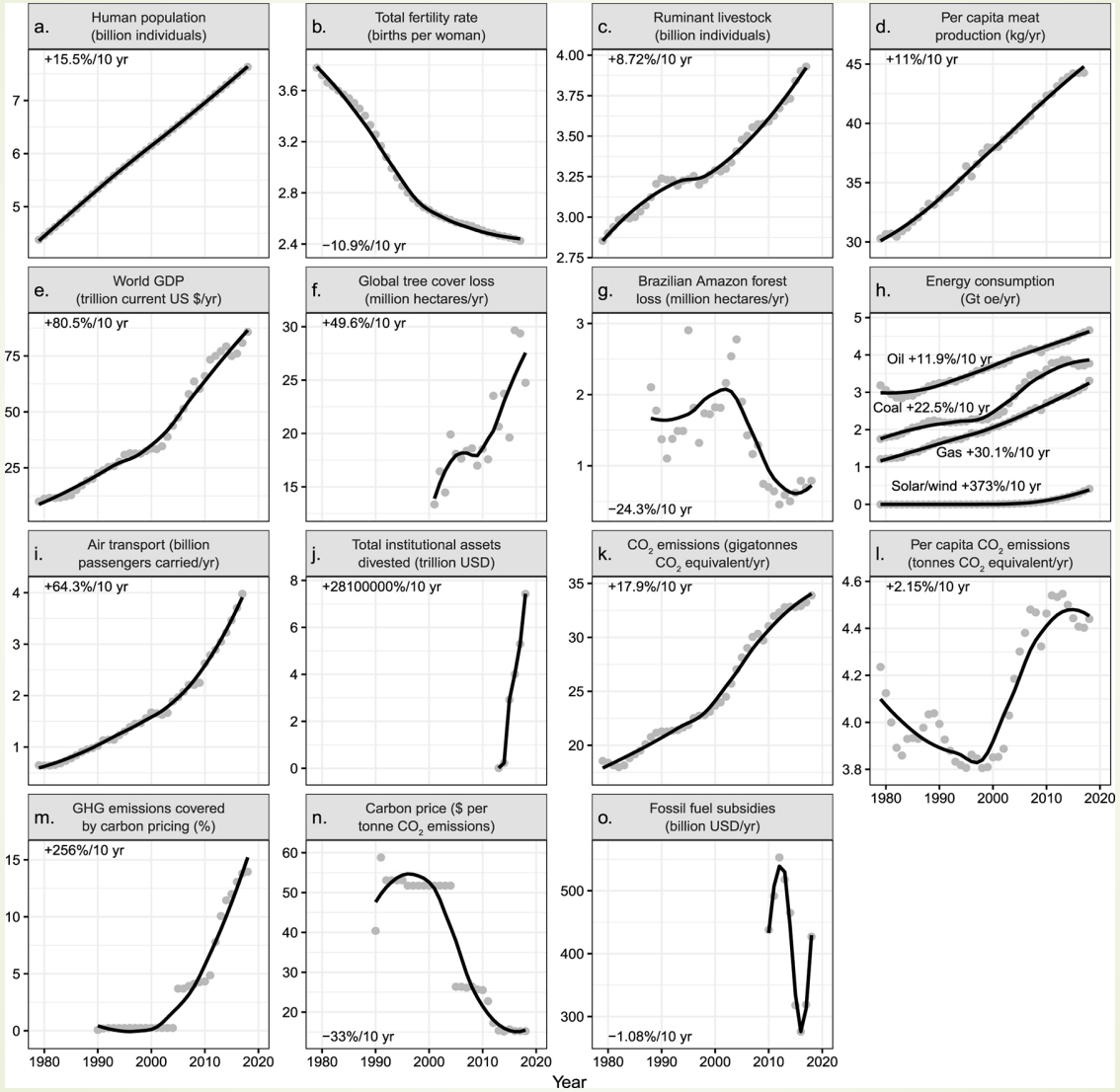
Issue Section: Viewpoint

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation and the graphical indicators presented below, we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

Why did 11,000 scientists declare a climate emergency?

- ”Emergency” implies high risk of dangerous change that requires a rapid response

Figure 1. Change in global human activities from 1979 to the present.



BioScience, biz088, https://doi.org/10.1093/biosci/biz088

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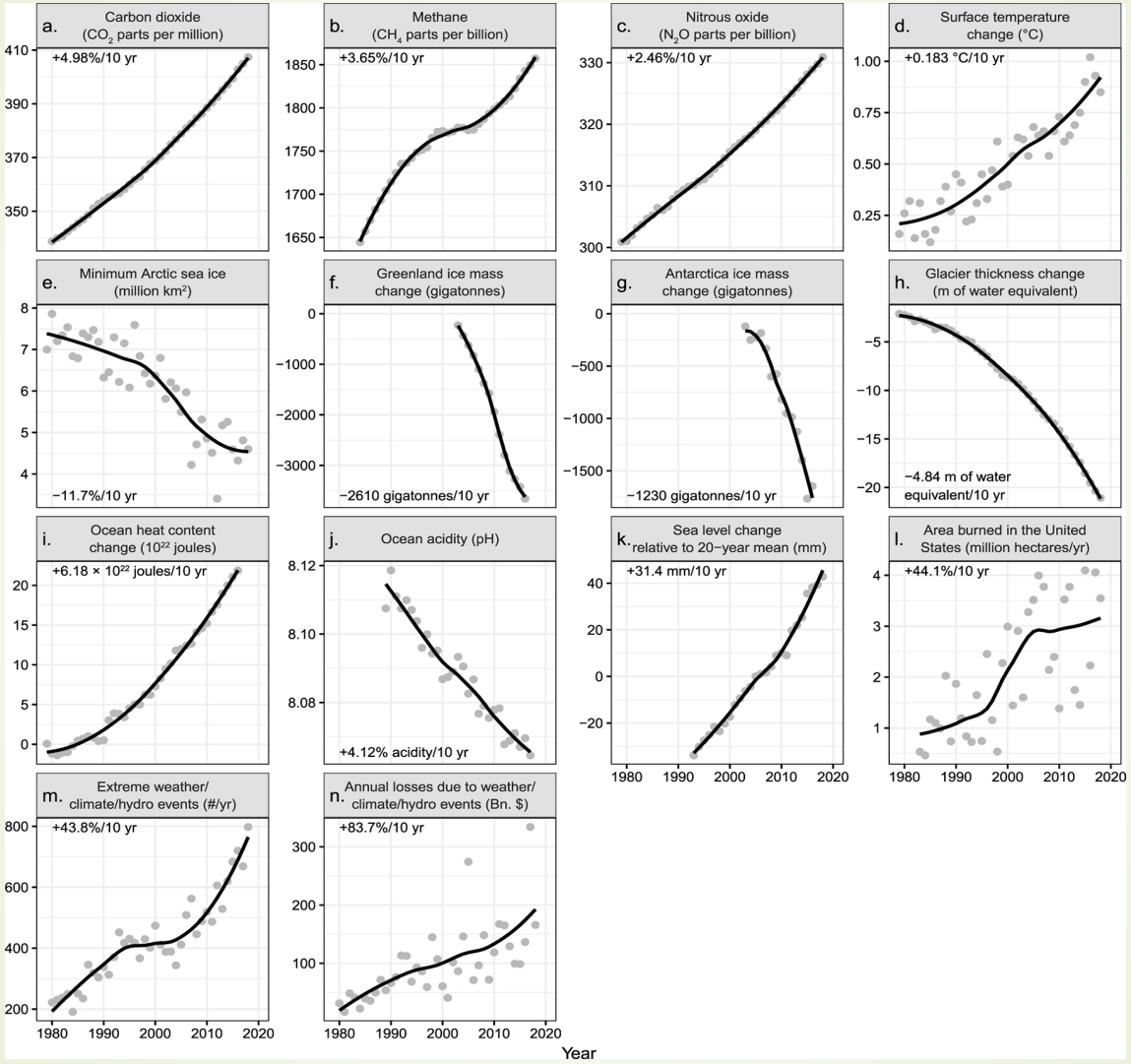
Figure 2. Climatic response time series from 1979 to the present.



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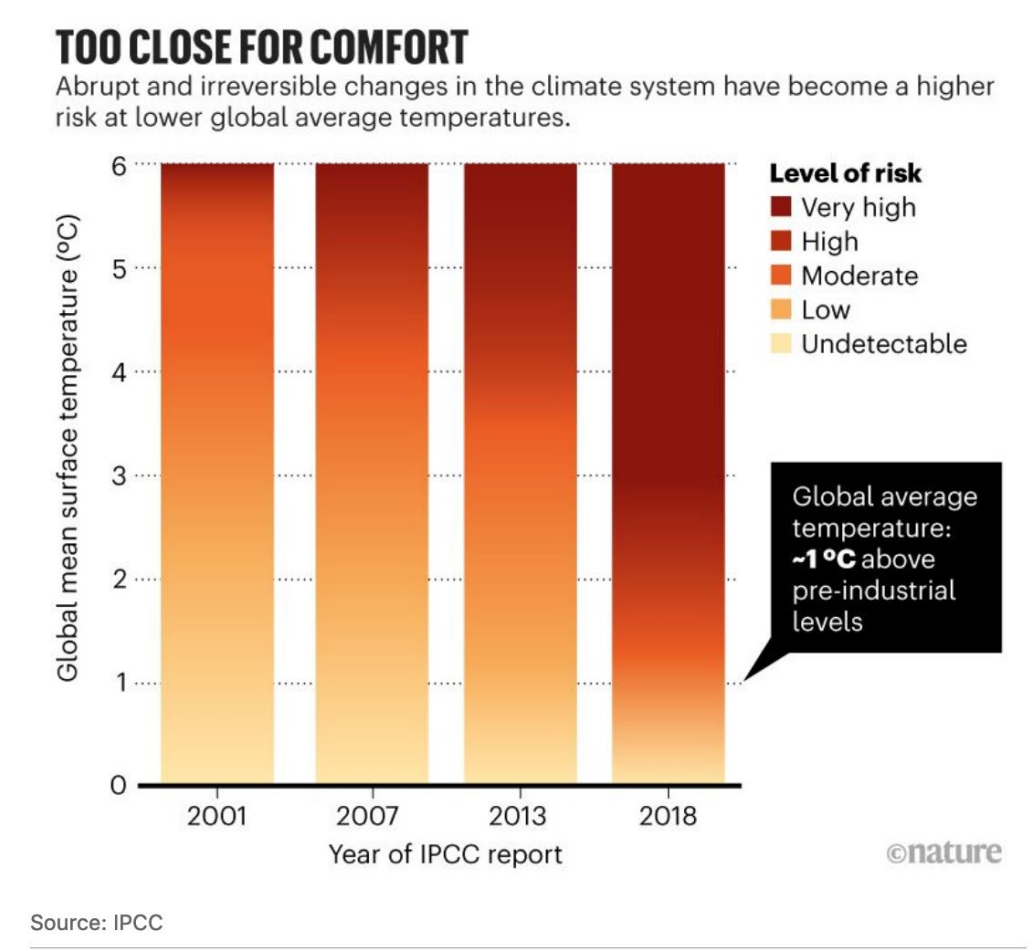
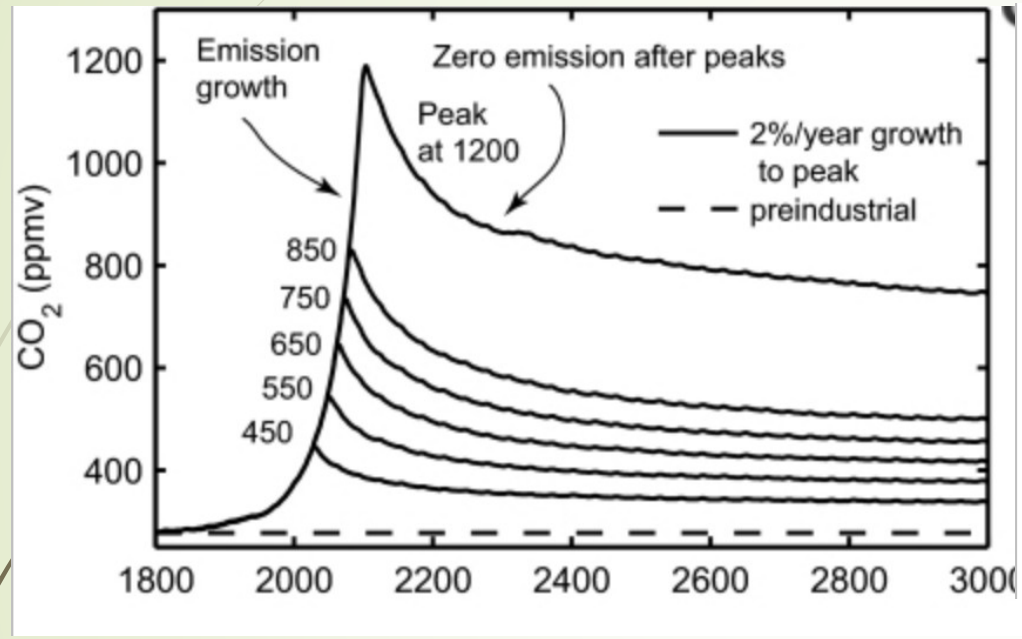
Six sets of actions to address climate change in climate emergency paper

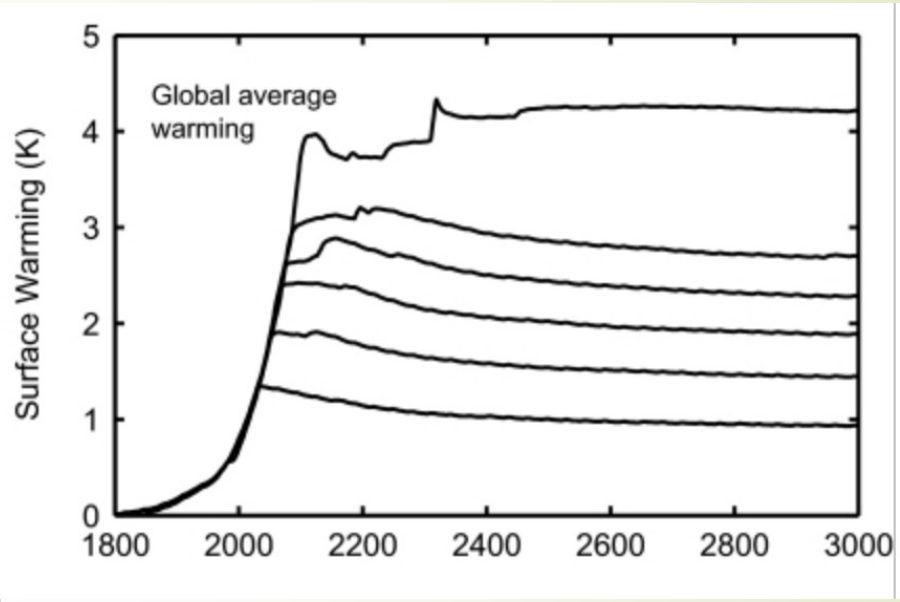
- Energy – Halt subsidies for fossil fuels and transform energy systems to be more efficient and with zero and low emission sources
- Short lived pollutants – Reduce release of black carbon from combustion and methane, nitrous oxide and heat trapping industrial chemicals
- Nature – Protect and restore earth's carbon sequestering ecosystems like forests, wetlands, savannas, grasslands mangroves and seagrasses
- Food – Shift food consumption away from animal sources and towards more plant based foods
- Economy – Reduce economic activities that release most heat trapping gases, and create a carbon-free economy that sustains ecosystems and improves human well-being
- Population – Stabilize human numbers while ensuring social integrity by providing education and access to family-planning services for girls and young women

As science has improved we see abrupt and irreversible change becoming likely at lower increases in temperature



- CO_2 ppm
- Global average warming





Urgent action is needed to limit and reverse the growth of heat trapping gases in the atmosphere

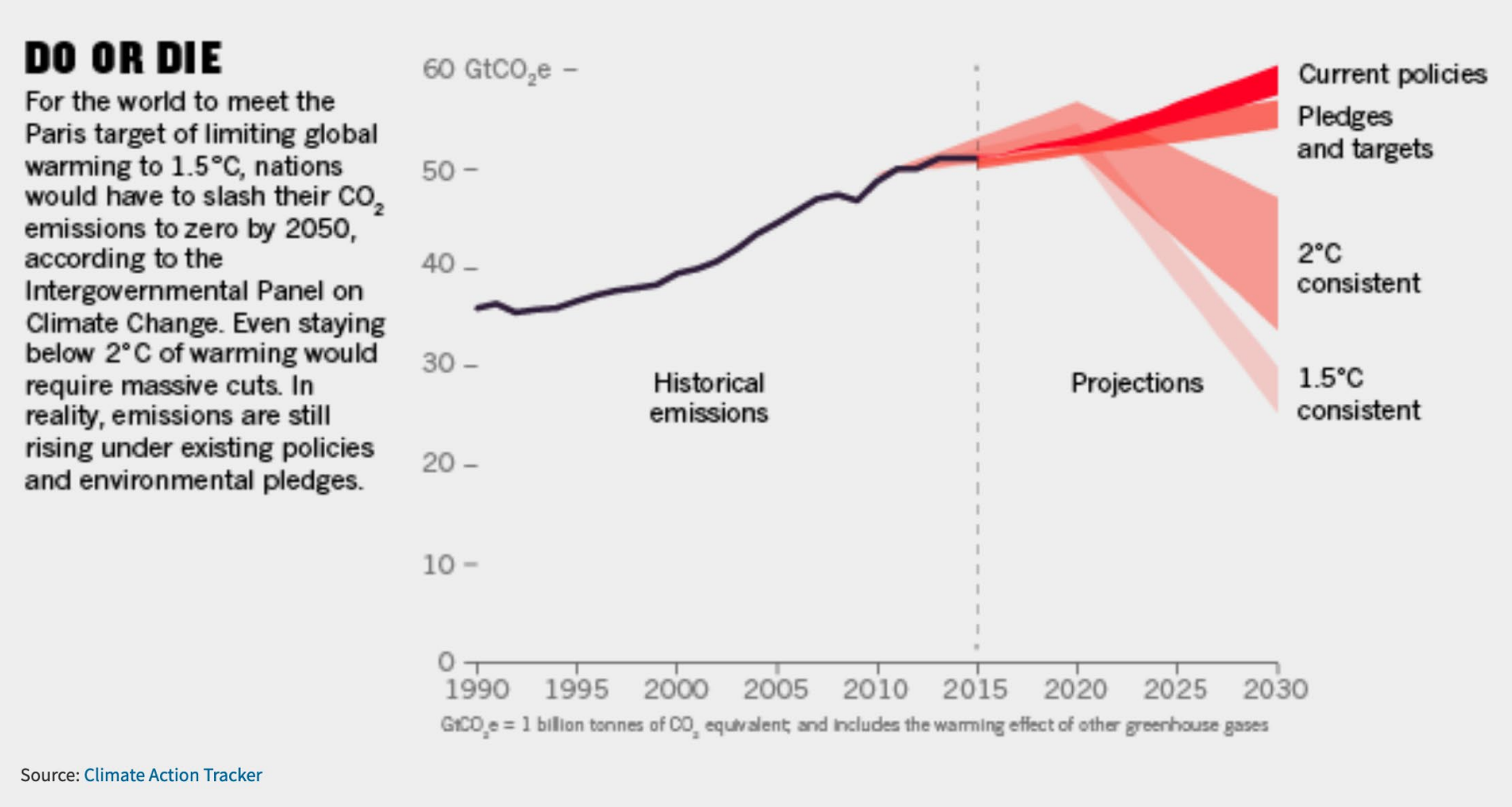
Solomon et al 2009

There are changes in the world that are alarming and some may be irreversible

Climate tipping points — too risky to bet against
"The growing threat of abrupt and irreversible climate changes must compel political and economic action on emissions."

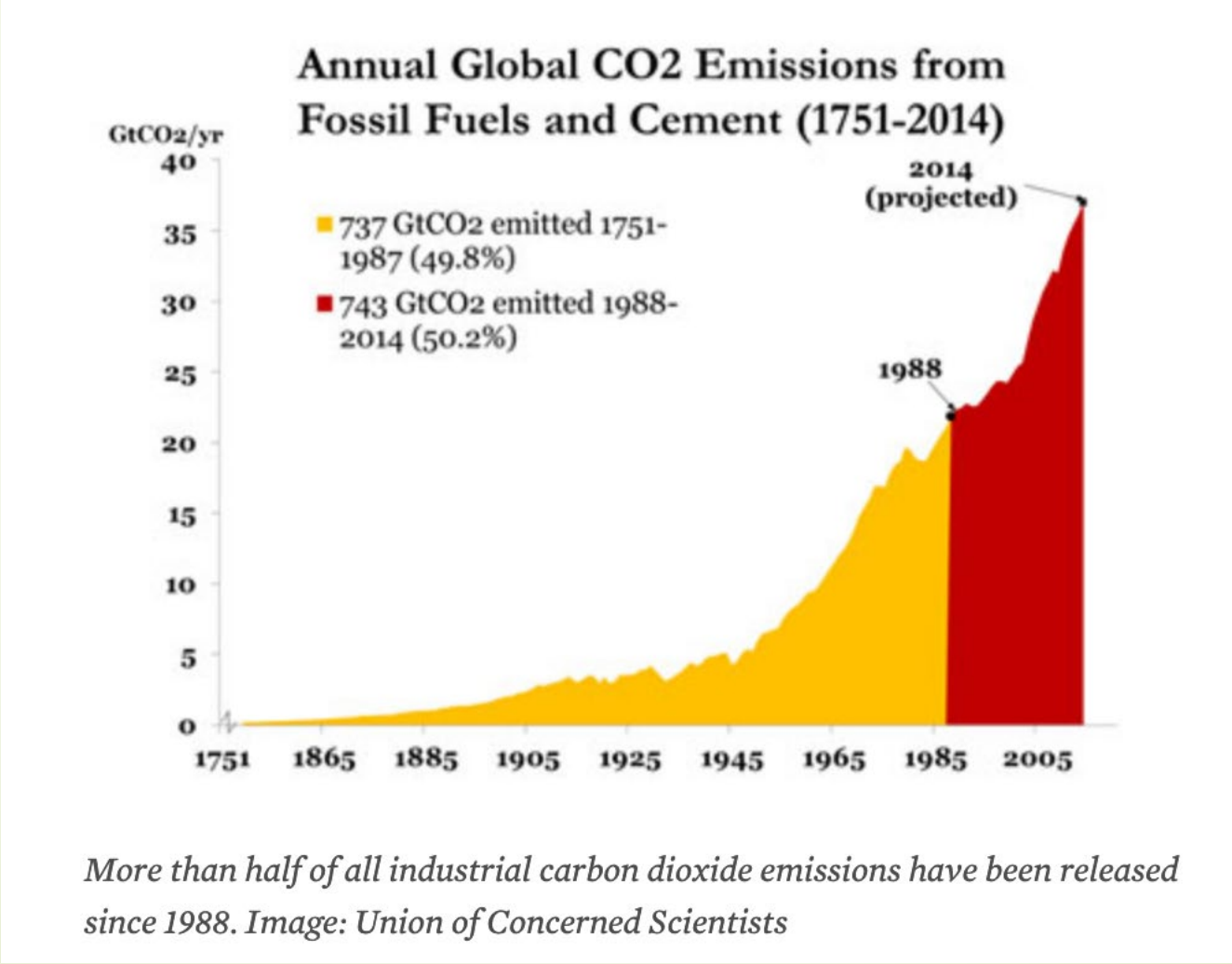
Lenton et al, Nature 27 November 2019

Are we Running out of time?
There is woefully inadequate action to address the accelerating rate of climate change



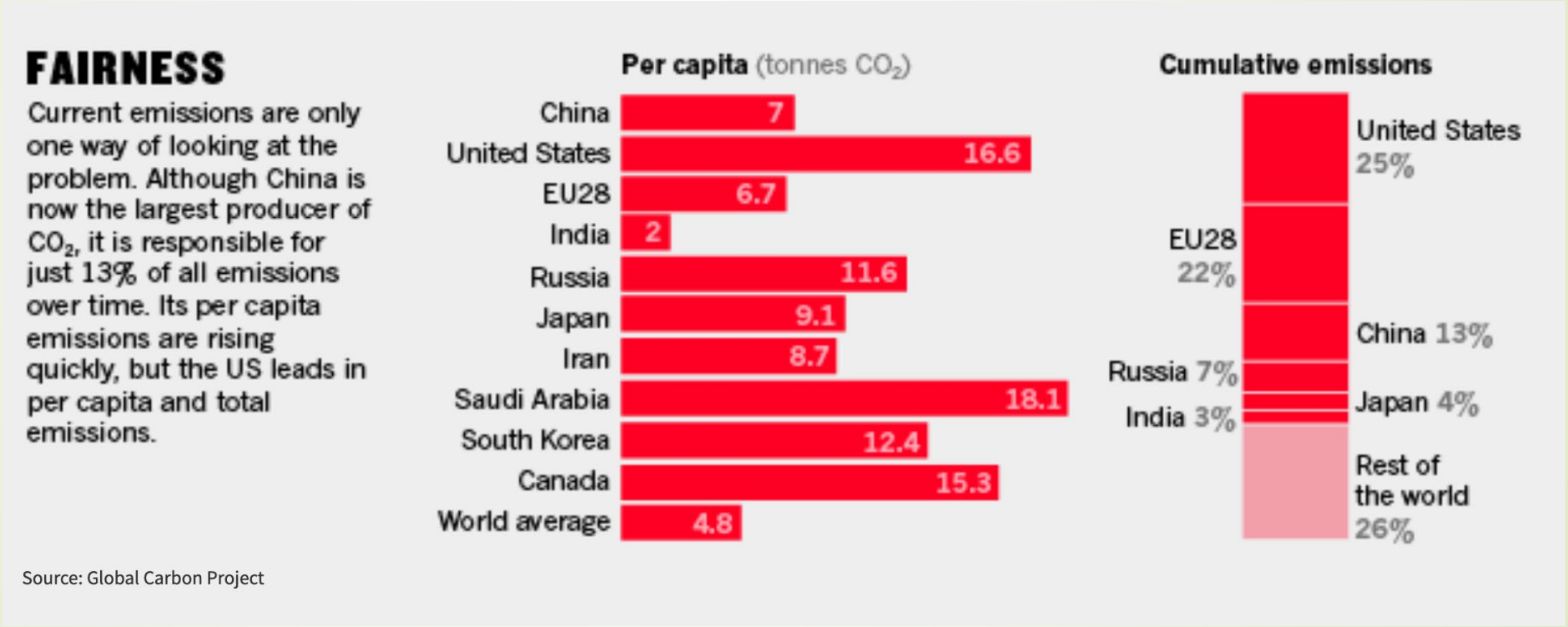
"The hard truths of climate change — by the numbers
A set of troubling charts shows how little progress nations have made toward limiting greenhouse-gas emissions." Jeff Tollefson Nature, 18 September 2019

Half of heat trapping carbon dioxide from fossil fuels and industry emitted since 1988



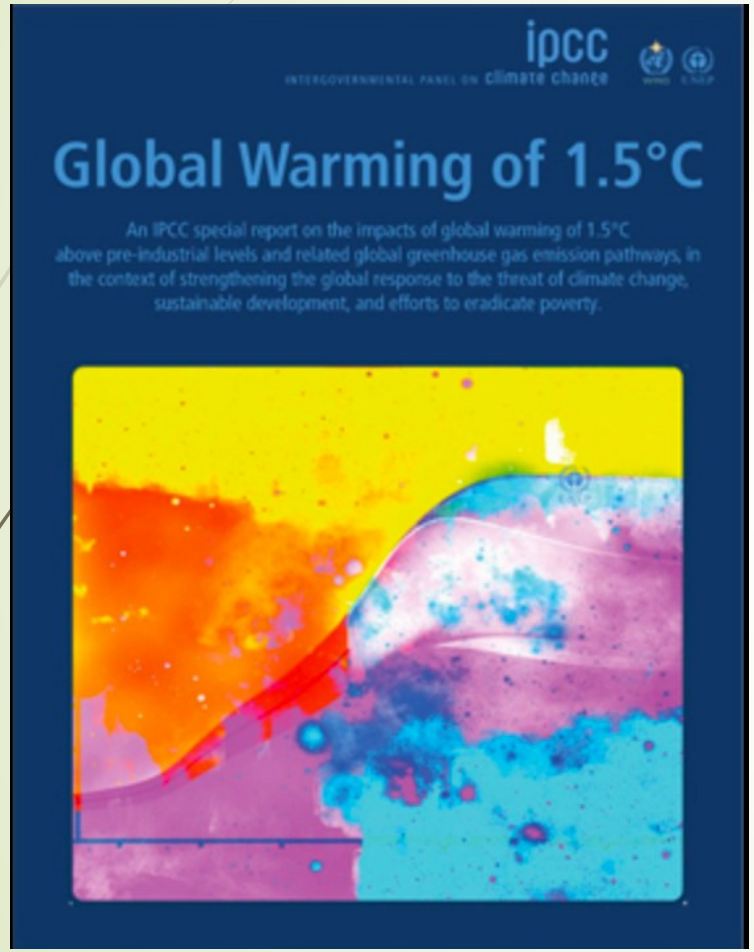
More than half of all industrial carbon dioxide emissions have been released since 1988. Image: Union of Concerned Scientists

Who is responsible for reducing emissions?



In bleak report, U.N. says drastic action is only way to avoid worst effects of climate change 26 November 2019

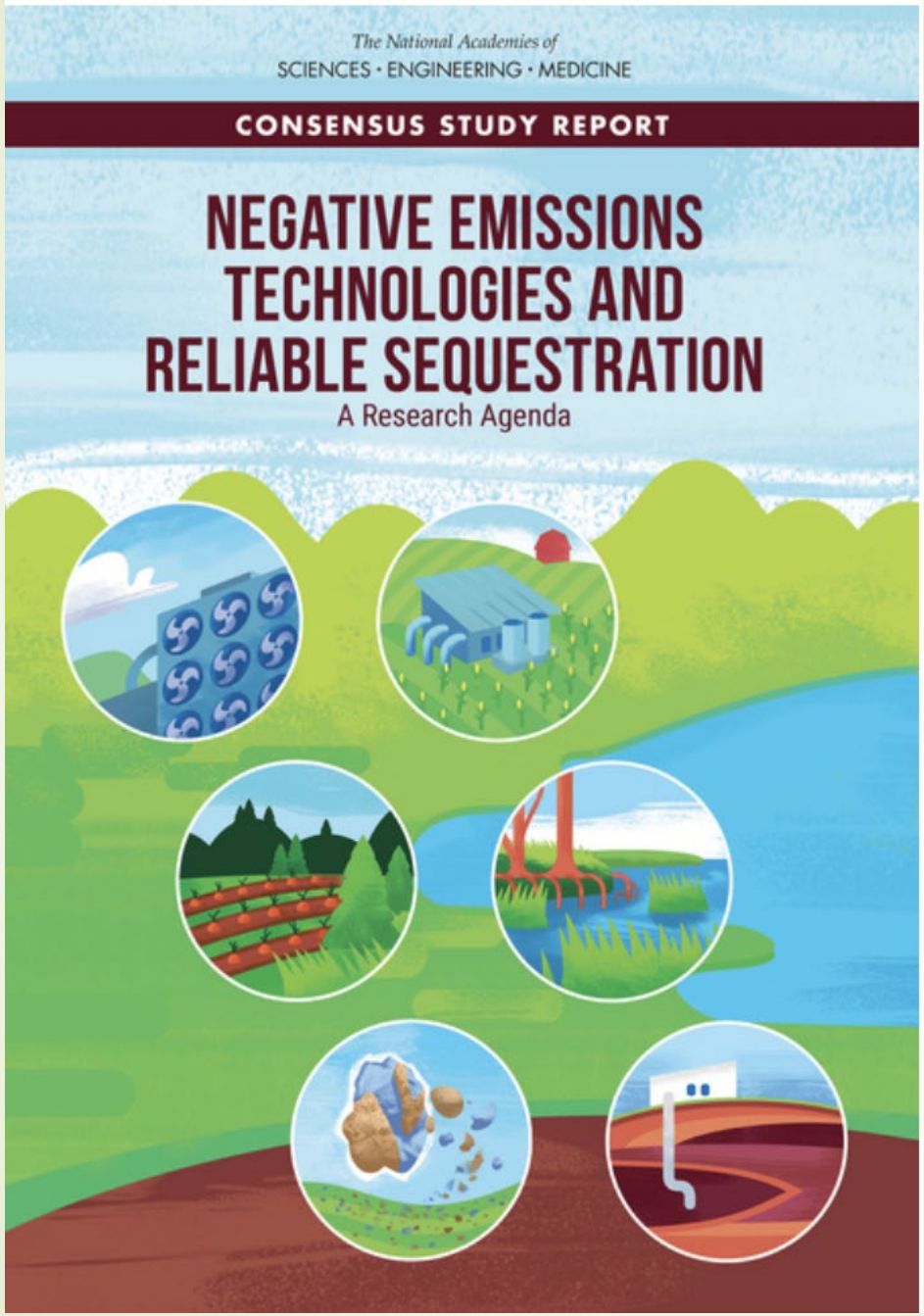
- "We need to catch up on the years in which we procrastinated," a top official says."
- "Global greenhouse gas **emissions must begin falling by 7.6 percent each year** beginning 2020 — a rate currently nowhere in sight — to meet the most ambitious aims of the Paris climate accord."
- "The World Meteorological Organization reported that levels of greenhouse gases in the atmosphere had hit a record high and that the trend "means that future generations will be confronted with increasingly severe impacts of climate change." UN Press release 29 November 2019



Intergovernmental Panel on Climate Change Special Report *Global Warming of 1.5°C (2.7°F)* October 8, 2018

To keep temperatures from rising excessively
"… global ***net*** anthropogenic carbon dioxide emissions (must) decline by about 45% from 2010 levels by 2030 … reaching ***net*** zero around 2050 …"

Must simultaneously reduce combustion emissions and increase removal of atmospheric carbon dioxide by forest growth



"NETs may be less expensive and less disruptive than reducing some emissions, such as a substantial portion of agricultural and land-use emissions and some transportation emissions."

Afforestation, Reforestation and Bioenergy with Carbon Capture and Storage and *Blue Carbon* Coastal wetlands

In Switzerland, a giant new machine is sucking carbon directly from the air (DACCS) Cost is 10 times removal from a stack. In 2017, these devices removed 4000 tons CO_2

https://www.newyorker.com/magazine/2017/11/20/can-carbon-dioxide-removal-save-the-world

"David Keith, a physicist at Harvard University … co-founded a company focused on DAC. In 2015, Carbon Engineering launched its first pilot plant for capturing CO_2 in British Columbia in Canada. …Their technology can capture CO_2 for between $94 and $232 per ton." Science 2018 doi:10.1126/science.aau4107

Evaluation of Direct Air Capture

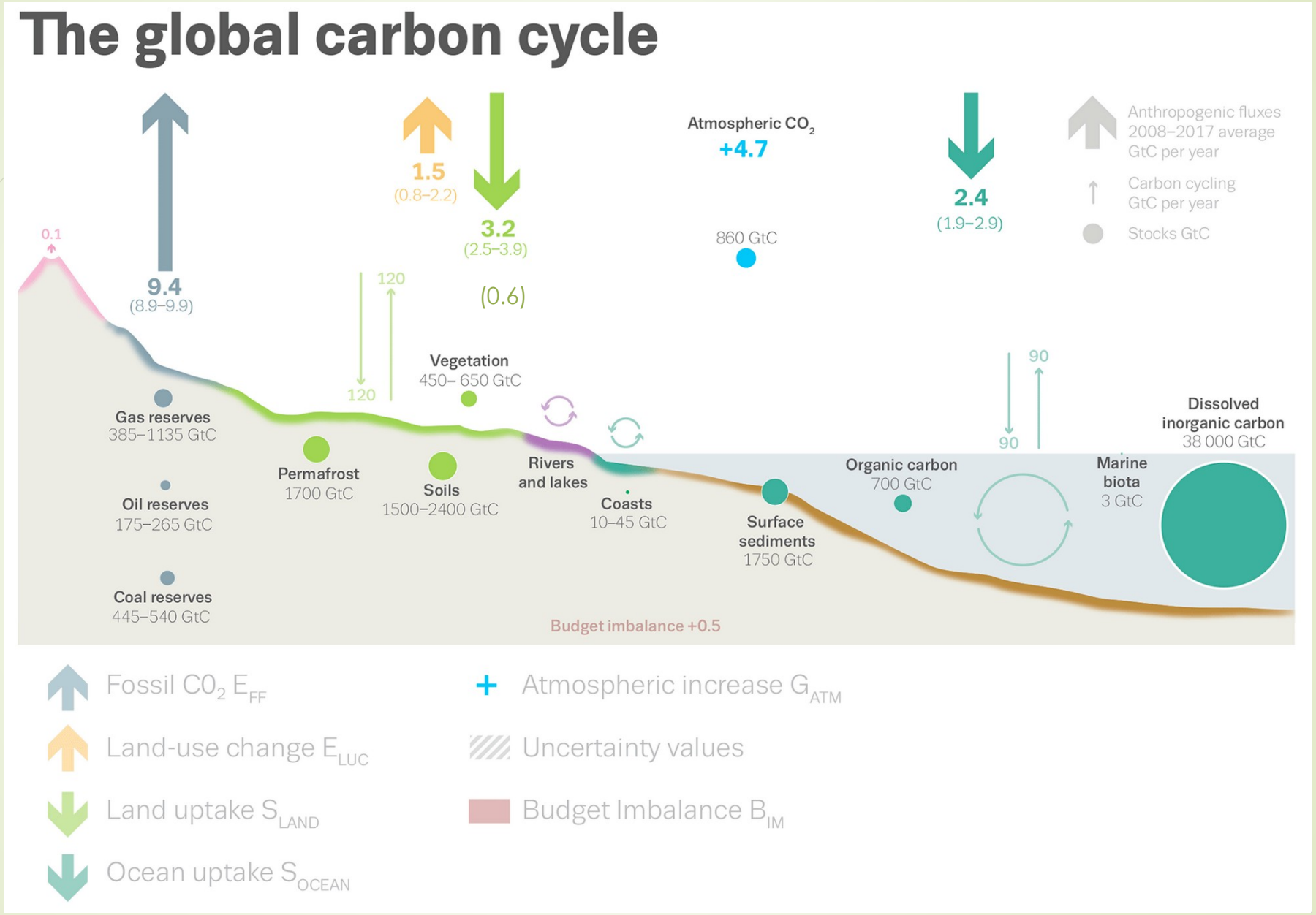
Mark Jacobson Energy and Environmental Science 12 2019

- For two types examined, "net of only 10.8% of the CCU* plant's CO_2-equivalent (CO_2e) emissions and 10.5% of the CO_2 removed from the air by the SDACCU* plant are captured over 20 years, and only 20–31%, are captured over 100 years."
- "…the CCU and SDACCU plants both increase air pollution and total social costs relative to no capture"
- "Once fossil fuel emissions end, Carbon Capture and Use (for industry) and Synthetic Direct Air Capture CU social costs need to be evaluated against the social costs of natural reforestation and reducing nonenergy halogen, nitrous oxide, methane, and biomass burning emissions."
- It is always better to use low carbon energy sources like wind and solar directly than to use them to operate Direct Air Capture

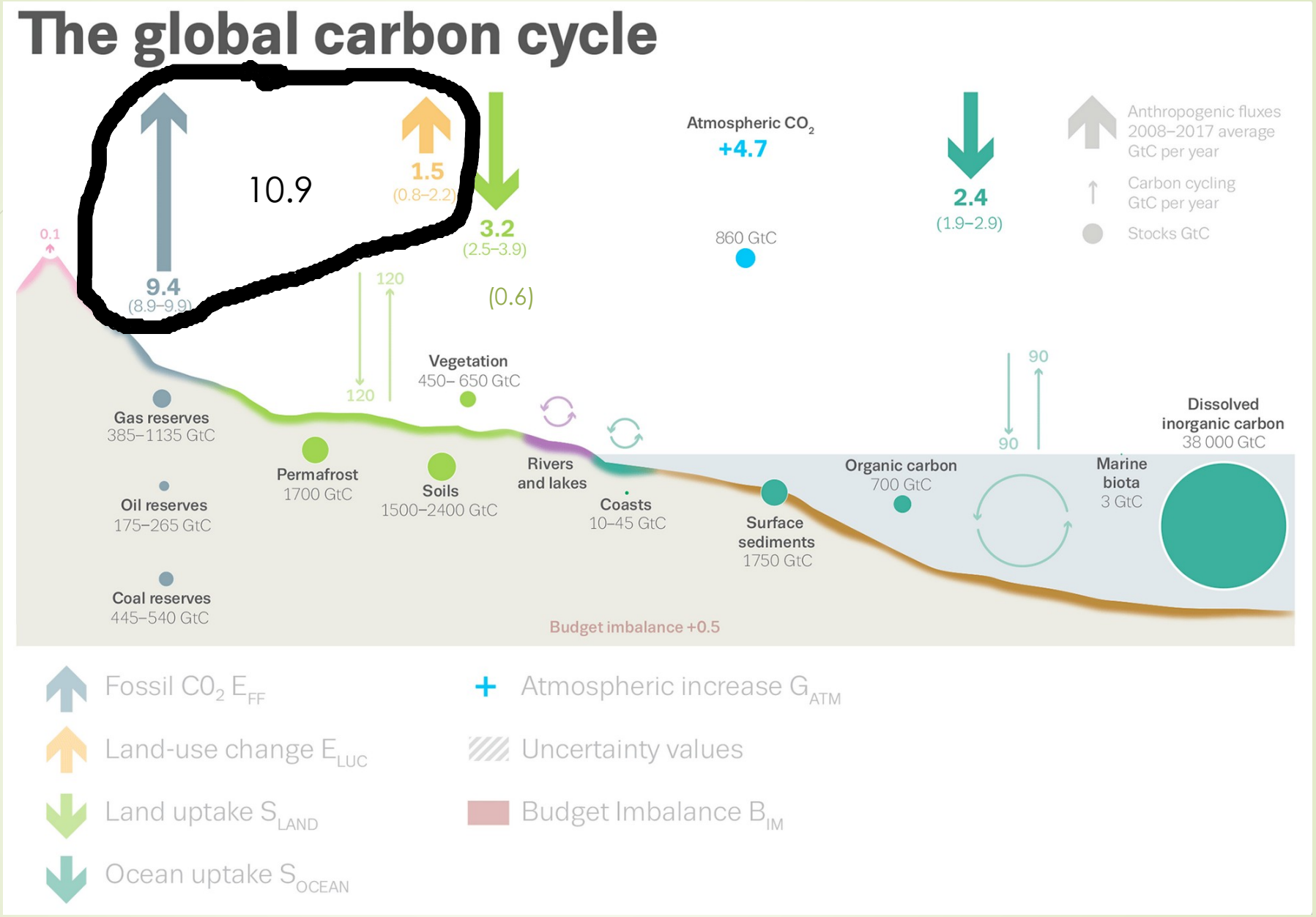
- *Carbon Capture and Utilization and Synthetic Direct Air CCU

Other recent proposals

- “Plant one trillion trees” - Davos 2020
- Microsoft commitment to remove by 2050 all of its legacy emissions since founding in 1975 Proforestation - Beginning now with protecting some 30 forest areas and spending $1 billion in next four years to develop technical solutions



https://www.earth-syst-sci-data.net/10/2141/2018/ Le Quere et al, 2018



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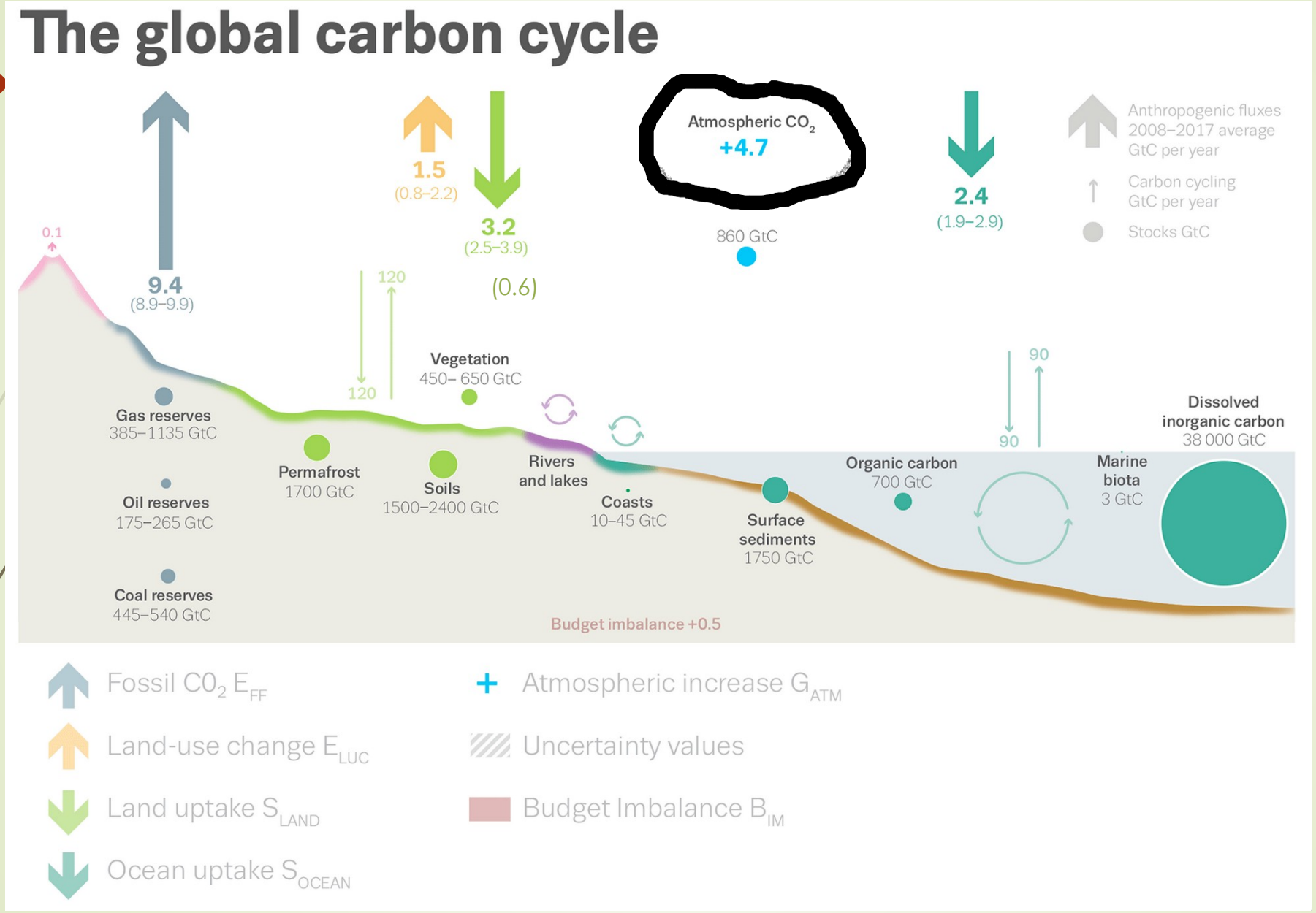

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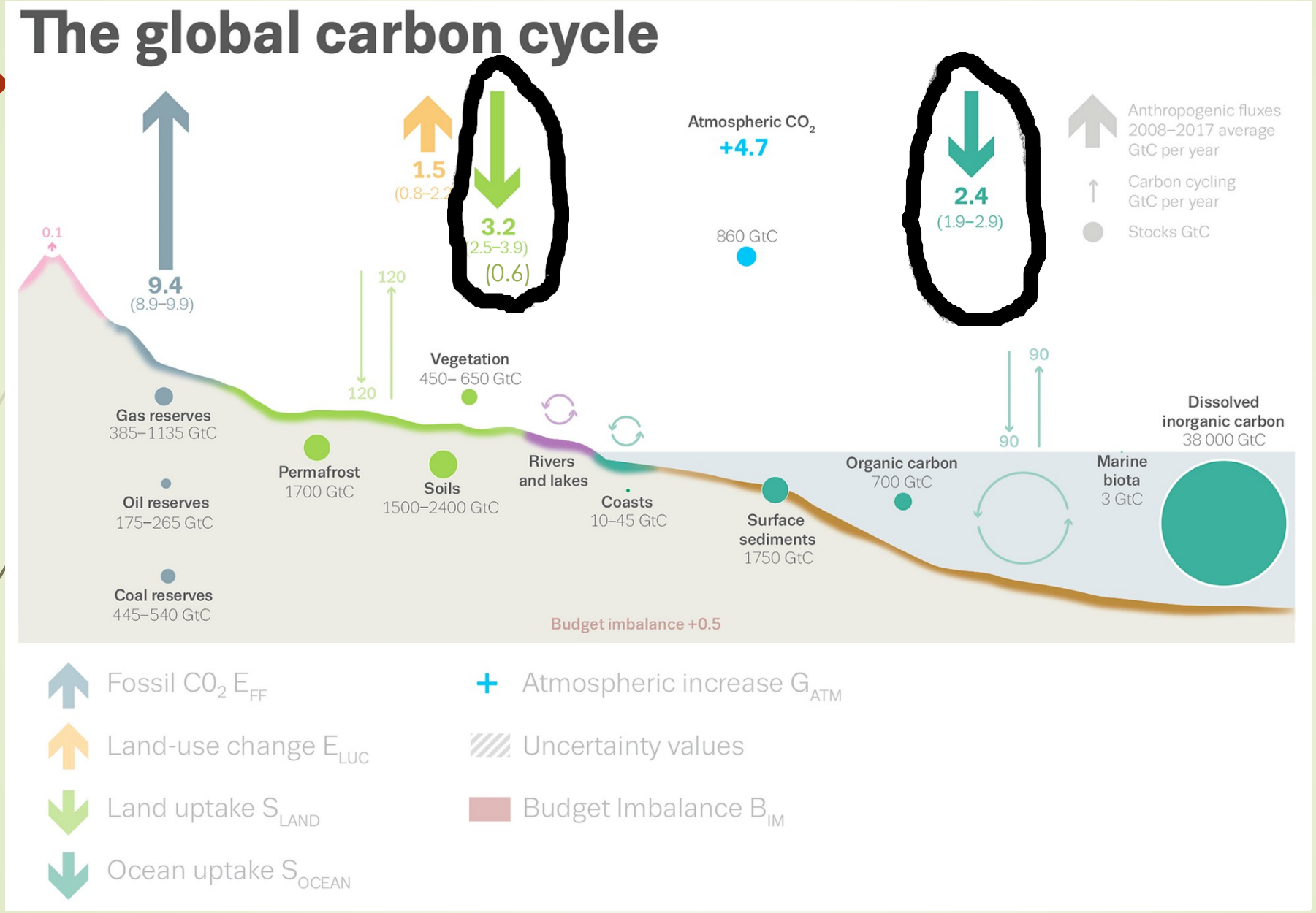


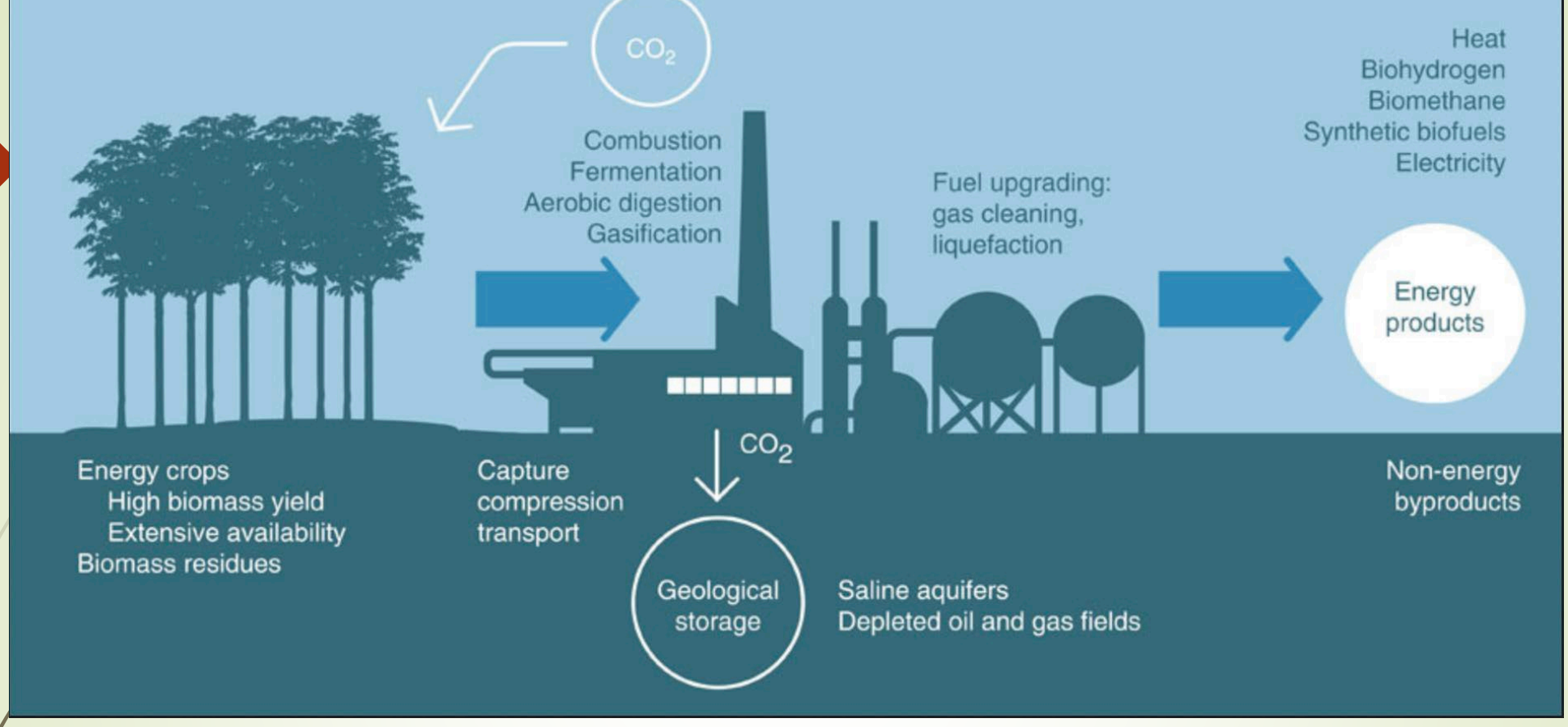
https://www.earth-syst-sci-data.net/10/2141/2018/ Le Quere et al, 2018

Increasing carbon sequestration by nature based solutions (NBS)

- If natural systems are reducing *net* emissions, can their role be increased?
- Adding more carbon to oceans is increasing acidity
- Wetland soils store as much carbon as standing forests, and especially salt water marshes are most productive per hectare of any ecosystem on earth in building carbon.
  - Unfortunately, wetlands are considered to be wastelands and are often filled and drained
- Grasslands and agricultural soils have a large potential to store more carbon
- Greatest potential is to increase the capacity of forests and forest soils

AFFORESTATION

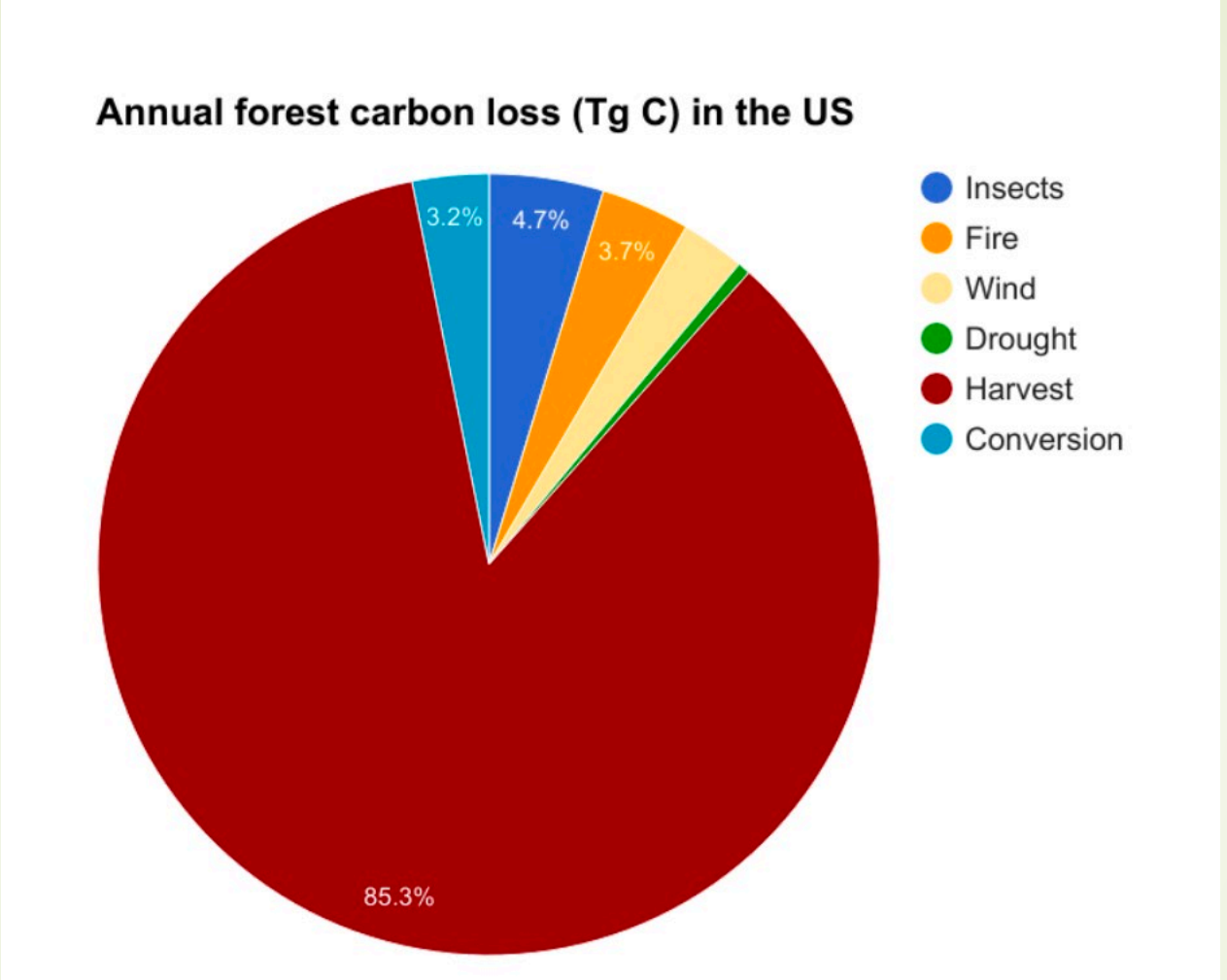
Added forest area required for afforestation to stay within 1.5°C is the size of Canada which is 9.9 million km^2



Bioenergy Carbon Capture and Storage (BECCS)

TECHNOLOGY DOES NOT EXIST
AND REQUIRES MASSIVE LAND AREA FOR TREE PLANTATIONS

BECCS would require a forest plantation area of 7.7 million km^2 The size of Australia



2016 US forest harvesting (162 MMtC/y) exceeds US fossil fuel emissions from heating commercial and residential building sectors (149 MMtC/y)

Where is carbon stored in forest products?

- Since forest harvesting began in Oregon in 1900 (Hudiburg et al, 2019)
  - Just 20% of the original carbon is in long-lived wooden products
  - 20% is in landfills
  - 60% is in the atmosphere as carbon dioxide
- Estimates of carbon storage in wood products is overestimated between 2-100-fold (Harmon, 2019)
- Longer harvest cycles for harvested timber increases the amount of carbon stored in forests rather than in the atmosphere
- Reducing the use of single use paper products and making them of recycled fiber instead of centuries old trees keeps more carbon out of the atmosphere

“Clean” Woody biomass for electric power

- “The report, co-written by Madhu Khanna, a professor of agricultural and consumer economics at Illinois, determined the greenhouse gas (GHG) intensity of wood pellet-based electricity is between 74 and 85 percent lower than that of coal-based electricity.”

- By Pellet Mill Magazine Staff January 25, 2016 Biomass Magazine

Pellet industry harvesting in North Carolina: ***"Little remains but stumps and puddles in what was once a bottomland hardwood forest"***

Joby Warrick, Washington Post 6/2/2015

"How Europe's climate policies led to more U.S. trees being cut down"

Drax

We “*never cause deforestation*”

Photo courtesy Dogwood Alliance

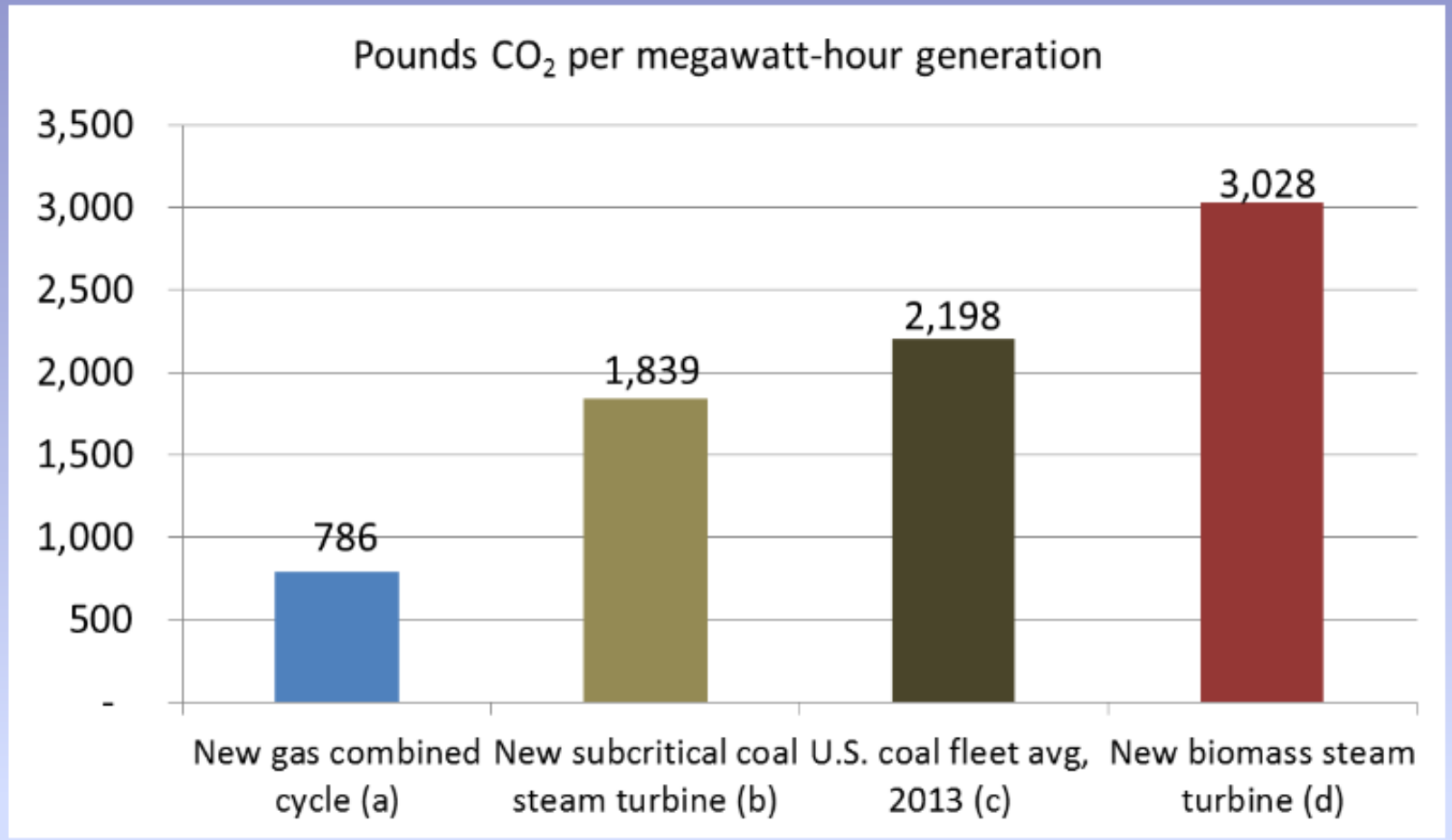
http://www.bloomberg.com/news/videos/2015-05-20/how-green-is-biomass-power-from-forest-to-furnace

Enviva pellet plant, Ahoskie, North Carolina

Photo: Dogwood Alliance (www.dogwoodalliance.org)

Replacing coal with 8 million tons of North Carolina pellets in UK

Biomass power plants emit more CO_2 per megawatt-hour than coal or gas facilities



Biomass plants being built today emit **~65%** more CO_2 per MWh than modern coal plants, and **~285%** more than natural gas combined cycle plants

Reduce heat trapping gas emissions and increase removal rates by nature

- Replace burning fossil fuels and wood for energy
  - Wood releases more carbon dioxide per unit of heat or electricity than coal
- Reduce emissions from conversion of forestlands, wetlands and grasslands to urban, industrial and agricultural uses
- Maintain natural systems and increase the storage of atmospheric carbon dioxide by allowing more forests to continue growing to meet their ecological potential for removing carbon and storing it in trees and soils

Increase carbon sequestration and storage by terrestrial ecosystems

- Existing forests and grasslands can remove twice as much atmospheric carbon as they currently do (Erb et al 2018)
- Soils and wetlands can sequester substantially more carbon dioxide than they currently do (Moomaw et al 2017)
- Carbon in forests and soils is carbon not in the atmosphere! (Bev Law 2019)

Large-diameter trees in the Douglas-fir/western hemlock forest of Winder River, Washinton, USA Credit: James Lutz/Utah State University

"the largest one percent of trees in mature and older forests comprised 50 percent of forest biomass worldwide." Lutz 2018

New England Forests can store between 2.4 and 4.3 times current rates. Keeton 2011

Proforestation

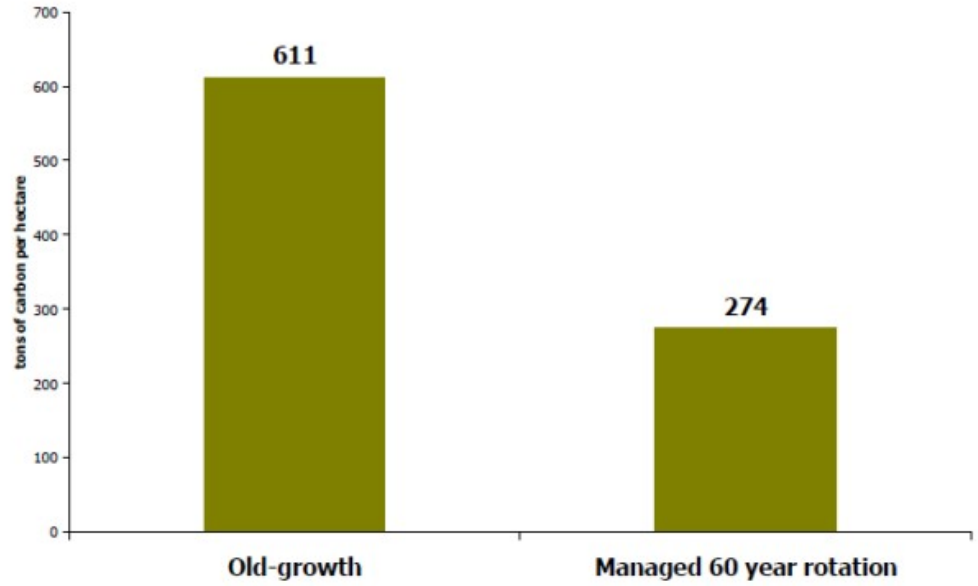
Alternative forest based management to let trees in existing forests grow to their full ecological potential for carbon storage in trees and soils. It also protects primary forests for their carbon stocks and continued accumulation of carbon

Moomaw, Masino & Fasion 2019 https://doi.org/10.3389/ffgc.2019.00027

Carbon storage at forest level

Figure 1

Harmon, Ferrell and Franklin (1990)



Source: Harmon, Mark E., William K. Ferrell, and Jerry F. Franklin. "Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests." *Science,* 9 February 1990: Vol. 247, pp 699–702

- Allowing secondary forests to continue growing and halting land use change will sequester 4.3 of the 4.7 GtC/yr gap between emissions and removal rates (Houghton and Nassikas 2018)

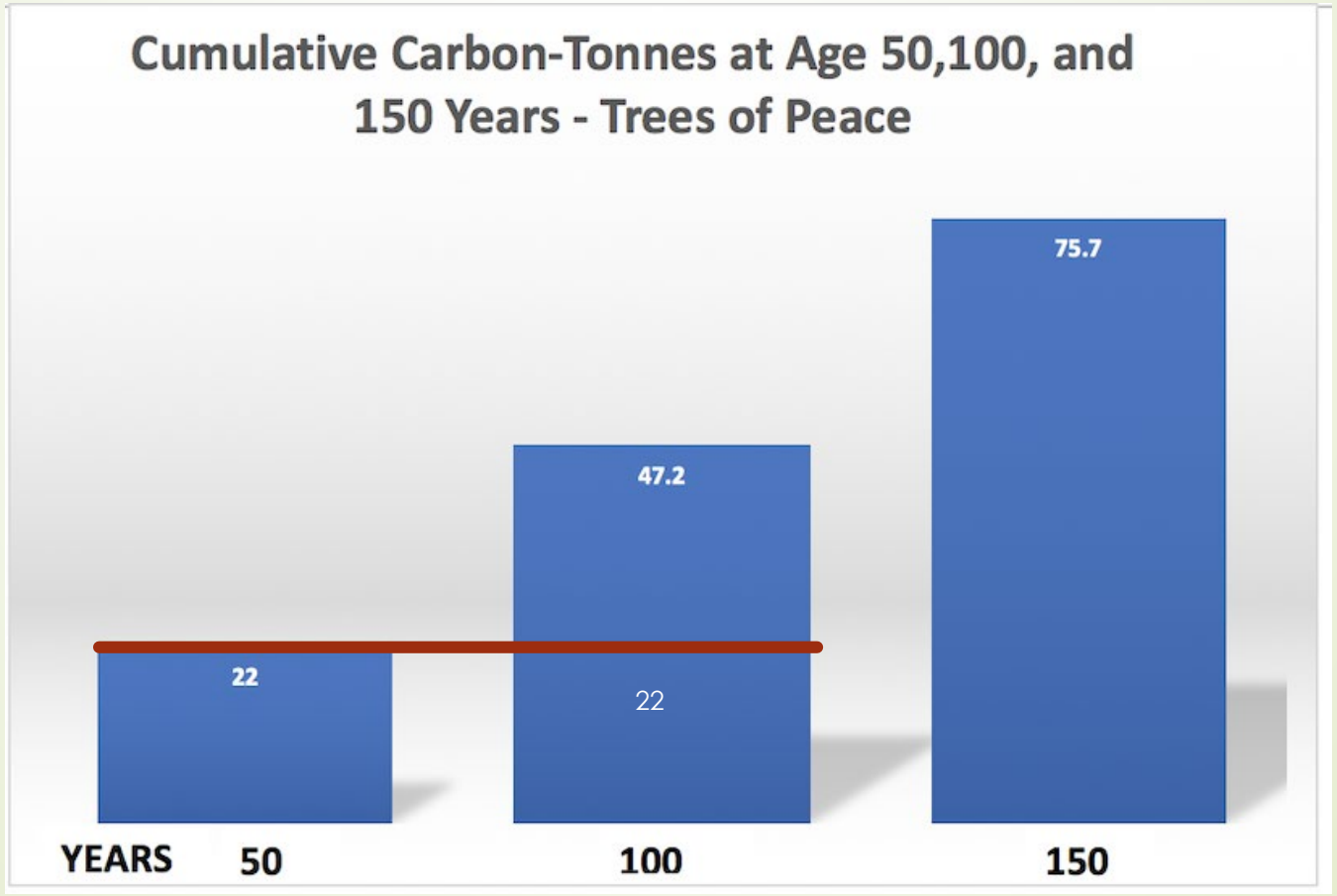
Planting trees is good
Letting them grow is better

Proforestation Management allows forests to reach their biological potential for carbon storage in trees and soils

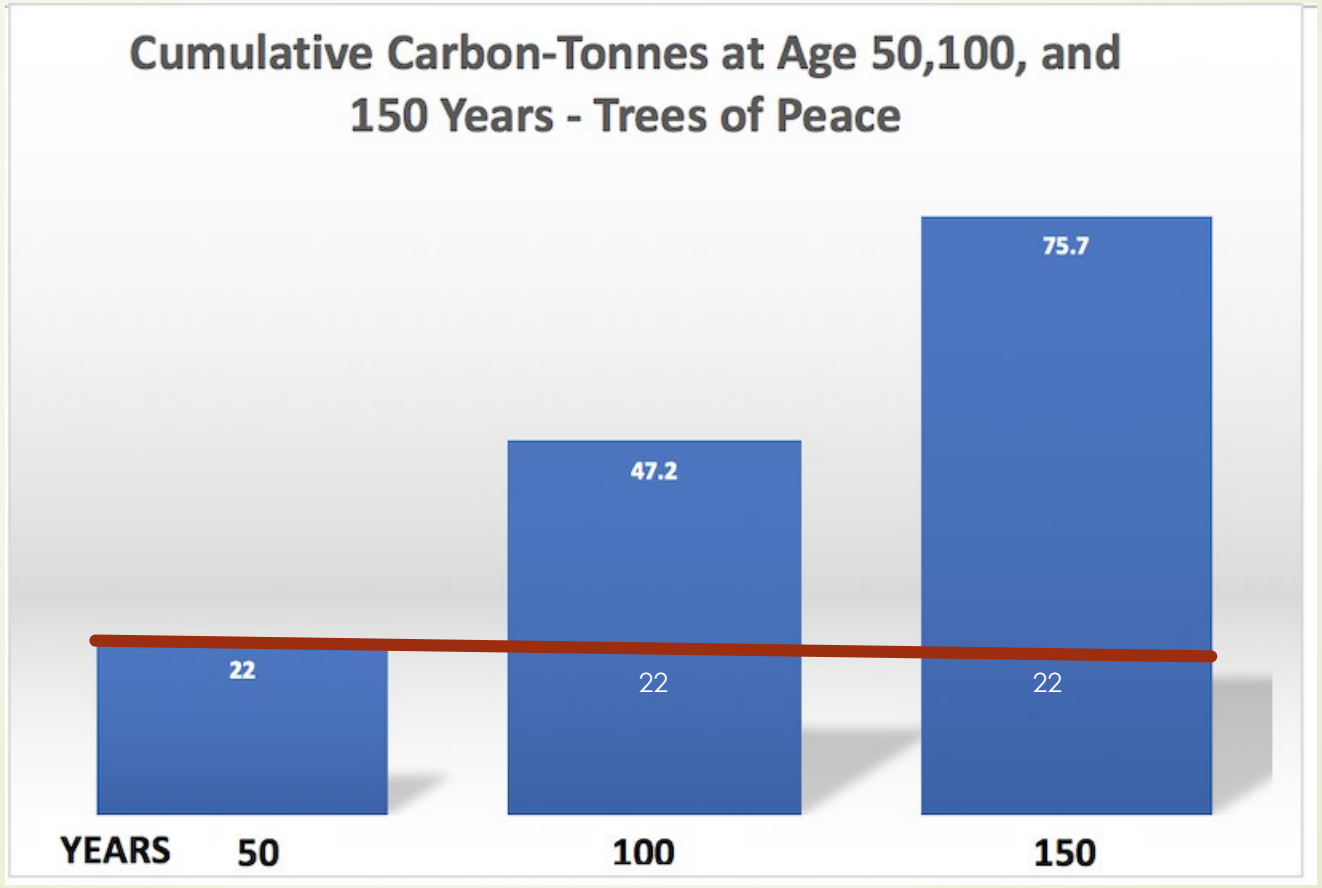
Larger trees in their prime growth period remove the most atmospheric carbon each year, and store the carbon in the wood of their trunk and limbs

Accumulated carbon in a one acre stand of white pine in Northeast United States

Tons per acre

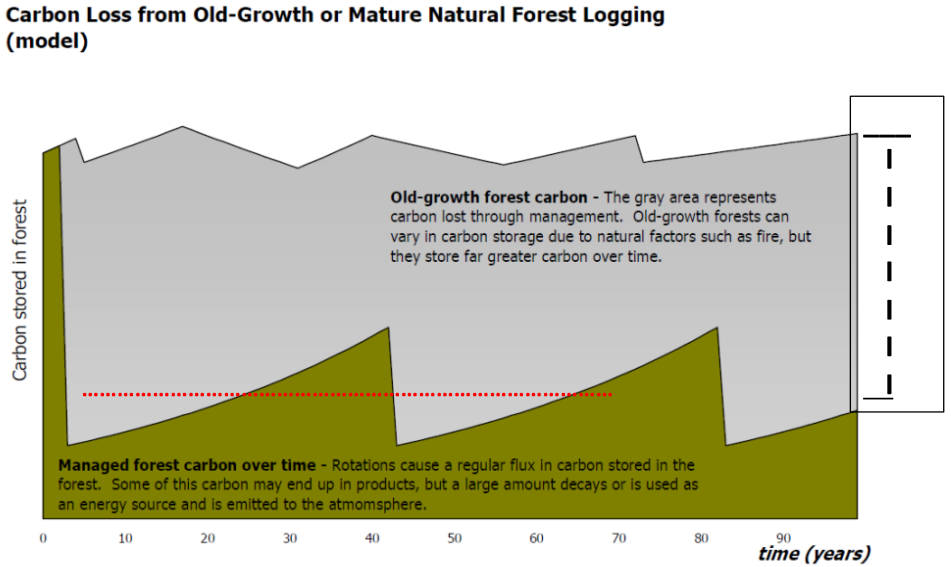


Why "carbon neutral" does not store as much carbon for bioenergy even if "sustainable forestry is practiced



Carbon storage in a sustainably managed forest

Carbon storage in a sustainably managed forest




COP25
CHILE
MADRID 2019
UN CLIMATE CHANGE CONFERENCE

Goals of COP 25

- Complete rule book for the Paris Agreement
- Prepare for COP 26 – COP of increased ambition

26,000 people in attendance in direct negotiations and “side events”

Holly Loomis head of US Delegation

Patrick Verkooijen head of UN Adaptation Agency


#TiempoDeActuar
COP25
CHILE
MADRID 2019
#TimeForAction
WWW.NEWS.CN

Another year wasted in Madrid 2019

- "…the talks were unable to reach consensus in many areas, pushing decisions into next year. Matters including … reporting requirements for transparency and "common timeframes" for climate pledges were all punted into 2020, when countries are also due to raise the ambition of their efforts." - Carbon Brief
- Brazil wanted to double count carbon in their forests and Australia wanted to shift the baseline for accounting for carbon stored in its forests
- The US blocked the developing country demands for compensation for loss and damage from climate change

THE TIMES

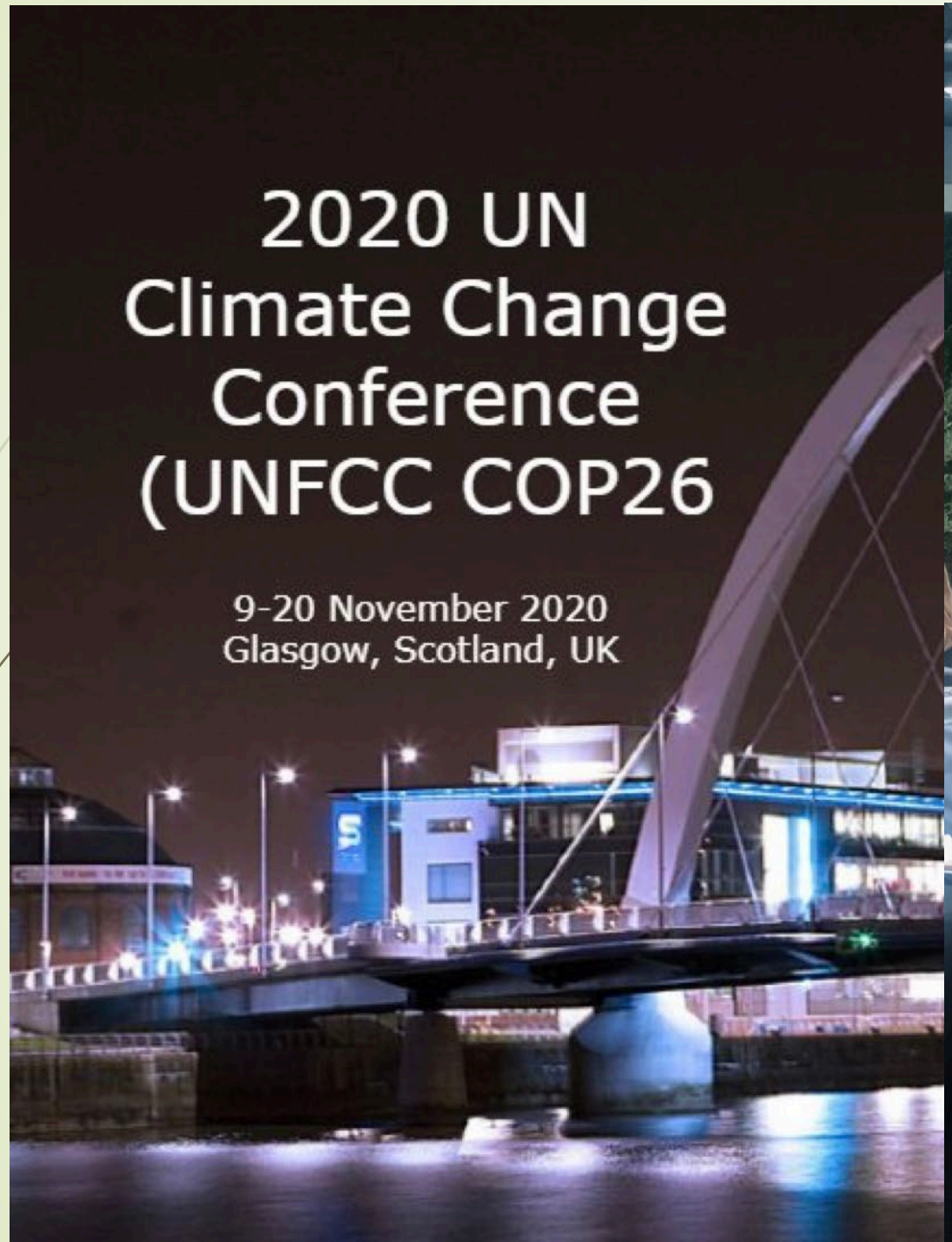
LEADING ARTICLE

DECEMBER 16 2019, 12:01AM, THE TIMES

Cop Out

It is now up to Britain to rescue the UN's climate agenda

"It will now fall to Britain, as the host of the COP26 in Glasgow in November next year, to find a way forward…The newly elected Conservative government has rightly committed to tough binding targets to reduce Britain's carbon emissions. Boris Johnson also says that he wants a post-Brexit 'Global Britain' to play a leading role on the world stage."


2020 UN
Climate Change
Conference
(UNFCC COP26
9-20 November 2020
Glasgow, Scotland, UK


RAISING
AMBITION
TOGETHER

The Climate has Changed!

WILDFIRES IN California 2019

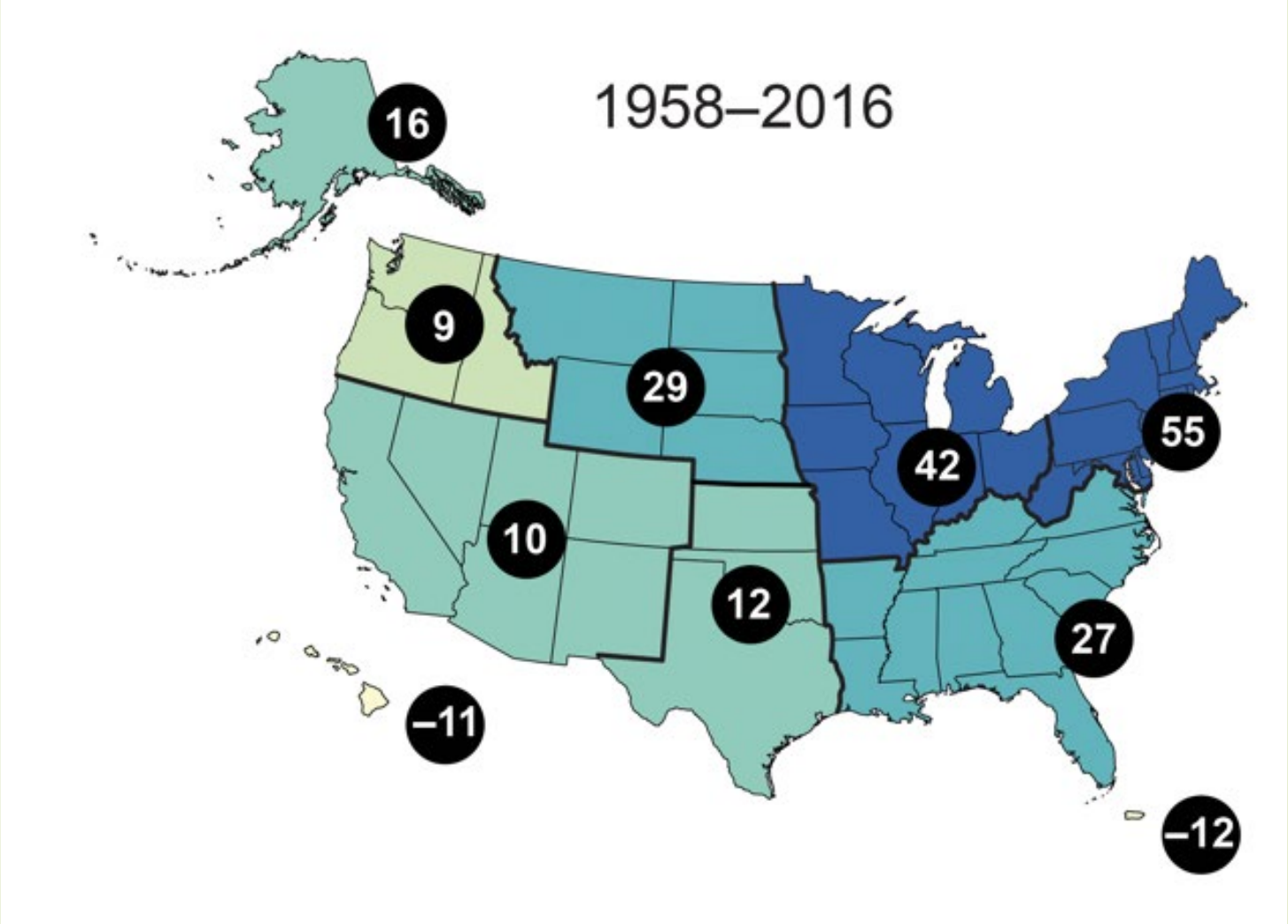
A kangaroo rushes past a burning house in Conjola on New Year's Eve

Australia fires 12/31/2019

Aquarium subway station Boston during “bomb cyclone” storm January 2018

Storm surge Scituate Massachusetts January 2018

Intense precipitation increase in top 1%



Worcester MA July 17, 2018

Worcester MA
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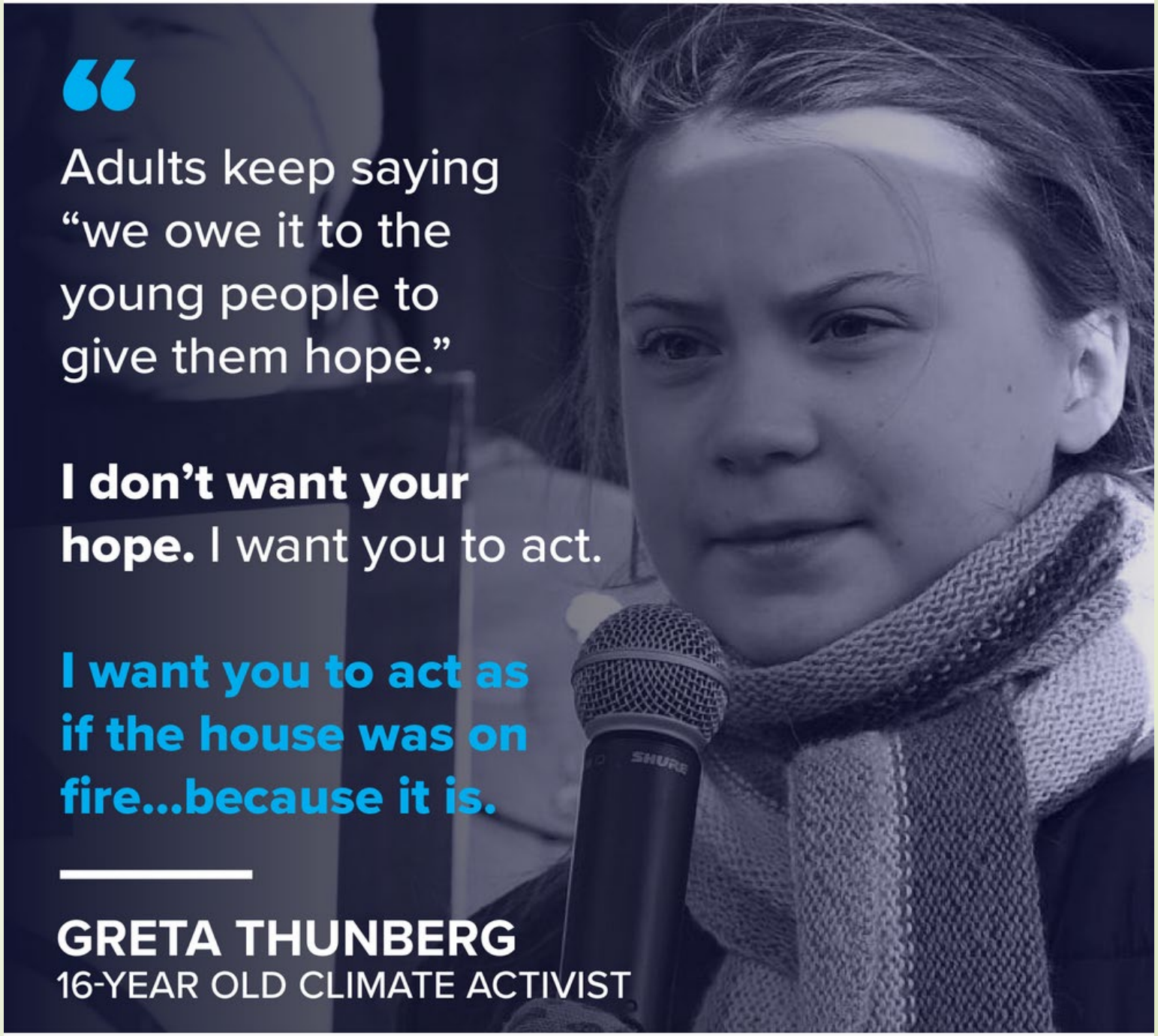
“
Adults keep saying “we owe it to the young people to give them hope.”
I don’t want your hope. I want you to act.
I want you to act as if the house was on fire...because it is.
GRETA THUNBERG
16-YEAR OLD CLIMATE ACTIVIST

"Time For Action" Bill Moomaw, Greta Thunberg and Louisa Neubauer on the panel, "Unite behind the Science" Madrid, Spain, Climate COP 25, 12/10/2019

Video of full panel presentation
https://drive.google.com/open?id=16GSMs6bGigebyEI7hmbpwoagd2fy1Tff


Let it grow!
Thank you