



PRES

Formulating Climate Change Solutions Under Deep Uncertainty



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RESILIENCE OF CHEMISTRY

The climate 'crisis':

- Its warming.
- The warming is caused by us.
- Warming is dangerous.
- We need to urgently transition to renewable energy to **stop** the warming.
- Once we do that, sea level rise will stop and the weather won't be so extreme.



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What's wrong with this narrative?

- We've vastly **oversimplified** both the problem and its solutions.
- The **complexity & uncertainty** is being kept away from the public & policy debate.
- The proposed solutions are **technologically & politically** infeasible on a global scale.
- **Overemphasizes** the role of manmade climate change in societal problems.



"97% of climate scientists agree"

- Surface **temperatures have increased** since 1880
- Humans are adding **carbon dioxide** to the atmosphere
- Carbon dioxide and other greenhouse gases have a **warming** effect on the planet

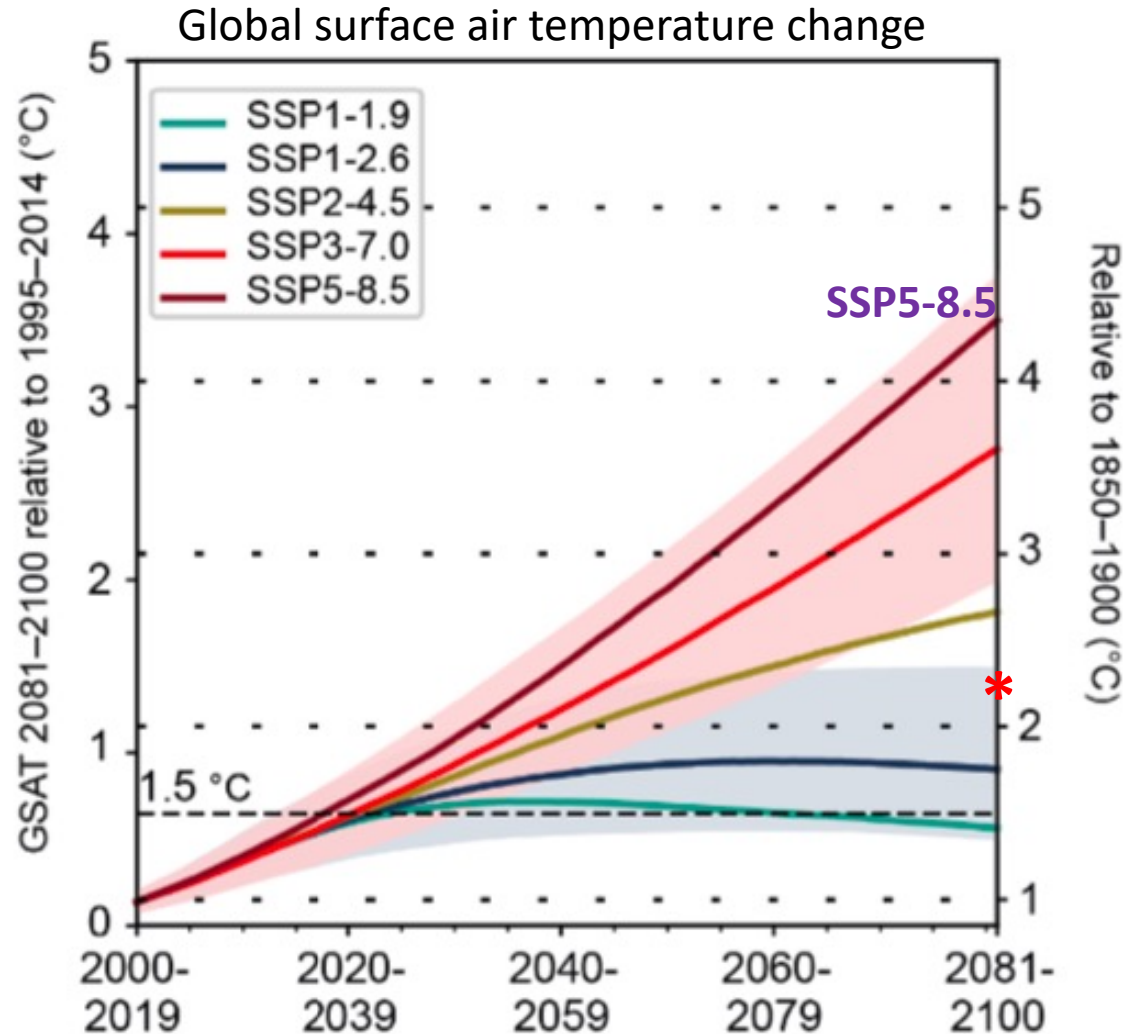
Disagreement among scientists:

- How much of the warming has been **caused by humans**
- **How much** the planet will warm in the 21st century
- Whether warming is '**dangerous**'
- How we should **respond** to the warming, improve human well being



Disagreement: how much warming in 21st century?

IPCC 6th Assessment Report: possible climate futures

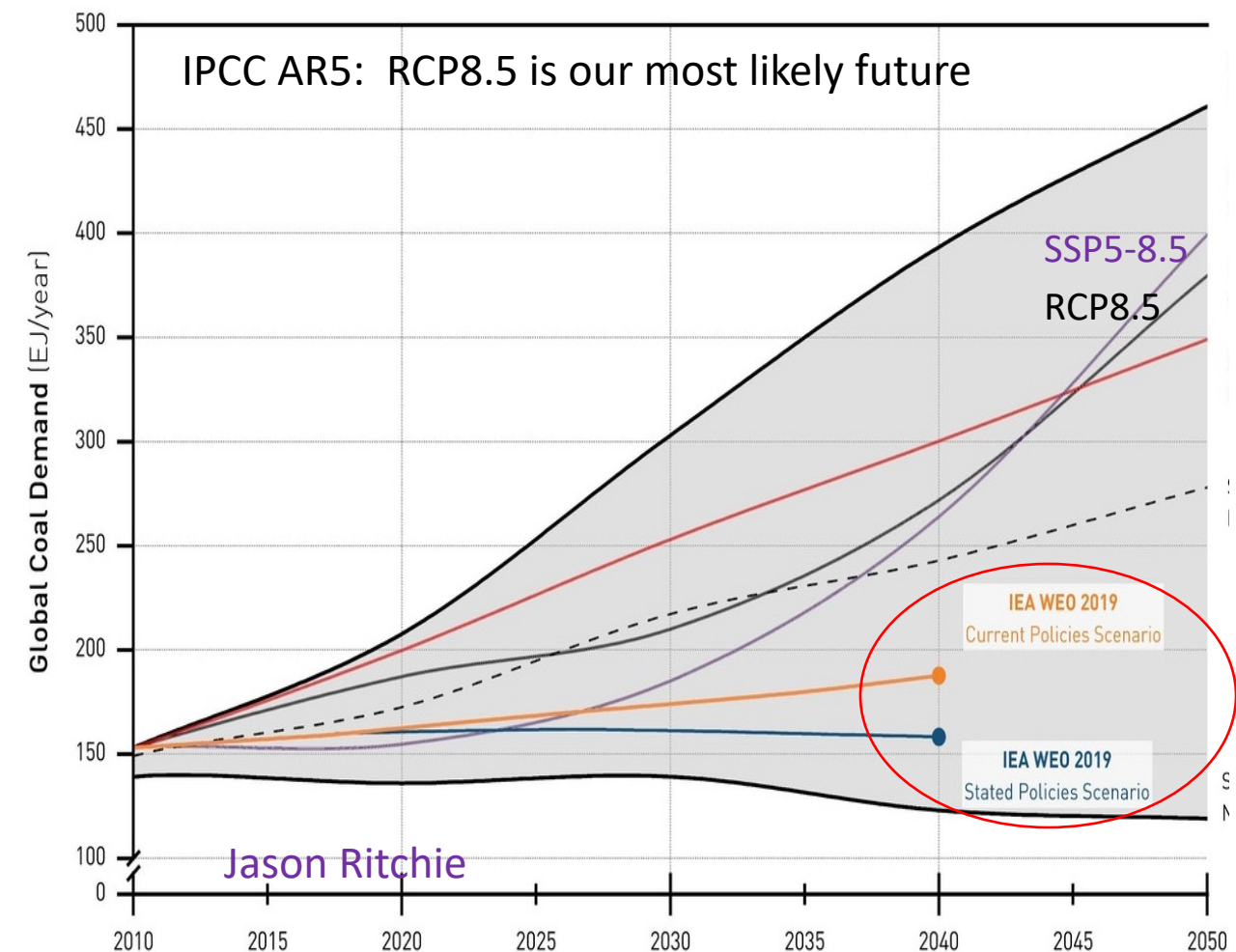


Why the IPCC simulations are not predictions:

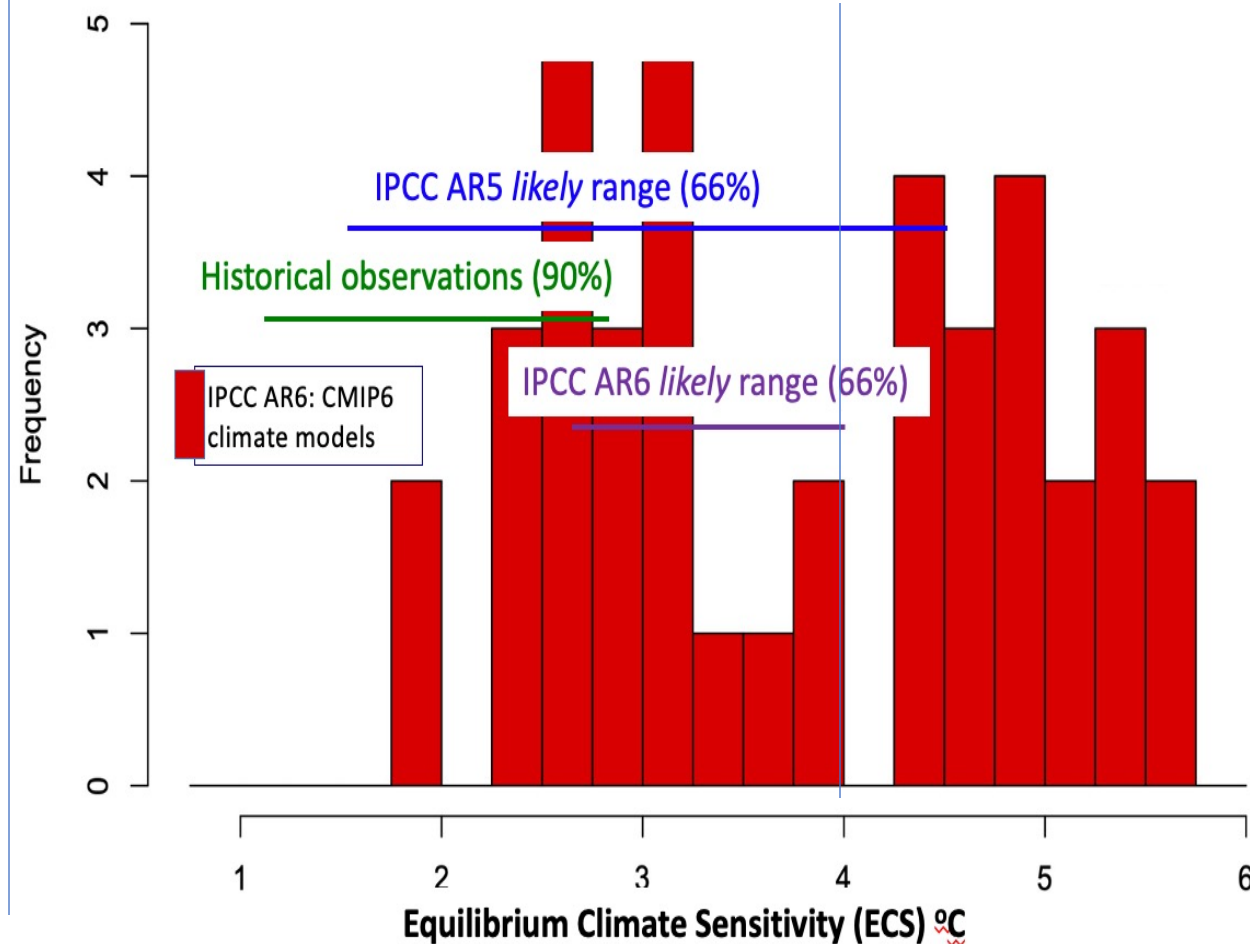
- Neglect solar, volcanoes, ocean oscillations
- Does not assess plausibility of emissions scenarios

Outdated emissions scenarios

Good news: the worst scenarios for warming are becoming increasingly implausible

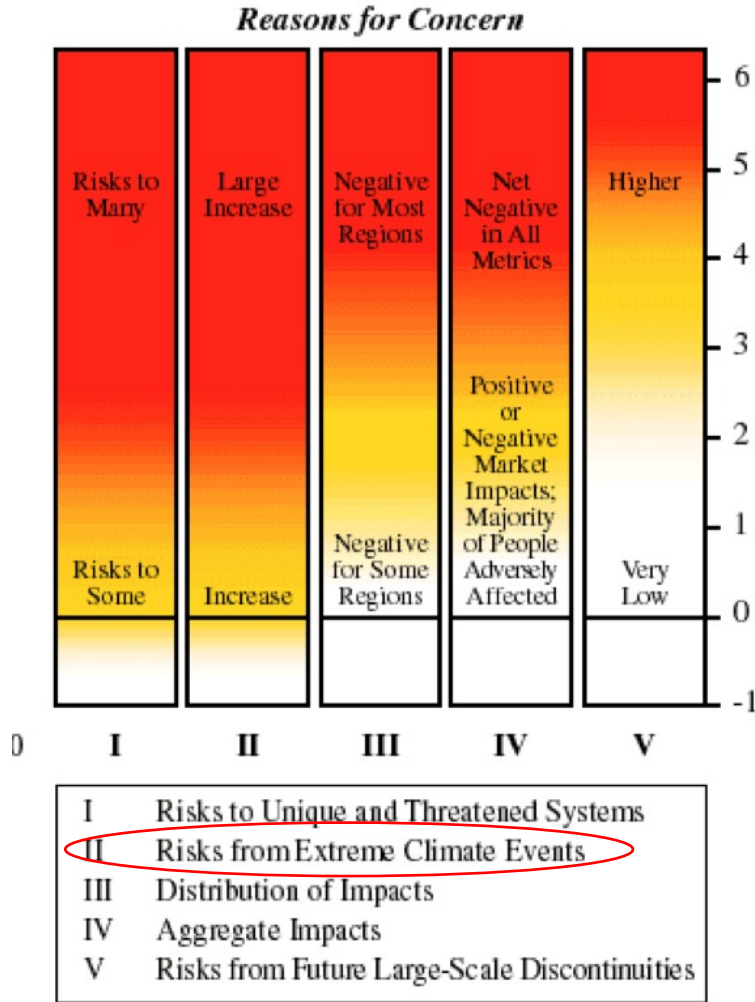


Large uncertainty in climate sensitivity to CO₂



Disagreement: is warming dangerous?

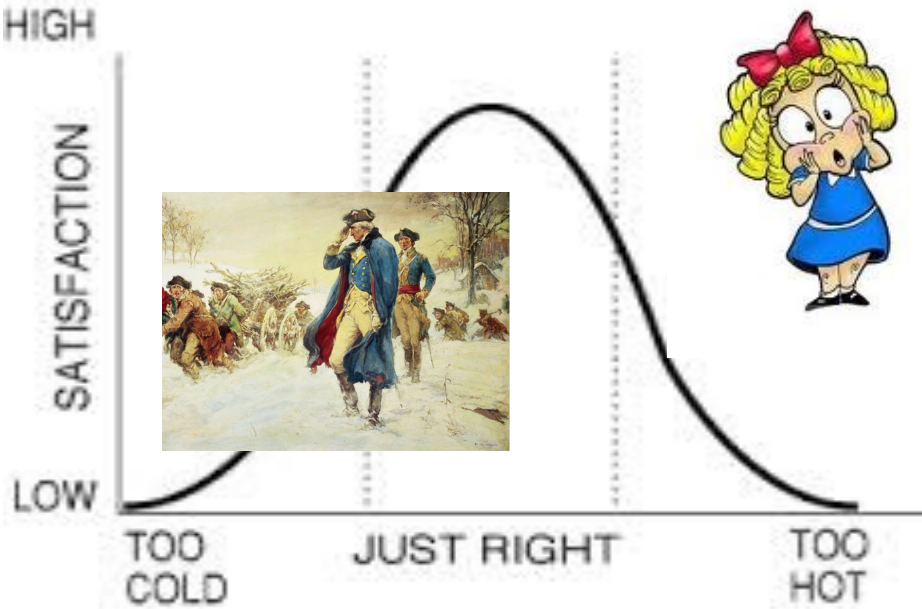
IPCC AR5 'burning embers' diagram



What climate do we want?

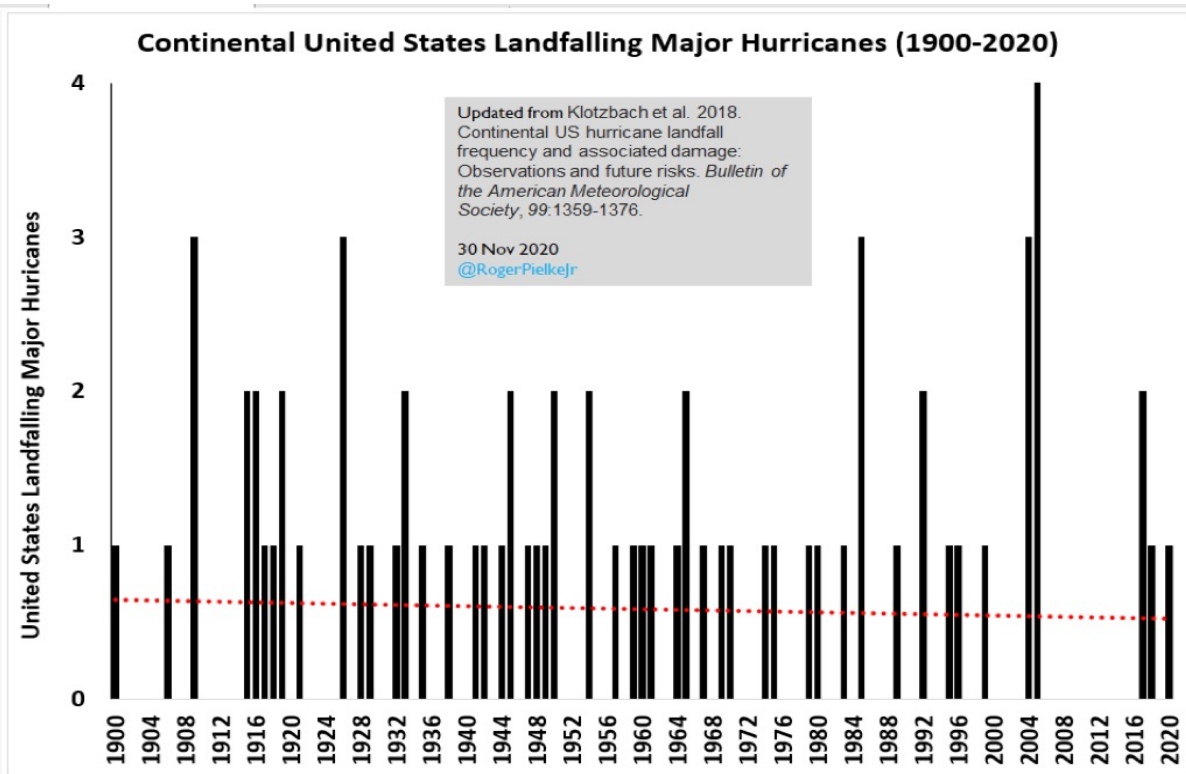
Winners & losers

Goldilocks Principle



Dangers from extreme weather

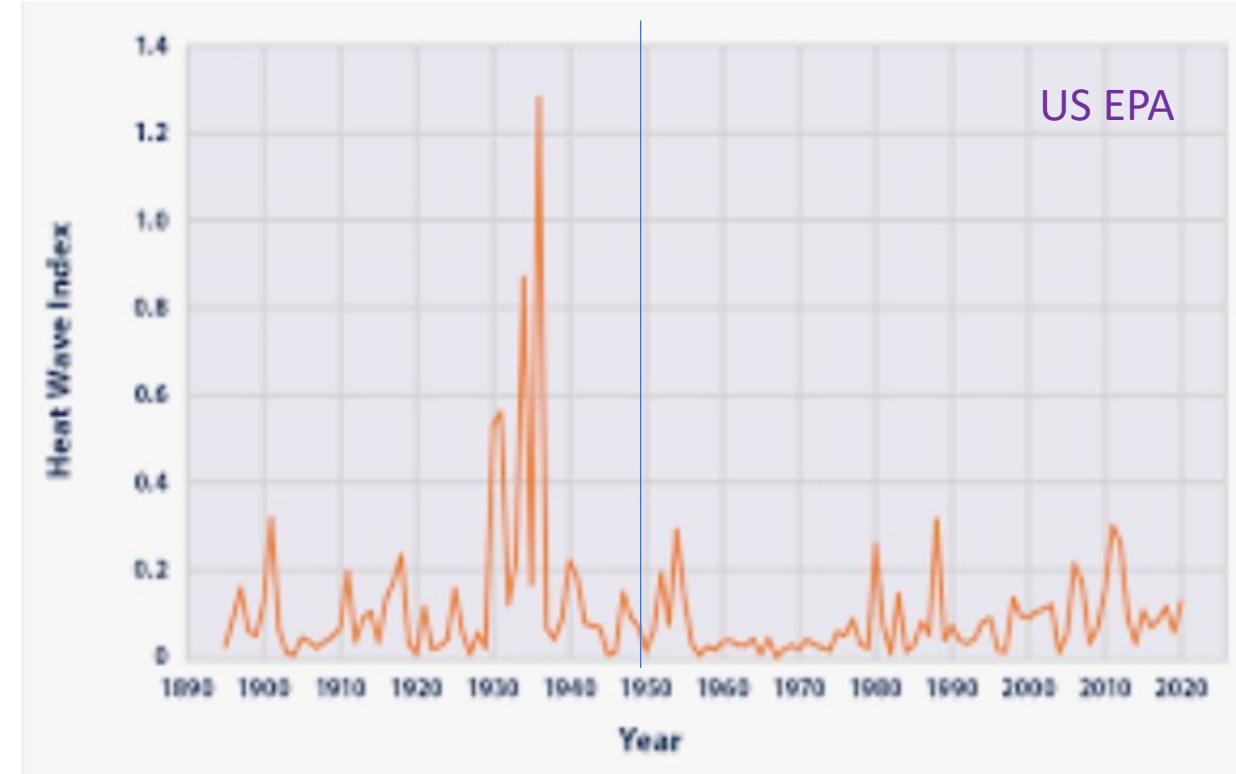
Hurricanes



IPCC AR6

“It is *likely* that the global proportion of major (Category 3–5) tropical cyclone occurrence has increased over the last four decades”

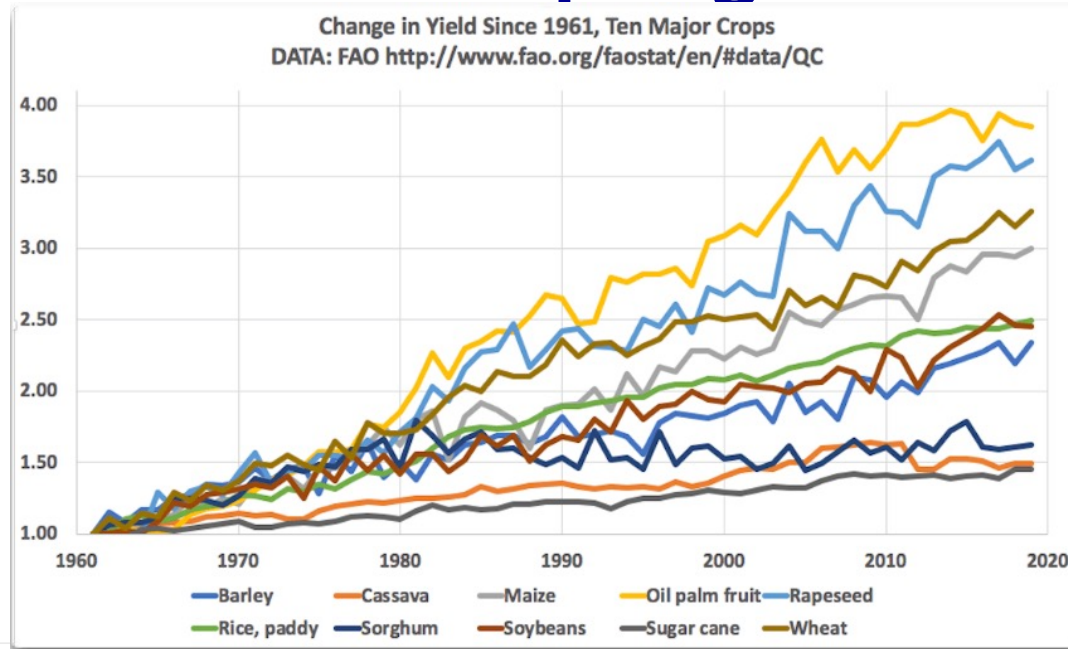
Heat Waves



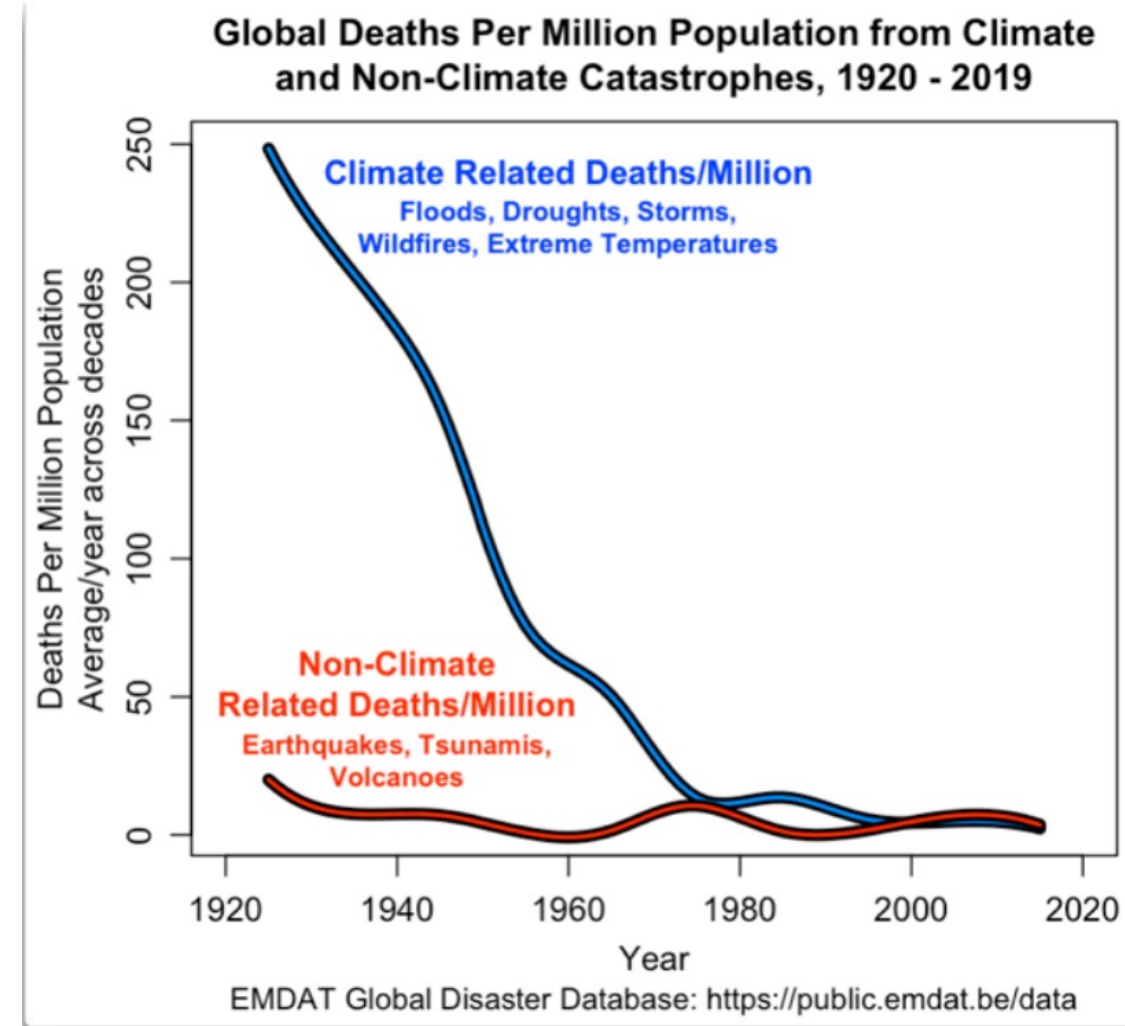
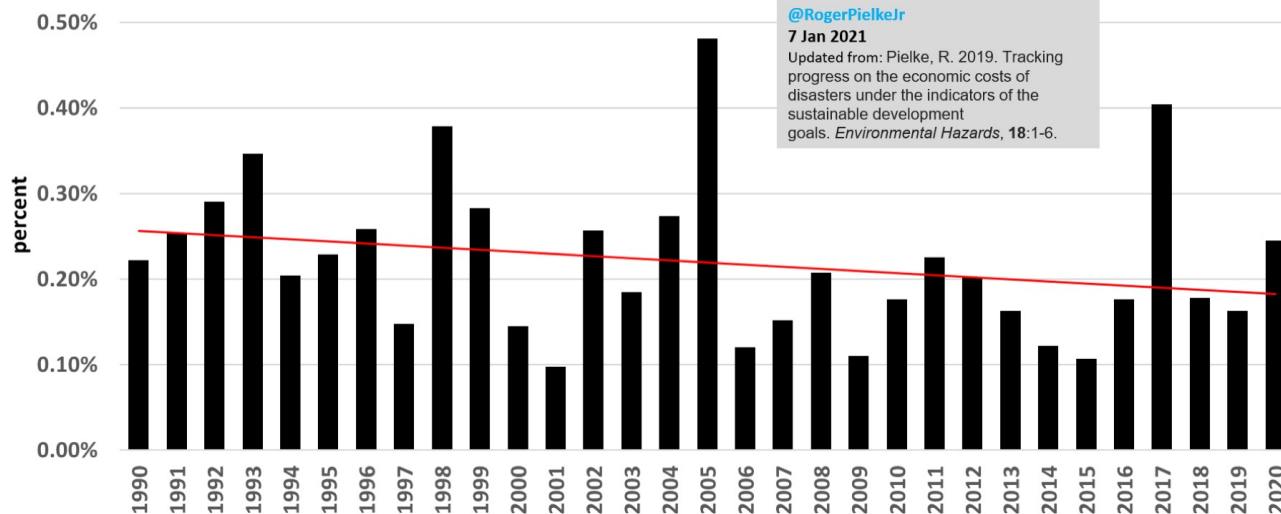
IPCC AR6

“It is *virtually certain* that heatwaves have become more frequent and more intense across most land regions since the 1950s, while cold waves have become less frequent and less severe”

The world is adapting to Xtreme weather, climate change



Global Weather Losses as Percent of Global GDP: 1990-2020
(Sources: Munich Re, World Bank)

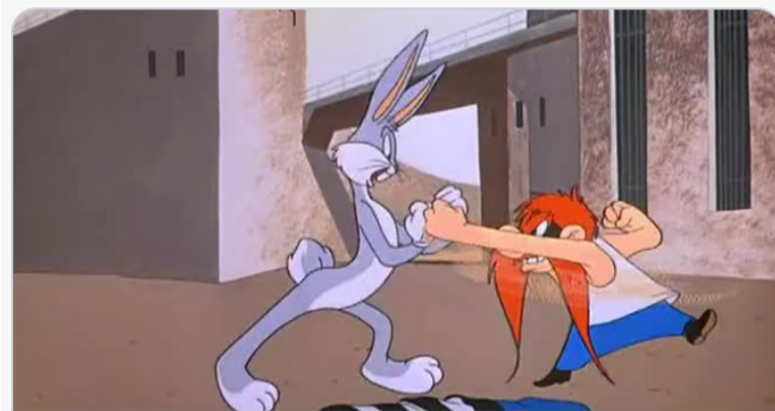


Should we urgently reduce emissions to prevent warming?

Yes – netzero by 2050

Plan A

- **Precautionary Principle**
- Reducing CO₂ emissions is **critical** for preventing future dangerous warming of the climate
- **Renewable energy** is preferred, particularly solar and wind



No

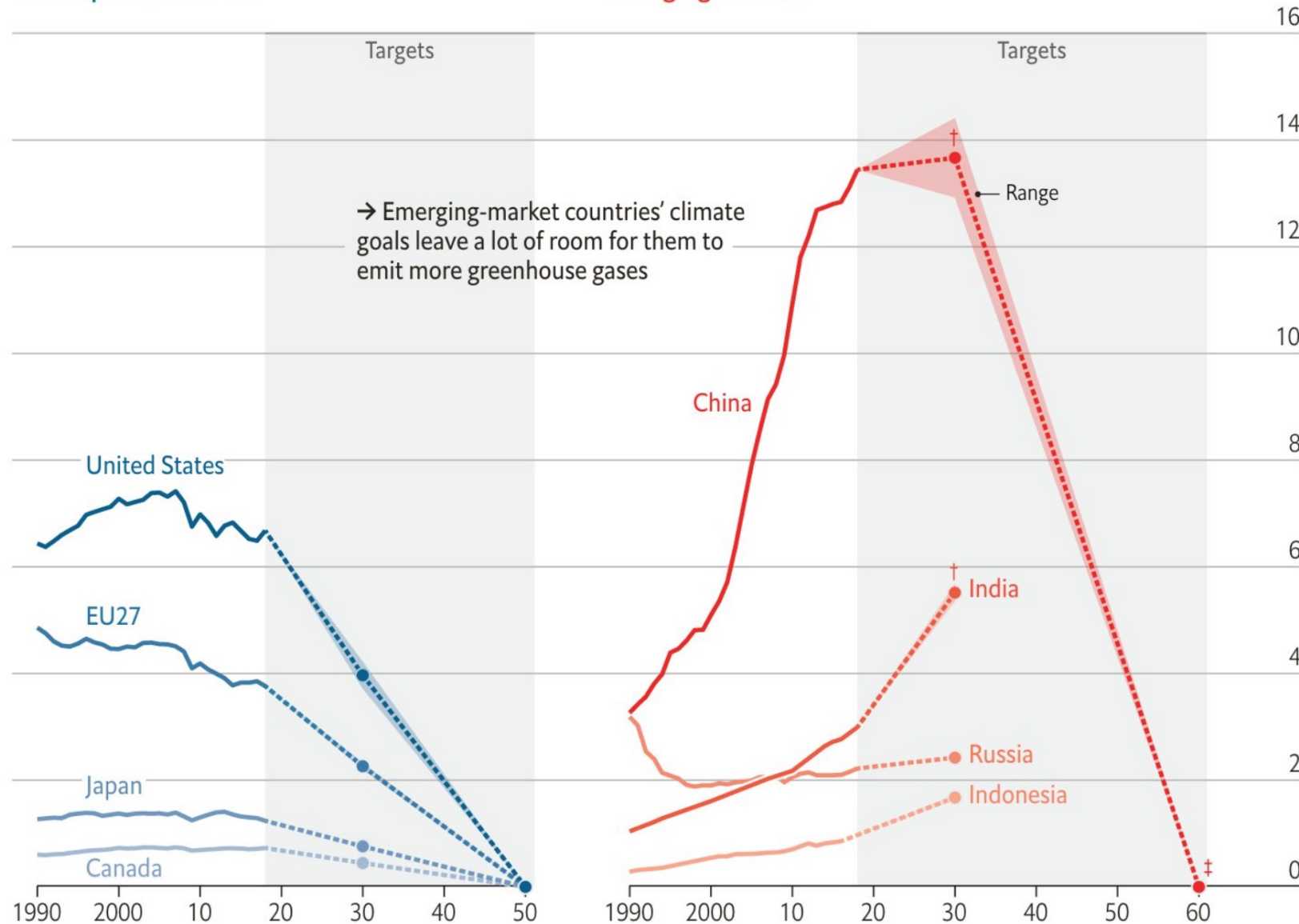
- Any near-term reduction in warming would be minimal and at **high cost**
- The ‘cure’ could be worse than the ‘disease’; **unintended consequences**
- Requires **global reduction in emissions**; highly unlikely
- Best to focus on **resilience**: keeping economies strong and making sure everyone has access to energy
- **Opportunity costs**; climate isn’t the only problem

Greenhouse-gas emissions*, tonnes of CO₂ equivalent, bn

Four largest emitters in each group

Developed economies

Emerging markets



*Excluding forestry and other land use, except net-zero targets which include emissions removals from these sources

†Multiple targets ‡Unclear whether this targets CO₂ or all greenhouse gases

Netzero by 2050 - IEA Roadmap Energy Sector

- Requires huge leaps in clean energy innovation
- Major efforts to build new infrastructure
- “Possible” but narrow pathway

Wicked problem:

- Multiple problem definitions
- Contentious methods of understanding
- Disagreement among experts
- Chronic conditions of ignorance
- Unintended consequences of solutions

Social 'mess':

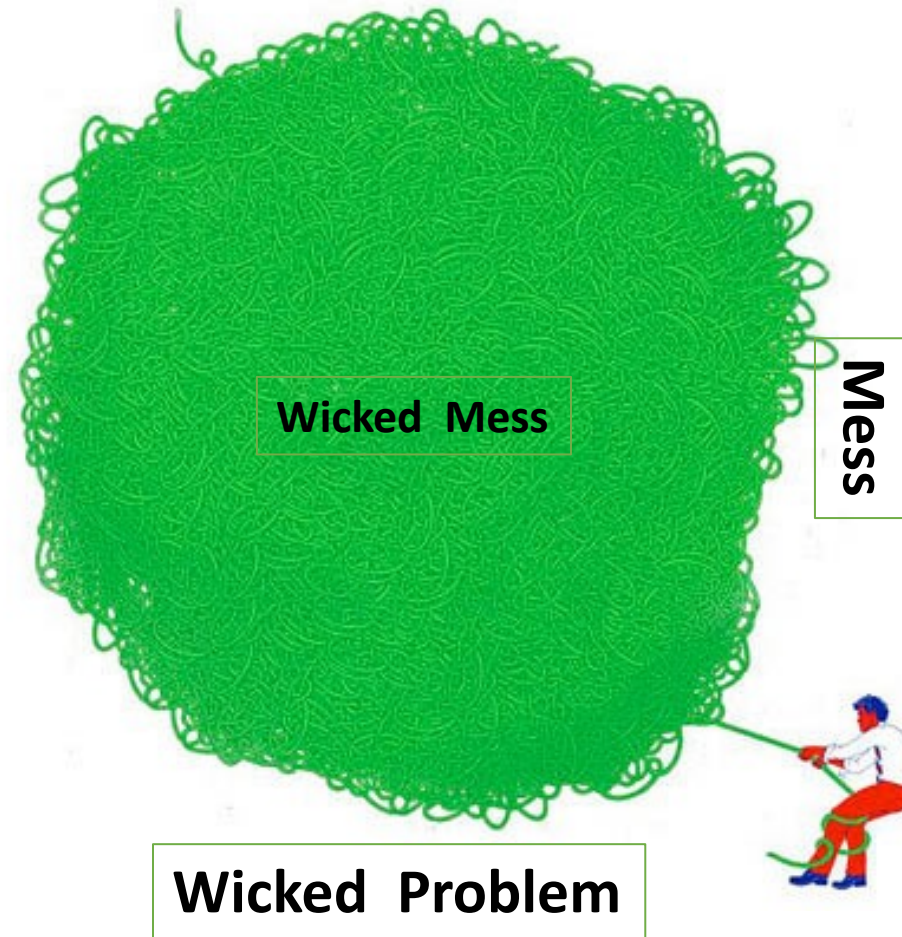
- No unique, correct view of problem
- Contradictory solutions
- Economic & political constraints
- Consequences difficult to imagine
- Great resistance to change

Deep uncertainty:

- Prediction models are inadequate
- Heavy reliance on subjective judgment
- Disagreement on desirable alternative outcomes

Tame problem:

- Everybody agrees on the problem and solution
- Cost/benefit analysis



Climate Pragmatism – Plan B

- Food
- Energy
- Water
- Ecosystems

- Accelerate energy **innovation**
- Build **resilience** to extreme weather
- **No regrets** pollution reduction
- Protect the **environment**

Low-hanging fruit:

- ‘Silver buckshot’ solutions – feasible, politically viable, affordable, no regrets
- Local solutions – secure the common interest

Benefits:

- near-term socioeconomic & environmental **benefits**
- supports climate mitigation & adaptation
- justifications **independent** of climate mitigation & adaptation

Avoids:

- political gridlock
- costly policies with minimal impacts on climate
- policies with adverse, unintended consequences

Does **not** require:

- agreement about climate science
- agreement about risks of uncontrolled greenhouse gases

Problems with mixing politics and science

"What you get when mix politics with science is . . . just politics, unfortunately."

Policy makers misuse science by:

- science as a vehicle to avoid 'hot potato' policy issues
- expecting black-and-white answers to complex problems
- demanding scientific arguments for desired policies
- government funding for a narrow range of projects that supports preferred policies.

Scientists misuse science for policy making by:

- playing power politics with their expertise
- conflating evidence with expert judgment
- ignore data and research paths that undermine their political preference
- entangling disputed facts with values
- intimidate scientists whose research interferes with their political agendas



Personal statement

My **job as a scientist**: to critically evaluate evidence and challenge and reassess conclusions drawn from the evidence.

4 years ago, I **resigned my tenured faculty position** because of academic political pressures that interfered with doing my job

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