

# Climate Change

## Gerzensee Presentation

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July 2023

# Intro, Level, Point

- ▶ Based on textbook (and soon tradebook).
- ▶ Very, very brief presentation of a very, very big topic.

<https://www.ivo-welch.info/research/presentations/>

# Big Takeaway

Surprisingly little worth disagreeing about

Shouldn't be very controversial

# Talk (and Textbook and Course) Outline

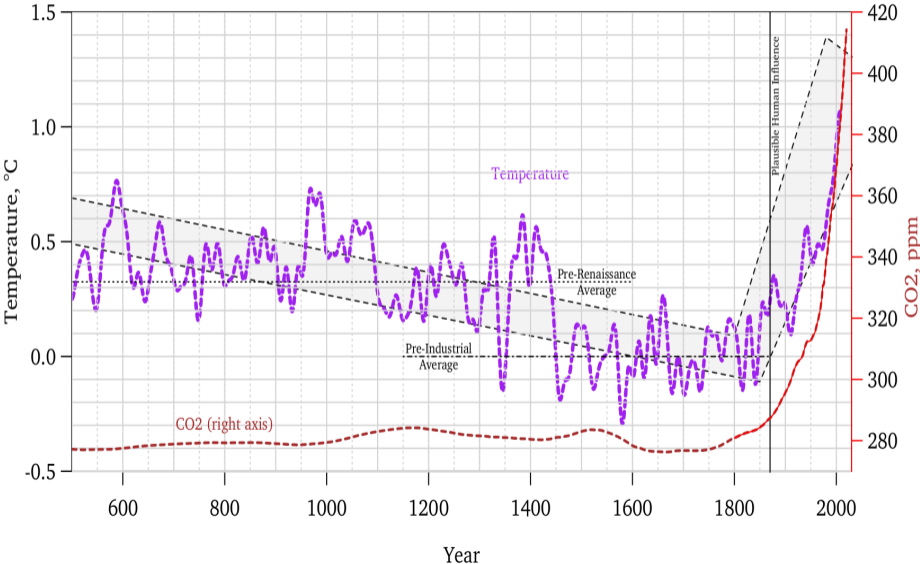
1. Climate Change Earth Science Background
2. Social Science Perspective
3. Technological Situation

# 1. Climate Change (Earth Science)

- ▶ **Hold policy questions until “2. Social Science.”**
- ▶ **Until 2, science questions only, please.**

- ▶ I use data and predictions from the IPCC.
  - ▶ Reasonably good, despite some (reasonable) quibbles.
    - ▶ Like economics: Not everything is correct and unbiased — but it's way better than the alternatives.
    - ▶ Like economics: In flux. Not knee-jerk but reasonably disciplined.
    - ▶ What would even be reasonable alternatives?
  - ▶ More than good enough for agreement.
    - ▶ Disagreements and quibbles are minor and unimportant *for us*.

# Strong Historical Evidence



There are many extra interesting and mostly self-contained figures on:  
<https://www.ivo-welch.info/research/presentations/ccfigs/>  
Omitted here.



# Strong Current Predictions

- ▶ Earth is and has been heating up
  - ▶ Measurable **current** radiation imbalance: In-Out.
- ▶ Earth will continue to do so.
  - ▶ Lots of uncertainty about **future**.
  - ▶ Only modest disagreement now. (See below.)
  - ▶ Mean consensus: Think  $\approx 2-3.5^{\circ}\text{C}$  by 2150 ( $1^{\circ}\text{C}$  already).
    - ▶ baseline always difficult to keep straight. I consult book.

# Meaning of Climate Change

- ▶ Think 100-mile distance for every 1°C.
- ▶ 2°C: Boston vs. NY vs. DC vs. Raleigh
- ▶ 4°C: Munich vs. Milan vs. Palermo
  - ▶ Think Scandinavia, Germany, Italy, Israel
  - ▶ Not uninhabitable, but different
  - ▶ Problems where hot, poor, and populous

# Far Worse Uncertainty Potential

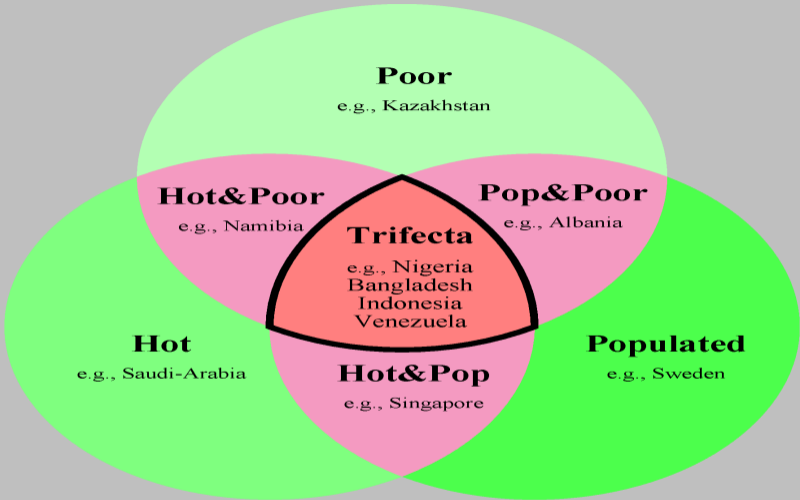
- ▶ High uncertainty:
  - ▶ doubling CO<sub>2</sub> leads to  $x^{\circ}\text{C}$
  - ▶ roughly, climate sensitivity coefficients of 1-5
- ▶ More catastrophic scenarios, say up to  $4^{\circ}\text{C}$ , possible.
  - ▶ domino effects, feedback loops, tipping points, unknowns.
  - ▶ low probability, but not farthest-possible prob tail
  - ▶ nothing is certain (also asteroids)

# Meaningful Reductions in Emissions (IPCC)

- ▶ RCP 4-5: Aggressive Activism: +2°C
- ▶ RCP 6-7: Complaisant Neglect: +2.5°C
- ▶ Difference: only 0.5°C.
  - ▶ Think 50 miles on 200-300 mile expected move.
  - ▶ Would likely be better for humanity *overall*
  - ▶ yet also think: 4.5x or 5.0x richer than today?
  - ▶ don't take models too seriously

# Harm Locations

- ▶ Not easy to predict.
- ▶ Diseases, deaths plausible — though odd.
- ▶ Reasonable guesses possible (next page)
- ▶ 4.5x or 5.0x perhaps less important than Africa/India?
- ▶ But growth today also hugely important.



**Poor**

e.g., Kazakhstan

**Hot&Poor**

e.g., Namibia

**Pop&Poor**

e.g., Albania

**Trifecta**

e.g., Nigeria  
Bangladesh  
Indonesia  
Venezuela

**Hot**

e.g., Saudi-Arabia

**Populated**

e.g., Sweden

**Hot&Pop**

e.g., Singapore

**Rich&Cold&Empty**

e.g., Antarctica

# MSL

- ▶ Expected Mean Sea Level (MSL) Rise:  $\approx$  1-2 feet.
  - ▶ probably much slower but also unstoppable
  - ▶ will/could be 6 feet if glaciers melt. (200 years?)
  - ▶ 240 feet since last ice age
  - ▶ fight climate change? 10 cm exp diff
  - ▶ argue? nah...leave it to Koonin. unimportant.

# CC Earth Science Summary

- ▶ likely bad, esp where hot&poor
  - ▶ would be better to reduce emissions
- ▶ likely not the end of the world
  - ▶ nothing is guaranteed
- ▶ please don't argue ideology.
  - ▶ you are not an advocat in court.



# Curse of Emission Fighting

At high CO2 levels, emission changes become less effective

- ▶ at 300 ppm, 100 years of zero OECD emissions would have made a big temp difference (perhaps 0.5°C).
- ▶ at 600 ppm, makes only half the temp difference.
- ▶ at 1200 ppm, makes only a quarter the temp difference.

# Constraint to Policy?

- ▶ Is CC policy limited by disagreement about CC science?

World Temp Maps and Trend Maps

# Economic Workhorse Models

- ▶ Integrated Assessment Models (IAM)
- ▶ Nordhaus, Stern IAMS
  - ▶ seminal and great (but) sketch models.
  - ▶ CC is economically harmful. SCC (not /tC but /tCO<sub>2</sub>).
  - ▶ Shadow price of emissions is \$30-\$50/tCO<sub>2</sub>.
  - ▶ Add in CC uncertainty, shadow price is more like \$100 / tCO<sub>2</sub>
    - ▶ convex damages
  - ▶ SCC should be rising in the future.

## Textbook Treatment of IAMs

- ▶ The textbook gives explanations of different perspectives.
  - ▶ Some disagreement on discount rate etc. Too literal?
  - ▶ Nordhaus believes in “climate pacts.”
  - ▶ Fair to many different valid perspectives.
- ▶ Optimal: \$30-\$100/tCO<sub>2</sub> tax.

# Really?

- ▶ Problem is not about what “we” *should* do.
- ▶ Problem is also not about blame or ethical considerations
- ▶ Problem is about what “we” *will* do (and *can promote*).
- ▶ Textbook covers IAMs.

# Book: Main Constraint on CC Policy

- ▶ 200 self-interested countries
- ▶ World is not the Borg
- ▶ Worldwide tax on CO<sub>2</sub> is cart before the horse.

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ca 2050-2100	OECD	Not OECD
Population	12%	88%
GDP	50%	50%
Emissions	28%	72%

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## Book: OECD

- ▶ OECD is only 1/3 of emissions, soon 1/4.
- ▶ Not a luxury problem.
- ▶ Won't do much to wipe out OECD.
- ▶ Whose SCC?
  - ▶ 2% or 10%?
  - ▶ 1 mo rent vs 5 mo rent?



# Need It More Obvious?

Spend all military expenses on CC instead?

Countries have militaries for the same reason why they will not decarbonize.

1. Arguing about whether a nuclear war will kill 1 or 5 billion people is irrelevant.
2. Arguing about the optimal world choice is irrelevant.
3. Arguing about what can realistically be done *asap* to reduce the probability of nuclear war may not be ideal but it is the only relevant discussion.

(Too) obvious?

# Already Revealed Preference

As of 2020s, three decades by now:

- ▶ World can suck out at  $< \$10/\text{tCO}_2$  *on the margin* today. Who is volunteering to pay?
- ▶ Who wants to pay to suck out China's and India's increasing GDP emissions?
- ▶ EU is unimportant. Corporate disclosures are unimportant. Fair shares are unimportant.
- ▶ Who wants to bet on these policies?

# Top Choices

Sector Emissions and Fuel Type Histories

# 1+2: Realistic Remedies

1. Must work around the world. 6-7bn people.
2. Must work over decades and generations.
3. Must not be too much against self-interest.
4. Must be able to sustain majority support.

# Quick Abbreviated Tour of Tech

- ▶ Electricity (can be 2/3 of power, 1/2 of emissions):
  - ▶ As-available: already cheaper clean
  - ▶ ON-demand: soon (batteries)
- ▶ Heat:
  - ▶ Much harder: FF is one-trick pony
- ▶ Transportation
  - ▶ Grid-near: soon, happening
  - ▶ Off-grid: hopeless

# Electricity Costs (LCOE), Rough:

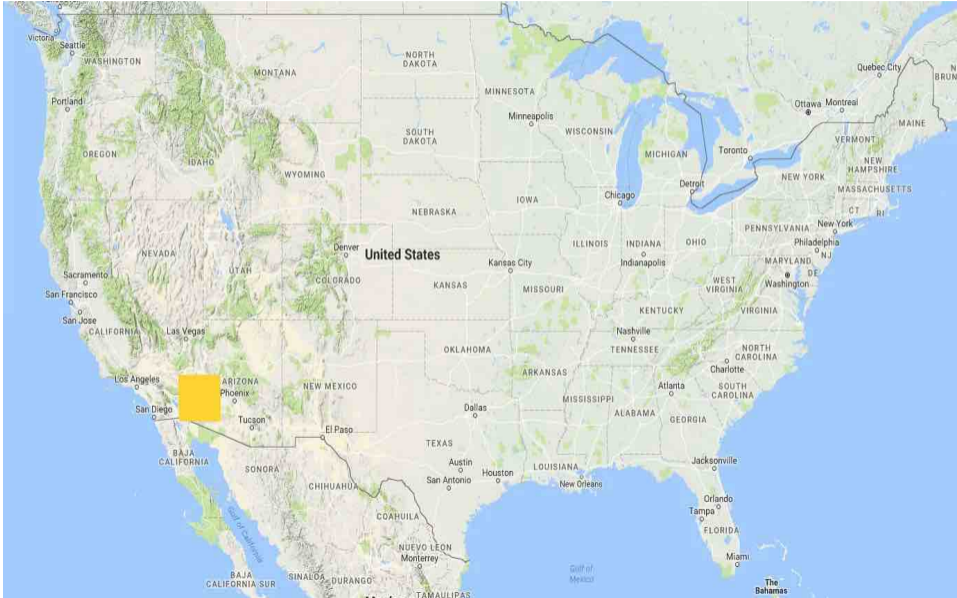
- ▶ Retail: \$200-300/MWh (incl xmit, billing)
- ▶ Coal Plant:
- ▶ Nuclear Plant:
- ▶ NatGas Plant:
- ▶ Solar / Wind:
- ▶ Battery:
- ▶ Grid Problems

# Propaganda and Truth

- ▶ Fossil fuels are nasty stuff.
- ▶ Don't trust surrogate propaganda
  - ▶ World has more than enough clean resources
  - ▶ but expect short-term hiccups
  - ▶ many self-induced.



# Little Mass



# Hydrogen

- ▶ Everybody's conceptual darling,
- ▶ but technology is *very* far away.
  - ▶ 5-10 times the cost of NatGas unsubsidized
  - ▶ *Both* fixed and variable costs are » Natgas
  - ▶ plus, highly corrosive, tough to hold
  - ▶ crazily huge IRA subsidies in US

# Industrial CO<sub>2</sub> sequestration

- ▶ deserves stupid spending (golden fleece) award
- ▶ trees for timber can do it 10 times cheaper

# Many Other Cheap Improvements (OECD)

## Urgent:

- ▶ Improve electrical grids
- ▶ Time-of-day pricing
- ▶ Concierge service for government permits
- ▶ Locally justifiable ff taxes

# Conclusion

- ▶ What is there to argue about that truly matters right now and that has a good chance of success *world-wide*?
  - ▶ we know world should do more
  - ▶ we know what world won't do
- ▶ What could environmentalists be doing more smartly?
- ▶ Much more detail and backup in our free textbook.
  
- ▶ Resources
  - ▶ <http://climate-change.ivo-welch.info/>
  - ▶ <https://www.climate-change.ivo-welch.info/home/16-cribsheet.html>

# Sidenote: My Own Current Empirical Work

- ▶ Harm so far determined more by heat than wealth. (EoY)
- ▶ IAMs have omitted contingent real-options insight