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Climate Change Economics

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Marin Academy
Lunch and Learn
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1

Outline

- Economic Building Blocks
- Climate Change
- Impacts of Climate Change
- Reducing Emissions
- Climate Change Policy
- Policy in Action

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2

Economic Building Blocks

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How Can Economists Help Fight Climate Change?

- By measuring climate change damages and estimating the costs of fighting climate change.
- By assessing behavioral reactions to climate change.
- By designing smart policies that minimize costs to society.

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4

4

Econ Basics: When Everything Is Simple, No Regulation Is Needed for Efficiency

- Simple transactions: buyer and seller feel all costs and benefits of sales
- They choose based on the costs & benefits they feel
- → Efficient number of transactions! (Maximizes social benefits)

5

When Our Decisions Affect Others, We Need Regulation

- **Pollution causes an EXTERNALITY: a side effect (here, a cost) that affects someone else**
  - Polluting things have an "unfair cost advantage" because part of cost is offloaded on others.
  - → Too much pollution is generated
  - Regulation limiting pollution has net benefits.
- ***The "efficient" amount of pollution balances costs & benefits of pollution***



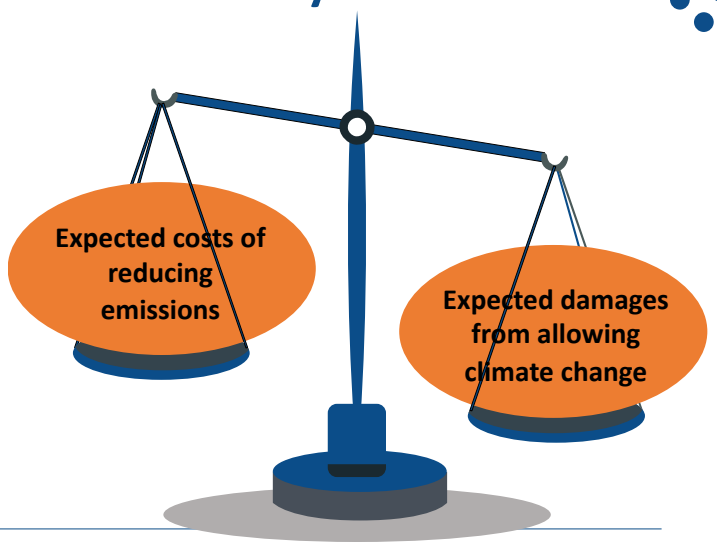
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How Economists Decide How Much to Fight Climate Change: Cost Benefit Analysis

Abating greenhouse gas emissions is costly…

… but without action, climate change damages are even more costly.

Goal is not zero emissions, but an efficient level that achieves a balance.

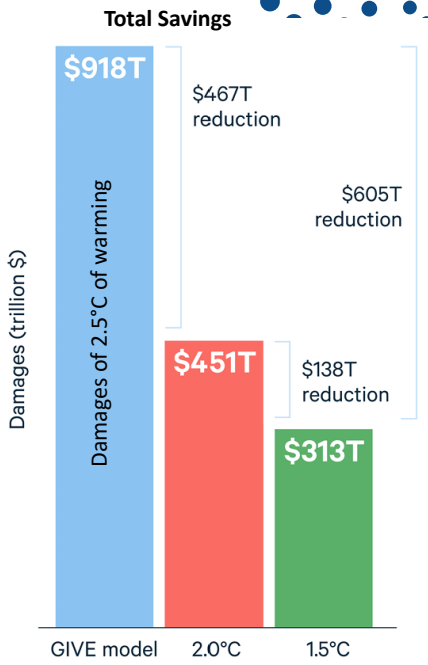


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Estimates of Benefits of Fighting Climate Change

- **Policies already declared should limit warming to 2.5°C.**
- **Keeping warming even lower would yield additional global benefits of:**
  - 2° → $5.2T annually ($467T Total)
  - 1.5° → $6.8T annually ($605T Total)
- **Global GDP is about $106 Trillion, so these numbers are big! (5-7%)**



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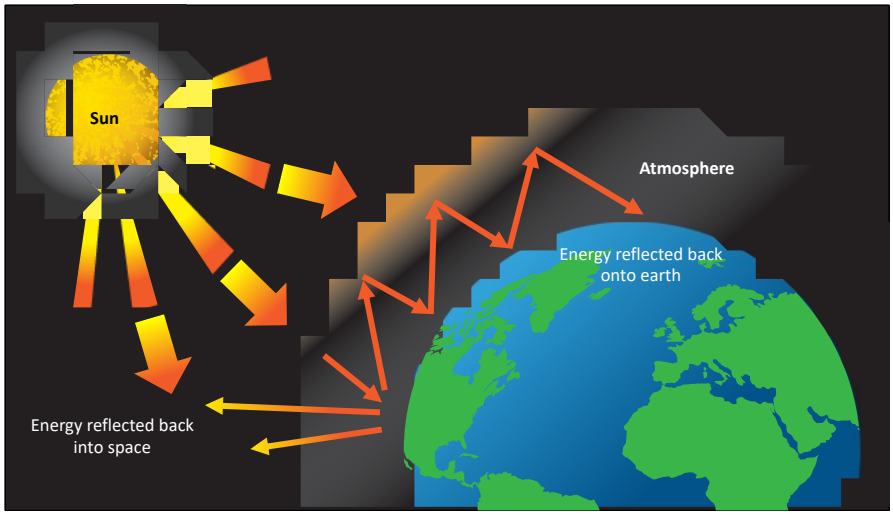
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Climate Change

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9

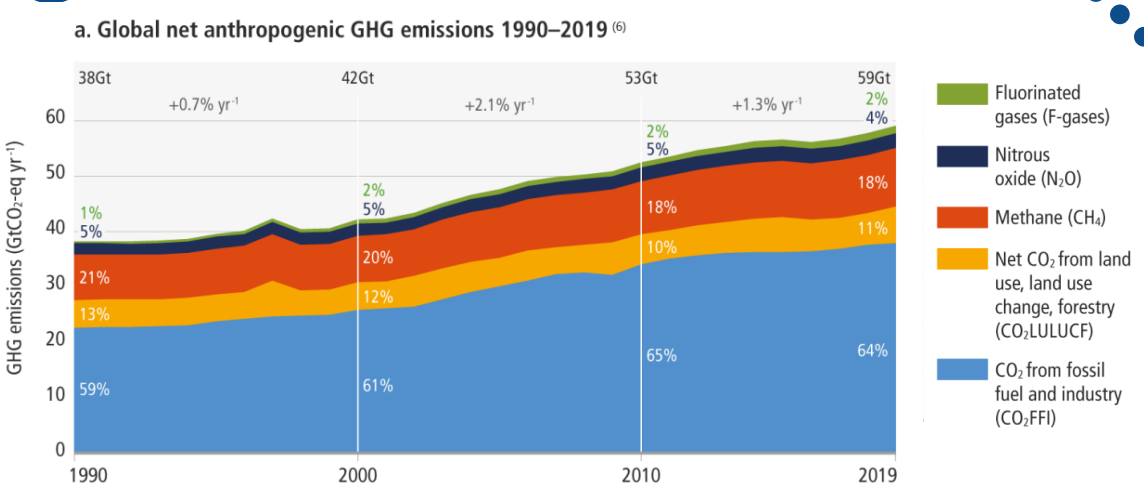
The Atmospheric Greenhouse Effect



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Greenhouse Gas Emissions 1990-2019

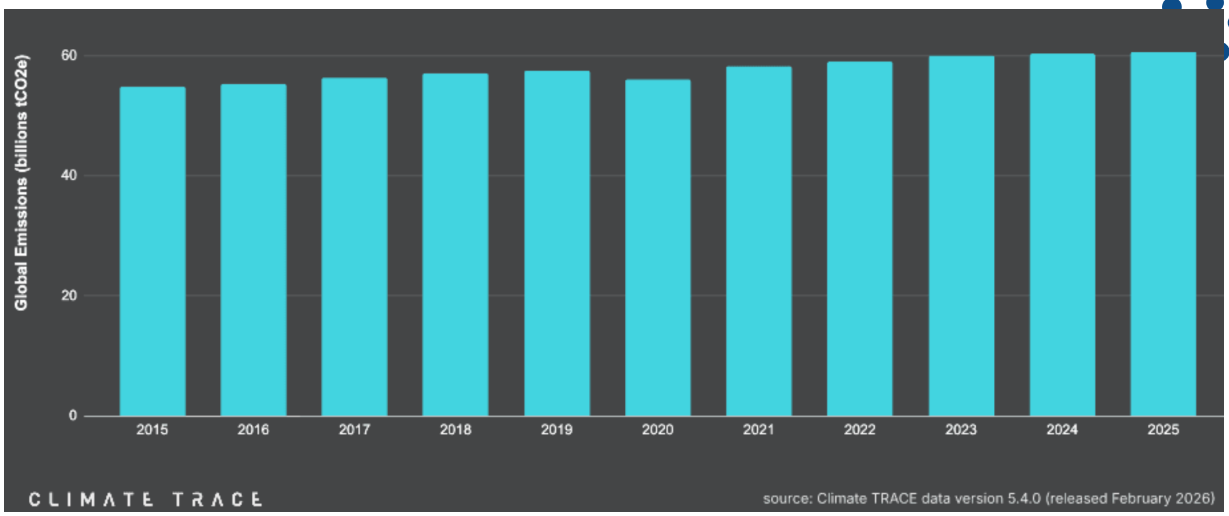


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Source: IPCC

11

Greenhouse Gas Emissions 2015-2025

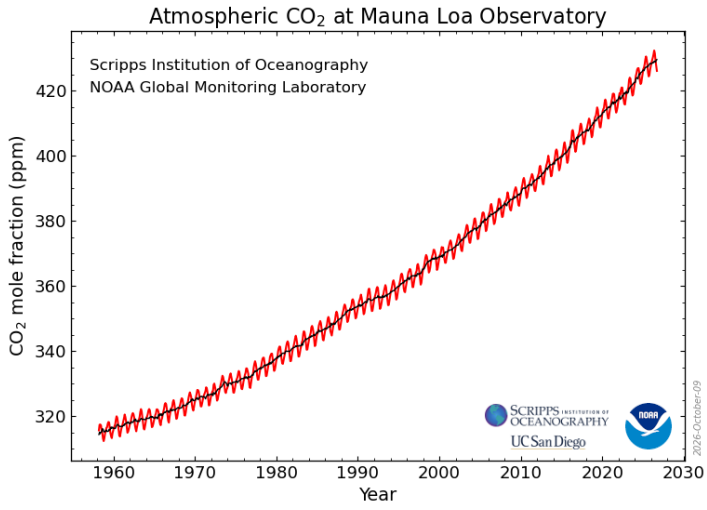


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Source: IPCC

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Atmospheric CO_2 Concentrations Up To Now



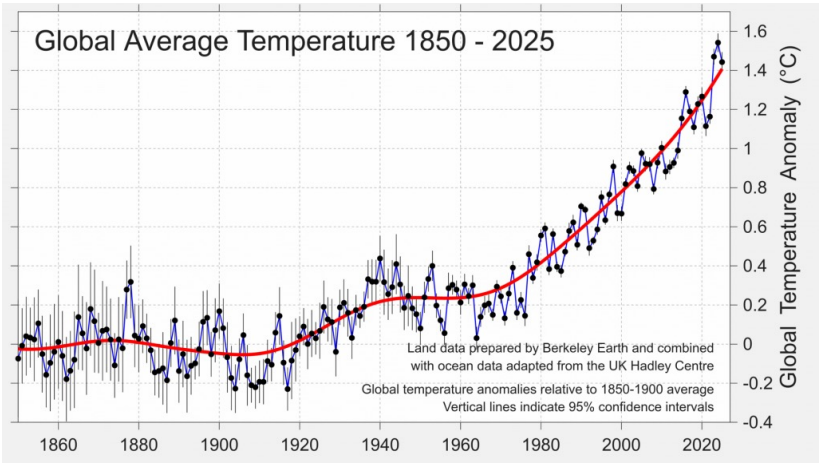
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Source: NOAA

13

Global Temperatures are Already Changing

Surface temperatures have increased 1.4°C already as of 2025



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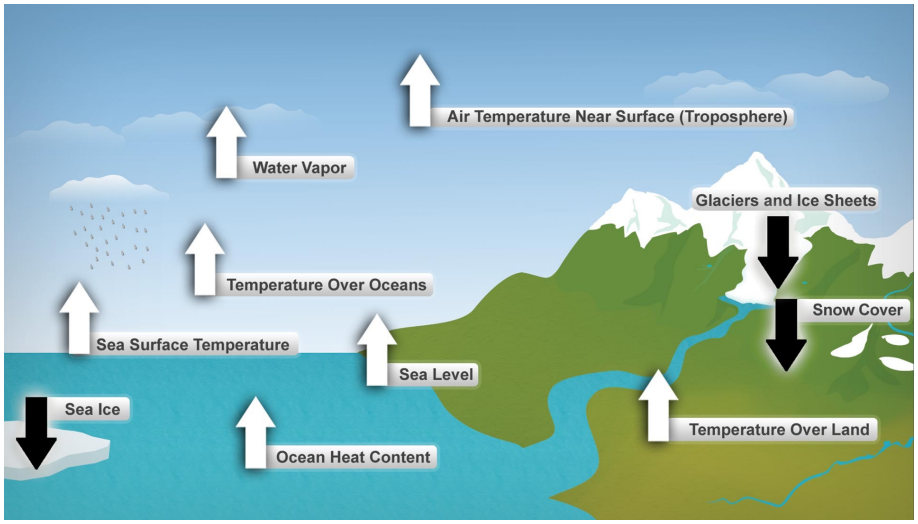
14

Impacts of Climate Change

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Global Warming Indicators



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How These Impacts Affect Humans

- Agriculture
- Fisheries
- Coastal damages
- Direct health effects, including sickness and death (temperature & drought; also pollution)
- Indirect health effects (vector-borne disease)
- Reduced fresh water availability
- Wildfires
- Shifting zones for important ecosystems, and desertification
- Reduced worker productivity
- Increased violence
- Some of these may cause human migration and/or conflict

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Social Cost of Carbon (SCC)

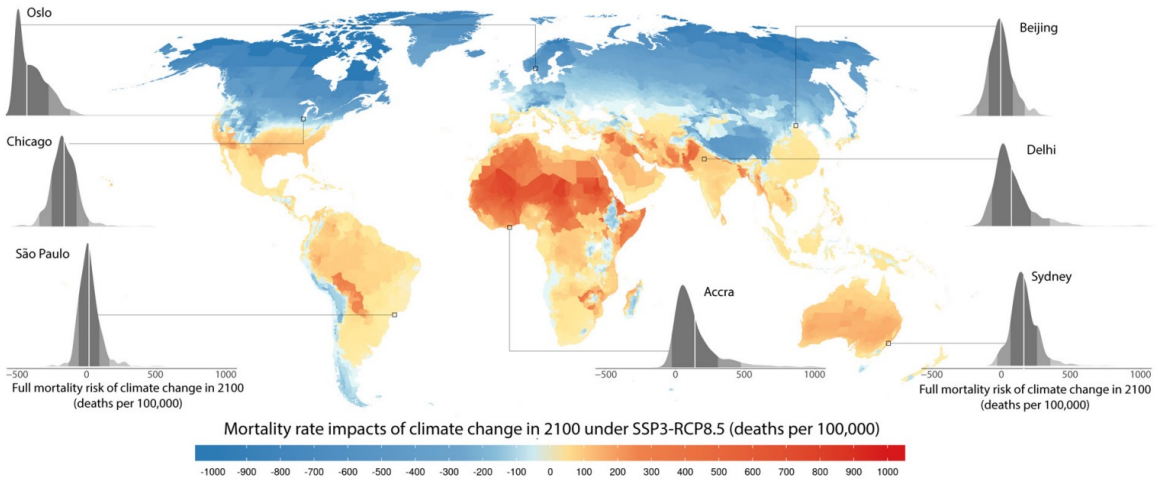
- The expected cost of damages from each unit of greenhouse gas emissions.
- Should increase over time.
- EPA used ~$51 per metric ton of CO_2 until 2024.
  - About $157/car per year.
  - $32 billion for all vehicles in the US.
- In 2024, adopted new estimate: $190.
- 2025: EPA proposes elimination of SCC.



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How Damages Will Vary Globally: Mortality as an Example



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Reducing Emissions

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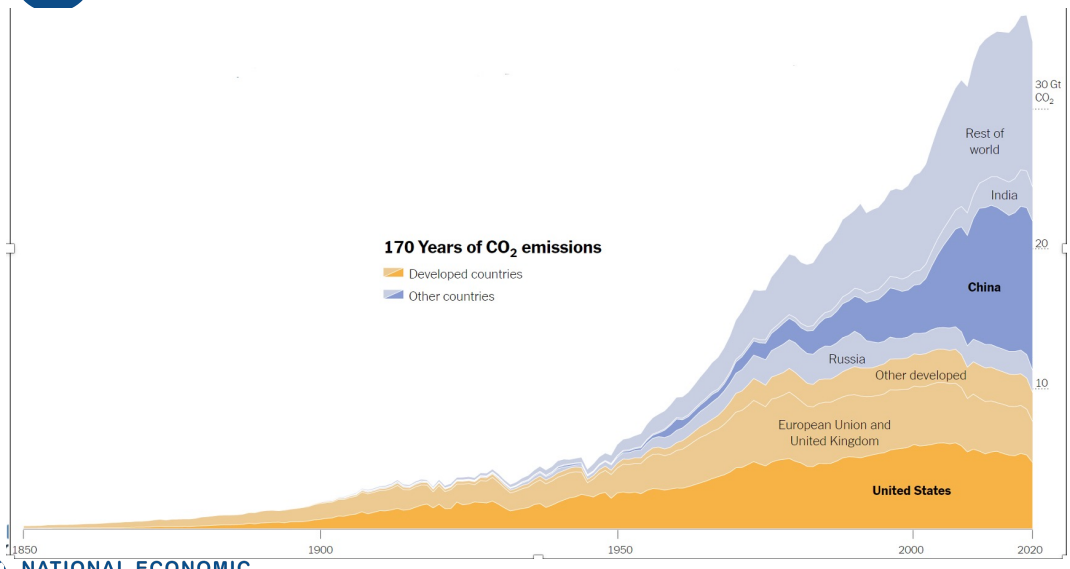
Global Net Emissions Are What We Care About

- **For climate impacts, we don't care where they are emitted, only how much.**
- **Gross emissions: volume of greenhouse gases (including CO2) we put out.**
- **Greenhouse gas sinks: ways to pull CO2 out of the air.**
  - Existing: oceans, forests.
  - Increase sinkage by planting trees, or other measures.

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Sources of the Global Flow of Emissions



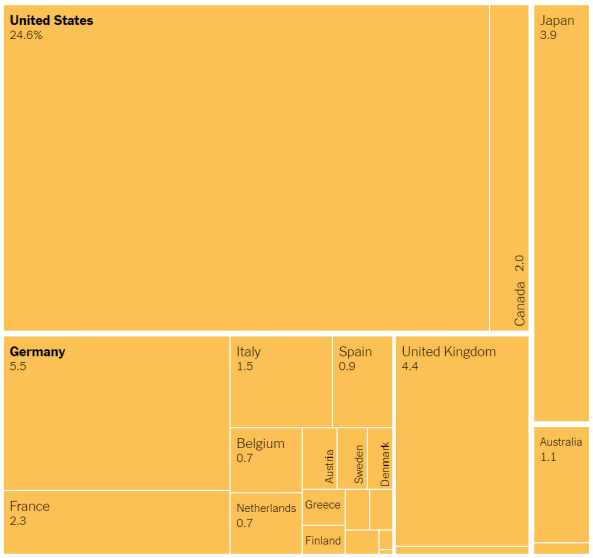
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22

Sources of the Global Stock of Emissions

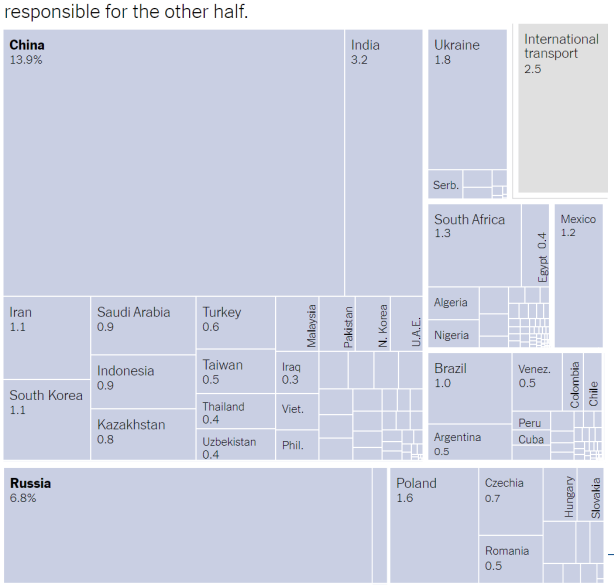
23 rich, developed countries are responsible for half of all historical CO_2 emissions.



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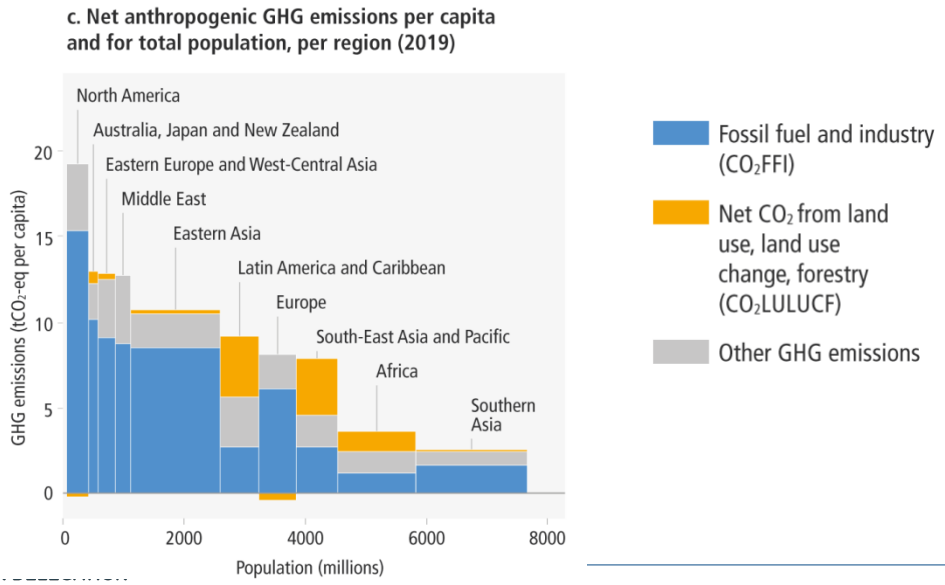
Sources of the Global Stock of Emissions

More than 150 countries are responsible for the other half.



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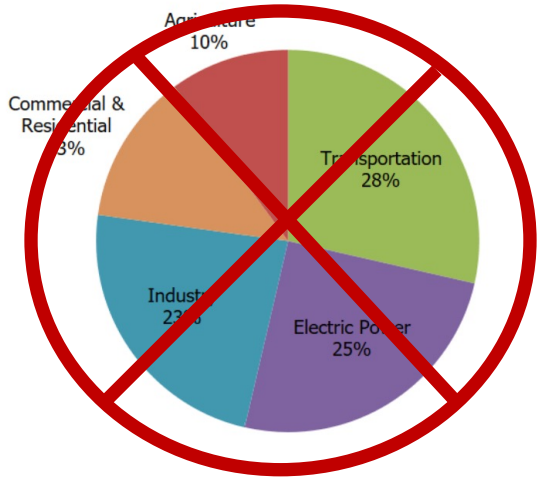
How Does This Look Per Capita (Per Person)?



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Which Emissions Should We Cut?



Total Emissions in 2021 are 6,340 Million Metric Tons of CO_2 equivalent. Percentages may not add up to 100%

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26

Which Emissions Should We Cut?



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27

Which Emissions Should We Cut?

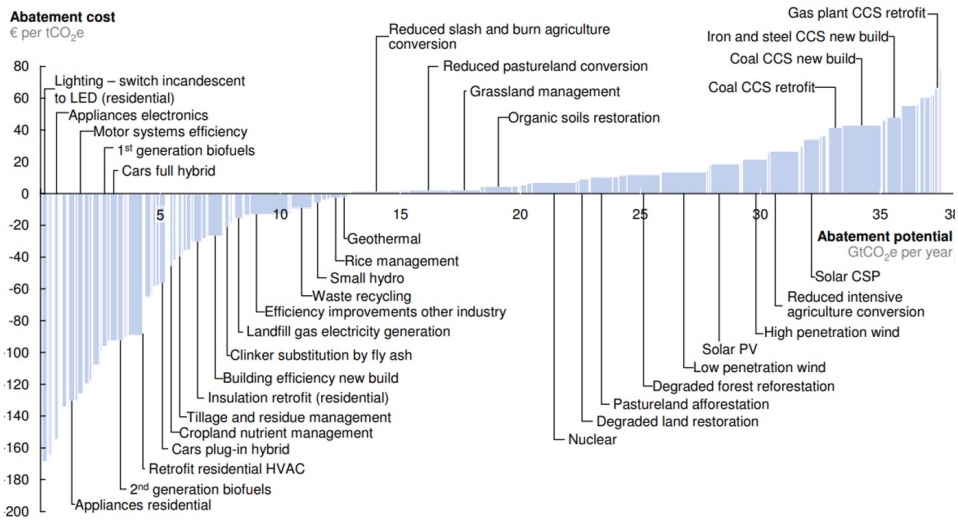
- List all possible ways to reduce emissions
- Figure out how much each can reduce in total
- Figure out how much each costs per unit of emissions reduced
- Line them up in order: cheapest to costliest
  - → Tackle first the cheapest ones!

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28

Example Abatement Cost Curve

(Don't trust these numbers, this is just to show the idea.)



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29

Climate Change Policy

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30

Policies That Reduce Emissions Directly

- **Command and control regulation**
  - Emissions standards or limits (e.g., Clean Water Act discharge limits)
  - Tech standards (e.g., require scrubbers on power plants)
- **Incentive-based policies**
  - Putting a price on emissions – leveling the playing field!
    - Tax or Cap & Trade
    - Subsidizing green energy (*e.g.*, feed-in tariffs)

How Does a Carbon Tax Work?

- **Choose activities to be covered (e.g., electricity sector, all emitters, etc.).**
- **Set tax level.**
  - Optimally, it represents the social cost of polluting.
- **Polluters must pay a tax for every unit emitted.**
  - Polluters with **low** abatement costs will **abate** to avoid the tax.
  - Polluters with **high** abatement costs will pollute and **pay the tax.**

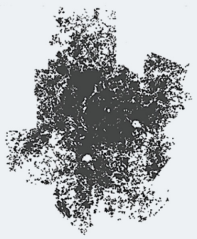
How Does Cap and Trade Work?

- **Choose activities to be covered (e.g., electricity sector, all emitters, etc.).**
- **Set maximum emissions level ("cap").**
- **Issue that many pollution permits.**
  - Can be auctioned off or given to polluters.
- **Every polluter in a covered sector must have a permit for every unit of pollution.**
- **Polluters buy and sell ("trade") permits on a market as they wish.**
  - Polluters with **low** abatement costs will make / save money by **abating** and selling / not buying permits.
  - Polluters with **high** abatement costs will buy permits and **pollute.**

Examples of Other Policies that Reduce Emissions

- **Research and development subsidies**
- **Renewable energy mandates (e.g., renewable portfolio standards)**
- **Energy efficiency mandates and subsidies (e.g. CAFE fuel economy standards)**
- **Grid / infrastructure improvements**
- **Public transportation**
- **Land use / zoning policies**

Atlanta and Barcelona Have Similar Populations but Very Different Carbon Productivity

Atlanta			Barcelona		
Built-up area			Built-up area		
					
Population	Urban area	Transport carbon emissions	Population	Urban area	Transport carbon emissions
2.5 million	4,280 km²	7.5 tonnes CO_2/person (public + private transport)	2.8 million	162 km²	0.7 tonnes CO_2/person (public + private transport)

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Source: New Climate Economy Report, 2014

35

Geoengineering and Carbon Capture

- **Technical pathways to reduce climate change without reducing emissions**
- **Carbon capture: captures CO2 emissions and stores them or "utilizes" them (for energy, pressure, etc.)**
  - Not yet proven at scale, but getting there.
- **Solar geoengineering: make the atmosphere reflect more light to regain earlier thermal balance**
  - Totally theoretical
  - Potentially risky

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36

Climate Change Policy in Action

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37

Thoughts on Regulation vs Market-Oriented

- **Equity.**
  - Both types of policies are regressive.
    - Cap and Trade and a Carbon Tax can offset the regressivity.
    - Regulations do/can not.
- **Efficiency.**
  - Market-oriented policies tend to achieve emissions reduction at much lower cost.
    - Example: CAFÉ Standards vs Carbon Tax
      - Tax is significantly more efficient.
      - Why?

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38

38

Efficiency: CAFÉ vs Carbon Tax

- **CAFÉ = Corporate Average Fuel Efficiency**
  - A fuel economy standard mandating that an auto-maker's vehicle fleet must meet minimum fuel economy standards.
- **Horse Race**
  - Tax on fuel applies to ALL vehicles, not just new.
  - Rebound Effect:
    - Driving a more efficient vehicle lowers the cost per mile driven
      - leading to more miles driven.
  - Slower turnover of inefficient vehicles: higher cost of new.
- **Summary**
  - A given level of emission reductions **costs 3-6 times more with CAFÉ** standards than under a comparable carbon tax.

39

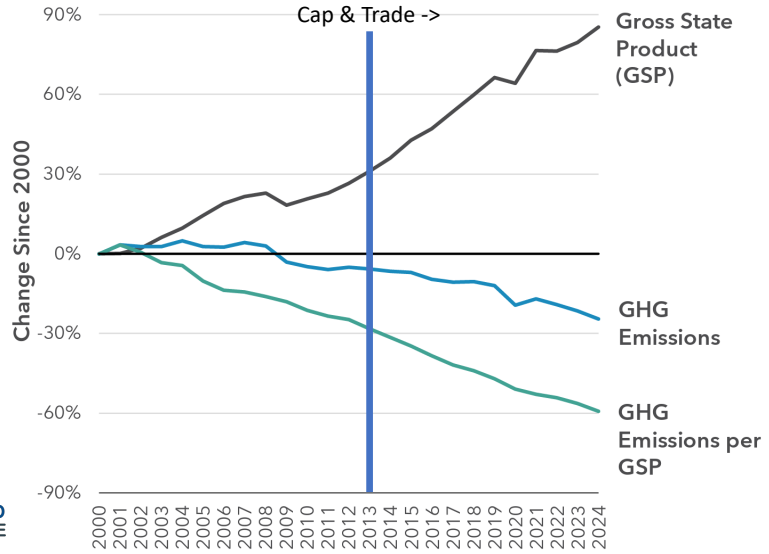
California's AB32: Global Warming Solutions



- **Passed in 2006**
- **California's goals:**
  - Reduce emissions to 1990 levels by 2020
  - An 80% reduction in emissions from 1990 levels by 2030
- **California's Tools:**
  - Cap and Trade
  - Renewable Portfolio Standard
  - Clean Cars Program
  - Low Carbon Fuel Standard

40

Changes in California Gross State Product and GHG Emissions since 2000



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41

Summary

- **Climate change is real, is caused by human actions, and has impacts we're already feeling.**
- **This problem won't solve itself; we need policy intervention, and fast.**
- **Smart policy can reduce greenhouse gas emissions by the right amount and at the lowest possible cost.**
  - For example, cap and trade and emissions taxes!
- **We also need policies to help with adaptation and support those bearing the greatest damages.**

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42

Thank you!

Any Questions?