Osher Lifelong Learning Institute, Spring 2023

Contemporary Economic Policy Issues

Duke University
May-June 2023

Host: Jon Haveman, Ph.D.
National Economic Education Delegation

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Available NEED Topics Include:

- US Economy
- Healthcare Economics
- Climate Change
- Economic Inequality
- Economic Mobility
- Trade and Globalization
- Minimum Wages
- Immigration Economics
- Housing Policy
- Federal Budgets
- Federal Debt
- Black-White Wealth Gap
- Autonomous Vehicles
- Healthcare Economics

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Course Outline

- **Contemporary Economic Policy**
  - Week 1 (5/2): US Economic Update (Geoffrey Woglom, Amherst College)
  - Week 2 (5/9): Monetary Policy (Geoffrey Woglom)
  - Week 3 (5/16): Healthcare Economics (Kelley Cullen, E. Washington University)
  - **Week 4 (5/23): Climate Change Economics (Sarah Jacobson, Williams College)**
  - Week 5 (5/30): The Black-White Wealth Gap (Mike Shor, Univ. of Connecticut)
  - Week 6 (6/6): Federal Debt (Jon Haveman, NEED)

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Climate Change Economics

Sarah Jacobson, Ph.D.
Williams College

Duke University

May 19, 2023

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Credits and Disclaimer

- **This slide deck was authored by:**
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  - NEED presentations are designed to be nonpartisan.
  - It is, however, inevitable that the presenter will be asked for and will provide their own views.
  - Such views are those of the presenter and not necessarily those of the National Economic Education Delegation (NEED).

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Outline

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

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Economic Building Blocks

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How Can Economists Help Fight Climate Change?

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

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Econ 101: 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)

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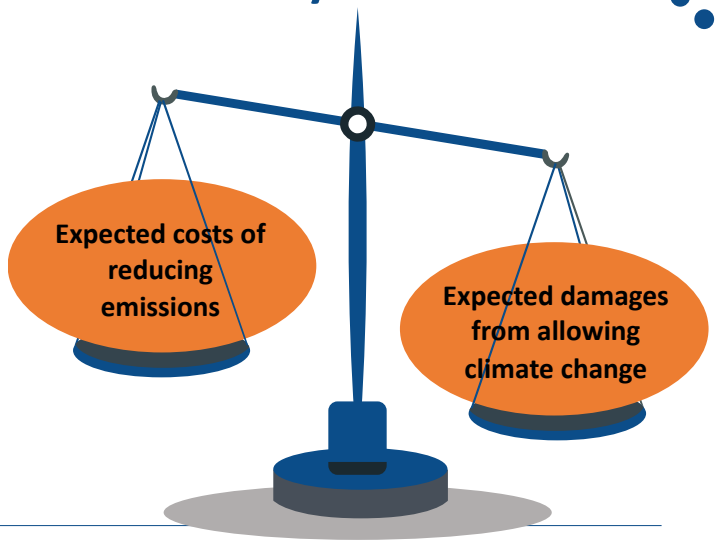
How Economists Decide How Much to Fight Climate Change: Cost Benefit Analysis

Abating greenhouse gas emissions is costly…

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

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



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Cost-Benefit Analysis of Fighting Climate Change

- **Most economic models suggest the costs of keeping warming below 2°C are relatively small, amounting to 1-4% of GDP by 2030.**
- **Costs of acting to keep warming below 2°C are almost certainly less than future economic damages they would avoid.**
  - Damages estimated to be between: **7-20% of worldwide GDP.**

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Climate Change

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A Climate Change Ladder

- Emissions
- Mitigation (a.k.a. Abatement)
- Adaptation
- Damages

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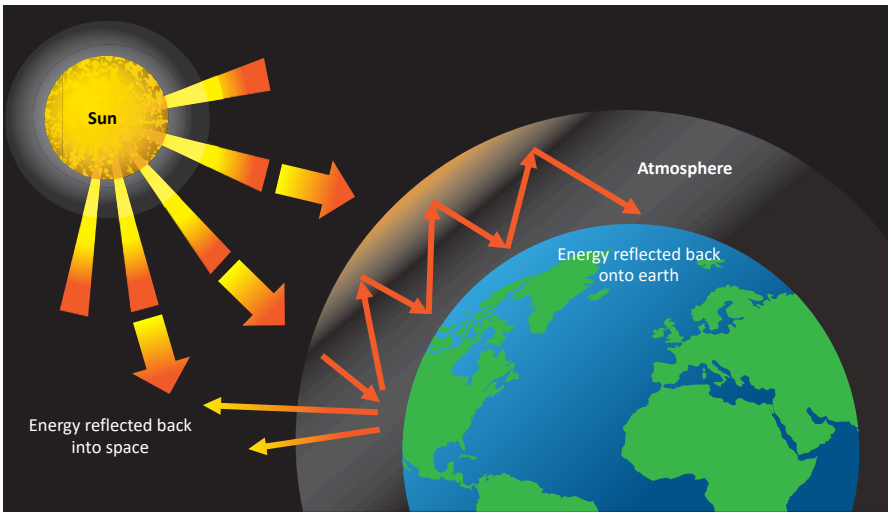
The Atmospheric Greenhouse Effect



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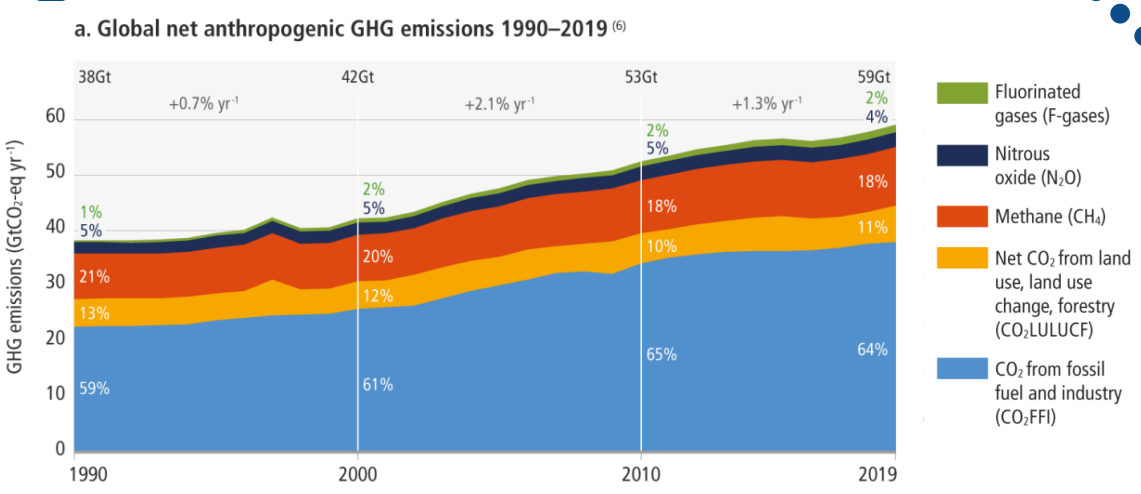
Greenhouse Gas Emissions 1990-2019



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Source: IPCC

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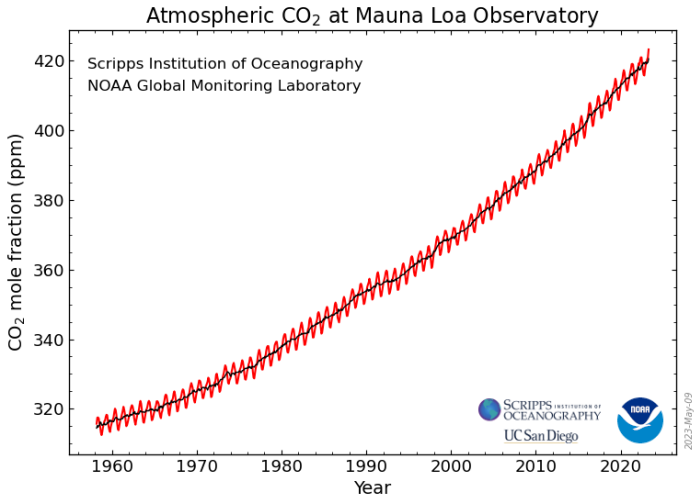
Atmospheric CO_2 Concentrations Up To Now



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Source: NOAA

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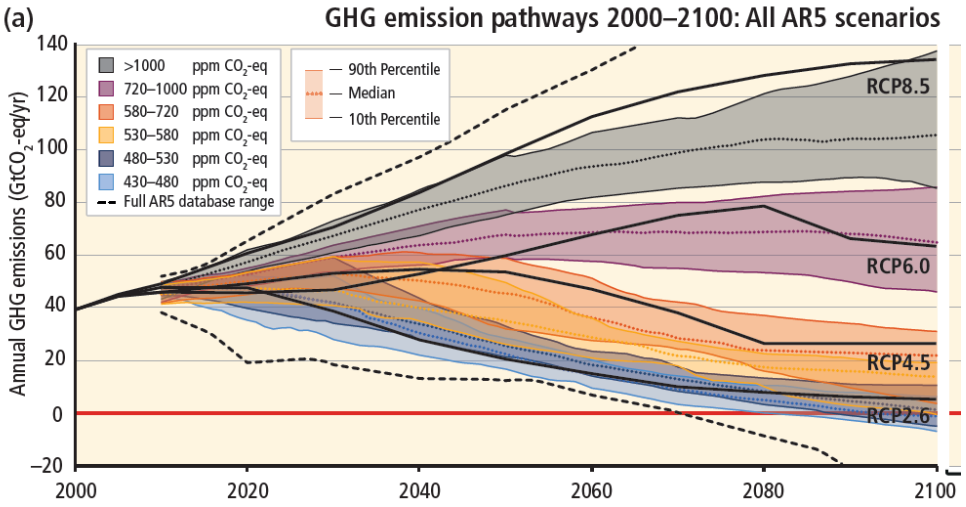
Emissions Trajectories into the Future



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Source: IPCC Assessment Report 5

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What Do Greenhouse Gas Emissions Do to the Planet?

- **Increased temperatures**
  - Sea level rise
  - Storm surges
- **Altered precipitation patterns**
- **More variable weather**
- **More / more powerful storms**
- **Carbon dissolves in ocean**

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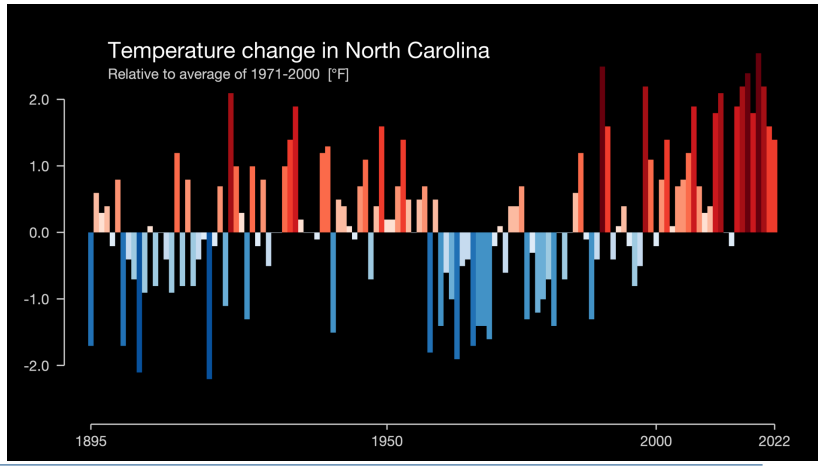
These Changes Are Already Underway

Use https://showyourstripes.info/ to see the temperature history of an area!

Here's North Carolina!



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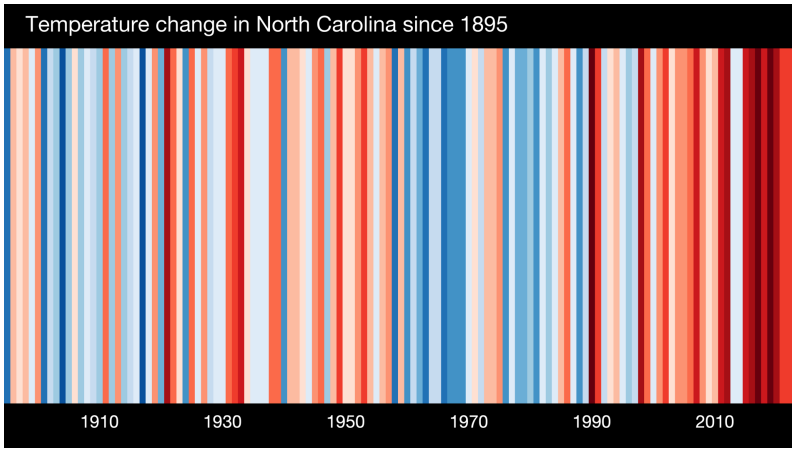

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Impacts of Climate Change

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How Climate Change Affects 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

- The expected cost of damages from each unit of greenhouse gas emissions.
- Current EPA estimate: ~$51 per metric ton of CO_2
  - About $157/car per year for an avg driver.
- But in 2022 they put forward a proposal to raise it to $190!
- Cost will increase over time.

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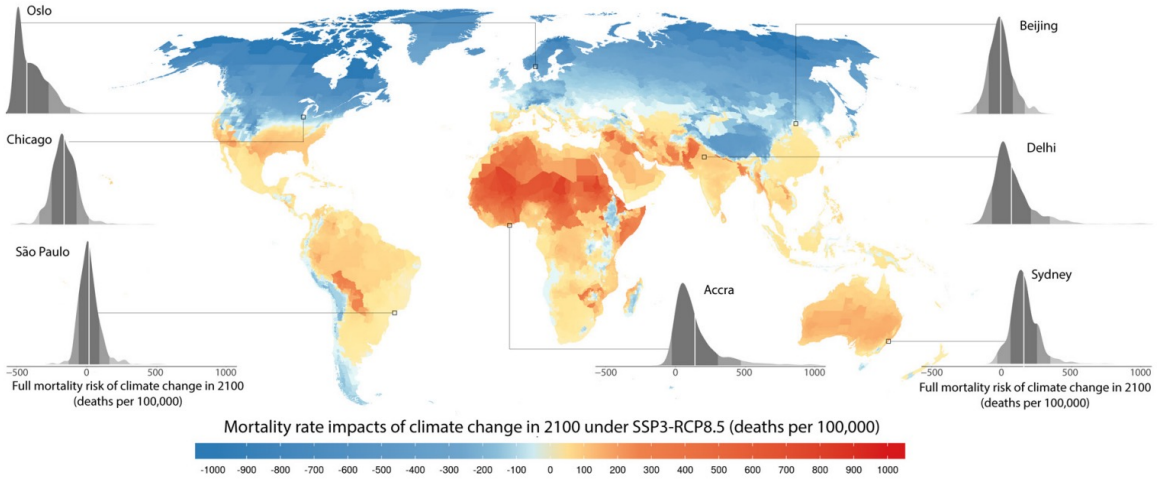
How Damages Will Vary Globally: Mortality as an Example



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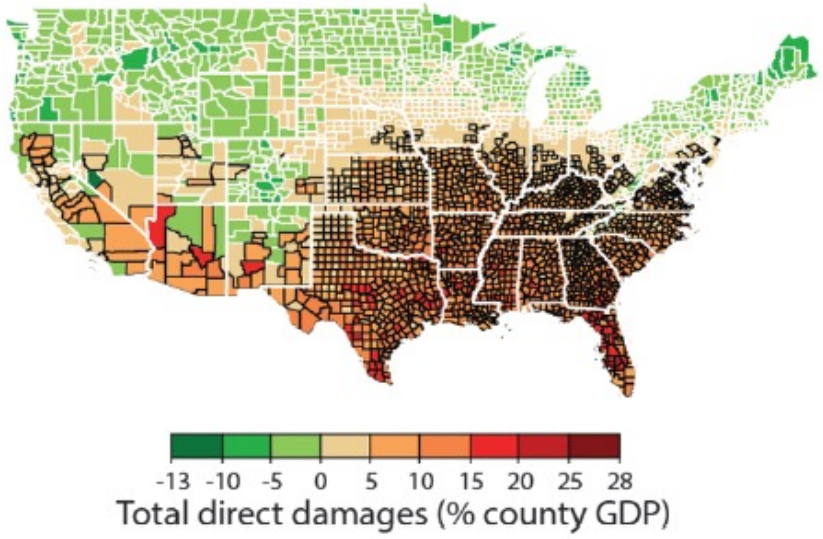
How Damages Will Vary in the US



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Adaptation Reduces Damages

- *Adaptation*: costly action that reduce damages from climate change.
- The net damage cost to society is the cost of adaptation plus the cost of remaining damages.
- People and firms will take some actions on their own, up to the point where they find it worthwhile.
- Some adaptation requires government involvement.

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Individual-Level Adaptation

- Perhaps you…
  - Stay inside more.
  - Turn on the air conditioning.
- Farmers may:
  - Plant at different times.
  - Plant new crops.
- Businesses may:
  - Give outdoor workers water / shade breaks.
- Everyone might:
  - Think about moving to a safer place.

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Public Adaptation

- **Governments can help:**
  - When collective action is less costly than everyone acting alone.
  - When individual action is not possible or likely.
  - When some people can't protect themselves.
- **Sea walls**
- **Ecosystems that provide protection**
- **Policies that protect workers or low-income and vulnerable populations**
- **Planned retreat (moving a community)**

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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**
  - There may be other local impacts
- **Gross emissions (greenhouse gas sources): how much 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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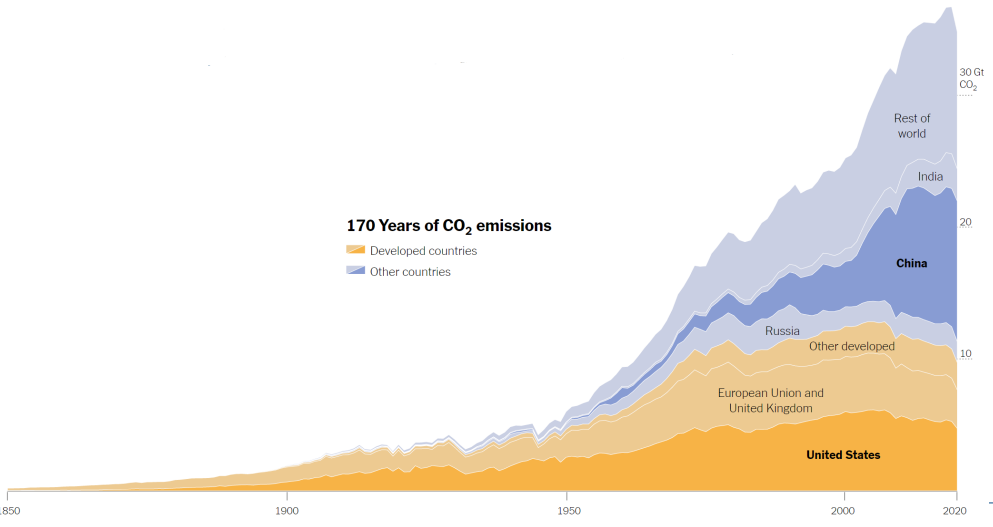
Sources of the Global Flow of Emissions



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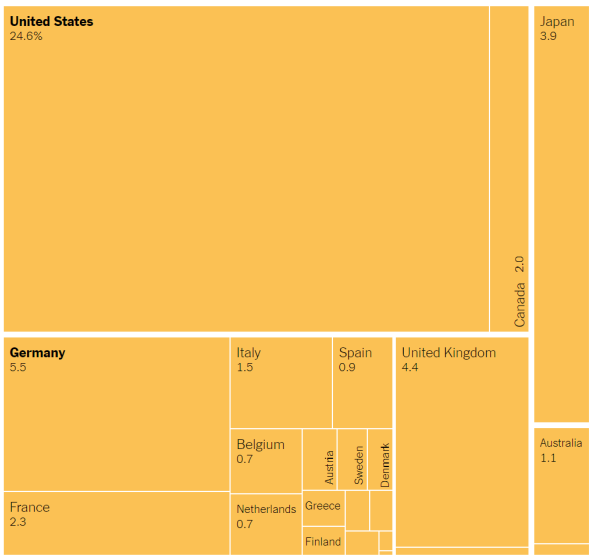
Sources of the Global Stock of Emissions

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



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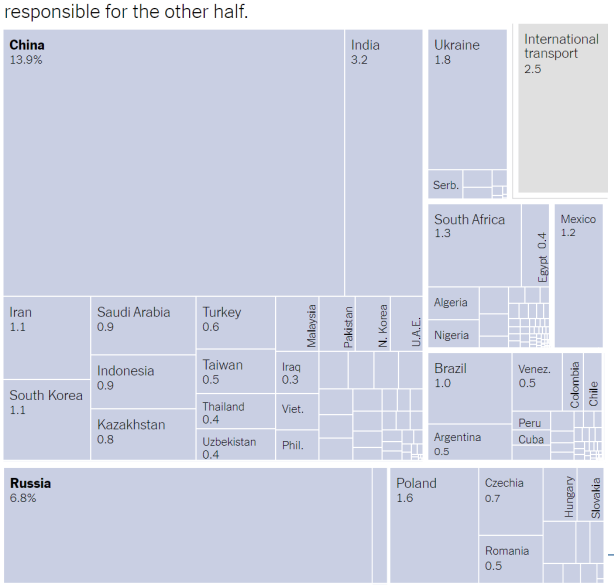
Sources of the Global Stock of Emissions

More than 150 countries are responsible for the other half.



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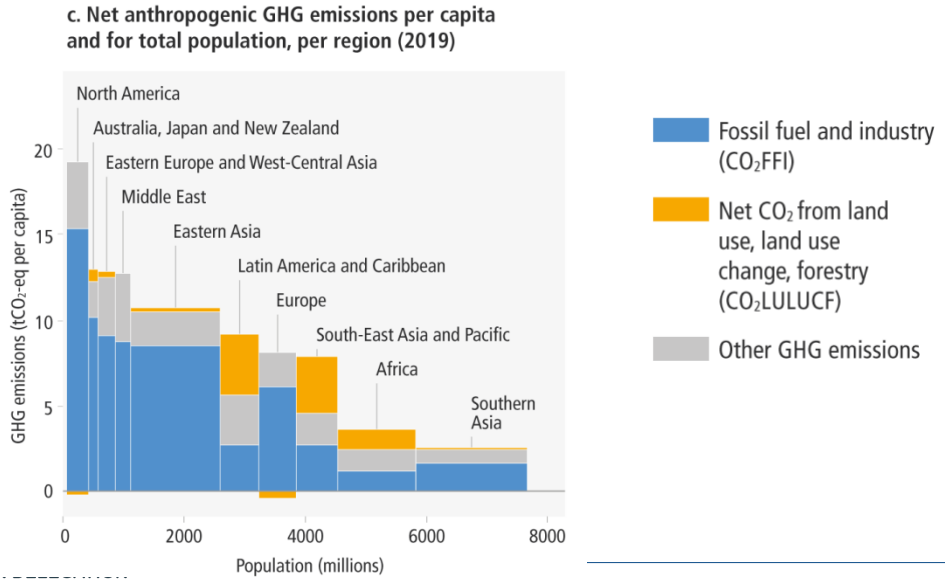
How Does This Look Per Capita (Per Person)?



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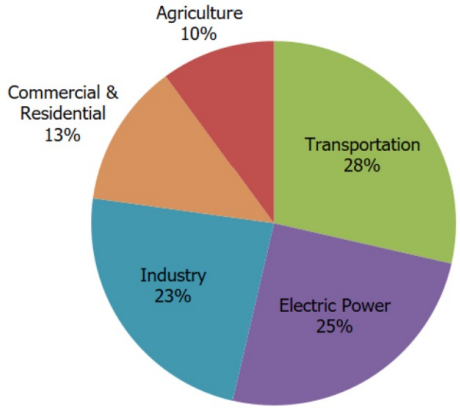
Total US Greenhouse Gas Emissions by Economic Sector in 2021



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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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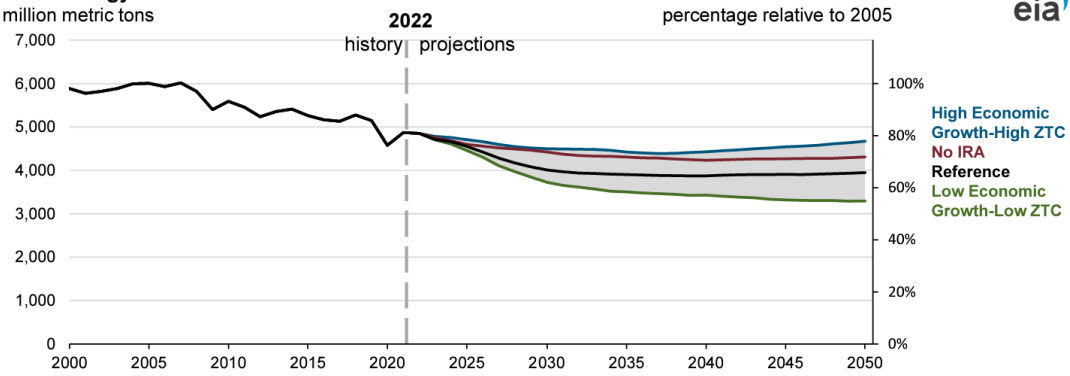
Energy Related Emissions Are Falling (though They Still Need to Fall Further)

Total energy-related carbon dioxide emissions



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)
Note: Shaded regions represent maximum and minimum values for each projection year across the AEO2023 Reference case and side cases. ZTC=Zero-Carbon Technology Cost; IRA=Inflation Reduction Act.

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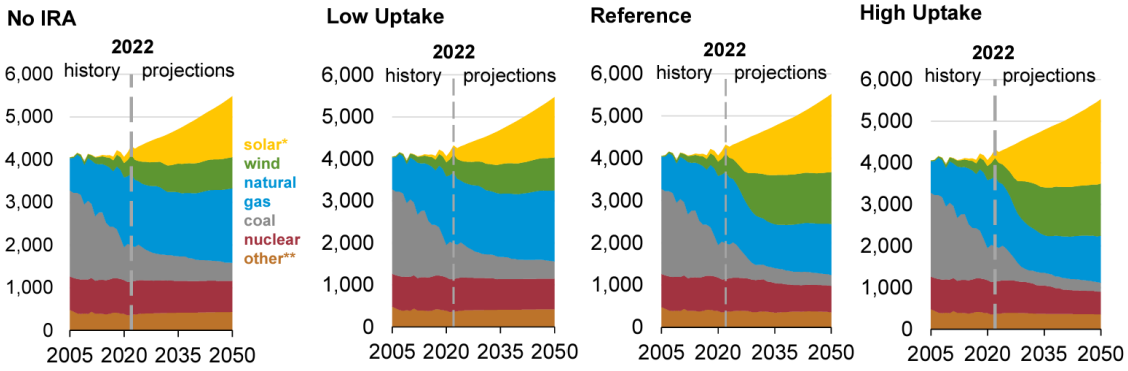
US Electricity Sources

U.S. net electricity generation by fuel
billion kilowatthours



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)
Note: IRA=Inflation Reduction Act
*Includes utility-scale and end-use photovoltaic generation and excludes off-grid photovoltaics.
**Includes petroleum, conventional hydroelectric power, geothermal, wood and other biomass, pumped storage, non-biogenic municipal waste in the electric power sector, refinery gas, still gas, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.

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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 ("marginal abatement cost curve")
  - → Tackle first the cheapest ones!

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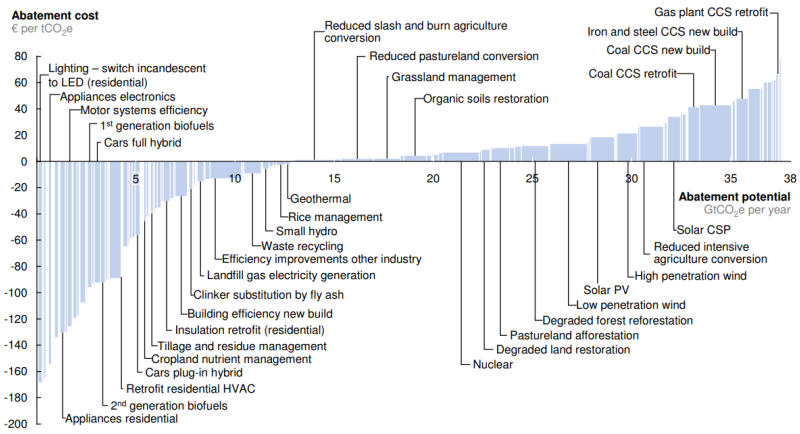
Example Abatement Cost Curve

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

V2.1 Global GHG abatement cost curve beyond BAU – 2030



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Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €80 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.
Source: Global GHG Abatement Cost Curve v2.1

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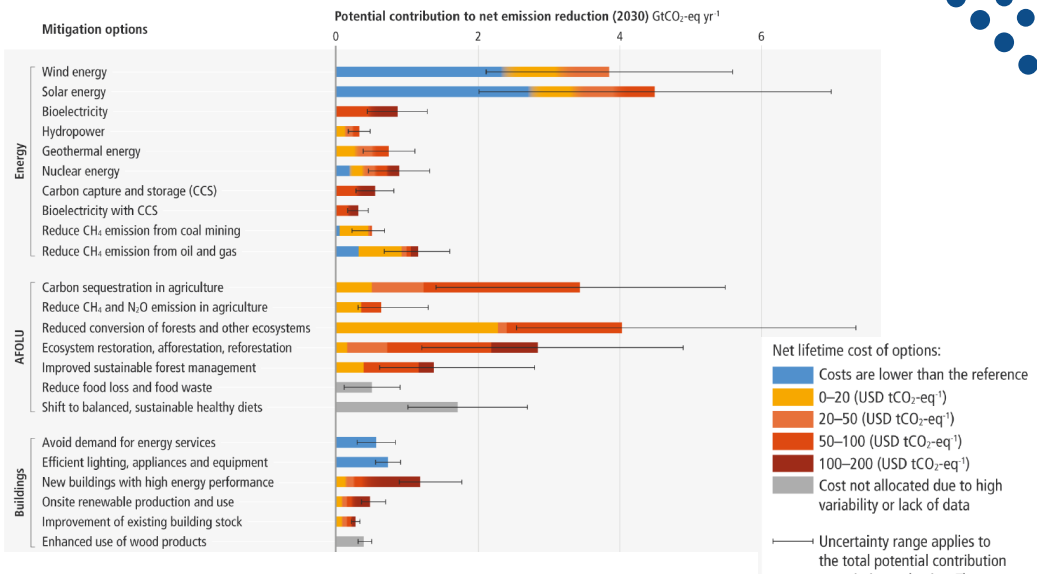
Newer Estimated Abatement Cost Curve



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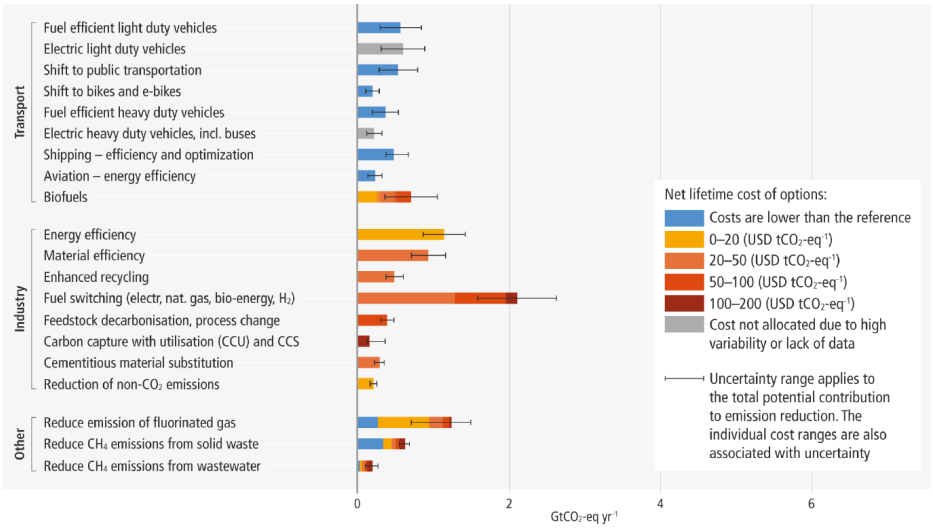
Newer Estimated Abatement Cost Curve



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Costs and Barriers Can Be Difficult to Assess

- **Difficult to project future costs for new technology**
  - Costs of renewables have been dropping fast
- **Investments in research and development and infrastructure (e.g., EV charging) can lower future costs**
- **Barrier to expanding renewable energy: intermittency**
  - Battery technology under development

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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
- **Solar geoengineering: make the atmosphere reflect more light to regain earlier thermal balance**
  - Totally theoretical
  - Potentially risky

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Climate Change Policy

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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)

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Command and Control vs. Incentive-Based Regulation

- **Efficiency**
  - Both can achieve the same amount of emissions reduction.
  - Incentive-based policies can achieve emissions reduction at much lower cost.
- **Equity**
  - Both have may regressive impacts (low-income families bear costs that are a larger percent of their incomes vs hi-income families)
    - However, new evidence increasingly questions this.
  - Cap and trade and carbon tax can generate revenues that can be used to offset the regressivity.
    - E.g.: "carbon dividend"
  - Command and control regulations do not.

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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**

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How Does Cap and Trade Work?

- **Choose activities to be covered (e.g., electricity sector, all emitters, etc.).**
- **Set maximum emissions level ("cap").**
- **That many pollution permits are issued.**
  - 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**

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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**

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Offsets and "Net Zero"

- **Carbon offsets are assets that can be purchased that correspond (theoretically) to reductions in emissions elsewhere**
  - Either reduction / prevention of a carbon source or generation / prevention of loss of a carbon sink
  - Examples: capping landfills for methane leaks; forest protection
- **This lets global net emissions decline more than direct emissions do**
  - Net zero emissions goal means new offsets must equal new emissions
- **Can fit into any regulatory scheme to "count against" direct emissions (if the regulation allows them)**
- **Concerns: verifiability, additionality, ethics / justice**

Leakage and Regulatory Interconnections

- **If some areas are more tightly regulated than others, polluters may move from the high-regulation to the low-regulation areas**
  - This is called leakage
  - It may cause overall pollution to not decline
  - So far, there's little evidence that firms relocate because of enviro rules
- **Rationale for old "broad, then deep" approach**
- **Climate economists have been surprised by profusion of local & regional climate regulations**
- **Now some may get stitched together – "deep, then broad"?**

Border Carbon Adjustments

- To avoid leakage & stay competitive, high-regulation places can impose border carbon adjustments
- Tweak prices up on imports from low-regulation places to reflect "correct" regulated price because of embodied pollution

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Climate Change Policy in Action

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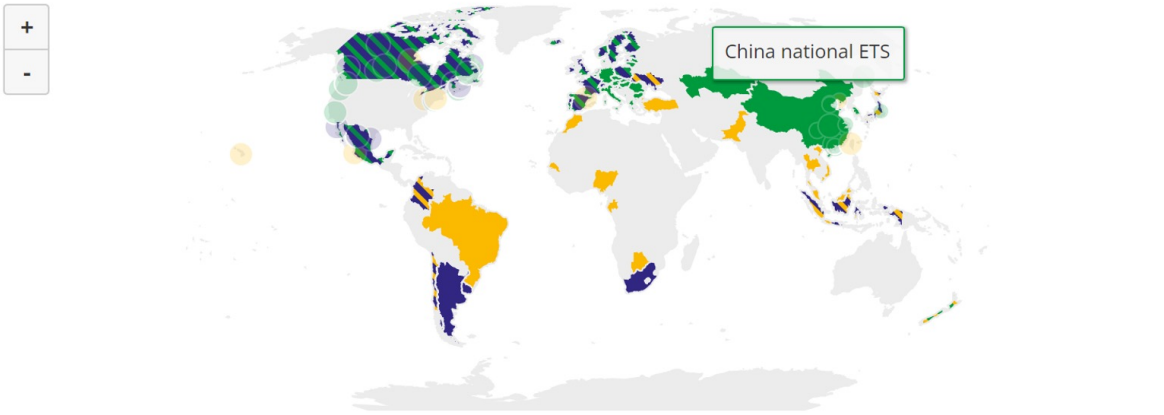
Incentive-Based Climate Policies Right Now

Summary map of regional, national and subnational carbon pricing initiatives



- ETS implemented or scheduled for implementation
- ETS or carbon tax under consideration
- ETS implemented or scheduled, ETS or carbon tax under c...
- Carbon tax implemented or scheduled for implementation
- ETS and carbon tax implemented or scheduled
- Carbon tax implemented or scheduled, ETS under consider...

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Source: World Bank Carbon - Pricing Dashboard

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California's Cap and Trade System Since 2012

0.7%

of global greenhouse gas emissions

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California's AB32: Global Warming Solutions

- **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

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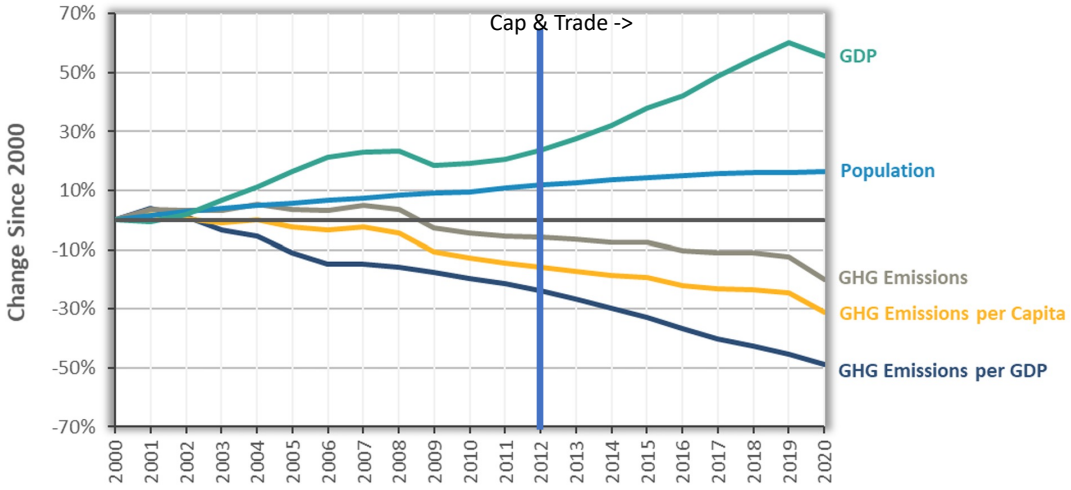
Change in California GDP, Population, and GHG Emissions since 2000



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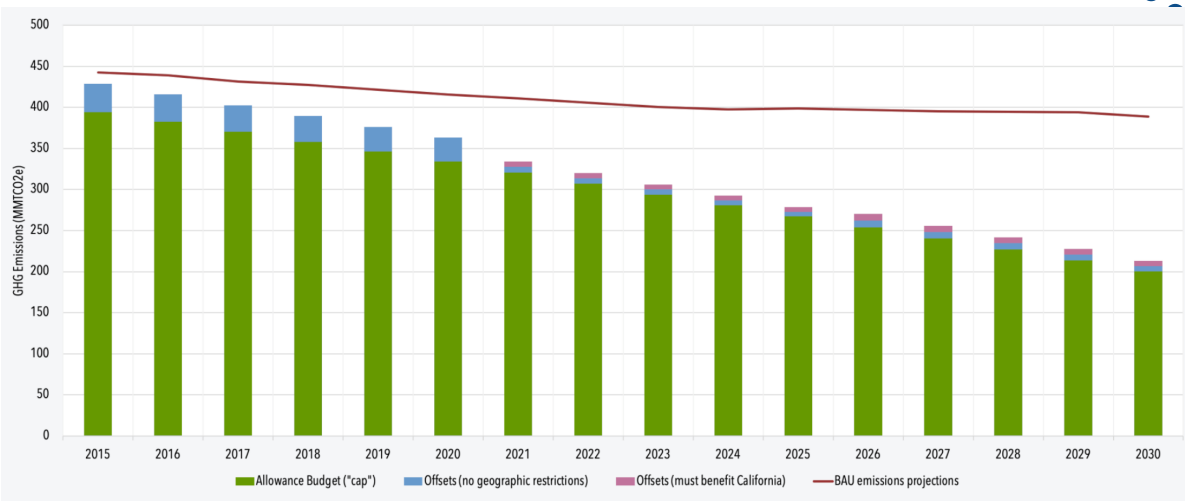
Projected trends in California's emissions



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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.**
  - Fortunately, a lot of action is happening – we need to double down!
- **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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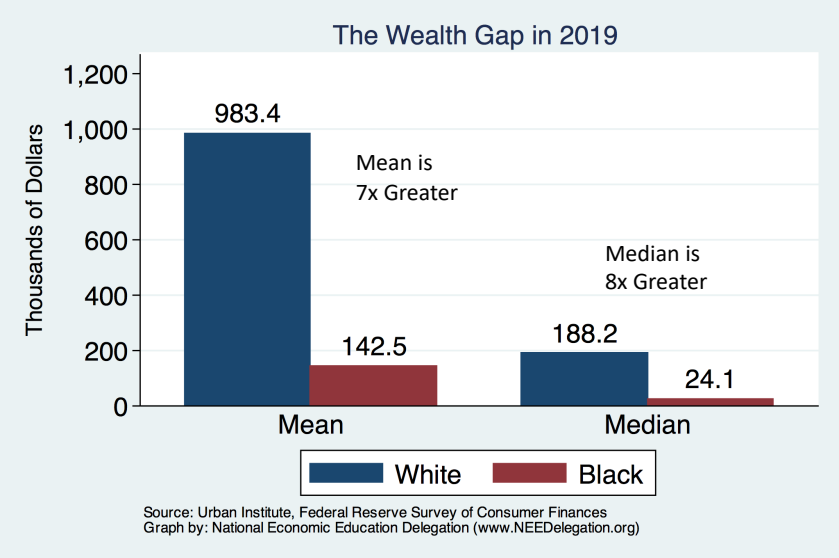
The B-W Wealth Gap: Mike Shor



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Thank you!

Any Questions?

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