



Climate Change Economics

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National Economic Education Delegation

- **Vision**

- One day, the public discussion of policy issues will be grounded in an accurate perception of the underlying economic principles and data.

- **Mission**

- NEED unites the skills and knowledge of a vast network of professional economists to promote understanding of the economics of policy issues in the United States.

- **NEED Presentations**

- Are **nonpartisan** and intended to reflect the consensus of the economics profession.



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 - It is, however, inevitable that the presenter will be asked for and will provide their own views.
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Outline

- Climate change science
- Impacts of climate change
- Economics of responding to climate change
- Addressing the sources of our emissions
- Climate change policy
- Policy in action



But First: What Is Economics?

- **Economics is about making choices under scarcity.**
 - Individuals and firms
- **How do goods and services get allocated among entities in society?**
- **How is value created by trade?**
- **How do “market failures” restrict that value creation?**



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How Can Economists Contribute to Thinking about Climate Change?

- **They can assess behavioral reactions to climate change.**
- **They can measure the damage and estimate the economic costs of fighting climate change.**
- **They can help design smart policies that minimize costs.**
 - Balance economic growth with GHG emission mitigation.

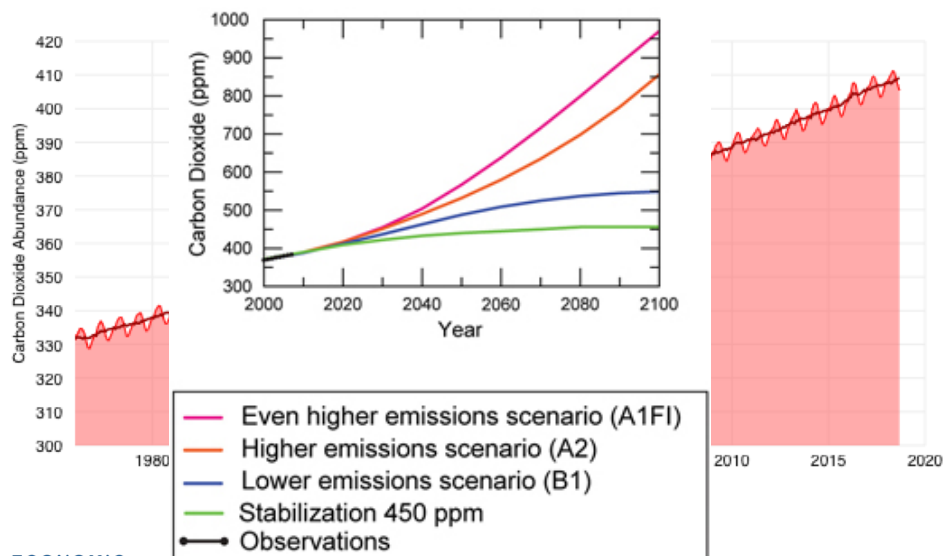


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Climate Change Science



Atmospheric CO₂ Concentrations



Source: IPCC data distribution center and climate.gov

Uncertainty

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How Much Pollution Does Society Want?

Analogy: How Many Oranges Does Society Want?

- People grow and sell oranges for a price that at least covers costs.
- People will not pay more for them than what they consider to be their value.
- Prices let supply and demand balance out. The price settles where:

of oranges people want to sell = # of oranges people want to buy

- This is the “right” number of oranges for society.
- Prices reflect scarcity and the social value of the resource.

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Pollution Is Different From Oranges

- Human activity creates pollution.
- Pollution is an **EXTERNALITY**: a side effect (cost or benefit) that affects someone else when something is bought or sold.
 - The power company sells you electricity for your house, but the pollution from the power plant affects everyone, not just you!
 - This is a *market failure*.
- All of the effects are not always felt by the buyers and sellers.
 - The price of electricity does not reflect all of the costs—there is too much pollution! Electricity is too cheap. The balance is wrong.



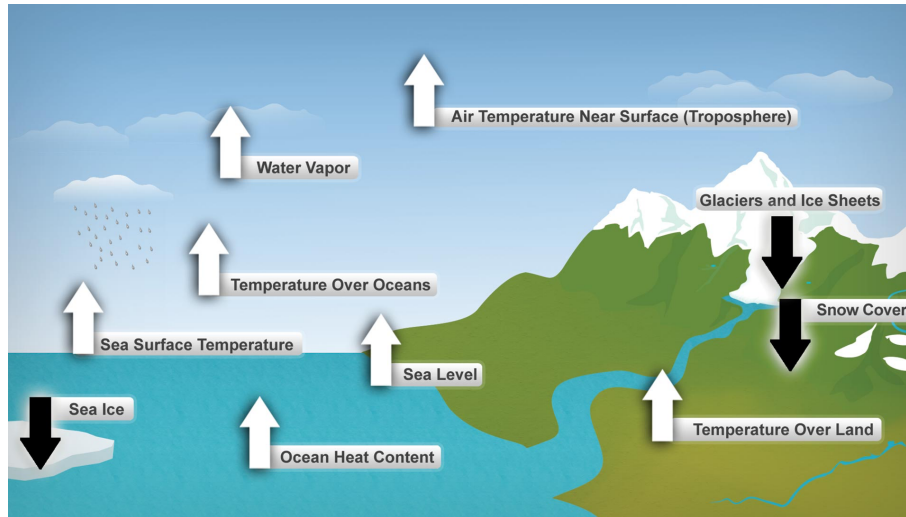
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Impacts of Climate Change



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Global Warming Indicators



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

Adaptation Reduces Damages

- Human *adaptations* are costly actions that can reduce damages from climate change.
- The net cost to society is the cost of adaptation plus the cost of the remaining damages.
- People will take some actions on their own, up to the point where they find it worthwhile.
- Some responses require government involvement: large-scale actions or actions with shared benefits.
- Adaptation is already underway.



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Individual-Level Adaptation Examples

- **Do you behave differently on a hot day?**
 - Staying inside more often.
 - Turn on the air conditioning.
 - Plant at different times.
 - Plant new crops.
 - Think about moving.



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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**
- **Supporting low-income and vulnerable populations**
- **Moving residents of a town**



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Social Cost of Carbon

- **The expected cost of damages from each unit of greenhouse gas emissions.**
- **Current EPA estimate: ~\$40 per metric ton CO₂.**
- **Social cost of carbon will increase over time.**



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Economics of Responding to Climate Change



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International Climate Policy Goals

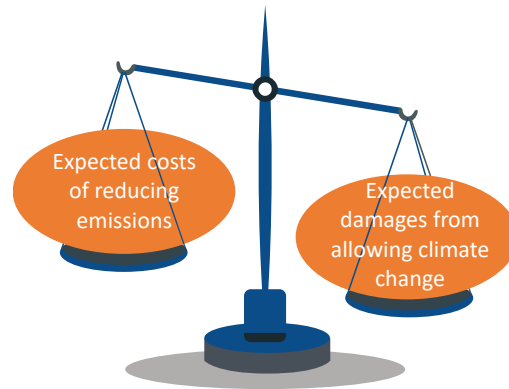
- **Intergovernmental Panel on Climate Change (IPCC)**
 - Global effort to fight climate change
 - Reports on consensus of climate science, including economics
- **IPCC report in 2007:**
 - Recommended goal: < 2 degrees C (3.6 degrees F)
 - Industrialized countries should reduce GHG emissions between 25% and 40% below 1990 levels by 2020.
- **IPCC report in 2014:**
 - Temperature increased already by 0.85 degrees C
- **2016 Paris Agreement:**
 - Basic goal of 2 degrees C: requires 40-70% GHG reduction 2010 → 2050
 - Reach goal of 1.5 degrees C: requires 70-95% GHG reduction 2010 → 2050



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How Economists Decide How Much to Fight Climate Change

- **Cost Benefit Analysis:**
- **Weigh:**



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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.**
 - Stern Report estimate: damages could be as high as 20% of worldwide GDP.
- **Caveats:**
 - Putting a monetary value on priceless things.
 - Uncertainty and risk
 - Inequality



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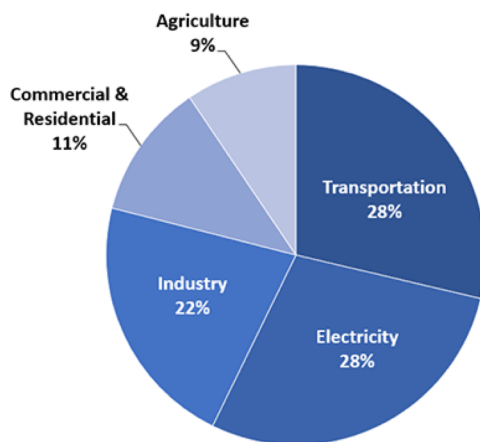
Economic Growth and Climate Change Action Are Compatible

- Abating greenhouse gas emissions is costly...
... but climate change damages are even more costly.
- Economic growth comes with consequences that we have to deal with, including climate consequences.
- Economies with environmental regulations can still be dynamic.
- Goal: design policies that reach climate goals at the least possible cost.

Addressing the Sources of Our Emissions

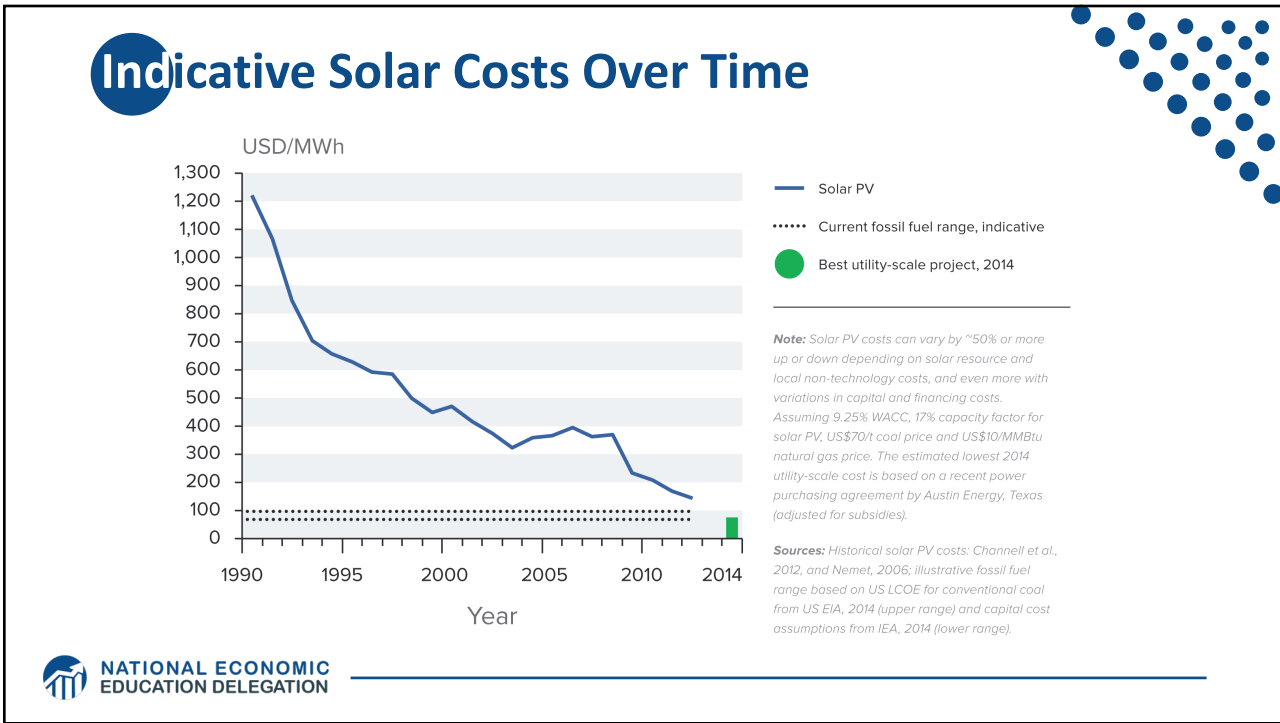
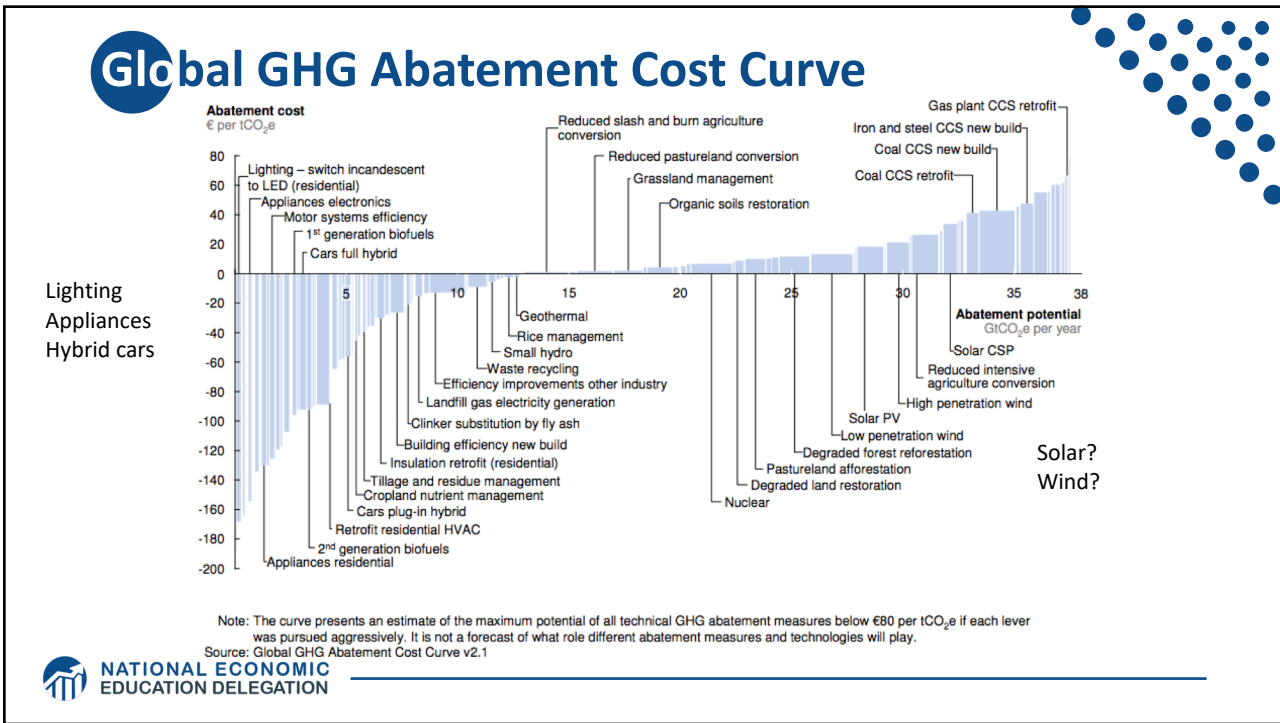


Total U.S. Greenhouse Gas Emissions by Economic Sector in 2016

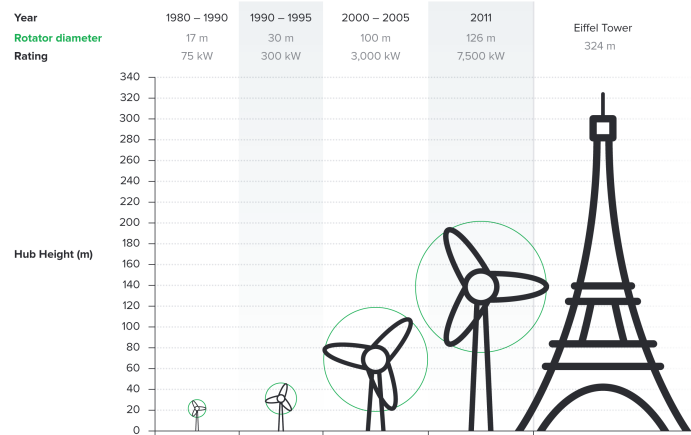


U.S. Environmental Protection Agency (2018). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016





Wind Turbines Have 100 Times More Power Generation Capabilities Than 30 Years Ago



Challenges with Renewable Energy

- It's intermittent - only produced if there is sun or wind.
- Energy is needed all day and night, with peak times.
- Limited w/o storage.

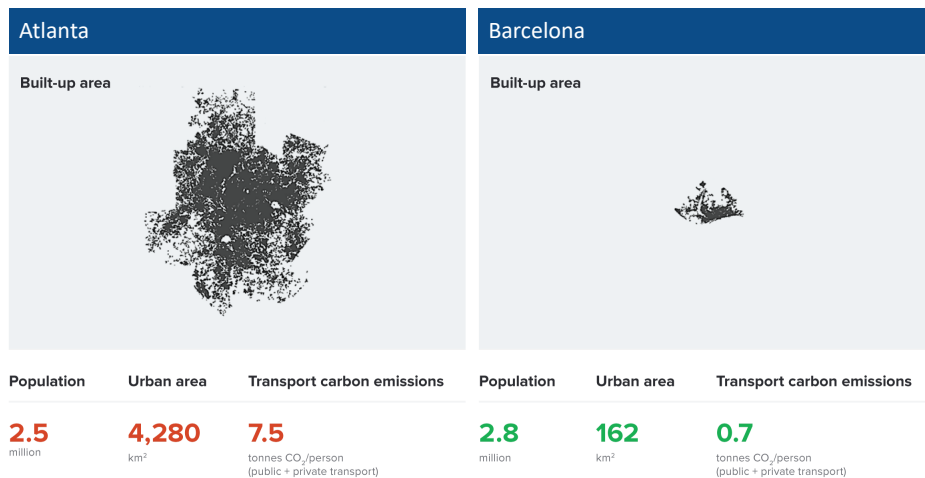


Infrastructure and Climate Change

- **\$90 trillion in investment will be needed for U.S. infrastructure, 2015-2030.**
- **Add \$4 trillion (< 5%!) to make it low-carbon infrastructure.**
 - This would also reduce climate damage to infrastructure.
 - Railway, urban transport, renewables.
- **The electrical grid is particularly troublesome.**
 - It is outdated and not suited for renewable energy storage.
 - Those with solar panels use the grid but contribute little to its upkeep.



Atlanta and Barcelona Have Similar Populations but Very Different Carbon Productivity



Source: New Climate Economy Report, 2014

Climate Change Policy

Direct and Indirect



Policies That Reduce Emissions: Directly

- **Regulation**

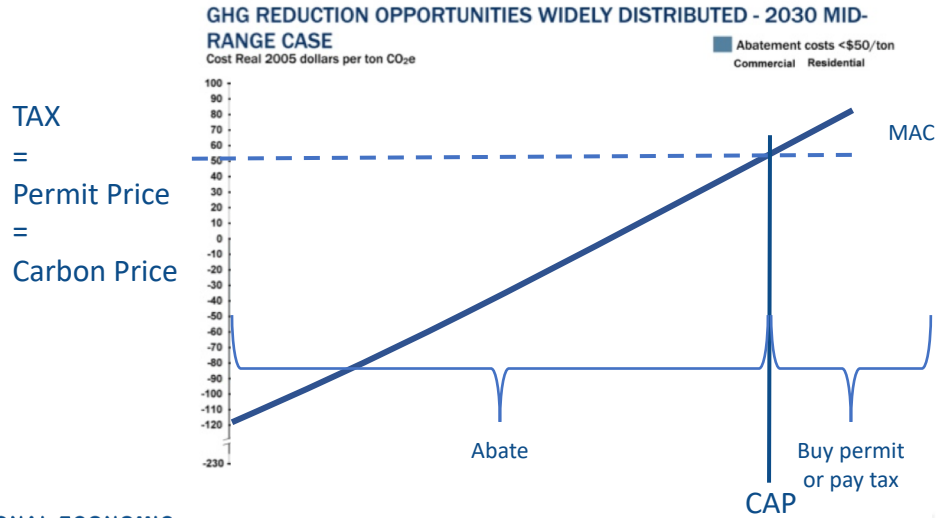
- Emissions standards or limits

- **Market oriented policies**

- Putting a price on emissions
 - Subsidizing green energy (*e.g.*, feed-in tariffs)
 - Tax or cap & trade!



Putting a Price on Carbon



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Carbon Prices: the Good and Bad

- **Good:**
 - Provide price signal to lower emissions.
 - They yield low-cost reductions in emissions.
- **Bad:**
 - Regressive
 - Costs weigh more heavily on low-income people.
 - Firms might leave to flee regulation.
 - It is necessary to monitor emissions.



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Carbon Tax and Cap & Trade: the Differences

	Carbon Tax	Cap & Trade
Carbon Price	Certain	Uncertain
Emissions	Uncertain	Certain
Ease of Implementation	Likely easier	
Additional concerns	Always generates revenue	May be more susceptible to lobbying
	May require legislation to change	Only generates revenue if government sells permits
		Cap can be changed by regulator



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Policies That Reduce Emissions: INDIRECTLY

- Subsidizing R&D
- Grid / infrastructure
- Land use policies
- Energy efficiency mandates and subsidies
- Mandating renewable energy (*e.g.*, renewable portfolio standards)

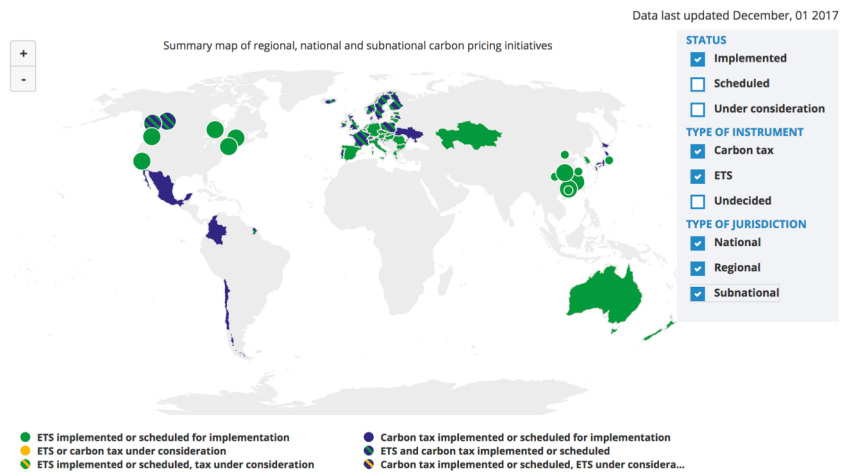


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Climate Change Policy in Action



Carbon Policies Across the World



Source: World Bank Carbon - Pricing Dashboard

Cap and Trade

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Cap and Trade Policies Around the World

Summary map of regional, national and subnational carbon pricing initiatives

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Source: World Bank - Carbon Pricing Dashboard

California's Cap and Trade System (2013)



0.7%

of global
greenhouse gas
emissions

California's System Is Flexible



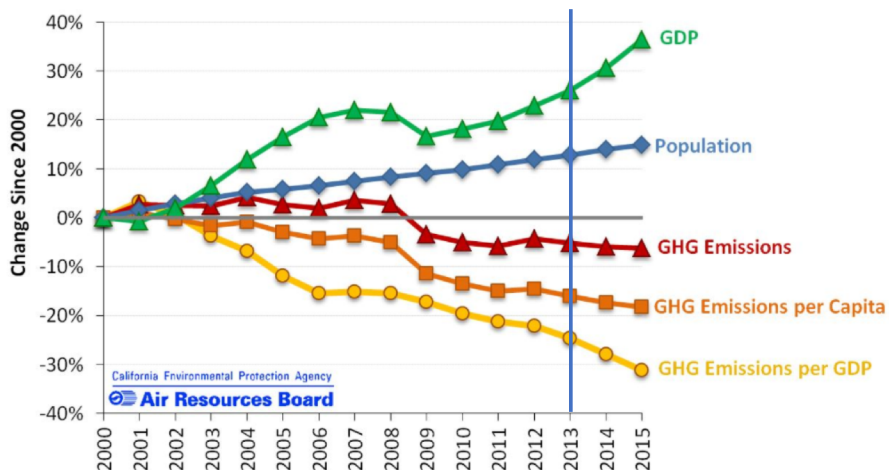
- **California's goals:**

- 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

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



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European Union's Emissions Trading Scheme

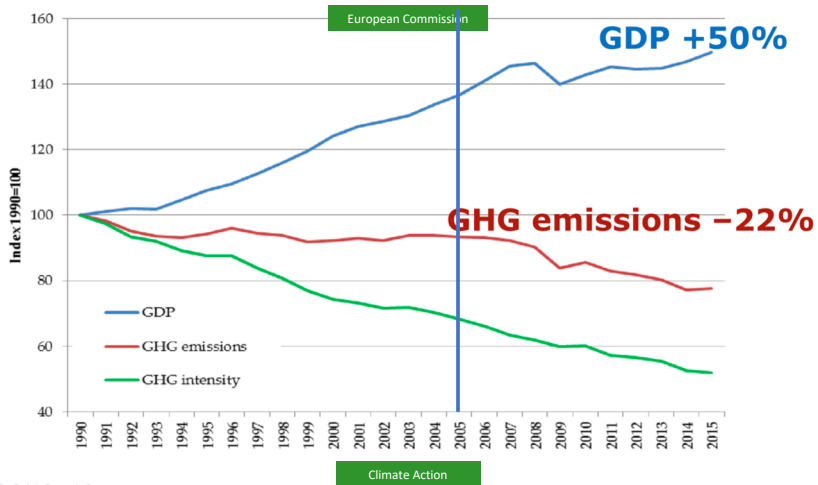


4%

of global greenhouse gas emissions (2005)

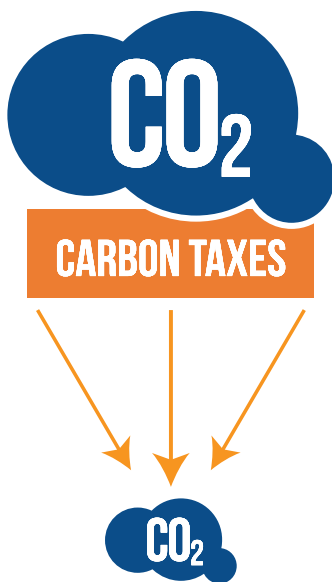
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EU Has Decoupled Economic Growth from Greenhouse Gas Emissions



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Carbon Tax



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Worldwide Carbon Taxes

26

carbon tax programs

24

national jurisdictions covered

5.3%

of global greenhouse gas emissions

British Columbia's Carbon Tax Policy

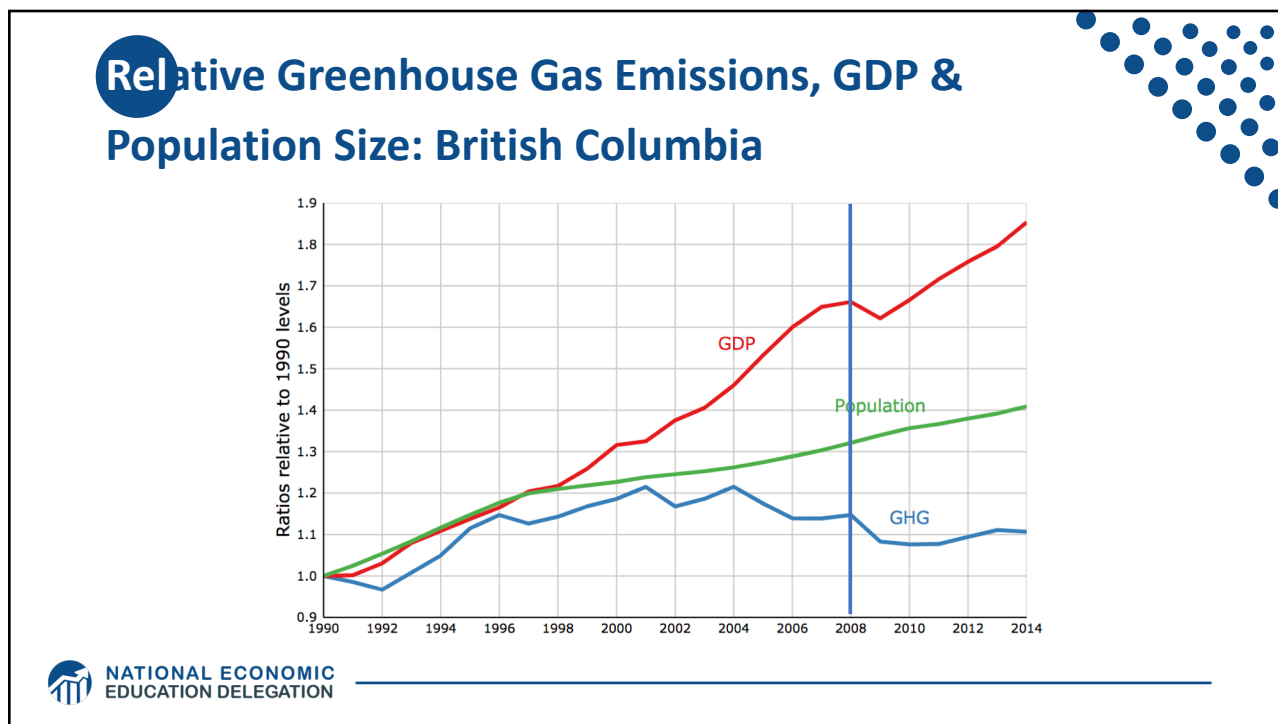


0.1%


of global greenhouse gas emissions

“ Tax the pollution we do not want, and return the money for what we do want — money in people’s pockets, jobs and investment. ”

- B.C. Government - Carbon Tax Brochure



Sweden's Carbon Tax Policy

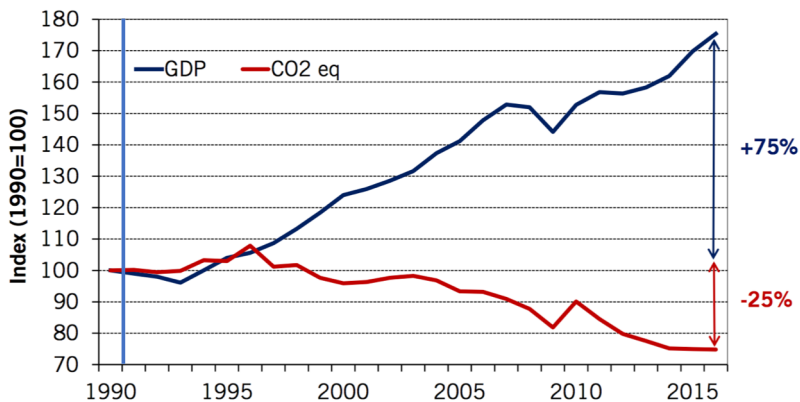


Started in 1991

Currently at \$140/ton

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Real GDP and Domestic CO₂eq Emissions¹ In Sweden, 1990-2016



Year	Real GDP (Index 1990=100)	Domestic CO ₂ eq Emissions (Index 1990=100)
1990	100	100
1995	105	100
2000	125	95
2005	145	90
2010	155	80
2016	175	75

¹ In accordance with Sweden's National Inventory Report, submitted under the UNFCCC and the Kyoto Protocol. CO₂ = approx. 80 % of total CO₂eq emissions. Preliminary data for 2016.
 Sources: Swedish Environmental Protection Agency, Statistics Sweden

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U.S. Carbon Tax Plans

- Climate Leadership Council
- Citizens Climate Lobby
- States and municipalities:
Washington state, Oregon,
Washington, DC



Summary

- Climate change is real, is caused by human actions, and has impacts we're already feeling.
- We need to reduce emissions to balance the costs of action against the costs of inaction.
- Scientists and the IPCC recommend that we work to keep warming below 2 degrees celsius.

- *Economists believe that this goal is well worth the costs!*

Summary – *continued*

- There are many ways to reduce emissions.
- Economics-inspired policies can help us do this at the lowest cost.
- Taxes and cap and trade are proven effective tools to fight climate change!



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Thank you!

Any Questions?

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