


# Climate Change Economics

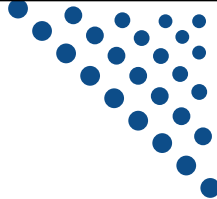
Jon Haveman, Ph.D.



## Climate Corps Retreat

Sausalito, CA  
February 15, 2019

# 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.




---

2

## Credits and Disclaimer

- **This slide deck was authored by:**
  - Shana McDermott, Trinity University
  - Sarah Jacobson, Williams College
  - Sharon Shewmake, Western Washington University
- **This slide deck was reviewed by:**
  - Jason Shogren, University of Wyoming
  - Walter Thurmon, North Carolina State University
- **Disclaimer**
  - 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).

## 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?**



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Economics Informs Almost Everything

- **Prices**
- **Incentives**
- **Externalities**
- **Cost-Benefit Analysis**
- **Growth**
- **Inflation**
- **Interest Rates**
- **Climate Change**
- **International Trade**
- **Immigration**
- **Housing**
- **Education**
- **Health Care**
- **Gun Control**



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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.

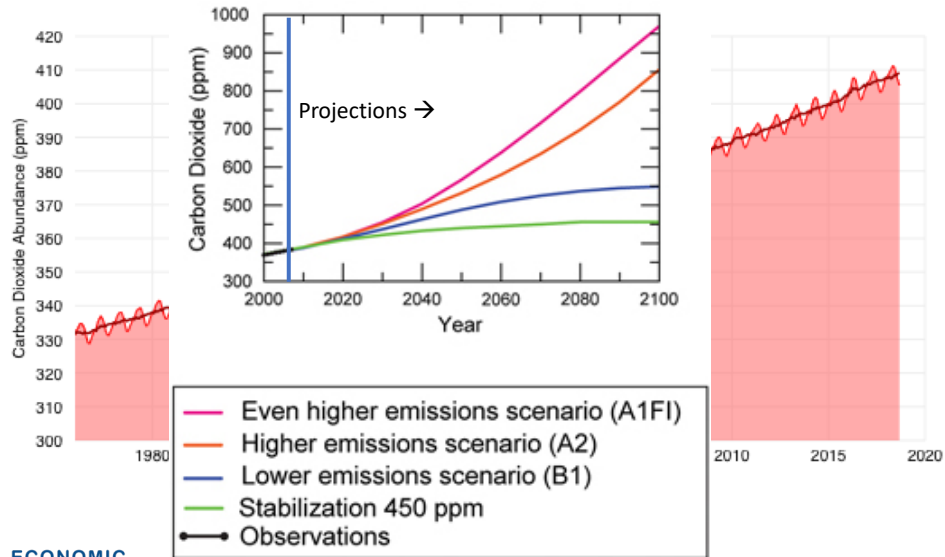


## Climate Change Science





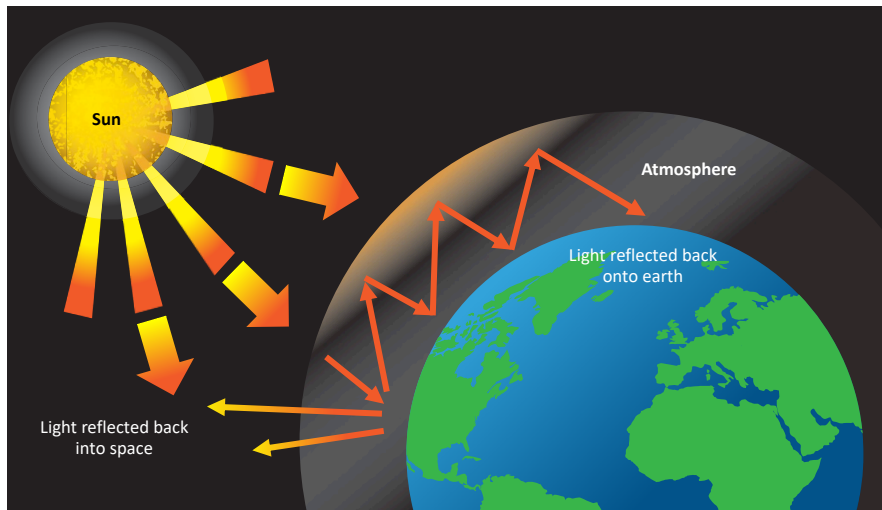
# Atmospheric CO<sub>2</sub> Concentrations



NATIONAL ECONOMIC EDUCATION DELEGATION

Source: IPCC data distribution center and climate.gov

# The Atmospheric Greenhouse Effect



NATIONAL ECONOMIC EDUCATION DELEGATION

## Uncertainty



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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 (**supply**).
- People will not pay more for them than what they consider to be their value (**demand**).
- 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.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Pollution Is Different From Oranges

- **Human activity creates pollution.**
  - The goal is not zero pollution but society's best balance between pollution and human benefits.
- **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.



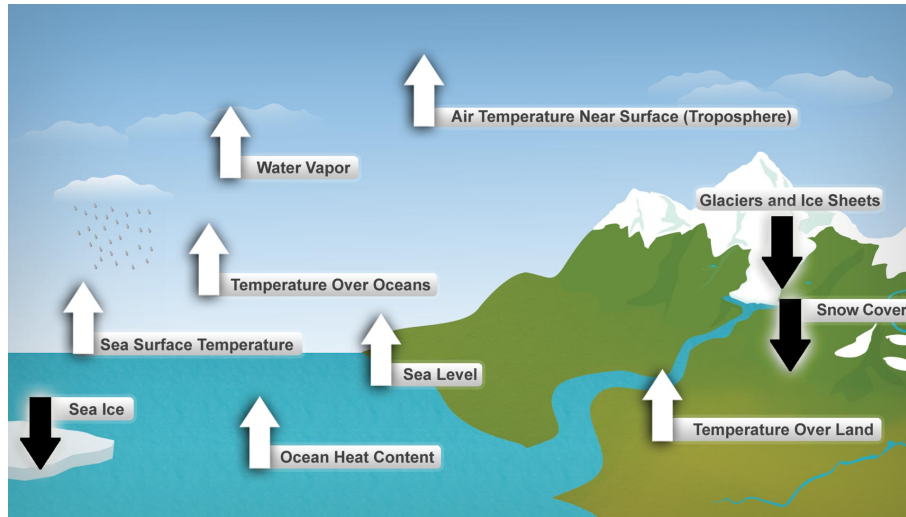
NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Impacts of Climate Change



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Public Adaptation

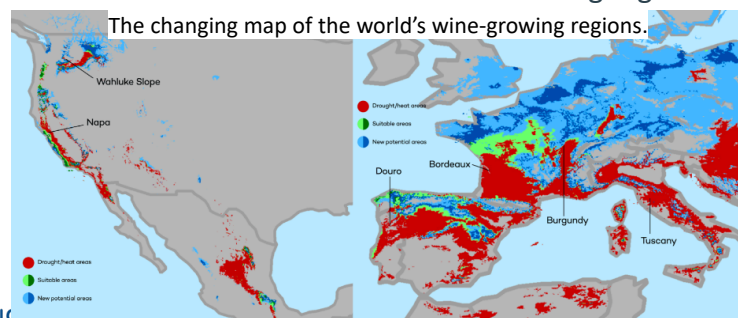
- **Governments can help**
  - When collective action is less costly than everyone acting alone.
  - When individual action is not possible or likely.
  - When some people can't protect themselves.
- **Sea walls**
- **Ecosystems that provide protection**
- **Supporting low-income and vulnerable populations**
- **Moving residents of a town**



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Market Based Adaptation

- **Prices and costs influence behavior.**
  - Where to live.
  - Where/when/what to plant.
- **Avoid barriers to market adjustment.**
  - Trade barriers, immigration restrictions, federal flood insurance, agricultural subsidies, and zoning regulations.

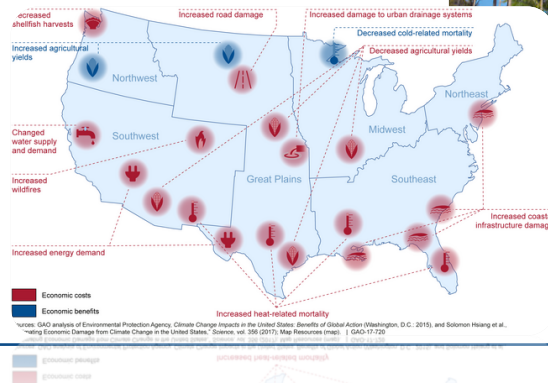


NATIONAL ECONOMIC  
EDUCATION DELEGATION

20

## Most Vulnerable People and Places

- Tropical areas
- Low-lying coastal areas
- Low-income people



## Social Cost of Carbon

- Cost above price paid.
- The expected cost of damages from each unit of greenhouse gas emissions.
- Current EPA estimate: ~\$40 per metric ton of CO<sub>2</sub>.
  - About \$123/car per year.
  - \$26 Billion for all vehicles in the US.
- Social cost of carbon will increase over time.





# Economics of Responding to Climate Change



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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.
- **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
- **IPCC report in 2018:**
  - Temperature has already increased by 1.0 degrees C - Recommended: < 1.5 C

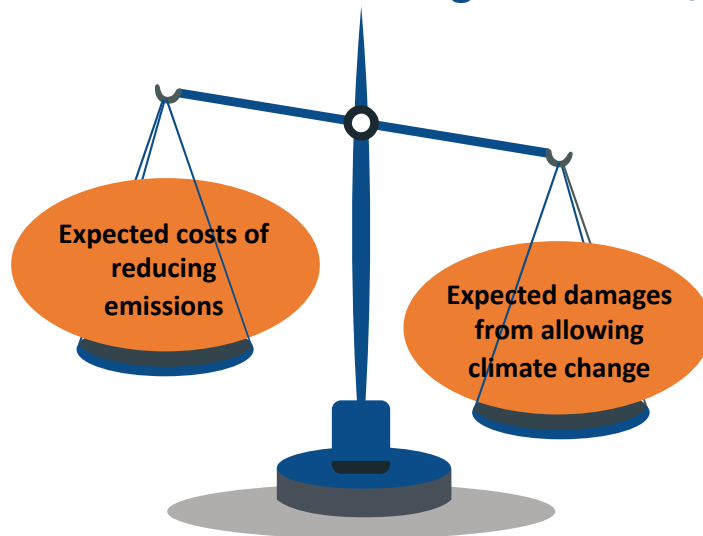


NATIONAL ECONOMIC  
EDUCATION DELEGATION



## How Economists Decide How Much to Fight Climate Change

- Cost Benefit Analysis
- Weigh:



## 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



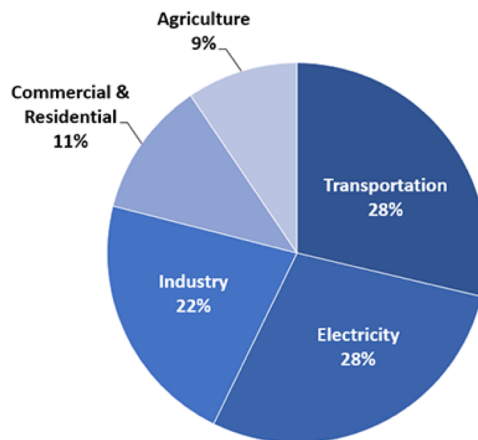
## **Economic Growth and Climate Change Action Are Compatible**

- 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

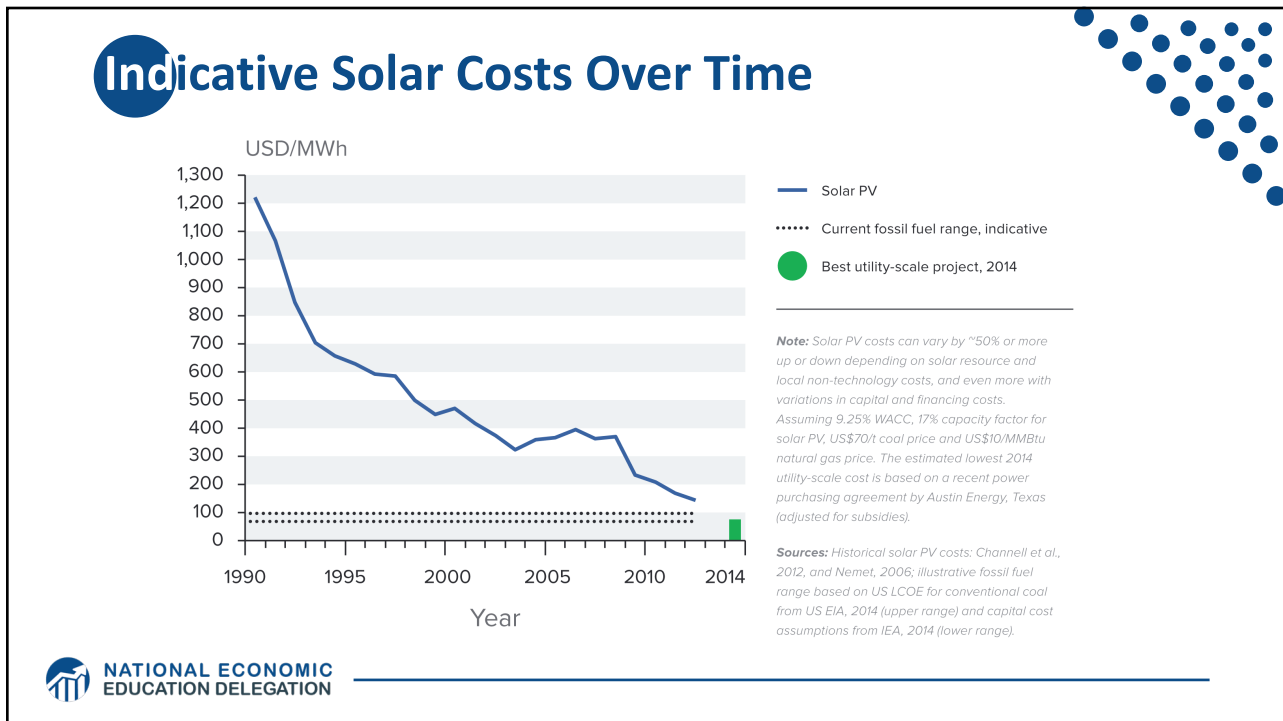
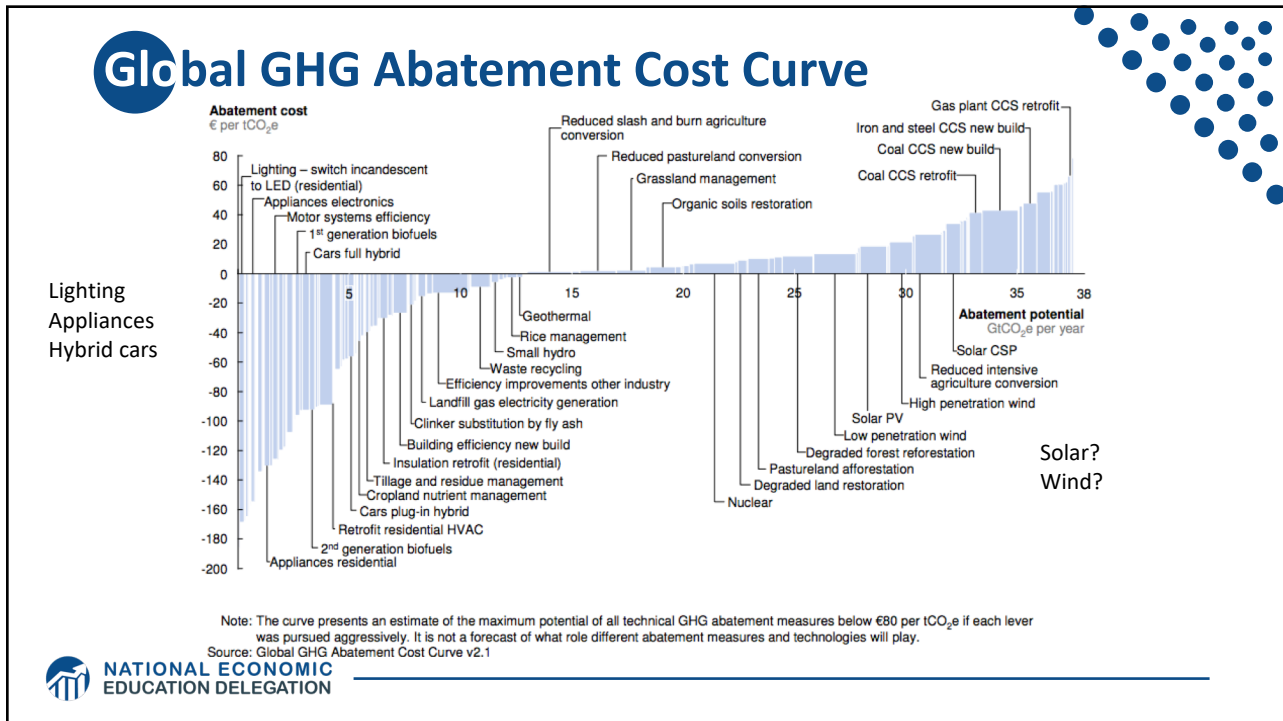


## Total U.S. Greenhouse Gas Emissions by Economic Sector in 2016

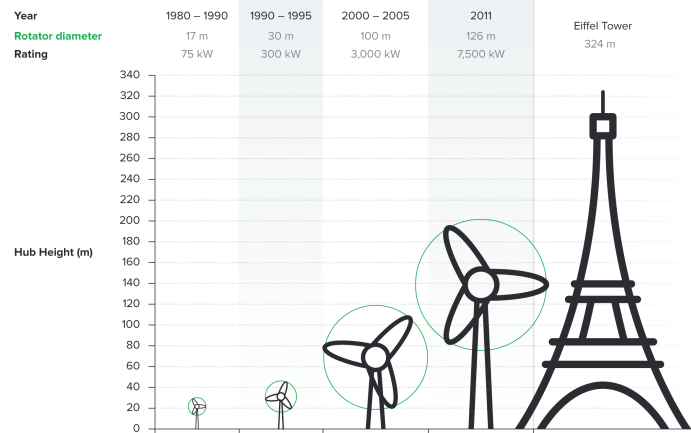


U.S. Environmental Protection Agency (2018). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016





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



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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.
  - Creative storage options are under development



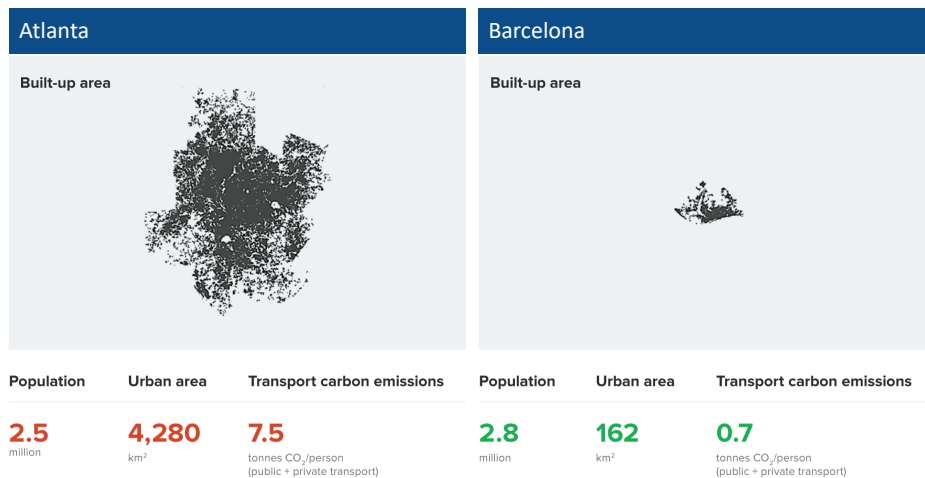
NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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

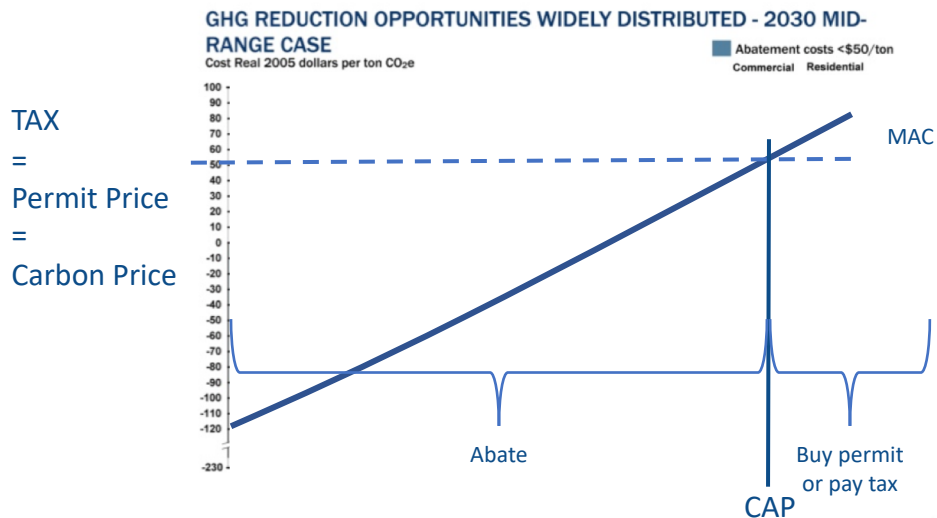


## Policies That Reduce Emissions: Directly

- **Regulation**
  - Emissions standards or limits
- **Market oriented policies**
  - Putting a price on emissions
    - Subsidizing green energy
    - Tax or cap & trade



## Putting a Price on Carbon



 NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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.



 NATIONAL ECONOMIC  
EDUCATION DELEGATION



## 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



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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)



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## 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!*

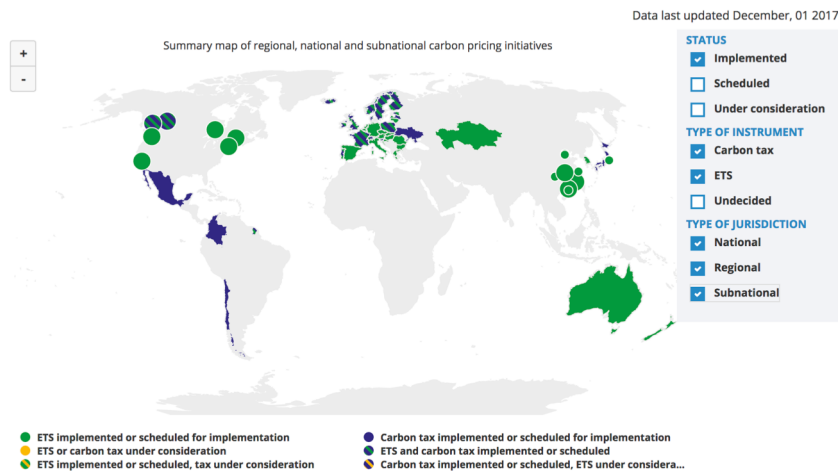
## Summary – *continued*

- 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!

# Climate Change Policy in Action



## Carbon Policies Across the World



Source: World Bank Carbon - Pricing Dashboard

# Cap and Trade

**NATIONAL ECONOMIC EDUCATION DELEGATION**

# Cap and Trade Policies Around the World

Summary map of regional, national and subnational carbon pricing initiatives

**NATIONAL ECONOMIC EDUCATION DELEGATION**

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



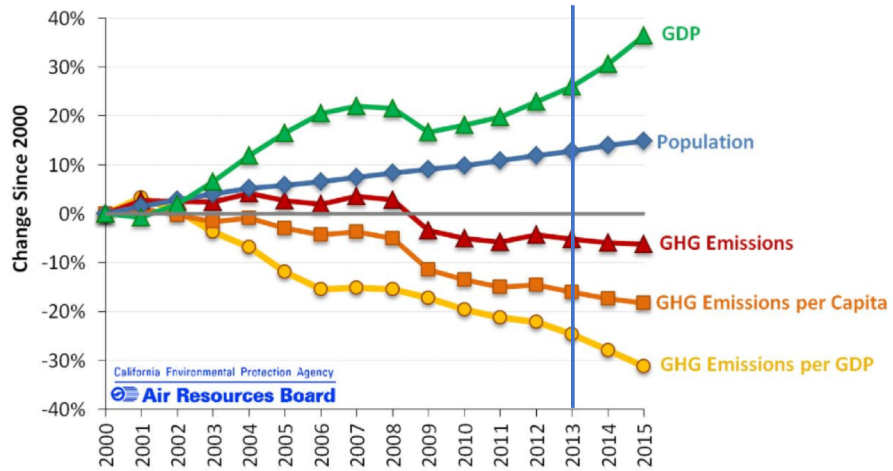
- **California's goals:**

- 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



NATIONAL ECONOMIC EDUCATION DELEGATION

## European Union's Emissions Trading Scheme

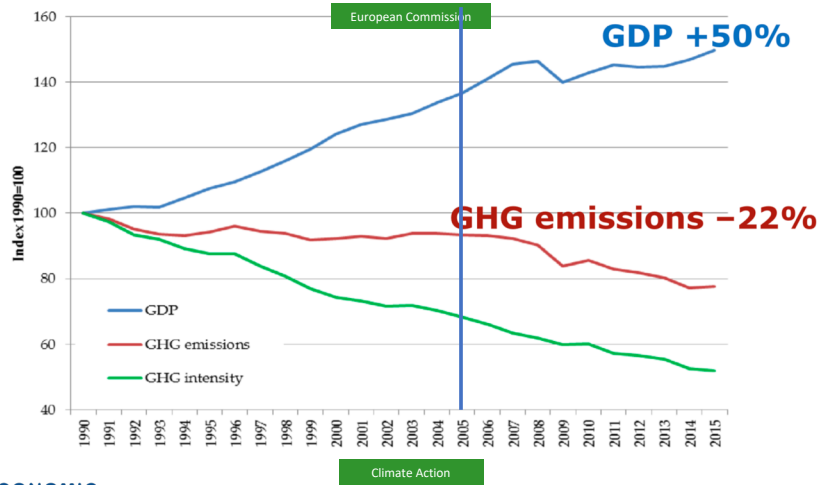


4%

of global greenhouse gas emissions (2005)

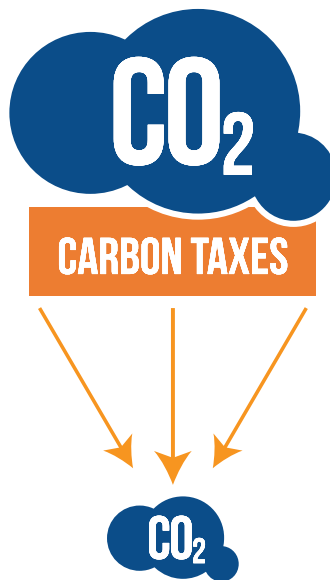
NATIONAL ECONOMIC EDUCATION DELEGATION

# EU Has Decoupled Economic Growth from Greenhouse Gas Emissions



NATIONAL ECONOMIC EDUCATION DELEGATION

# Carbon Tax



NATIONAL ECONOMIC EDUCATION DELEGATION

## Worldwide Carbon Taxes

26

carbon tax programs

24

national jurisdictions covered

5.3%

of global greenhouse gas emissions



NATIONAL ECONOMIC EDUCATION DELEGATION

## British Columbia's Carbon Tax Policy



0.1%

of global greenhouse gas emissions



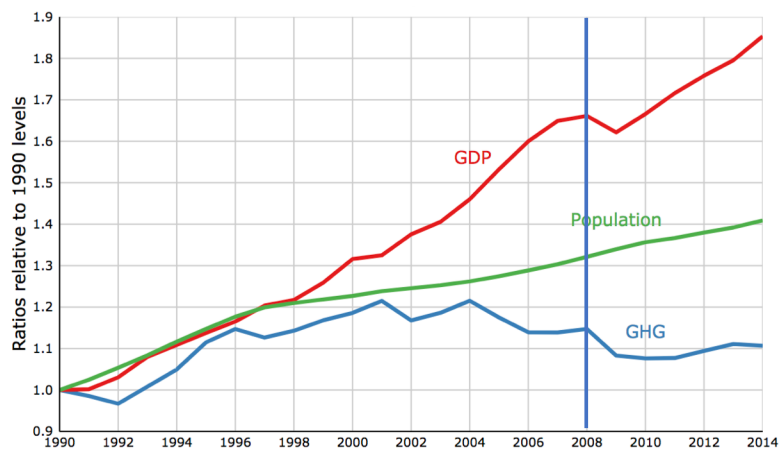
NATIONAL ECONOMIC EDUCATION DELEGATION



**“ 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

## Relative Greenhouse Gas Emissions, GDP & Population Size: British Columbia



NATIONAL ECONOMIC  
EDUCATION DELEGATION

# Sweden's Carbon Tax Policy

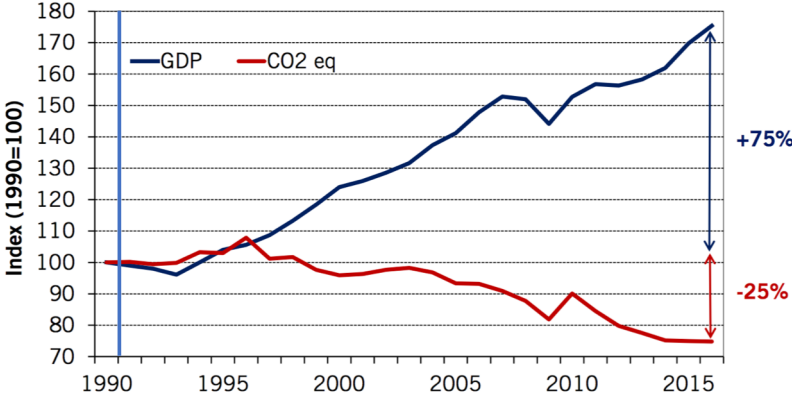


## Started in 1991

Currently at \$140/ton

**NATIONAL ECONOMIC EDUCATION DELEGATION**

# Real GDP and Domestic CO<sub>2</sub>eq Emissions<sup>1</sup> In Sweden, 1990-2016



Year	Real GDP (Index 1990=100)	Domestic CO <sub>2</sub> eq Emissions (Index 1990=100)
1990	100	100
1995	105	100
2000	125	95
2005	145	90
2010	155	80
2015	175	75

<sup>1</sup> In accordance with Sweden's National Inventory Report, submitted under the UNFCCC and the Kyoto Protocol. CO<sub>2</sub> = approx. 80 % of total CO<sub>2</sub>eq emissions. Preliminary data for 2016.

**Sources:** Swedish Environmental Protection Agency, Statistics Sweden

**NATIONAL ECONOMIC EDUCATION DELEGATION**

## U.S. Carbon Tax Plans

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



Thank you!

## Any Questions?

[www.NEEDelegation.org](http://www.NEEDelegation.org)

Jon Haveman, Ph.D.

Jon@NEEDelegation.org

Contact NEED: [NEEDelegation@gmail.com](mailto:NEEDelegation@gmail.com)