


# Climate Change Economics

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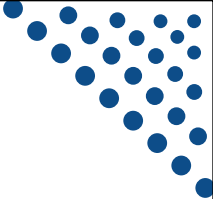


## Rafael Racquet Club, Earth Day

April 22, 2020

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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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## Who Are We?

- **Honorary Board: 48 members**

- 2 Fed Chairs: Janet Yellen, Ben Bernanke
- 6 Chairs Council of Economic Advisers
  - o Furman (D), Rosen (R), Bernanke (R), Yellen (D), Tyson (D), Goolsbee (D)
- 3 Nobel Prize Winners
  - o Akerlof, Smith, Maskin

- **Delegates: 500+ members**

- At all levels of academia and some in government service
- All have a Ph.D. in economics
- Crowdsource slide decks
- Give presentations

- **Global Partners: 45 Ph.D. Economists**

- Aid in slide deck development

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## Available NEED Topics Include:

- **Coronavirus Economics**
- **US Economy**
- **Climate Change**
- **Economic Inequality**
- **Economic Mobility**
- **US Social Policy**
- **Autonomous Vehicles**
- **Trade and Globalization**
- **Trade Wars**
- **Immigration Economics**
- **Housing Policy**
- **Federal Budgets**
- **Federal Debt**
- **2017 Tax Law**

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## Credits and Disclaimer

- **This slide deck was authored by:**
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- **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).



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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**



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## How Can Economists Contribute to Thinking about Climate Change?

- By assessing behavioral reactions to climate change.
- By measuring the damage and estimating the economic costs of fighting climate change.
- By designing smart policies that minimize costs.
  - Balance economic growth with GHG emission mitigation.

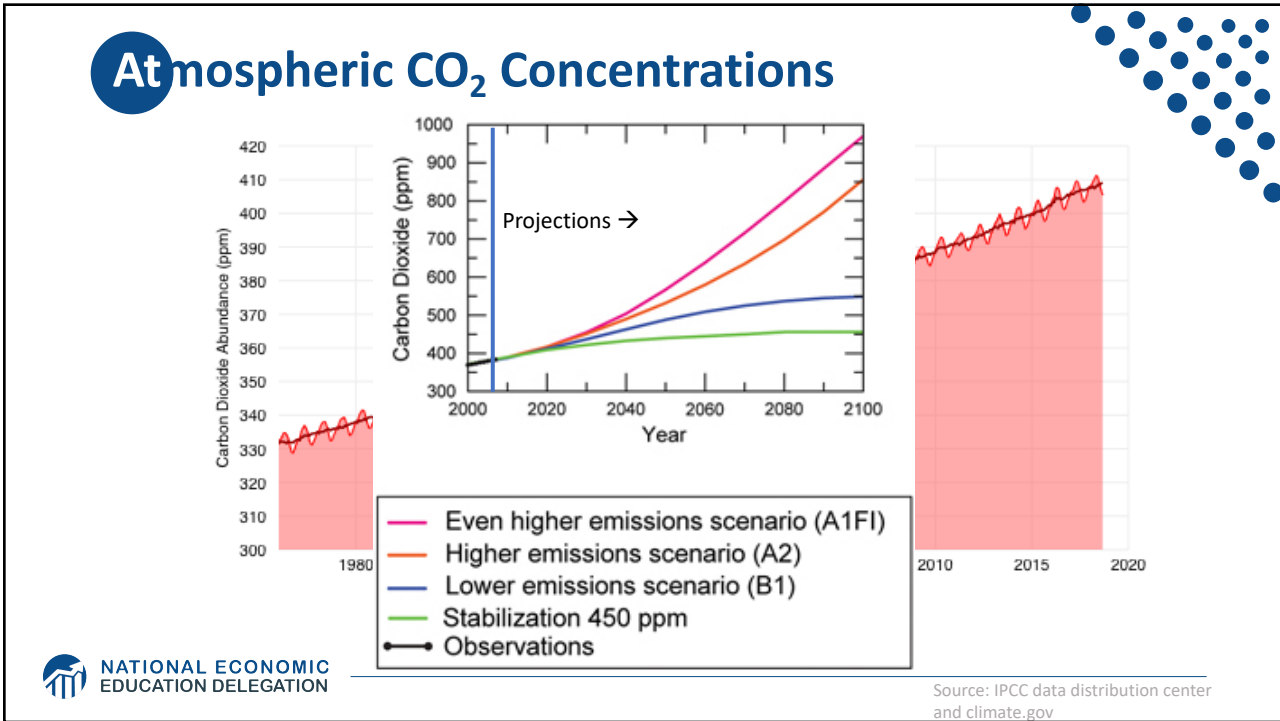


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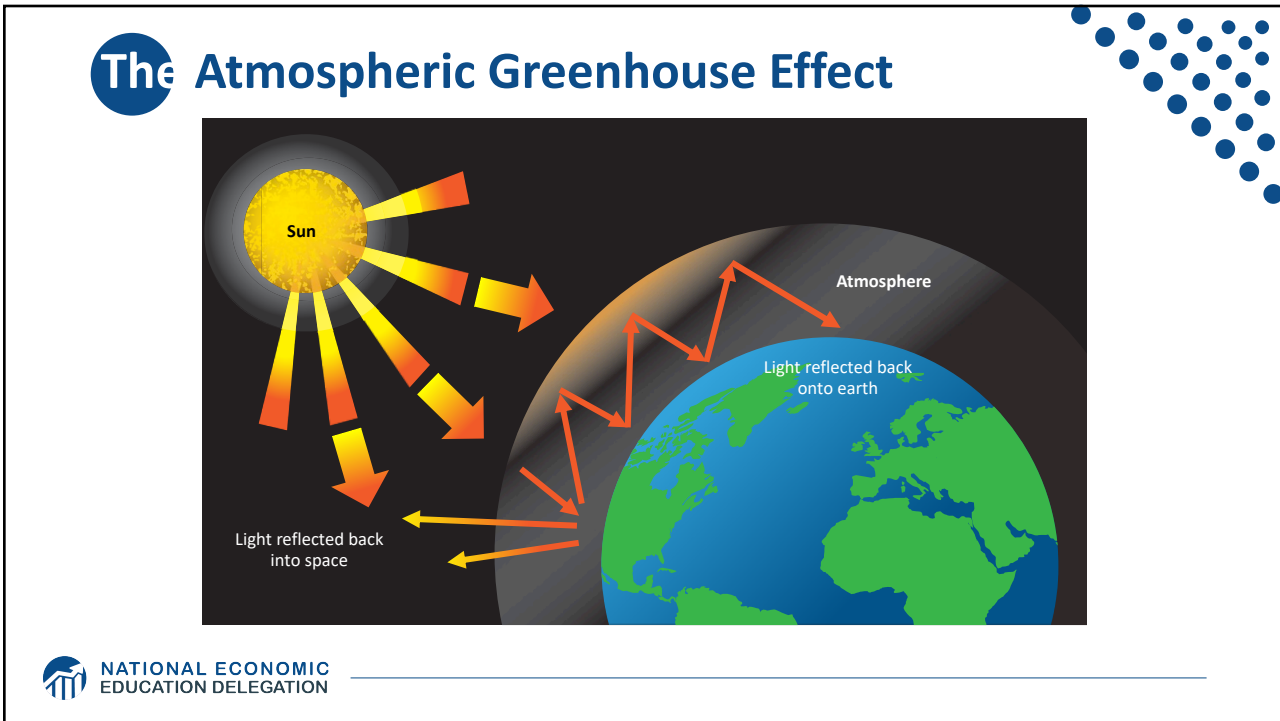
## Climate Change Science



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## Uncertainty

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## Electricity Is Different From Oranges

- Many sources of electricity generate pollution.
- Pollution is an **EXTERNALITY**:
  - a side effect (cost or benefit) that affects someone else when something is bought or sold.
  - This is a *market failure*.
- The price of electricity does not reflect all of the costs.
  - Electricity is too cheap.
  - There is too much pollution.

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## 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.



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## Externalities

- An externality occurs when market activity affects people outside of a market.
  - Market activity SPILLS OVER onto others.
  - A **negative externality** occurs when a **cost** spills over.
  - A **positive externality** occurs when a **benefit** spills over.




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# Examples of Externalities

- **Negative Externalities:**
  - Heating your house
  - Smoking
  - Getting a dog
  - Pig farming
- **Positive Externalities**
  - Education
  - Growing apples
  - Getting a vaccination
  - Basic scientific research

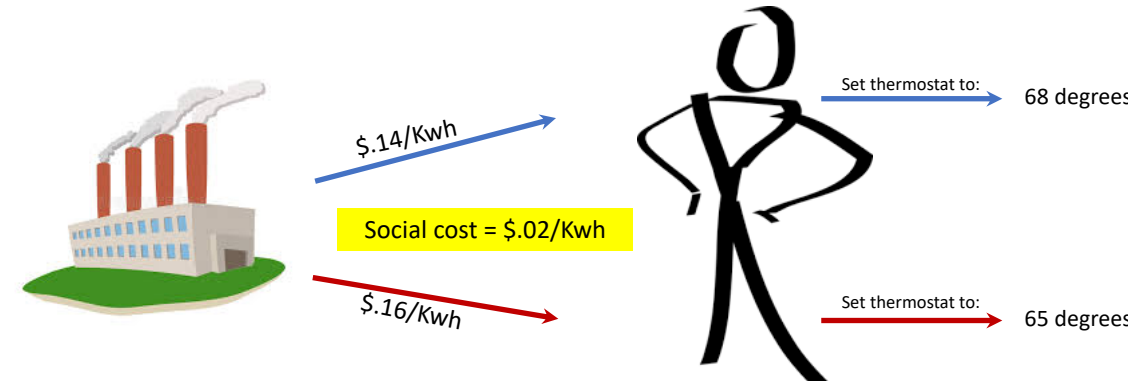


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# Addressing a Negative Externality



The social cost of \$.02/kwh has been INTERNALIZED.



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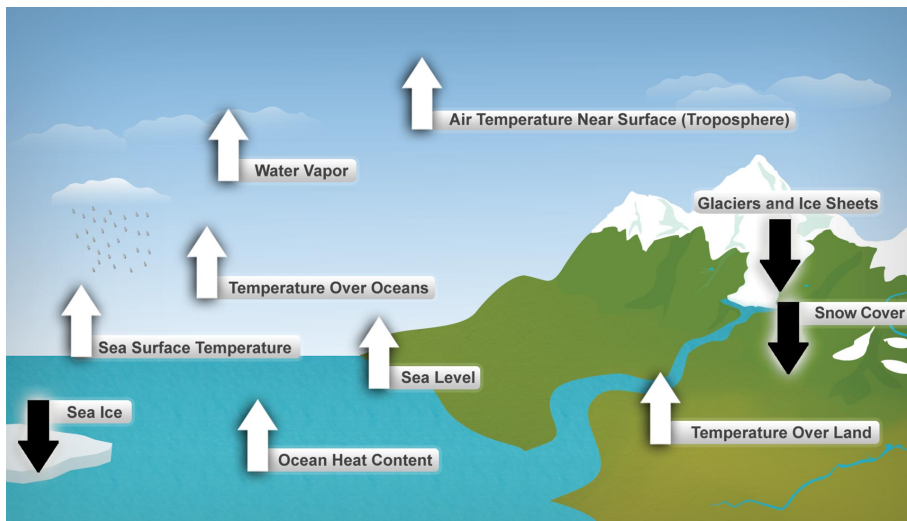
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# Impacts of Climate Change

## 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



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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.
- **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

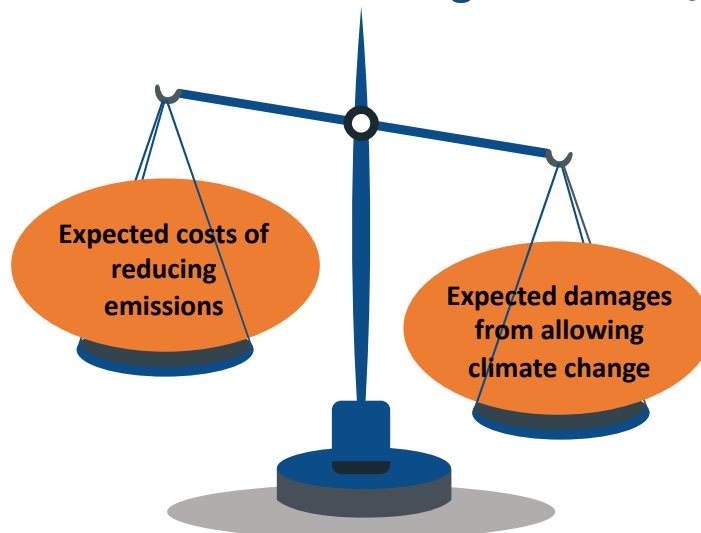


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## How Economists Decide How Much to Fight Climate Change

- **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.
  - Costs amount 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.**
- **Caveats:**
  - Putting a monetary value on priceless things
  - Uncertainty and risk

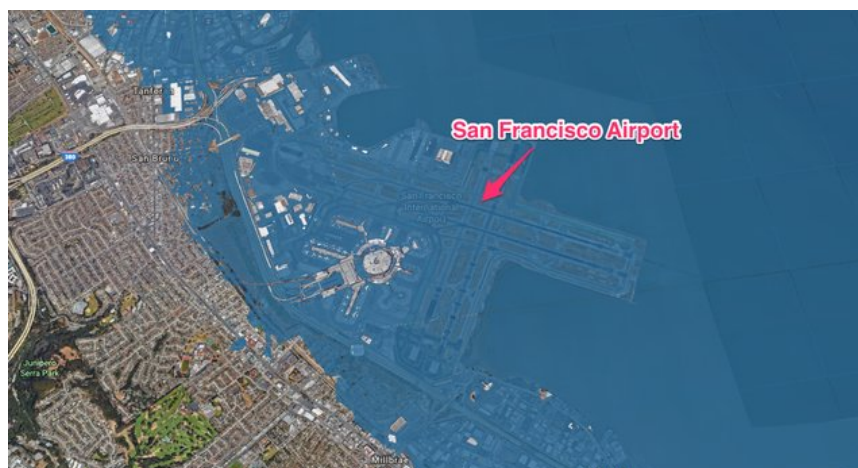


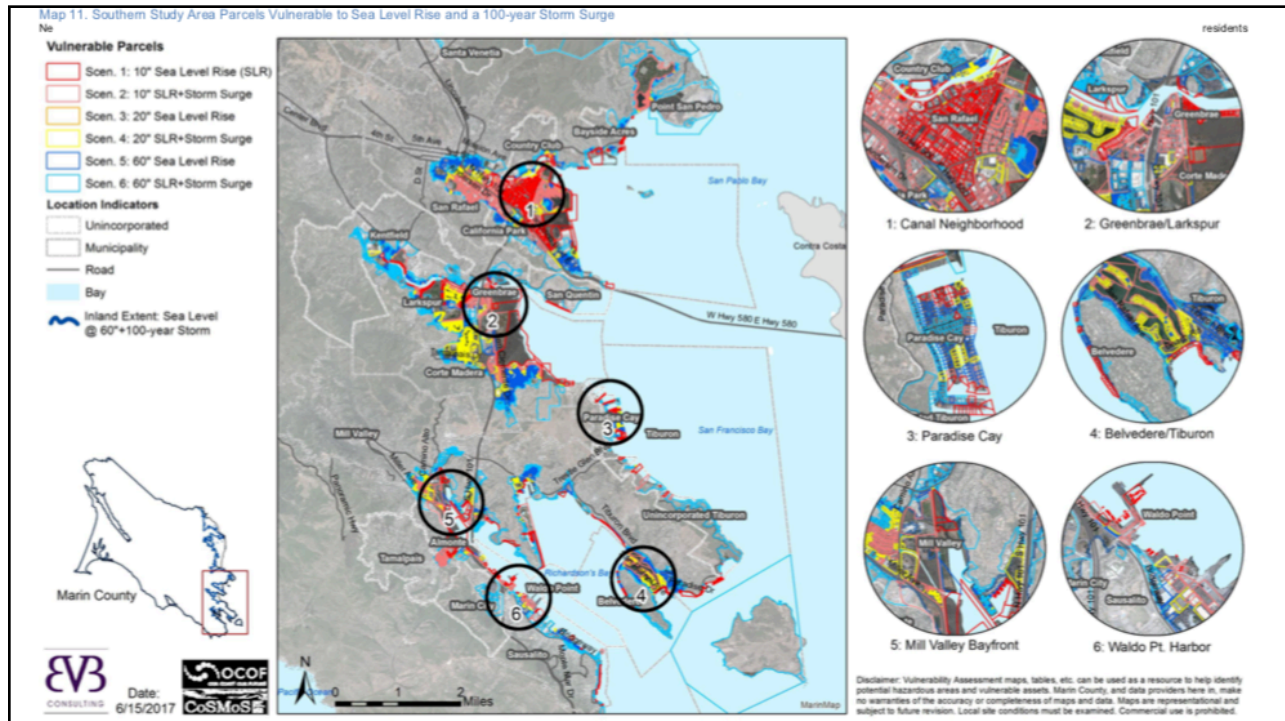
## This is What Precisely Wrong Looks Like



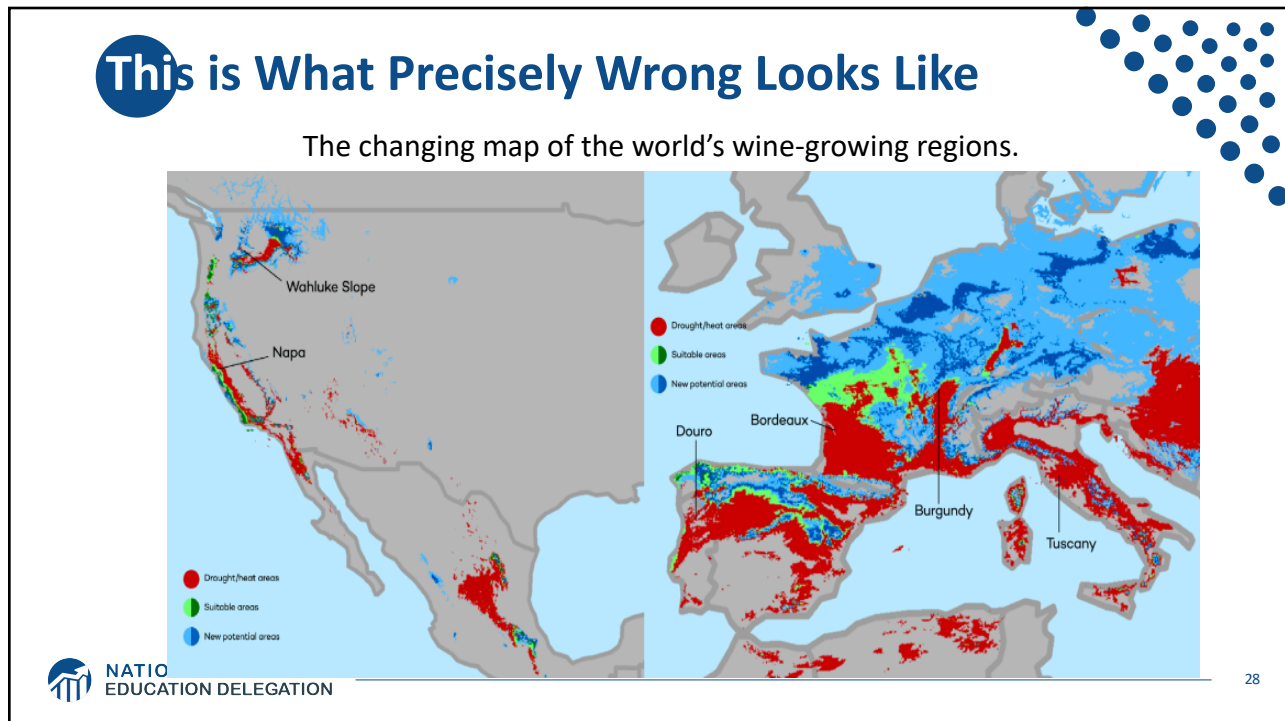
Facebook's office may be fully underwater by 2100, based on worst-case scenario sea level rise projections. Shayanne Gal/ Business Insider

## This is What Precisely Wrong Looks Like





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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.**



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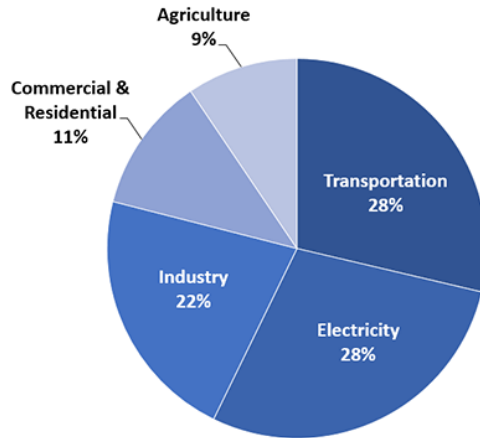
## **Addressing the Sources of Our Emissions**



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

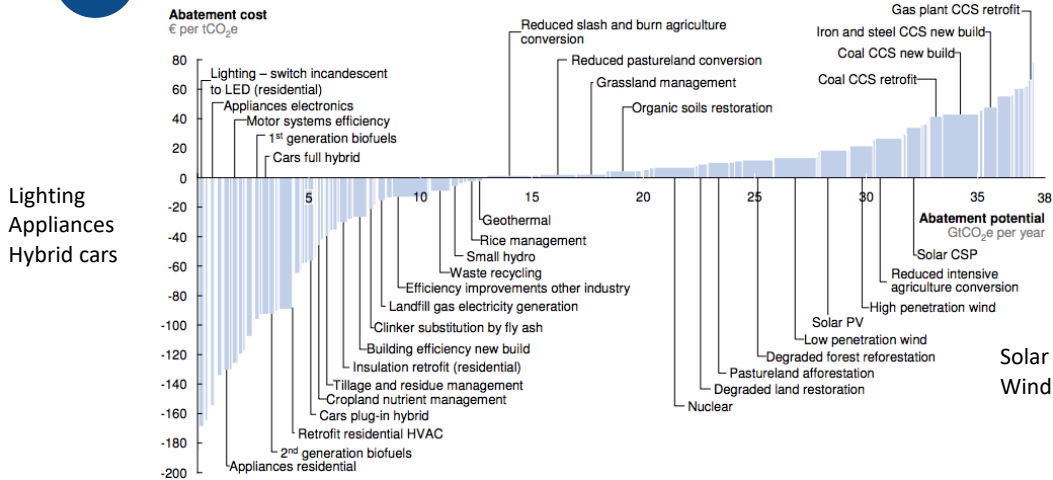


U.S. Environmental Protection Agency (2018). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016



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## Global GHG Abatement Cost Curve



Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €80 per tCO<sub>2</sub>e 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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# Climate Change Policy



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## Policies That Reduce Emissions: Directly

- **Regulation**

- Emissions standards or limits
  - E.g., CAFE standards

- **Market-oriented policies**

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



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## How Does Cap and Trade Work?

- **Activities to be covered are determined.**
- **Acceptable emissions levels are indicated.**
- **“Permits” that allow acceptable emissions levels are issued.**
  - How?
    - According to historical emissions?
    - Evenly across emitters?
    - Sold at some price?
- **A “market” is developed.**
- **Those desiring to emit will have to buy sufficient permits to accommodate their emissions.**
- **Those wishing to abate will offer their permits on the “market”.**
  - The price of a permit indicates:
    - The benefit of eliminating further emissions.
    - The cost of emitting.
- **Gov’t agency determines equality of permits in possession and emissions.**



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## How Does a Carbon Tax Work?

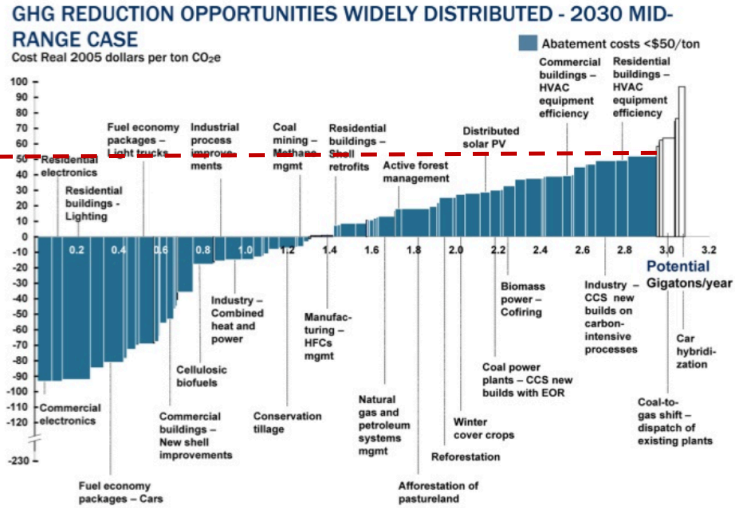
- **Activities to be covered are determined.**
- **The price of emissions is determined.**
  - Presumably some relation to the social cost of polluting.
- **Emissions are measured.**
- **Taxes are determined.**
- **Q: What to do with the tax revenue?**



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# Putting a Price on Carbon

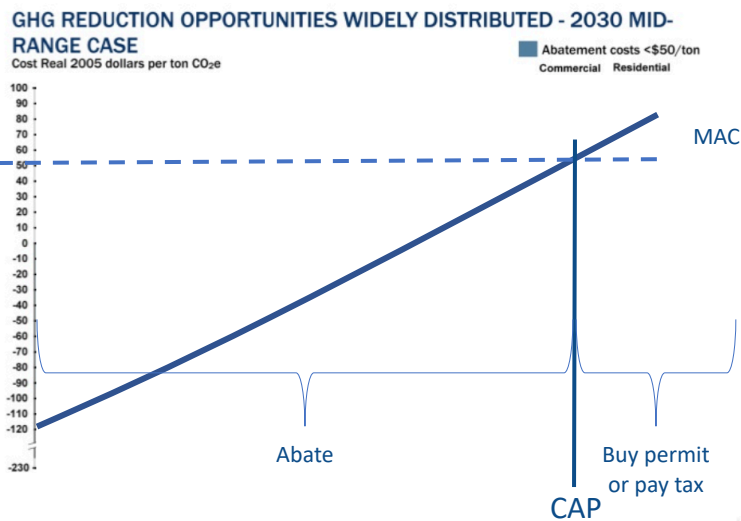
Suppose a Social Cost Of Carbon of \$50



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# Putting a Price on Carbon

TAX  
= Permit Price  
= Carbon Price



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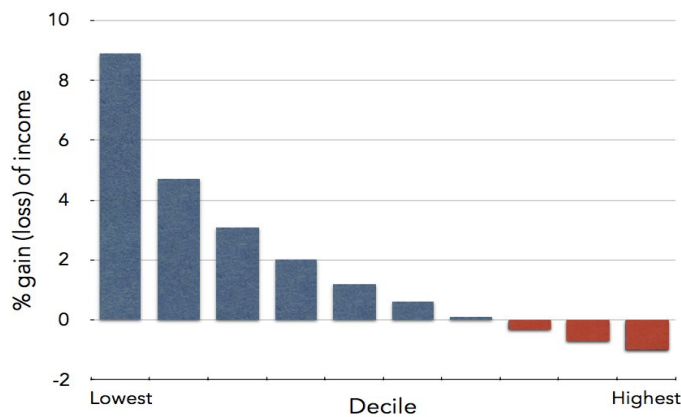
## Carbon Prices: the Good and Bad

- **Good:**
  - Provide price signal to lower emissions.
  - They yield low-cost reductions in emissions.
  - They spur innovation in clean technologies.
- **Bad:**
  - Firms might leave to flee regulation.
  - It is necessary to monitor emissions.
  - Potentially regressive
    - Costs may weigh more heavily on low-income households.




## Revenue Dividend Eliminates Regressivity

IMPACT OF CARBON DIVIDENDS ON U.S. FAMILY INCOMES



## Carbon Tax and Cap & Trade: the Differences


	Carbon Tax	Cap & Trade

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## Carbon Tax and Cap & Trade: the Differences

	Carbon Tax	Cap & Trade
Carbon Price	Targeted	Uncertain
Emissions	Uncertain	Targeted
Ease of Implementation	May be easier to implement	
Additional concerns	1) Always generates revenue. 2) May require legislation to change. 3) Predictability.	1) Only generates revenue if government sells permits. 2) Cap can be changed by regulator. 3) Susceptible to lobbying. 4) Less certainty over future. 5) Regulations reduce efficacy of Cap & Trade

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## One Other Thing: Cap and Trade vs. Carbon Tax

- **Emissions regulations and Cap and Trade can work at cross purposes.**
  - Regulations that lower emissions from big polluters...
    - Lower the demand for permits
    - Lowers the price of permits
    - Reduces incentives for other industries to cut emissions
- **Regulations can undermine the effectiveness of Cap and Trade.**
- **The same is not true of a carbon tax.**
  - Though regulations might cut tax revenue, revenue is not the goal of the carbon tax.



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## 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 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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## 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:
  - o 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**

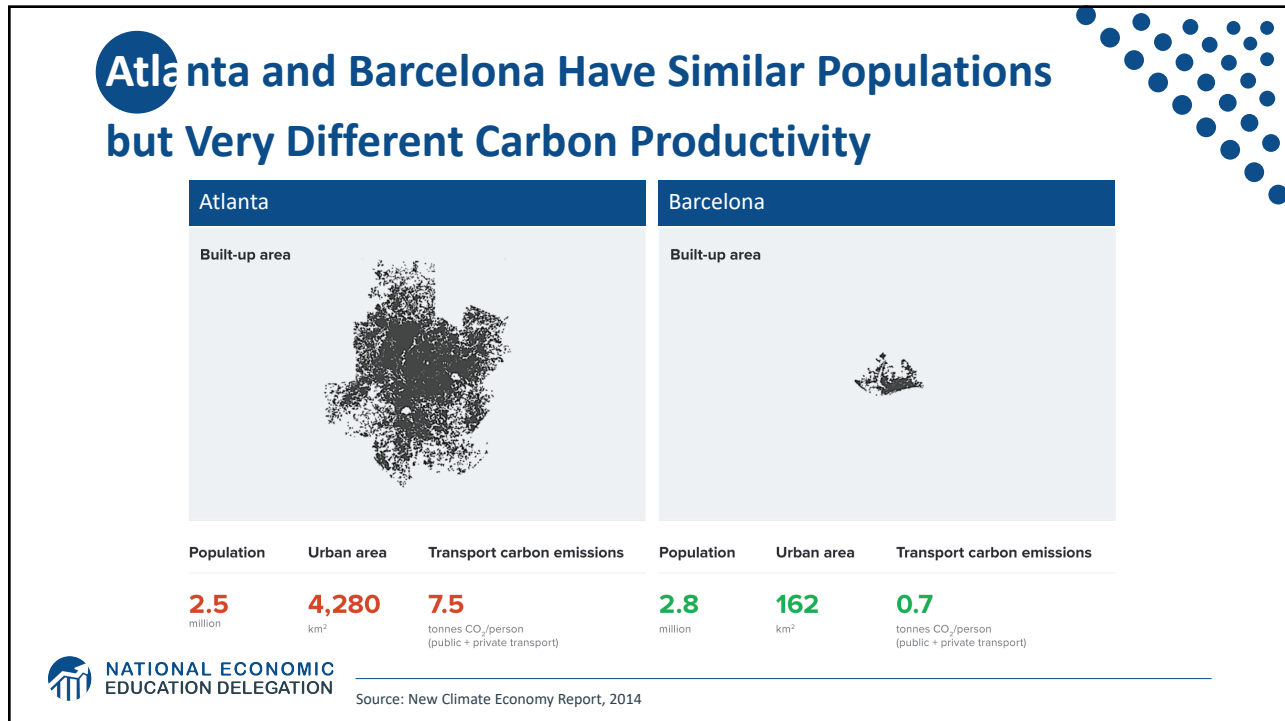
- A given level of emission reductions **costs 3-14 times more with CAFÉ standards** than under a comparable carbon tax.



## Policies That Reduce Emissions: INDIRECTLY

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






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## European Union's Emissions Trading Scheme



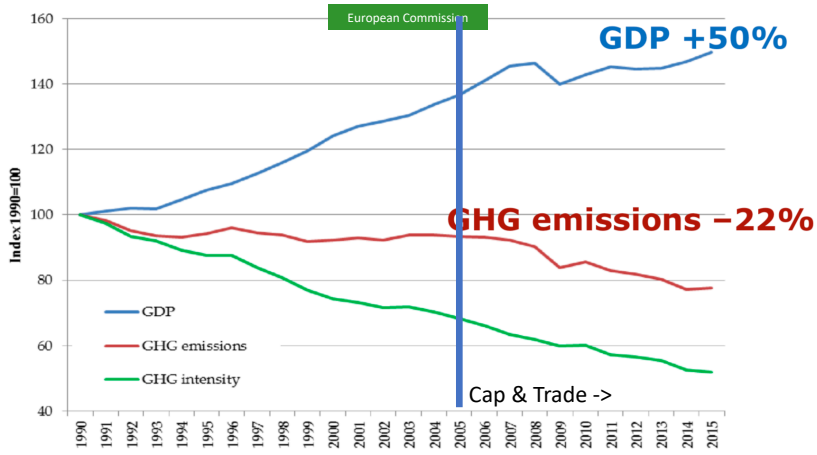
# 4%

of global  
greenhouse gas  
emissions  
Circa 2005

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## EU Has Decoupled Economic Growth from Greenhouse Gas Emissions



Year	GDP	GHG emissions	GHG intensity
1990	100	100	100
1995	105	95	90
2000	125	92	75
2005	135	93	70
2010	145	82	60
2015	150	78	55


**GDP +50%**  
**GHG emissions -22%**

European Commission (2005-2015)  
Climate Action (2015-2015)  
Cap & Trade ->

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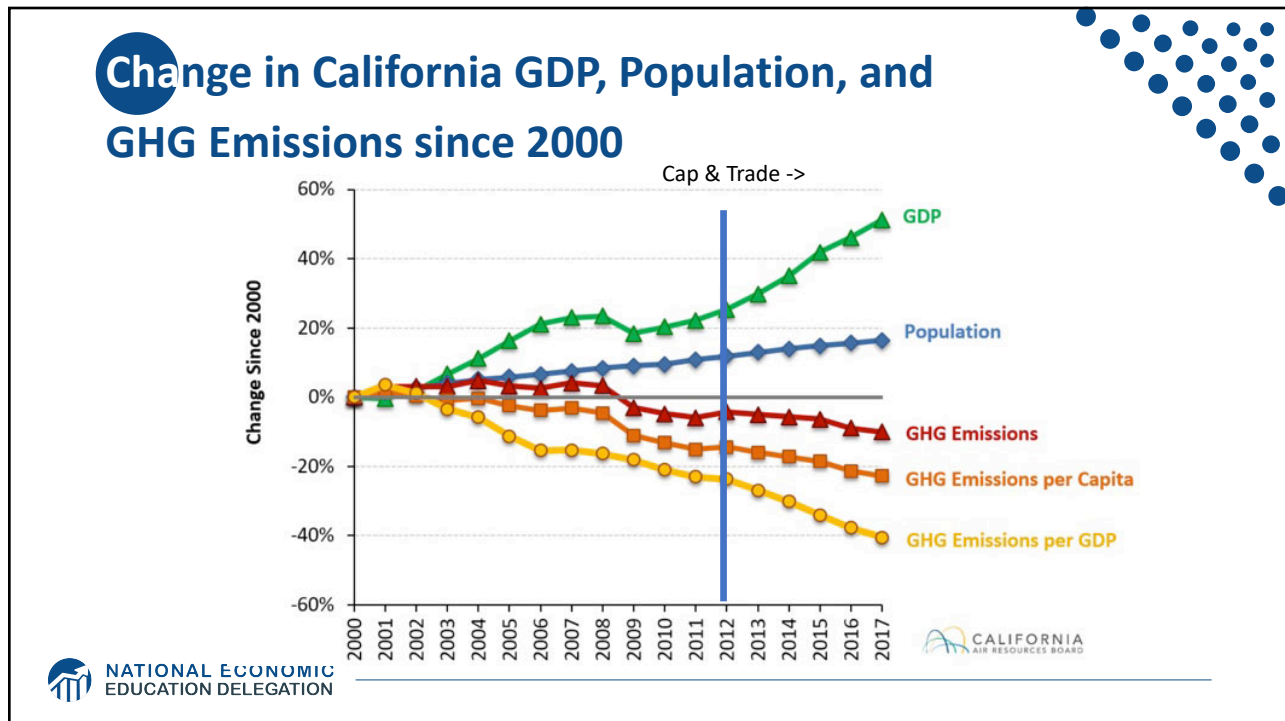
## California's Cap and Trade System: 2012+



**0.7%**  
of global  
greenhouse gas  
emissions


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## Sweden's Carbon Tax Policy



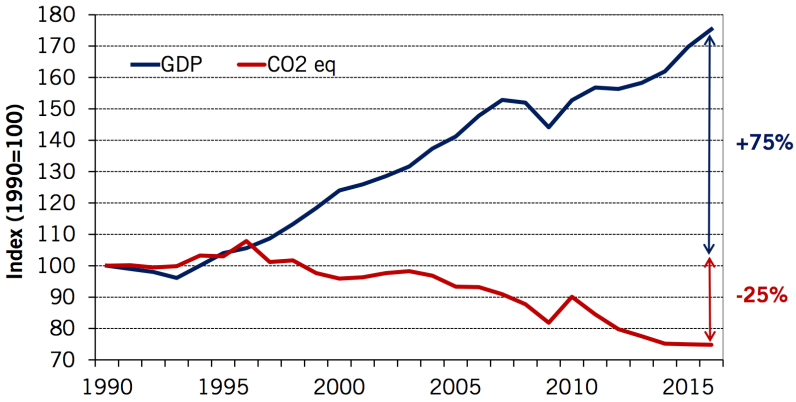
# Started in 1991

Currently at \$140/ton

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## 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	160	75
2016	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

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## U.S. Carbon Tax Plans

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



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## Summary

- There are many ways to reduce emissions.
- Taxes and cap and trade are proven effective tools to fight climate change!
- Economics-inspired policies can help us do this at the lowest cost.
- Other tools may also be necessary.
  - Regulations may well be necessary in some circumstances, but they are generally inefficient.
- Scientists and the IPCC recommend that we work to keep warming below 1.5 degrees celcius.
  - *Economists believe that this goal is well worth the costs!*



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**Thank you!**

## Any Questions?

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