NATIONAL ECONOMIC EDUCATION DELEGATION

Climate Change Economics

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Palo Alto Rotary Club

January 6, 2020

1

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

Who Are We?

- **Honorary Board: 46 members**
  - 2 Fed Chairs: Janet Yellen, Ben Bernanke
  - 6 Chairs Council of Economic Advisers
    - Furman (D), Rosen (R), Bernanke (R), Yellen (D), Tyson (D), Goolsbee (D)
  - 3 Nobel Prize Winners
    - Akerlof, Smith, Maskin
- **Delegates: 463 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: 43 Ph.D. Economists**
  - Aid in slide deck development

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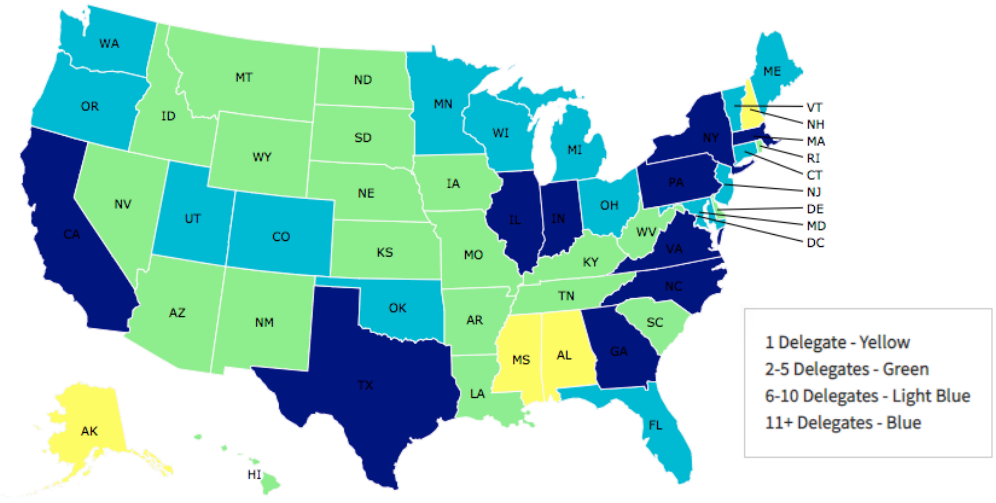
3

Where Are We?



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4

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).

5

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**

6

How Can Economists Contribute to Thinking about Climate Change?

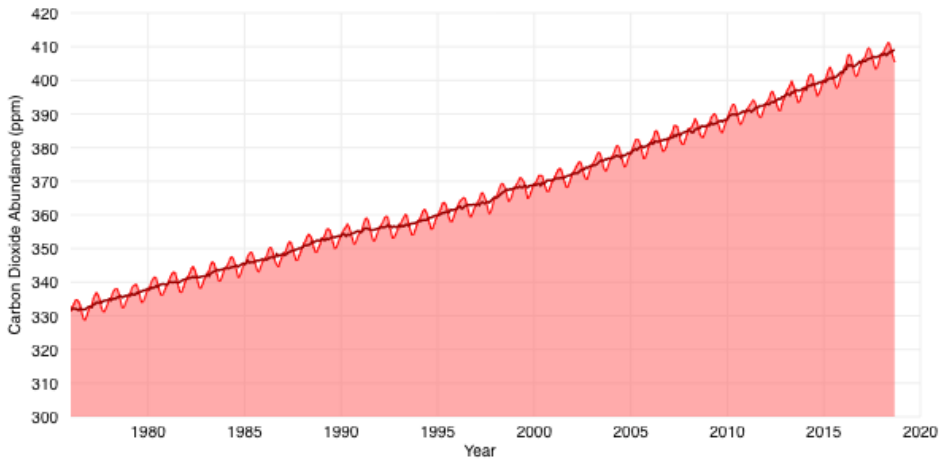
- **By assessing behavioral reactions to climate change.**
- **By measuring the damage and estimating the economic costs of fighting climate change.**
- **By designing smart policies that minimize costs.**
  - Balance economic growth with GHG emission mitigation.

7

Climate Change Science

8

Atmospheric CO_2 Concentrations



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Source: IPCC data distribution center and climate.gov

9

Impacts of Climate Change

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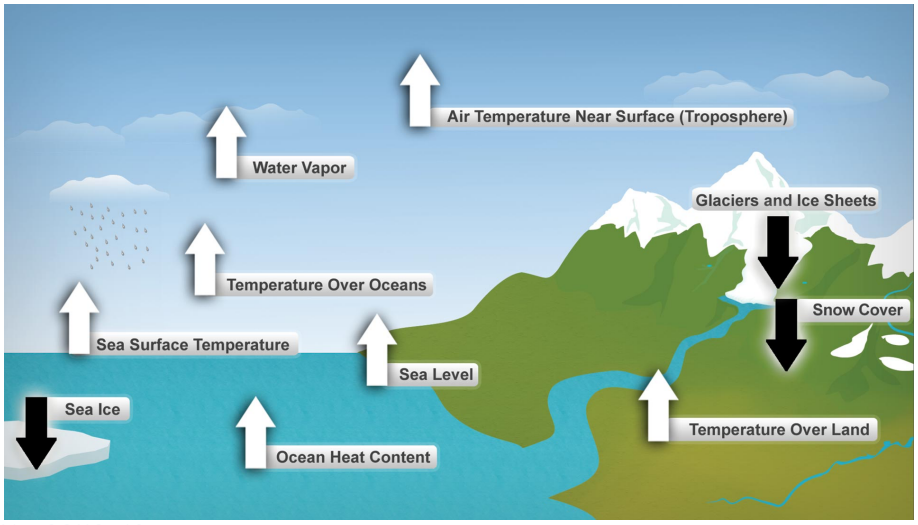
10

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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Pollution Is Different From Oranges

- **Human activity creates pollution.**
  - The goal is not necessarily zero pollution a 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.

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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_2.**
  - 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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14

Economics of Responding to Climate Change

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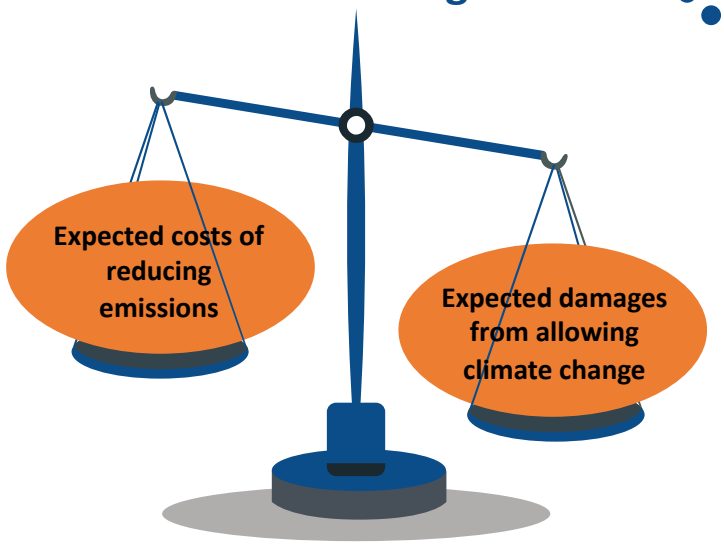
15

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.
- **Caveat: Uncertainty**

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17

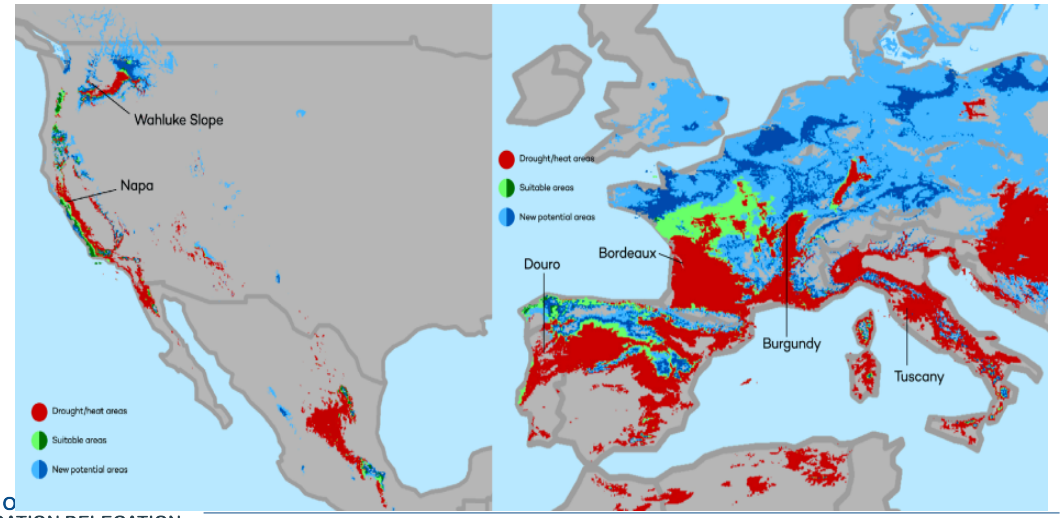
18

This is What Precisely Wrong Looks Like

19

This is What Precisely Wrong Looks Like

The changing map of the world's wine-growing regions.



20

Addressing the Sources of Our Emissions

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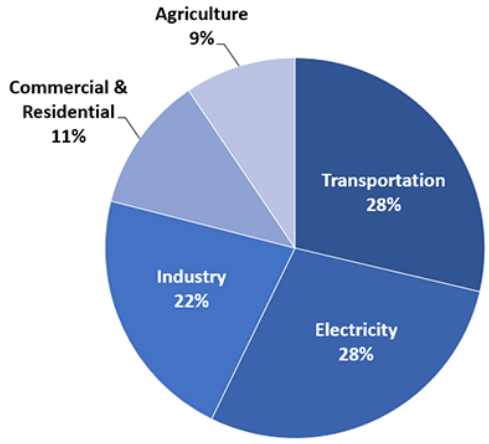
21

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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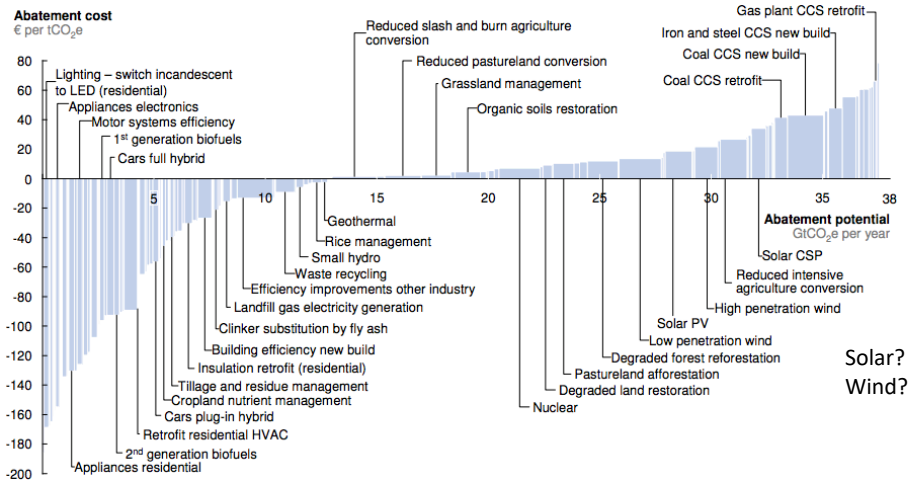
22

Global GHG Abatement Cost Curve



Lighting
Appliances
Hybrid cars

Solar?
Wind?

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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Climate Change Policy

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24

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

25

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?
- **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".
- **Gov't agency determines equality of permits in possession and emissions.**

26

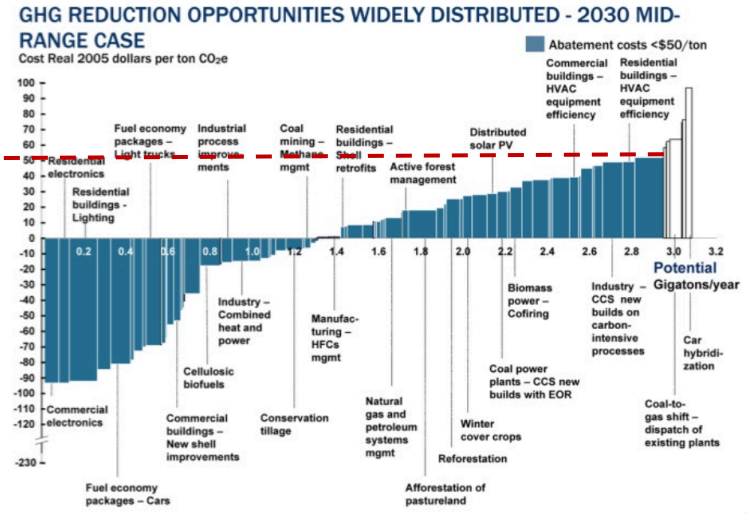
How Does a Carbon Tax Work?

- **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.**

27

Putting a Price on Carbon

Suppose a Social Cost Of Carbon of $50



28

Carbon Tax and Cap & Trade: the Differences

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

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29

Thoughts on Regulation vs Market-Oriented

- **Equity.**
  - Both types of policies can be 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.
        - Costs of reductions are 3-15 times higher with CAFE standards
      - Why?
        - New vehicles only, rebound effect, slower turnover

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30

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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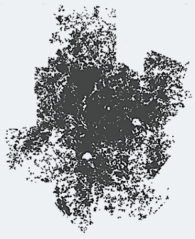
31

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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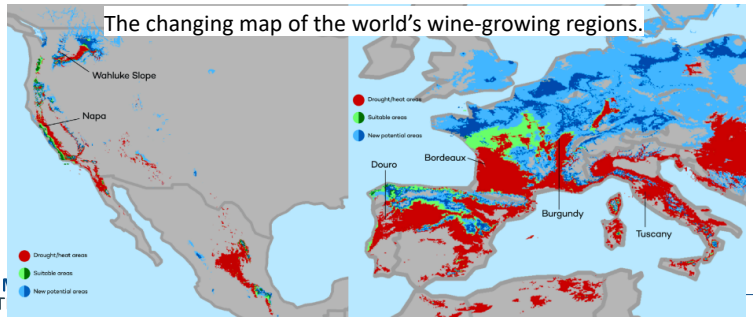
Source: New Climate Economy Report, 2014

32

Other Policies: Adaptation

- **Individual-level adaptation**
  - Air conditioning, move
- **Public adaptation**
  - Sea walls, ecosystems, moving towns, airports
- **Market-based adaptation**
  - Responding to prices



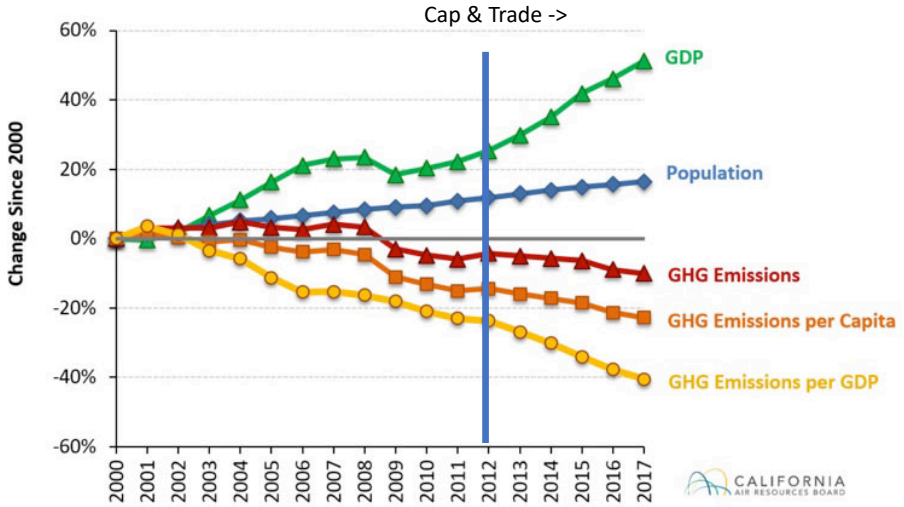
The changing map of the world's wine-growing regions.

33

Climate Change Policy in Action

34

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



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Sweden's Carbon Tax Policy

Started in 1991

Currently at $140/ton

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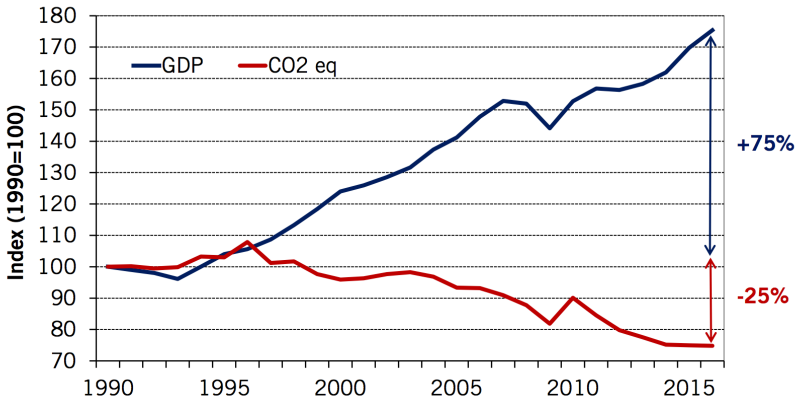
Real GDP and Domestic CO_2eq Emissions[1] In Sweden, 1990-2016



[1] In accordance with Sweden's National Inventory Report, submitted under the UNFCC and the Kyoto Protocol. CO_2 = approx. 80 % of total CO_2eq emissions. Preliminary data for 2016.

Sources: Swedish Environmental Protection Agency, Statistics Sweden

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37

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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38

Summary

- 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!
- Other tools may also be necessary.
- Scientists and the IPCC recommend that we work to keep warming below 1.5 degrees celsius.
  - *Economists believe that this goal is well worth the costs!*

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39

Thank you!

Any Questions?

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40

40