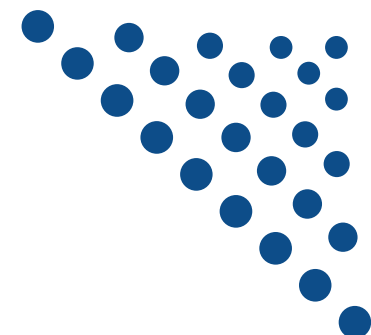


Climate Change Economics

OLLI
American University
July 17, 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.

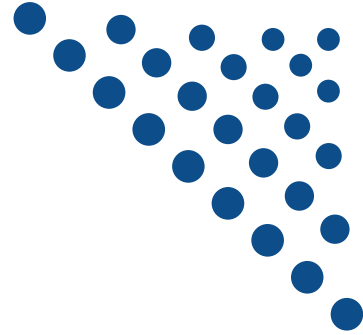
- **Mission**

- 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.

Credits and Disclaimer



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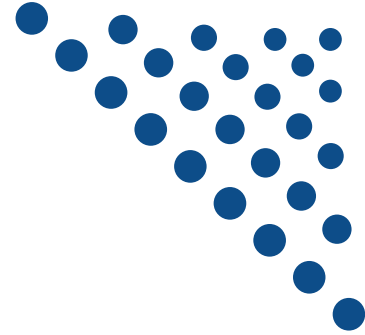
- Jason Shogren, University of Wyoming
- Walter Thurman, North Carolina State University

- **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).



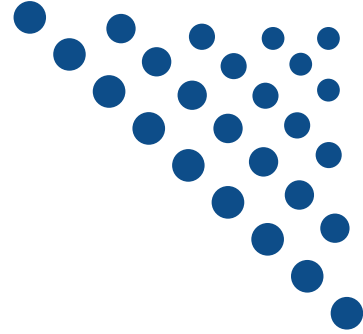
Outline



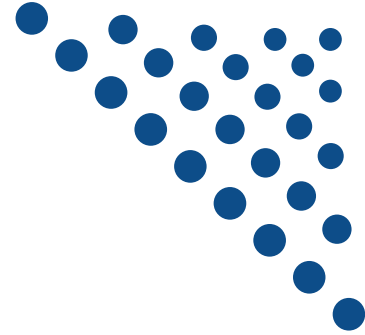
- **Climate change science**
- **Impacts of climate change**
- **Economics of responding to climate change**
- **Addressing the sources of our emissions**
- **Climate change policy**
- **Policy in action**



How Can Economists Contribute to Thinking about Climate Change?



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

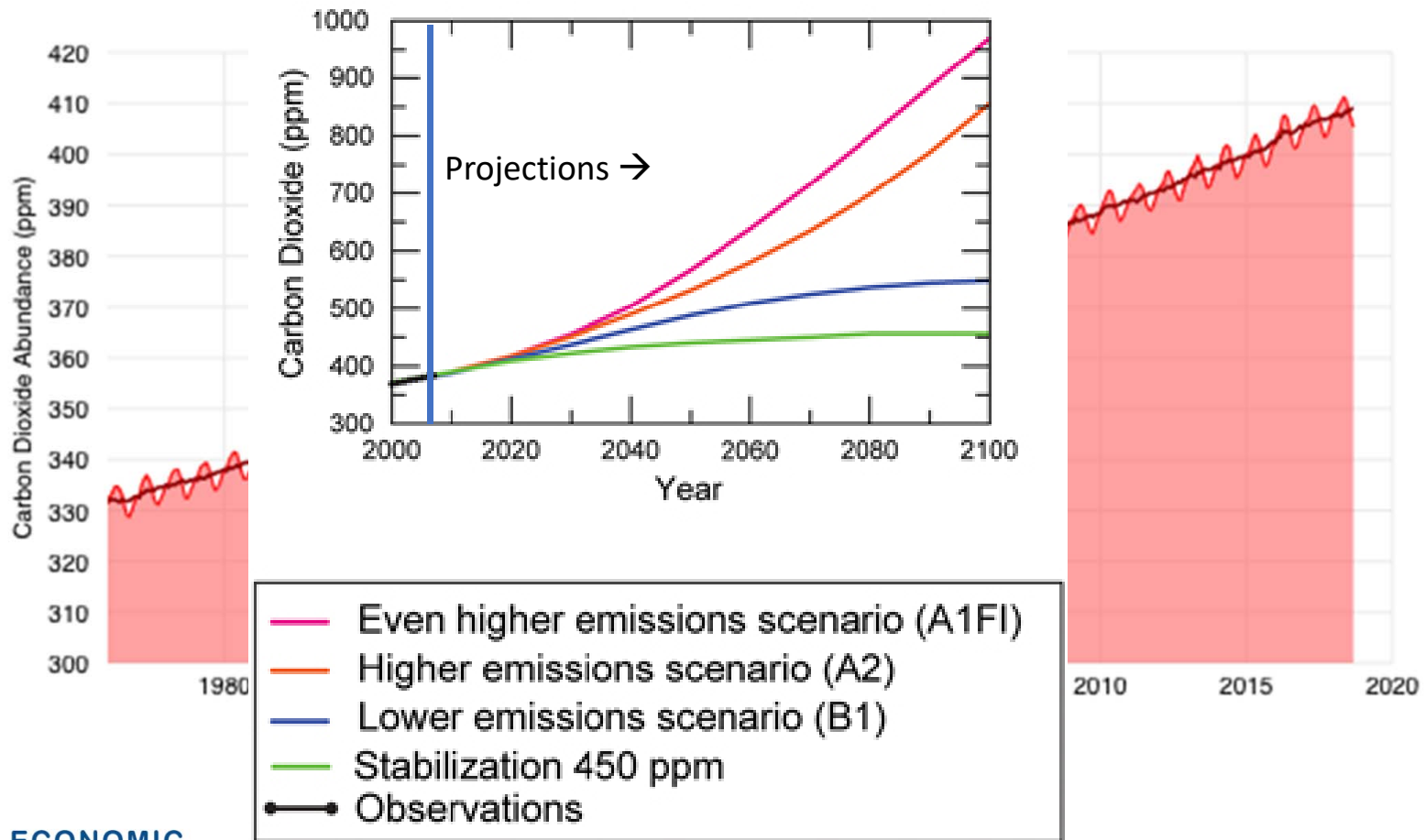


Climate Change Science

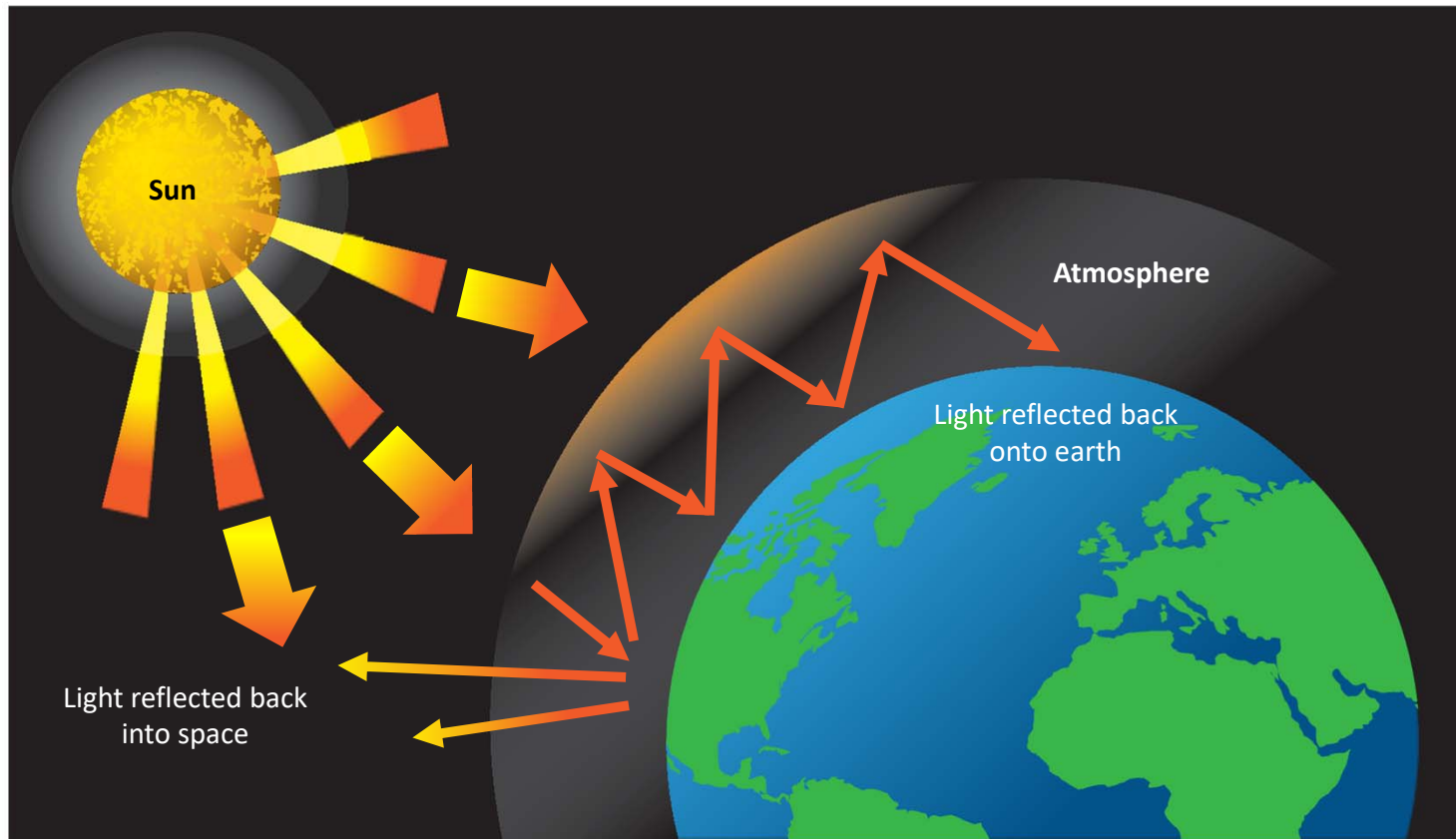


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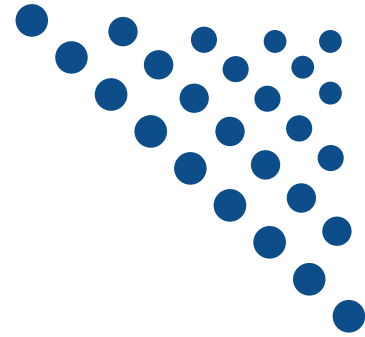
Atmospheric CO₂ Concentrations



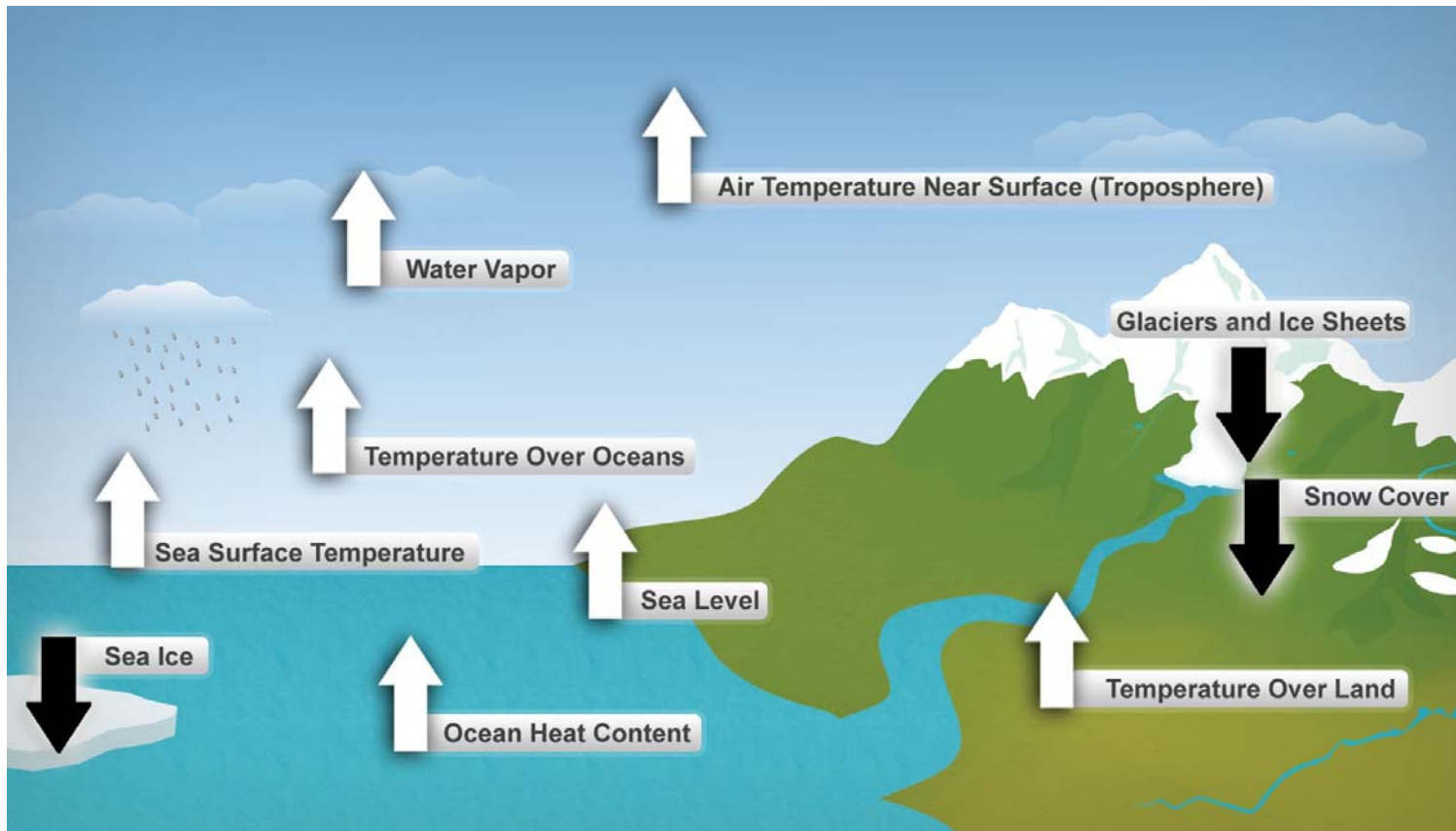
The Atmospheric Greenhouse Effect

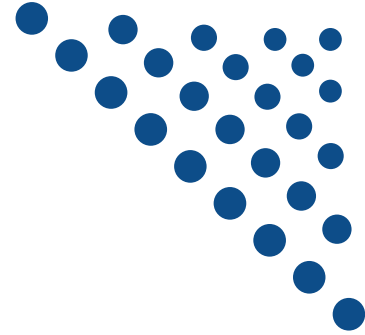


Uncertainty



Global Warming Indicators





Impacts of Climate Change



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



Projected Effects Vary Across the U.S. but Are Estimated at 1.2% of GDP per 1C Increase

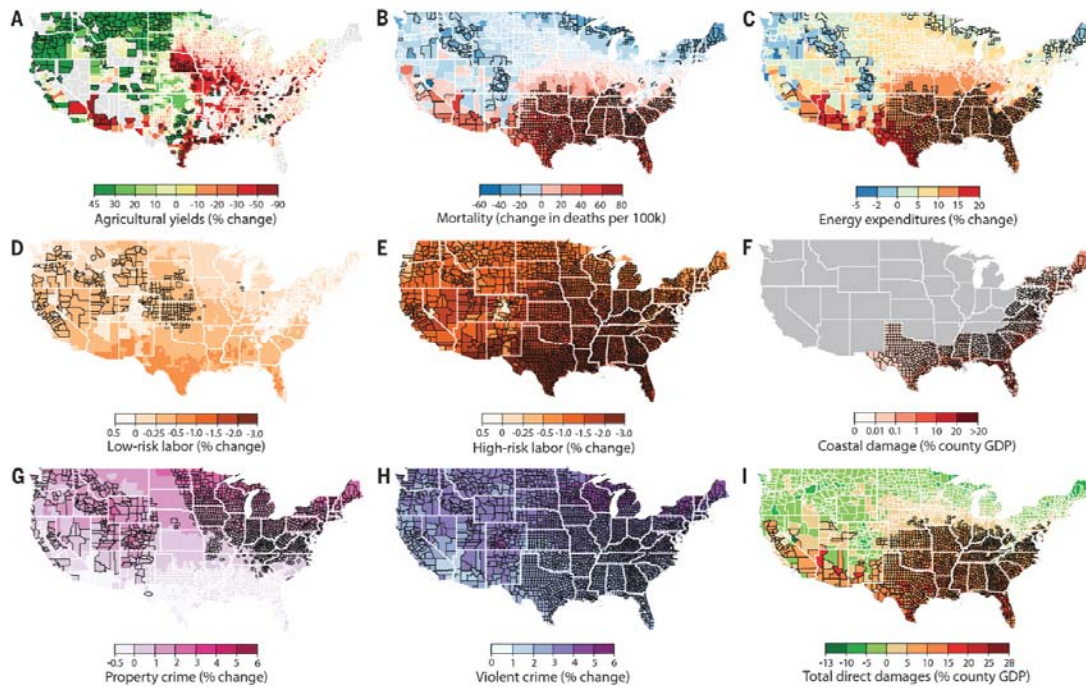
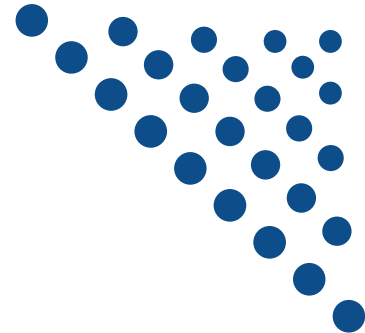


Fig. 2. Spatial distributions of projected damages. County-level median values for average 2080 to 2099 RCP8.5 impacts. Impacts are changes relative to counterfactual “no additional climate change” trajectories. Color indicates magnitude of impact in median projection; outline color indicates level of agreement across projections (thin white outline, inner 66% of projections disagree in sign; no outline, $\geq 83\%$ of projections agree in sign; black outline, $\geq 95\%$ agree in sign; thick white outline, state borders; maps without outlines shown in fig. S2). Negative damages indicate economic gains. (A) Percent change in yields, area-weighted average for maize, wheat, soybeans, and cotton. (B) Change in all-cause mortality rates, across all age groups. (C) Change in electricity demand. (D) Change in labor supply of full-time-equivalent workers for low-risk jobs where workers are minimally exposed to outdoor temperature. (E) Same as (D), except for high-risk jobs where workers are heavily exposed to outdoor temperatures. (F) Change in damages from coastal storms. (G) Change in property-crime rates. (H) Change in violent-crime rates. (I) Median total direct economic damage across all sectors [(A) to (H)].

Pollution Is an Externality

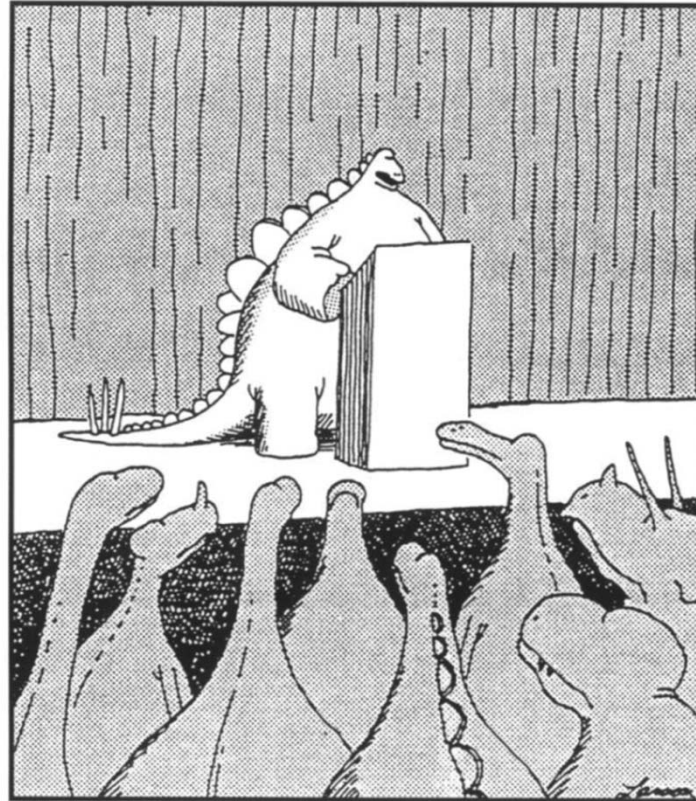
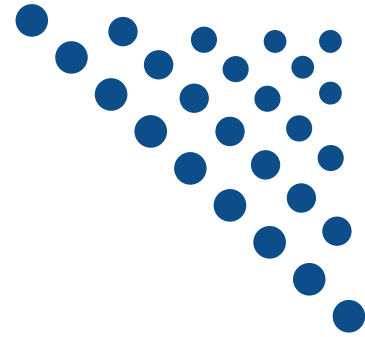
- **Human activity creates pollution.**
 - The goal is not zero pollution but society's best balance between pollution and human benefits.
- **Pollution is an EXTERNALITY: a side effect (cost or benefit) that affects someone else when something is bought or sold.**
 - The power company sells you electricity 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.



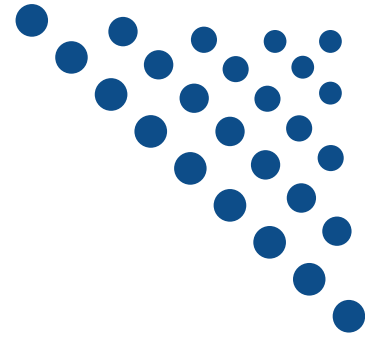
Social Cost of Carbon

- **Cost above price paid.**
- **The expected cost of damages from each unit of greenhouse gas emissions.**
- **Current EPA estimate: ~\$40 per metric ton of CO₂.**
 - About \$123/car per year.
 - \$26 Billion for all vehicles in the US.
- **Social cost of carbon will increase over time.**





"The picture's pretty bleak, gentlemen. ...
The world's climates are changing, the mammals
are taking over, and we all have a brain
about the size of a walnut."



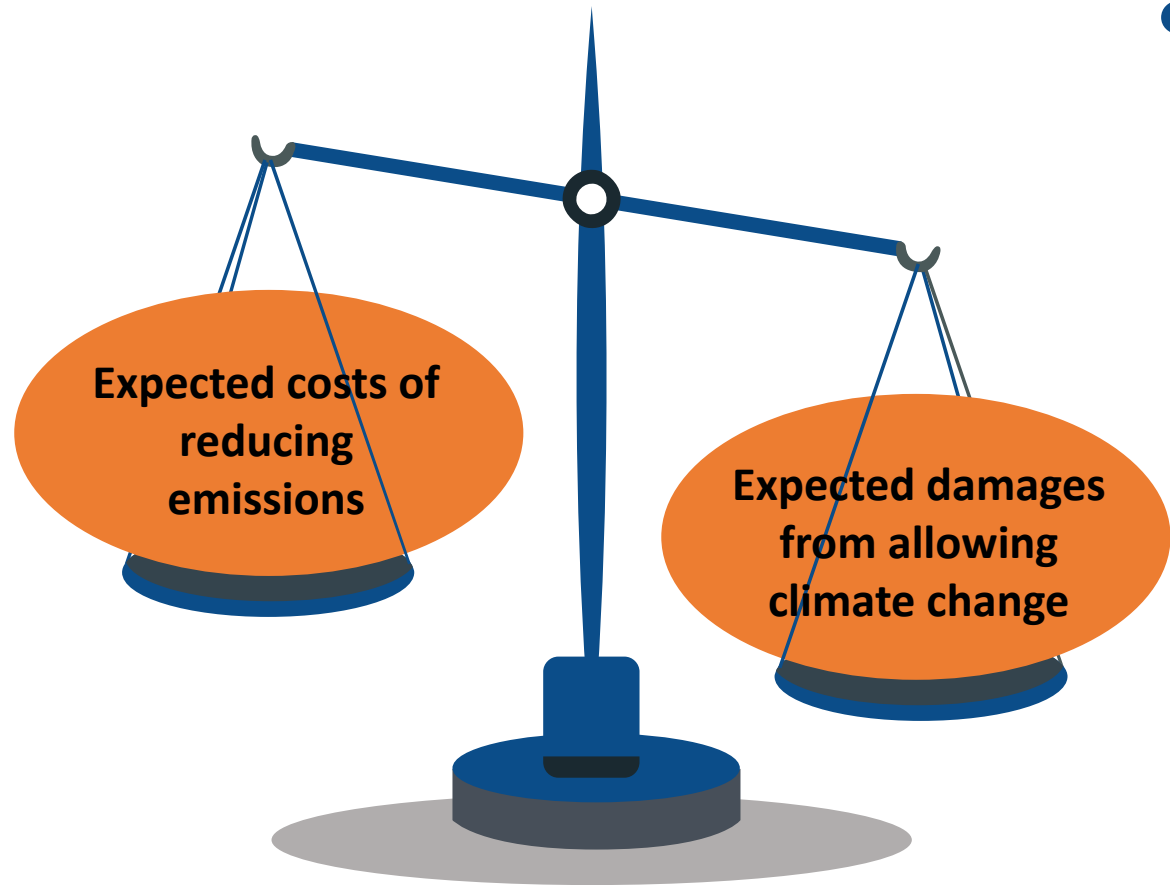
Economics of Responding to Climate Change



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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 per year.
- **Caveats:**
 - Putting a monetary value on priceless things
 - Uncertainty and risk
 - Inequality

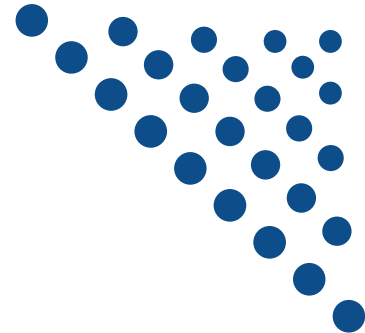




**“ It is better to be roughly right
than precisely wrong.”**

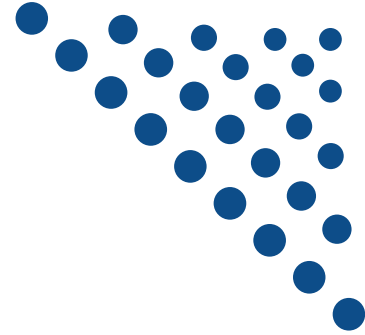
- John Maynard Keynes

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.**



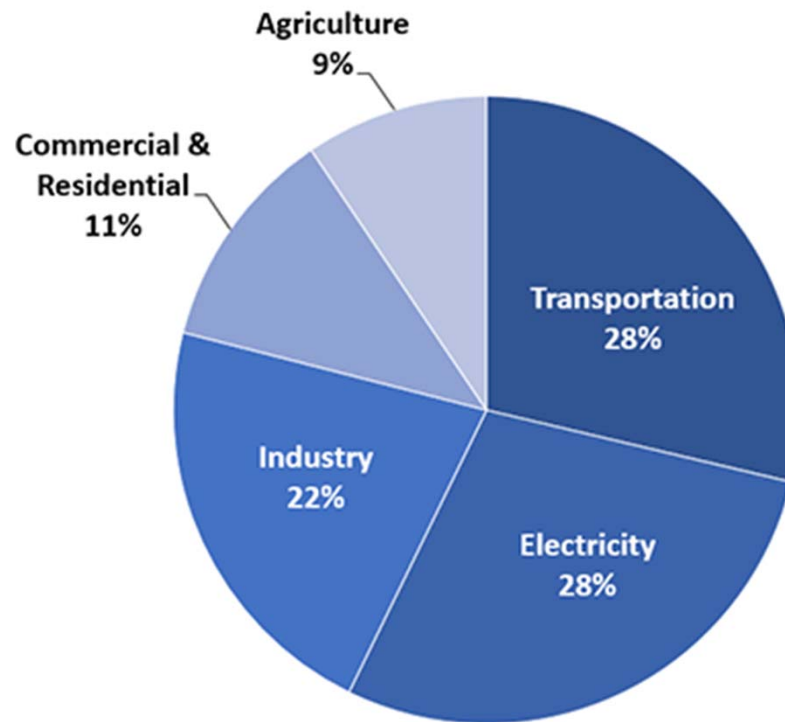
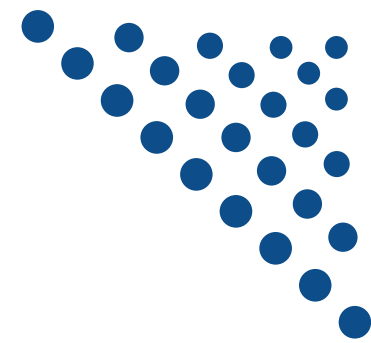


Addressing the Sources of Our Emissions



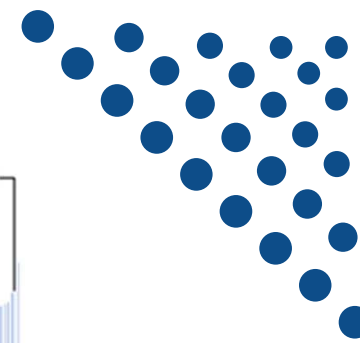
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Total U.S. Greenhouse Gas Emissions by Economic Sector in 2016

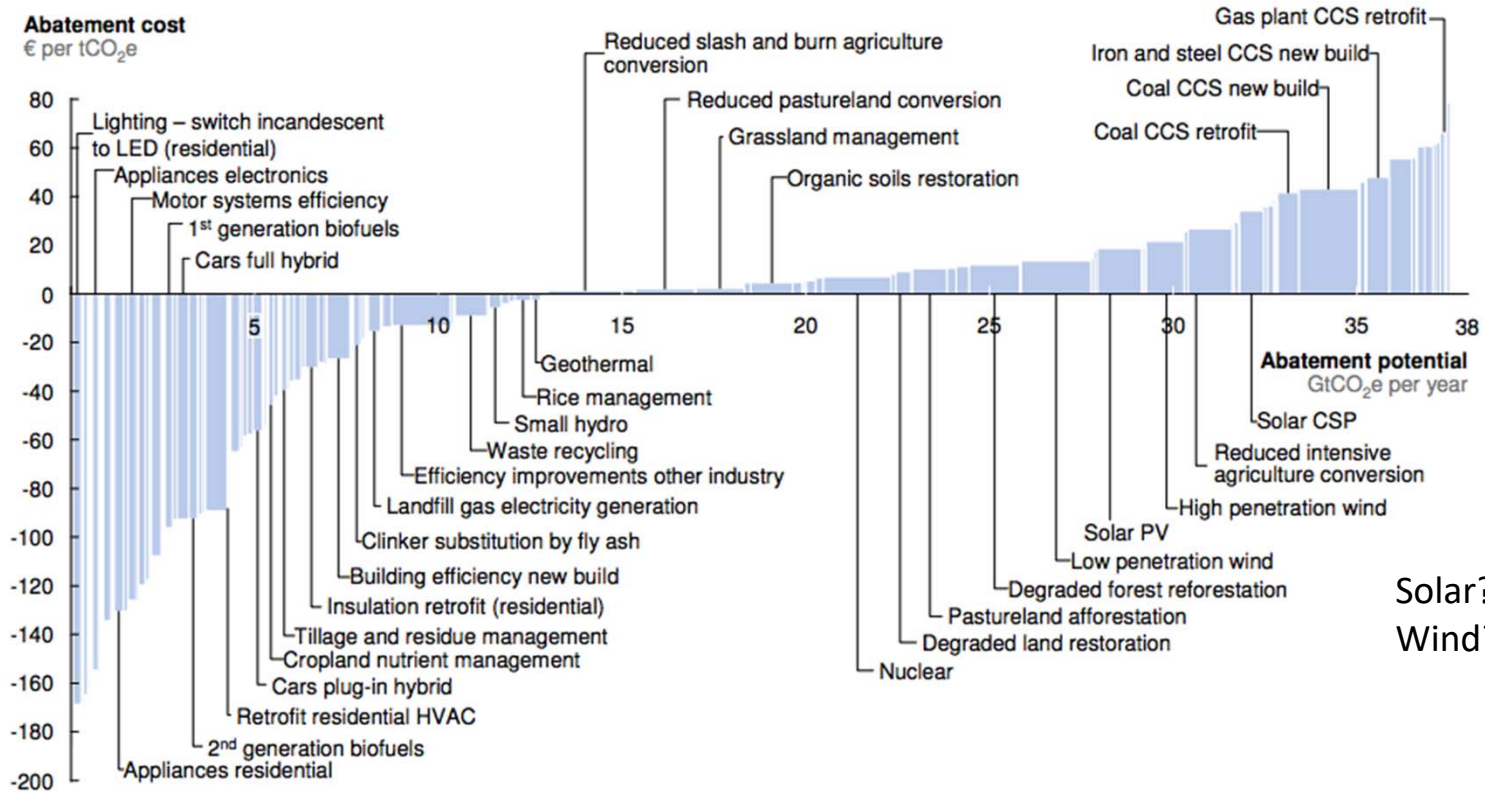


U.S. Environmental Protection Agency (2018). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016

Global GHG Abatement Cost Curve



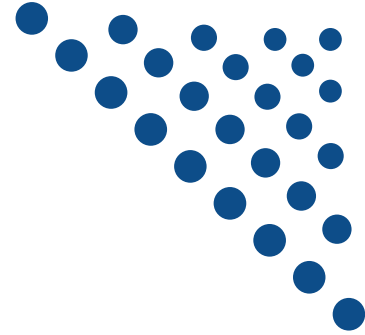
Lighting
Appliances
Hybrid cars



Solar?
Wind?

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €80 per tCO₂e 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

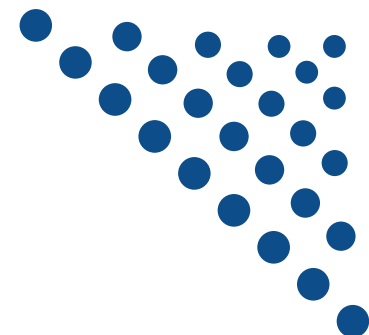


Climate Change Policy



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Policies That Reduce Emissions: Directly



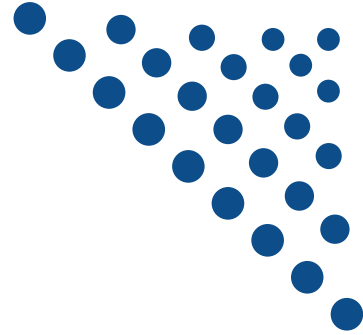
- **Regulation**

- Emissions standards or limits

- **Market oriented policies**

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

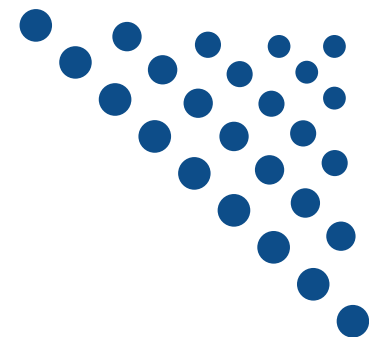
How Does Cap and Trade Work?



- **Activities to be covered are determined.**
- **Acceptable emissions levels are indicated.**
- **“Permits” that allow acceptable emissions levels are distributed. - 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 cost of emitting.
 - The cost of eliminating further emissions.
- **Agency determines equality of permits in possession and emissions**

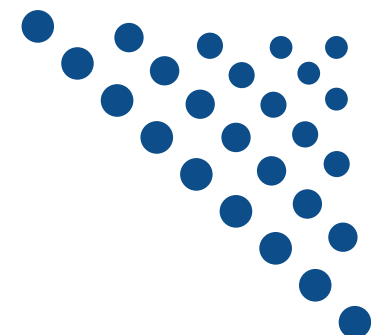


How Does a Carbon Tax Work?



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

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.

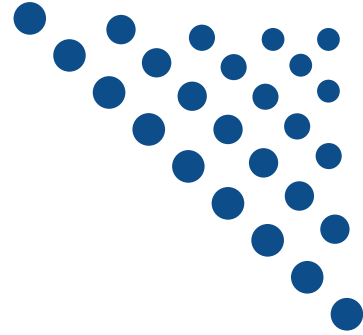


Carbon Tax and Cap & Trade: the Differences



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

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)

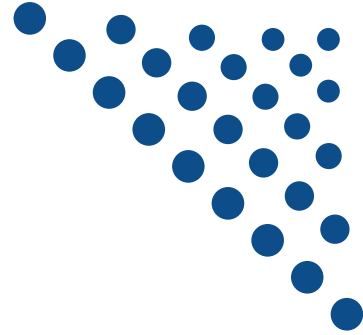


Challenges with Renewable Energy

- 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



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.

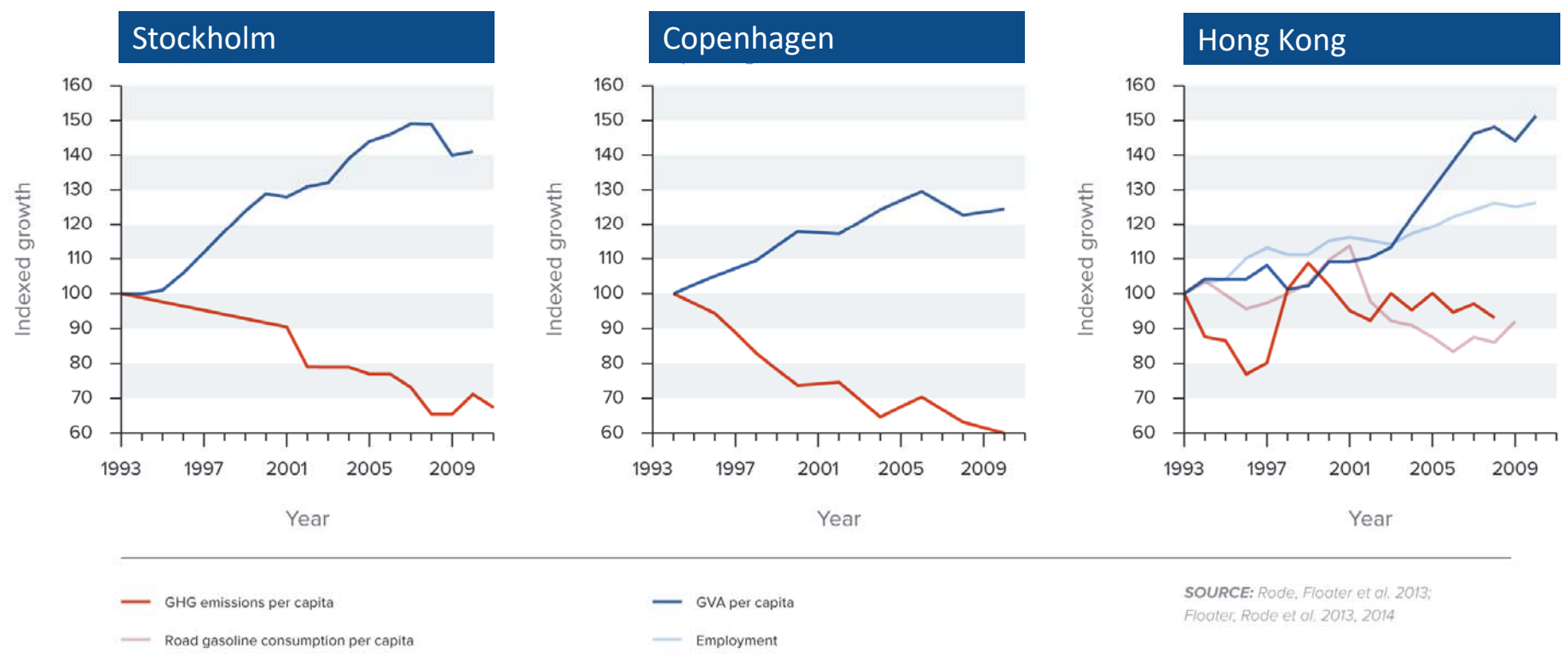




Atlanta and Barcelona Have Similar Populations but Very Different Carbon Productivity

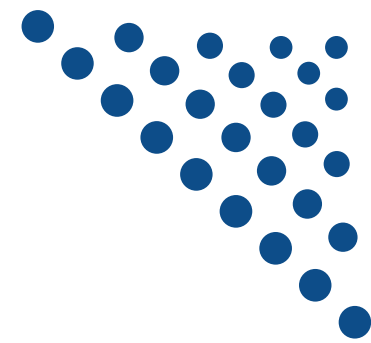
Atlanta			Barcelona		
Built-up area			Built-up area		
Population	Urban area	Transport carbon emissions	Population	Urban area	Transport carbon emissions
2.5 million	4,280 km ²	7.5 tonnes CO ₂ /person (public + private transport)	2.8 million	162 km ²	0.7 tonnes CO ₂ /person (public + private transport)

Compact and Connected Urban Pathways Can Go Hand-in-hand with Economic Growth



SOURCE: Rode, Floater et al. 2013; Floater, Rode et al. 2013, 2014

Land Use: Restoration Is Possible



1953



2000

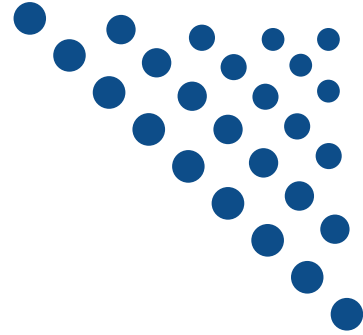
South Korea restored its forest cover from 35% to 64% of the country's total area



“ Economic policies will be central to accomplishing the goals we choose.”

- Harris and Roach (2007)

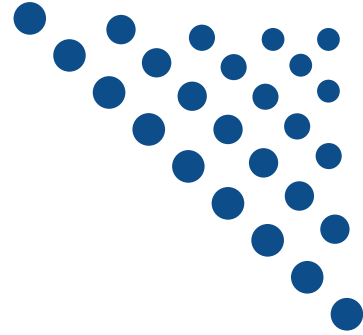
Summary



- **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!*



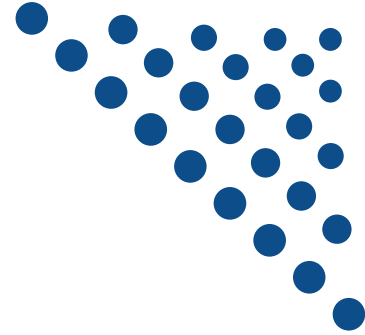
Summary – *continued*



- 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!



Thank you!



Any Questions?

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