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mate Change Economics

ThinkTank Tuesday: 10/02/18

Outline

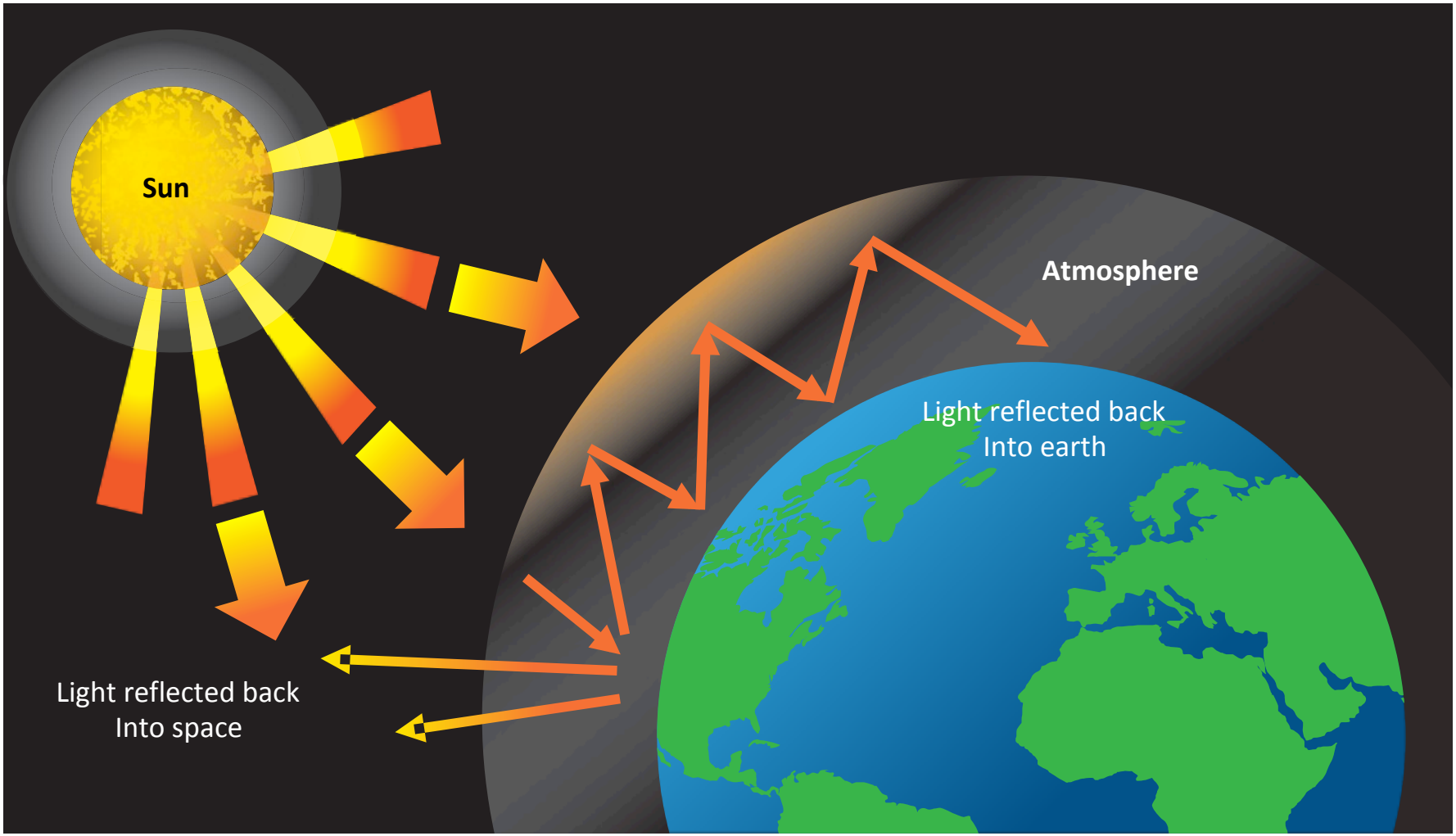
- Climate change science
- Impacts of climate change
- Economics of responding to climate change
- Addressing the sources of our emissions
- Climate change policy
- Policy in action

And How Does Economics Contribute to Thinking about Climate Change? A Preview.

- Account for behavioral reactions to climate change
- Estimate / measure costs of climate change damages and costs of fighting climate change
- Design smart policy to minimize costs of fighting climate change

Climate Change Science

ntro on the science



Uncertainty

Pollution Is Different From Oranges

Human activity creates pollution → goal is not 0 pollution but society's best balance between pollution and other things

Pollution is an EXTERNALITY: a side effect (cost or benefit) that affects someone else when something is bought or sold.

- Lights in your house → power plant sells you electricity → pollution affects whole planet, not just you!
- This is a market failure

When not all effects felt by buyer and seller

- Electricity price does not reflect all costs → electricity too cheap → wrong balance! Too much pollution!

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

Adaptation Reduces Damages

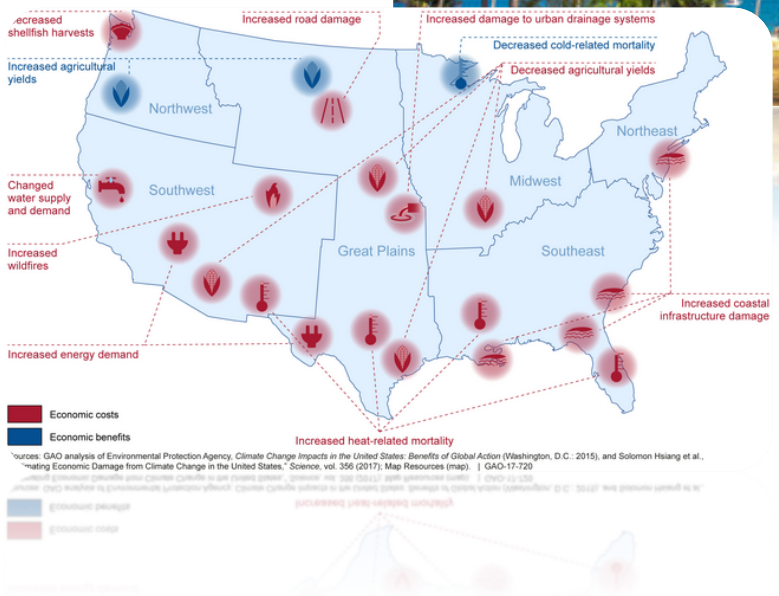
- Adaptation: costly actions that reduce damages from climate change
- Net cost to society is cost of adaption + remaining damages
- People will take some actions on their own – up to the point that it's worthwhile for them
- Some require government action – larger scale or shared benefits
- Adaptation is already underway

Most Vulnerable People and Places

Tropical areas

Low-lying coastal areas

Low-income people



Social Cost of Carbon

- The expected cost of damages from each unit of greenhouse gas emissions
- Current EPA estimate: ~$40 per metric ton CO_2
- Social cost of carbon will increase over time into the future

Economics of Responding to Climate Change

How Economists Decide How Much to Fight Climate Change

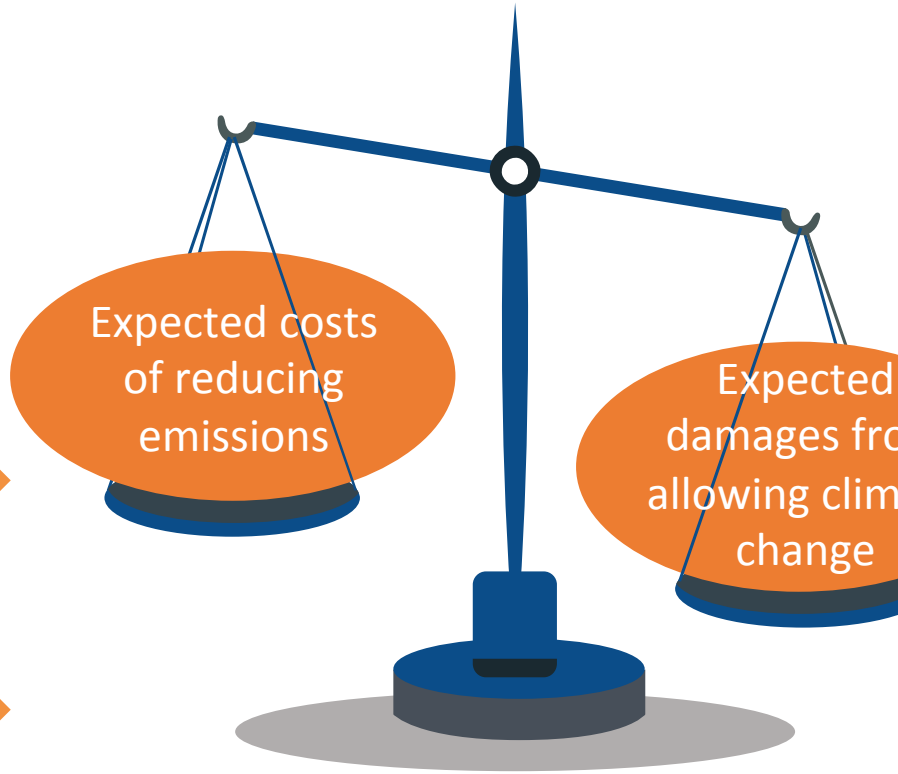
Cost Benefit Analysis:

Weigh:

Expected costs of reducing emissions

VS

Expected damages from allowing climate change



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:

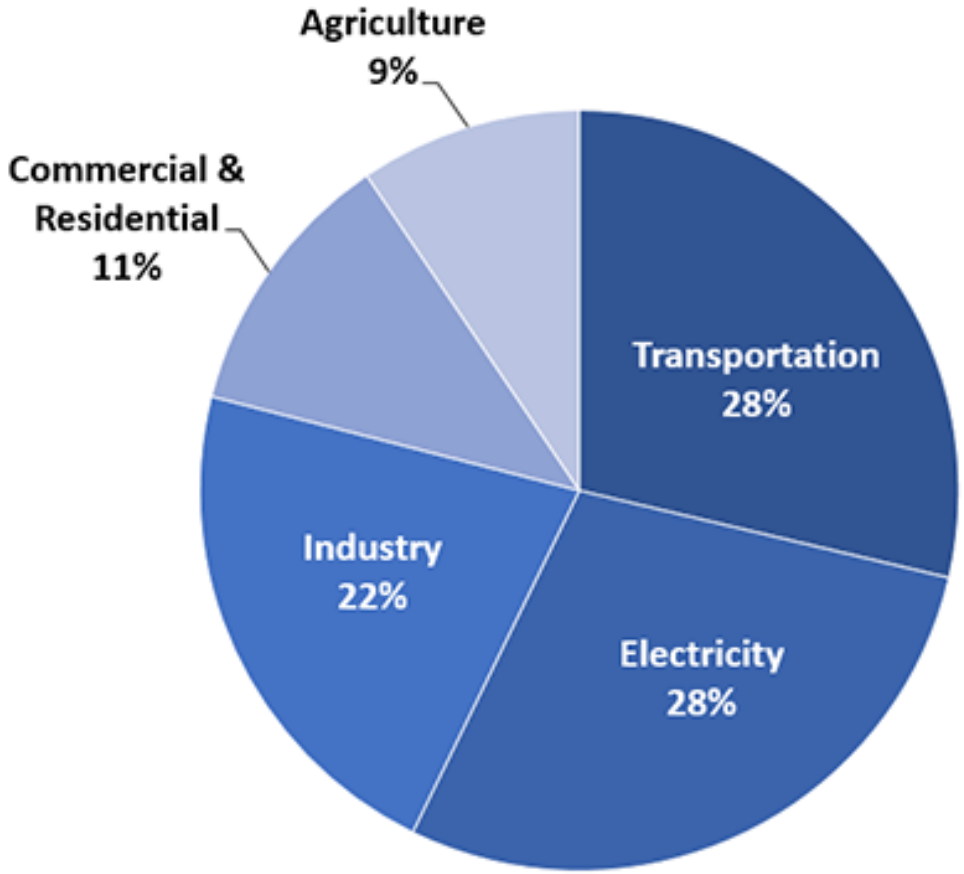
- Putting a money value on priceless things
- Uncertainty and risk
- Inequality

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

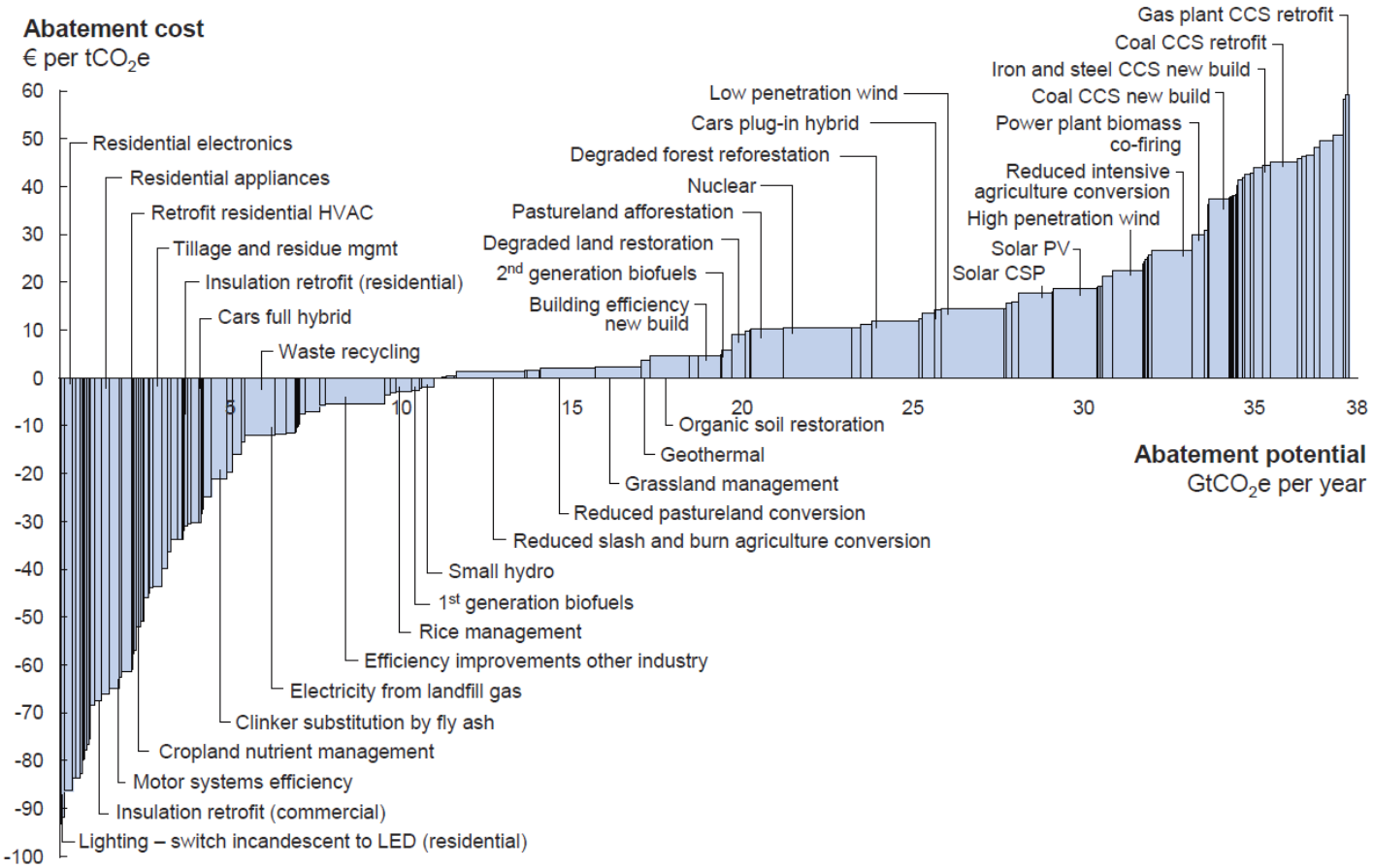
Addressing the Sources of Our Emissions

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

Global GHG Abatement Cost Curve Beyond Business-as-usual - 2030



Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 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 v2.0

Infrastructure and Climate Change

US infrastructure investment needed 2015-2030: $90 trillion

To make low-carbon: add $4 trillion (< 5%!)

- This would also reduce climate damage to infrastructure

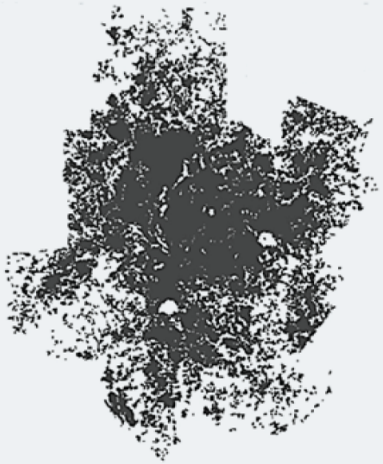
Electrical grid is particularly troublesome

- Outdated and not resilient
- Not suited to large amounts of renewable energy (intermittence, storage)
- Solar panels on houses use grid but very little electricity → how to pay for grid?

Atlanta And Barcelona Have Similar Populations But Very Different Carbon Productivity

Atlanta

Built-up area



Population	Urban area	Transport carbon emissions
2.5 million	**4,280** km²	**7.5** tonnes CO_2/person (public + private transport)

Barcelona

Built-up area

Population	Urban area	Transport carbon emissions
2.8 million	**162** km²	**0.7** tonnes CO_2/person (public + private transport)

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Source: New Climate Economy Report, 2014

Climate Change Policy

Policies to Fight Climate Change that Directly Reduce Emissions

Emissions standards or limits

Putting a price on emissions

- Subsidizing green energy (e.g. feed-in tariffs)
- Tax or cap & trade!

Policies to Fight Climate Change that Are More Indirect

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

Carbon Prices: the Good and Bad

Good:

- Provide price signal to lower greenhouse gas emissions
- Yield low-cost reductions in emissions: emitters choose how to reduce, and they choose the cheapest way

Bad:

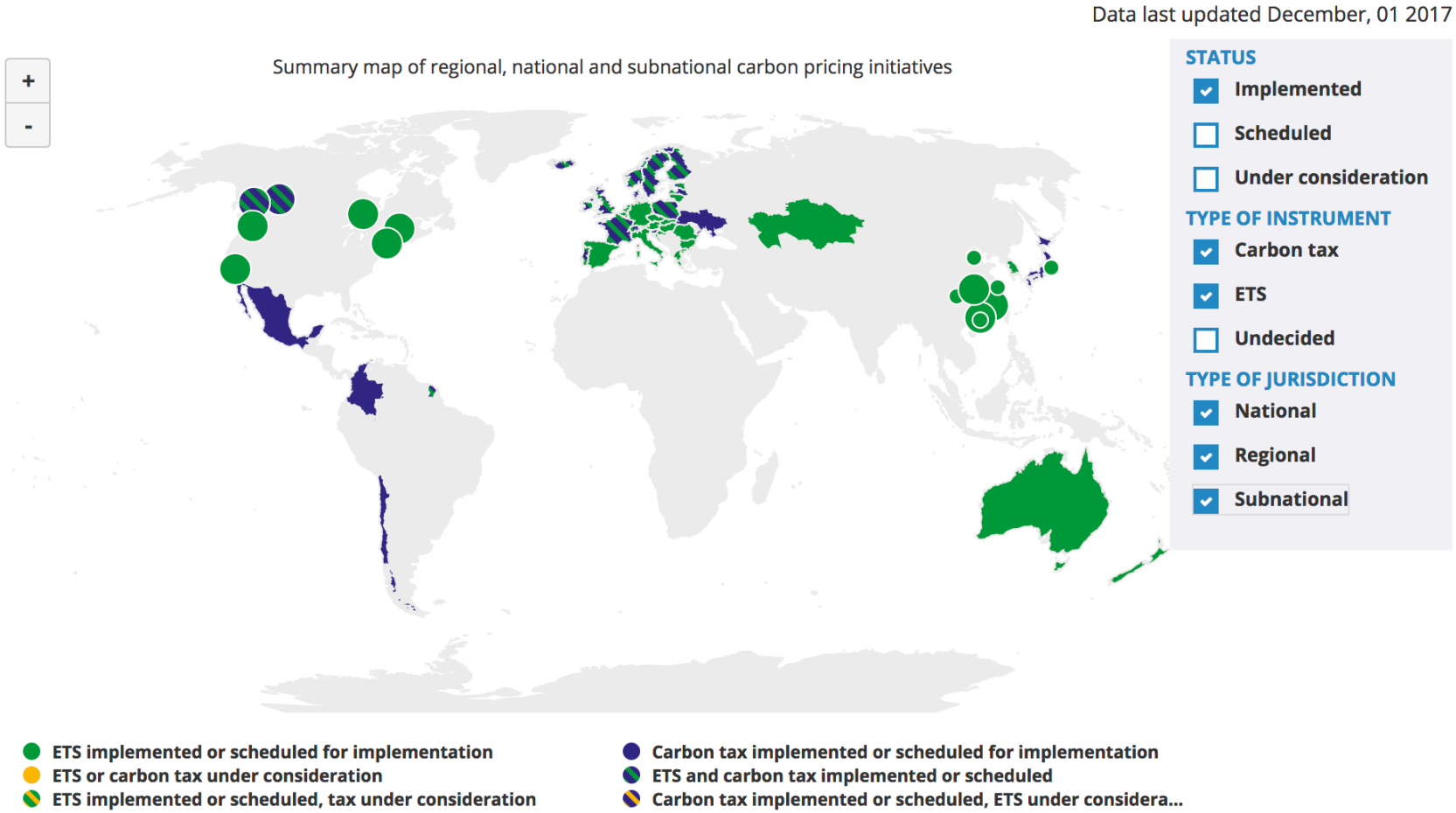
- Regressive (costs weigh more heavily on low-income people)
  - Can refund revenues to balance this; and would be true for any form of regulation
- Firms might leave to flee regulation
  - Doesn't seem to be a big problem in practice
- Monitoring costs

Carbon Tax and Cap & Trade: the Differences

	Carbon Tax	Cap & Trade
rbon Price	Certain	Uncertain
issions	Uncertain	Certain
se of Implementation	May be easier to implement	
ditional 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 regula

Climate Change Policy in Action

Carbon Policies Across the World



Source: World Bank Carbon - Pricing Dashboard

California's Cap and Trade System

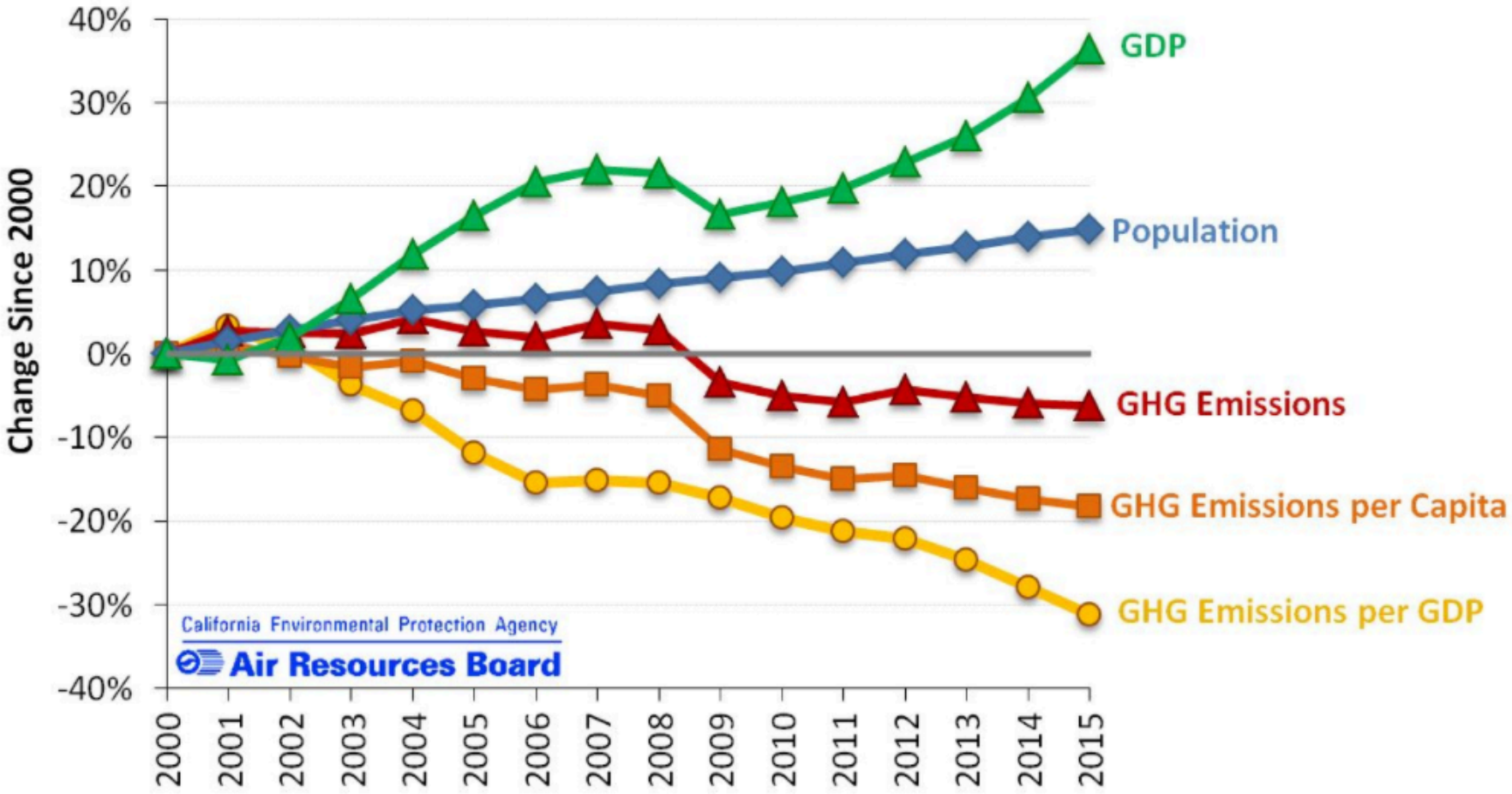
0.7%

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

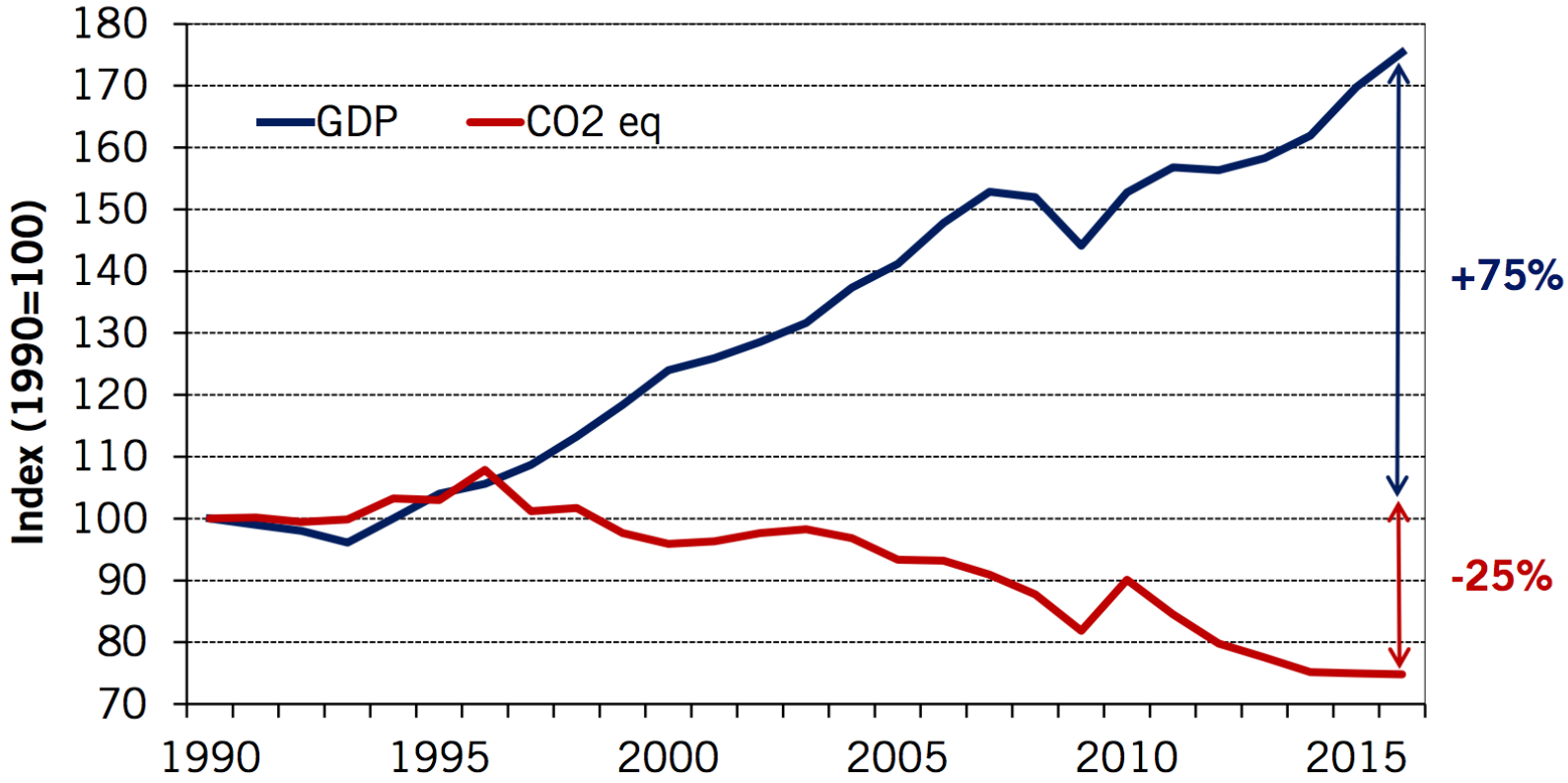


Sweden's Carbon Tax Policy

Started in 1991

Currently at $140/ton

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

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 C
- 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!