

# One Way to Pick a Climate Econ Research Question

Adapted from the first lecture of ECO481: Climate Economics

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# ECO 481 Course Overview

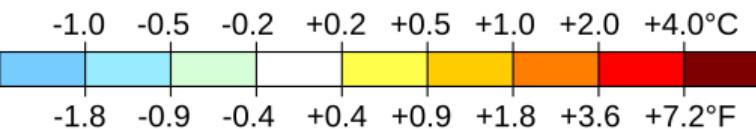
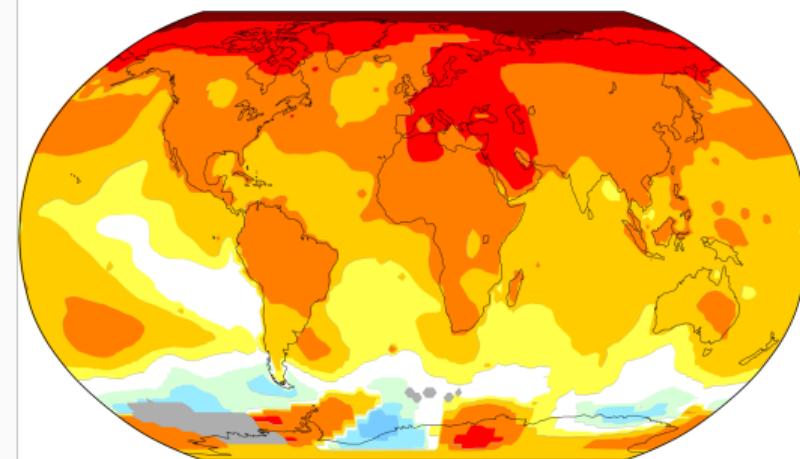
- What is the unique contribution of economists to climate research?
- This course's focus: Application of certain “structural modeling” methods to economic climate questions
- Focus on economic **substitution** and **equilibrium**, to study everything from flooding impacts to effectiveness of solar subsidies
- Focus on concrete “micro” questions
- This whole course: a gentle model of real graduate-level research
  - Very restricted in methods and tools
  - Enough to write a serious research paper

# Climate Economics

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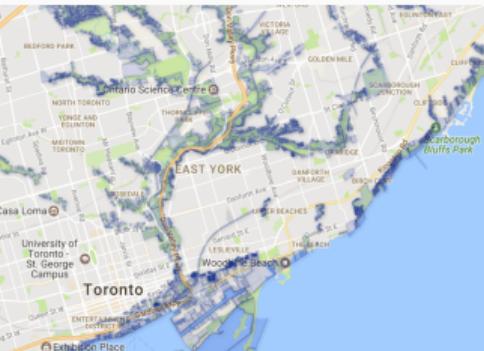
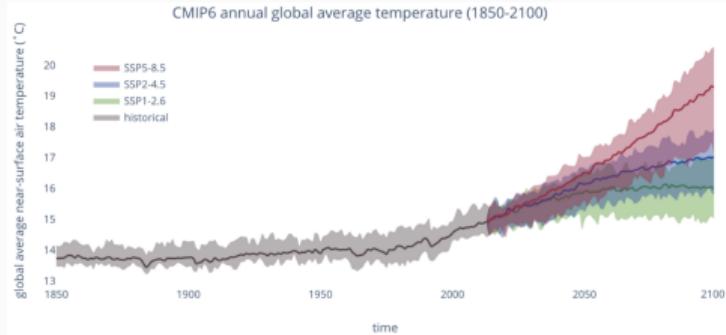
# Climate Change

Temperature change over the past 50 years



- Climate change is a *huge* phenomenon
- Driven by the interaction of emissions with complex natural systems
- Impacting almost every aspect of human life, now and in the future
- Where to even start?
  1. Narrow down the topic
  2. Narrow down the question
  3. Narrow down the method

# The Overwhelming Complexity of Climate Change



# Climate Research

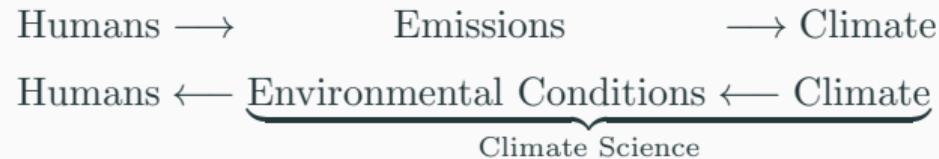
Humans → Climate

Humans ← Climate

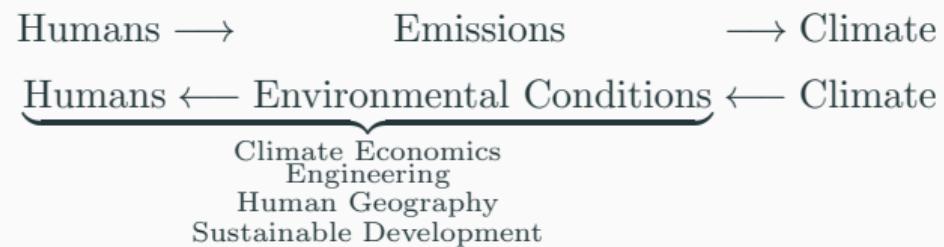
# Climate Research

Humans → Emissions → Climate  
Humans ← Environmental Conditions ← Climate

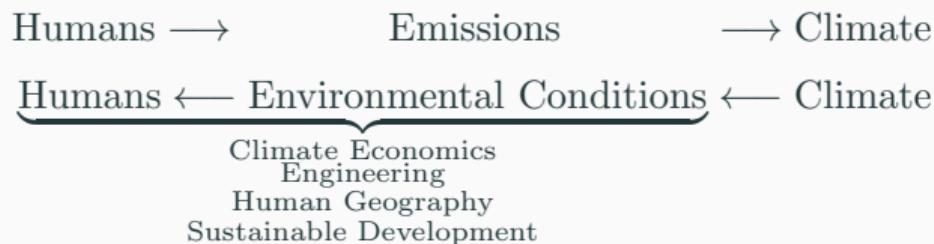
# Climate Science (Is Not Climate Economics)



# Climate Economics



# Climate Economics



How do **economic forces** shape:

- Emissions
- The impact of climate change on humans
- The impact of *policy* on emissions and impacts

# The Equilibrium Perspective

- How will people adopt solar panels in the future?
- How much would a carbon tax reduce emissions?
- Who would benefit/lose from a flood insurance subsidy?

## Remember:

- Economic outcomes always arise in **equilibrium**
- Policy/shocks do not *directly* determine outcomes, only shift the equilibrium.

## “Structural Micro” Climate Economics Within Economics

- All academic research comes out of “research communities,” made up of people
- Each community has its own subject matter, but also its own methods, norms, and epistemologies (ideas about what constitutes knowledge)
- What is the context of the approach I take in my class?

## “Structural Micro” Climate Economics Within Economics

- Climate *macro* tends to incorporate how climate drivers *interact* with climate impacts, e.g. through growth
- We focus on the *micro* level, where we can use data and theory to provide concrete answers to concrete questions
- “Reduced-form” climate/environmental/resource economics tends to focus on measuring specific responses: e.g. how much does a solar subsidy increase adoption?
- We take a more “structural” perspective, using some simple theory and modelling to interpret, understand, and predict responses
- Draw from macro, trade, industrial organization, urban, etc. An attempt to bring many tools together, rather than an established community

## Research Question

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## Our Type of Question

- Our only question: How will X shift the equilibrium?
- If something changes, something is causing that change.
- If it is government action, we call it “policy”.
- Anything else (e.g. tech, climate change, public opinion) we call a ”shock.”
- Policy targeting emissions we call “mitigation policy.”
- Policy targeting impacts we call “adaptation policy.”

Examples:

- How would allowing Chinese EVs affect emissions?
- How do EV charging station subsidies affect emissions?
- Which products would be made more expensive by a carbon tax?

# Mitigation



- How much will emissions be reduced by solar adoption?
  - How much would a solar subsidy help?
  - What would happen to electricity prices and quantities?
  - How much would a breakthrough storage technology help?
- Carbon capture? Methane leakage standards? International cooperation?

# Adaptation



- How will global warming affect crop yields?
  - What if farmers can choose which crops to grow?
  - How will this affect crop prices and food security?
- How will flooding affect welfare?
  - Will flood insurance subsidies hurt or help?
  - How unequal will these impacts be?

## A Menu of Questions: Mitigation (Emissions-Targeting Policies)

“How would policy/shock X affect emissions from Y, in equilibrium, when people have choices Z?”

“How would it affect welfare, inequality, and other outcomes?”

- Sources: Manufacturing, energy, transportation, land use...
- Possible Shocks: Technology, policy, consumption decisions...
- Mitigation Policy: Taxes, subsidies, regulations...

## A Menu of Questions: Adaptation (Climate Impacts-Targeting Policies)

“How would climate-driven environmental change X affect outcomes Y, in equilibrium, when people have choices Z?”

“How would this be different under policy/shock W?”

“How would this affect welfare, inequality, and other outcomes?”

- Physical Changes: Heat, flooding, fire, sea levels, weather...
- “Direct” Impacts: Agriculture, health, mortality, industry, trade, housing...
- Adaptation: AC, acclimatization, irrigation, migration, capital reallocation, construction, infrastructure...
- Equilibrium Responses: Populations, prices, land use, crop choice, violence, quality-of-life, everything in “direct impacts”...
- Considerations: Welfare, inequality, impacts of policy...

## Method

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## Example: A Hot Dog

Suppose the carbon footprint of a hot dog is 5 kg of CO<sub>2</sub>. My friend is about to buy a hot dog, but I tell her this and she decides not to. How much did I reduce emissions by?<sup>1</sup>

(Ignore considerations like, “One hot dog is too small to make a difference.” Think about the average effect of a million people making the same decision.)

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<sup>1</sup>Inspired by 2024 conference presentation at IPWSD by Celia Escribe (coauthored with Philippe Quirion).

## Example: A Hamburger

Suppose the carbon footprint of a hot dog is 5 kg of CO<sub>2</sub>. My friend is about to buy a hot dog, but I tell her this and she decides not to. How much did I reduce emissions by?

- If she buys a hamburger instead (10kg CO<sub>2</sub>), negative! (Substitution)
- In equilibrium, if many people buy less beef, the price of beef will fall. Others may eat more beef, but farmers may produce less beef.
- How much will the overall quantity of beef change by? (Equilibrium.)

How can we account for substitution and equilibrium in our analysis?

- We will cover and use some simple tools. This will tell us something, but still not the whole story!

# The Structural Approach

- Measure/estimate what we can (e.g. elasticity of substitution between beef and other things, relative carbon footprints, supply elasticity of beef)
- Hypothesize about how those measurements/estimates translate to predictions (under what conditions, at what time scales, etc.)
- This requires a **model**.
- We decide which features to *incorporate* and which features to *omit*.

## Narrow Methodology, Broad Questions

- We focus on the role of **substitution** and **equilibrium** in shaping the drivers and impacts of climate change
- Introduce simple, general tools for dealing with these considerations
- Extra credit: Do *one* extension *after* completing the main assignment

## Other Considerations

We will focus on substitution and equilibrium. Other interesting considerations include:

- Expectations
- Uncertainty
- Heterogeneity
- Partial Information and Learning
- Strategic Interaction
- Intertemporal Substitution and Dynamics
- Irrationality and “Behavioral Economics”
- Market Structure
- Financial Frictions
- Political Economy

## Results

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# Anatomy of a Paper

By the end of the semester, you will

1. Motivate
2. Design
3. Code
4. Estimate using data
5. Solve
6. Interpret

a simple model of a question of your choice.

# Anatomy of a Paper

1. Motivate: What is your research question?
2. Design: What considerations will you take into account? Which will you omit?
3. Code: Given a set of “fundamentals/parameters”, what is the resulting equilibrium?
4. Estimate using data: Use variation in observed equilibria (e.g. prices and quantities) to infer the values of those parameters
  - What assumptions are you making in doing so?
5. Solve: How would the equilibrium differ under a policy/shock
6. Interpret: What does this exercise teach us? Under what conditions will your prediction be good or bad?

Climate Economics  
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Research Question  
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Method  
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Results  
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