Energy Scenarios
Part 2

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LAB4ENERGY INTERNATIONAL

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The MIT Joint Program on the Science and Policy of Global Change

Plan for This Session

- **Part 2: Energy Emissions, Climate Change and Society's Response**
  - ✓ **Environmental cost of the energy system**
  - ✓ **Greenhouse effect and climate change**
  - ✓ **Energy and CO_2 emissions**
  - ✓ **Projections of climate change**
  - ✓ **Climate change effects**
  - ✓ **Society's response**

Energy-Economy Scenarios: What Concerns?

- **Planning future investments & policies**
  - ✓ **Government agencies**
  - ✓ **Energy companies**
- **Energy to support future economic life**
  - ✓ **Growing population and its needs**
  - ✓ **Depletion of resources (oil, gas, coal)**
- **Environmental cost of the energy system**
  - ✓ **Urban air pollution**
  - ✓ **CO_2 emissions and climate change**

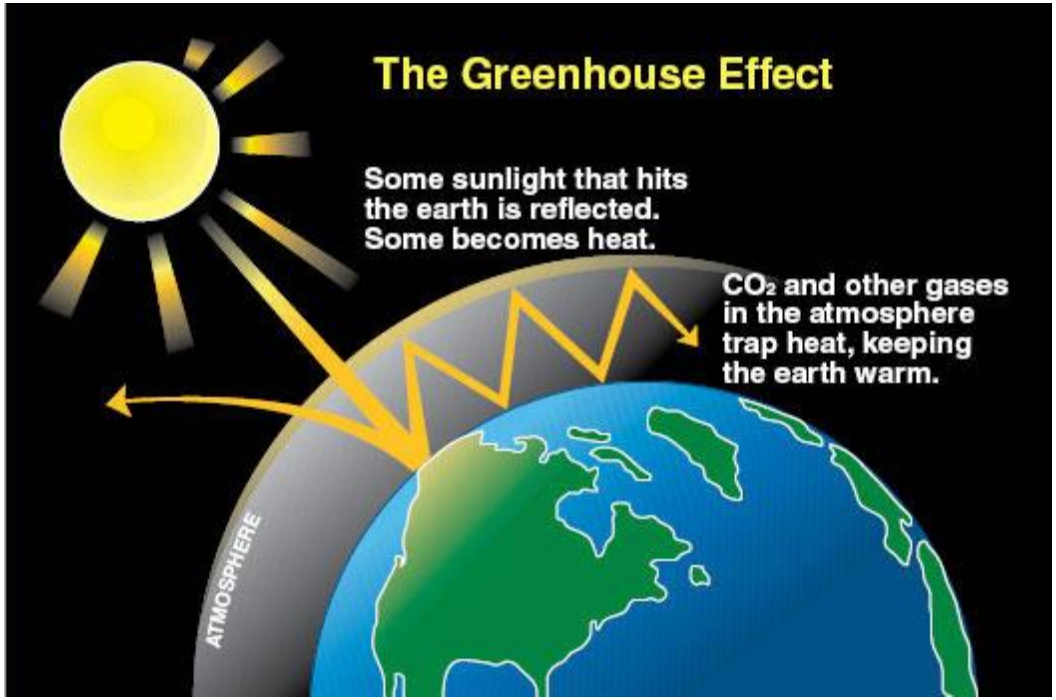
Environmental Costs of the Energy System

- **Urban air pollution**

- ✓ **Soot**
- ✓ **Smog**
- ✓ **Mercury**

Environmental Costs of the Energy System

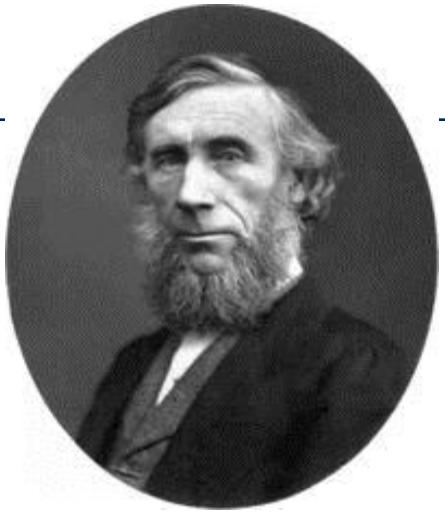
- **Emissions and climate change**



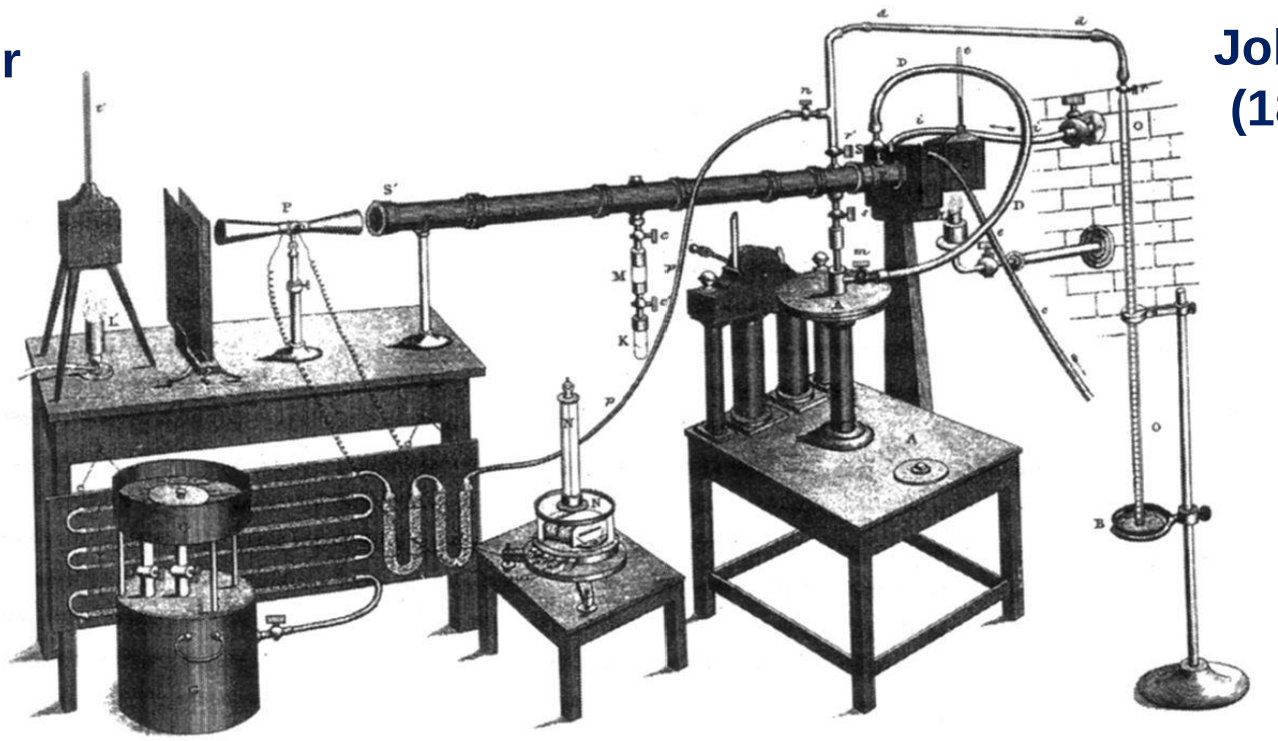
- ✓ CO_2
- ✓ Black carbon (soot)
- ✓ Non-CO_2 gases

Discovery of the Greenhouse Effect

Jean Baptiste Joseph Fourier (1768-1830)



John Tyndall (1820-1893)

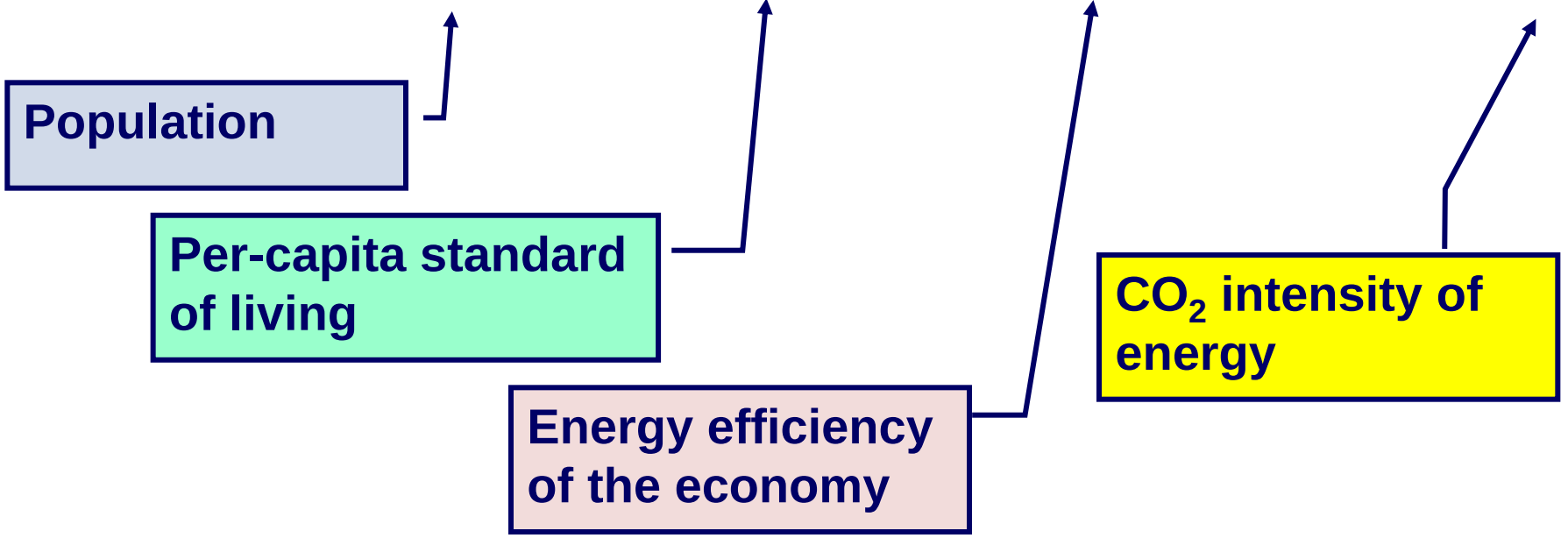


Energy, Economy and CO_2 Emissions

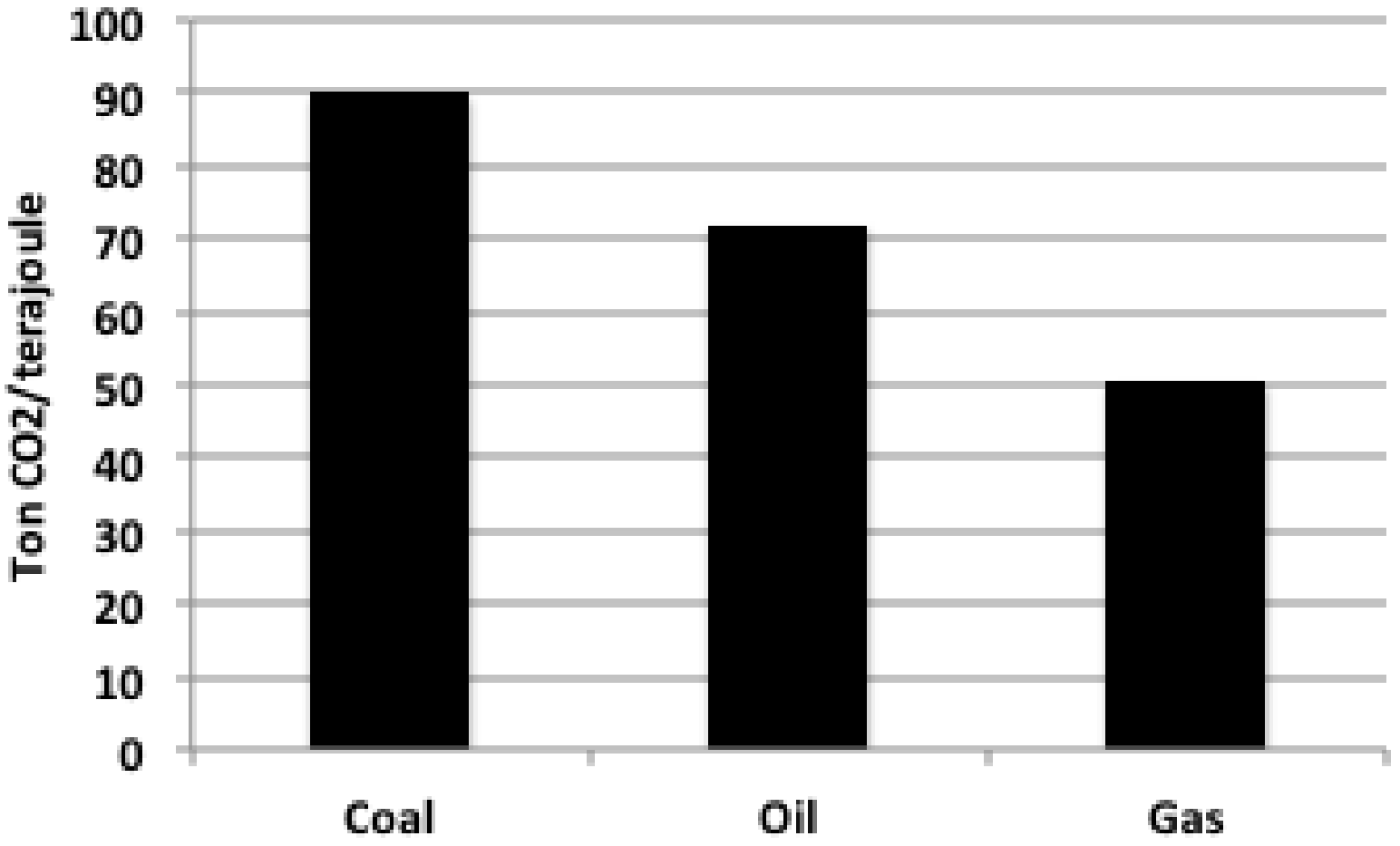
Extend to account for emissions from energy use

CO_2/E = tons of CO_2 per unit of energy use

$$E = Pop * GDP/Pop * E/GDP * CO_2/E$$

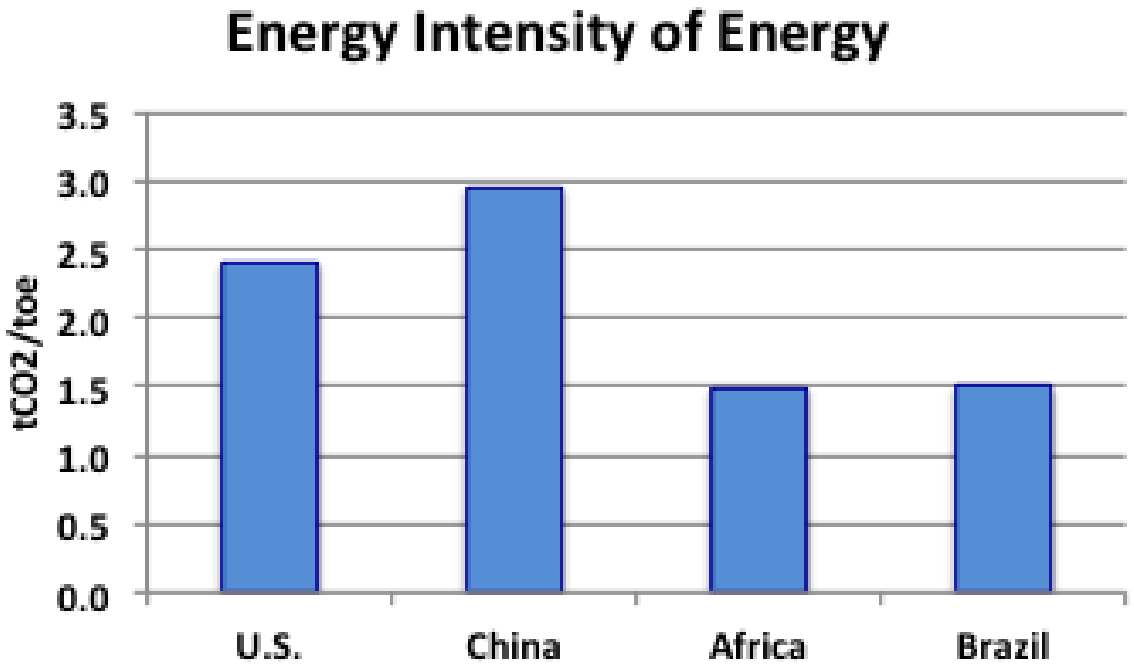


CO_2 Emissions from Fossil Fuels



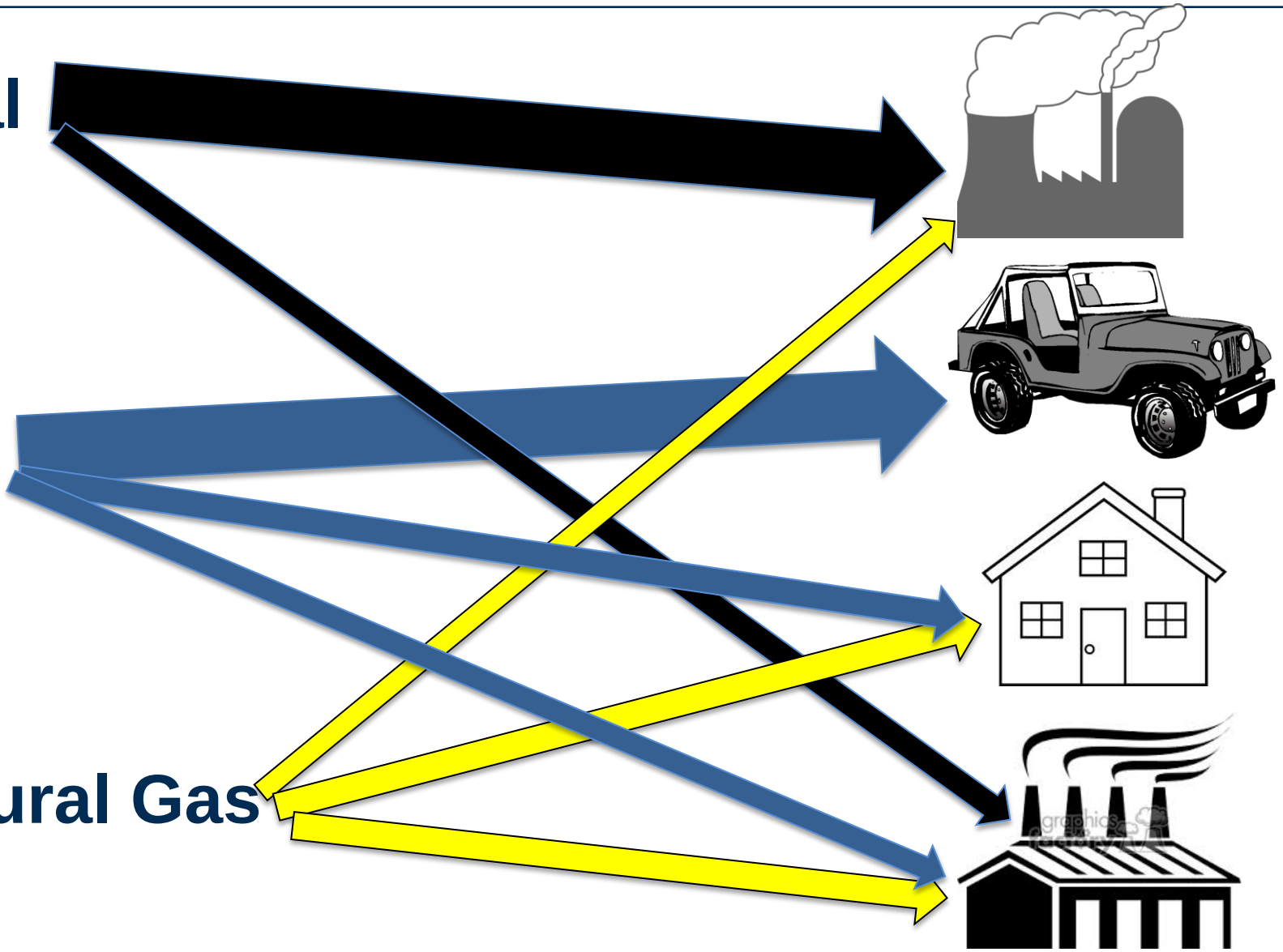
What Affects the CO_2 Intensity of Energy?

- **Some of the factors**
  - ✓ Type of fossil fuel used (coal vs. natural gas)
  - ✓ The amount of nuclear & hydro capacity
  - ✓ Use of renewables (biofuels, solar, wind)
- **Differences among countries**



Main Energy Sources of CO_2 Emissions

- Coal
- Oil
- Natural Gas



Non CO_2 Greenhouse Gases

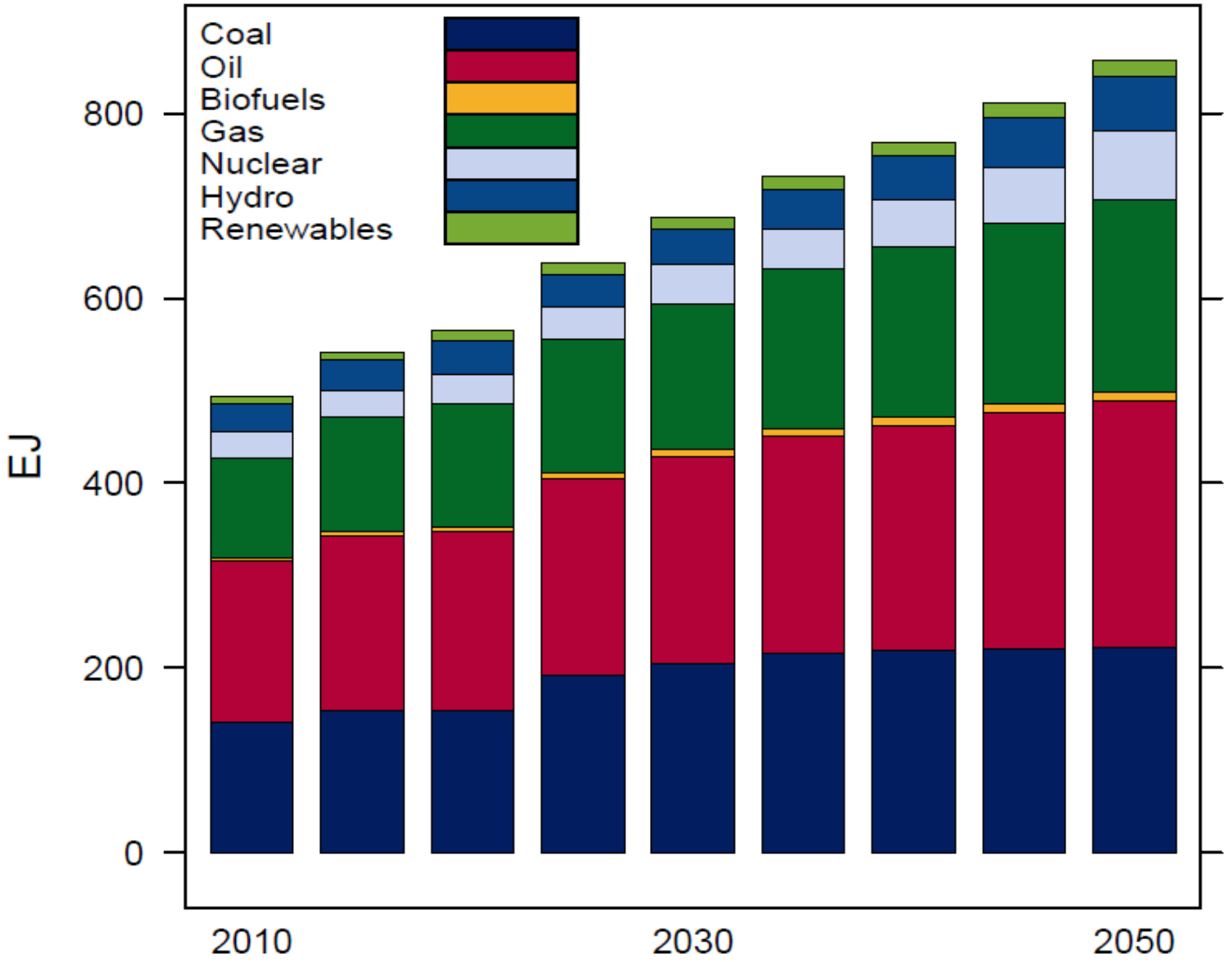
Methane (CH_4)
- Natural gas, oil and coal production & use
- Waste dumps, livestock, rice production

Nitrous Oxide (N_2O)
- Agricultural soils
- Chemical production

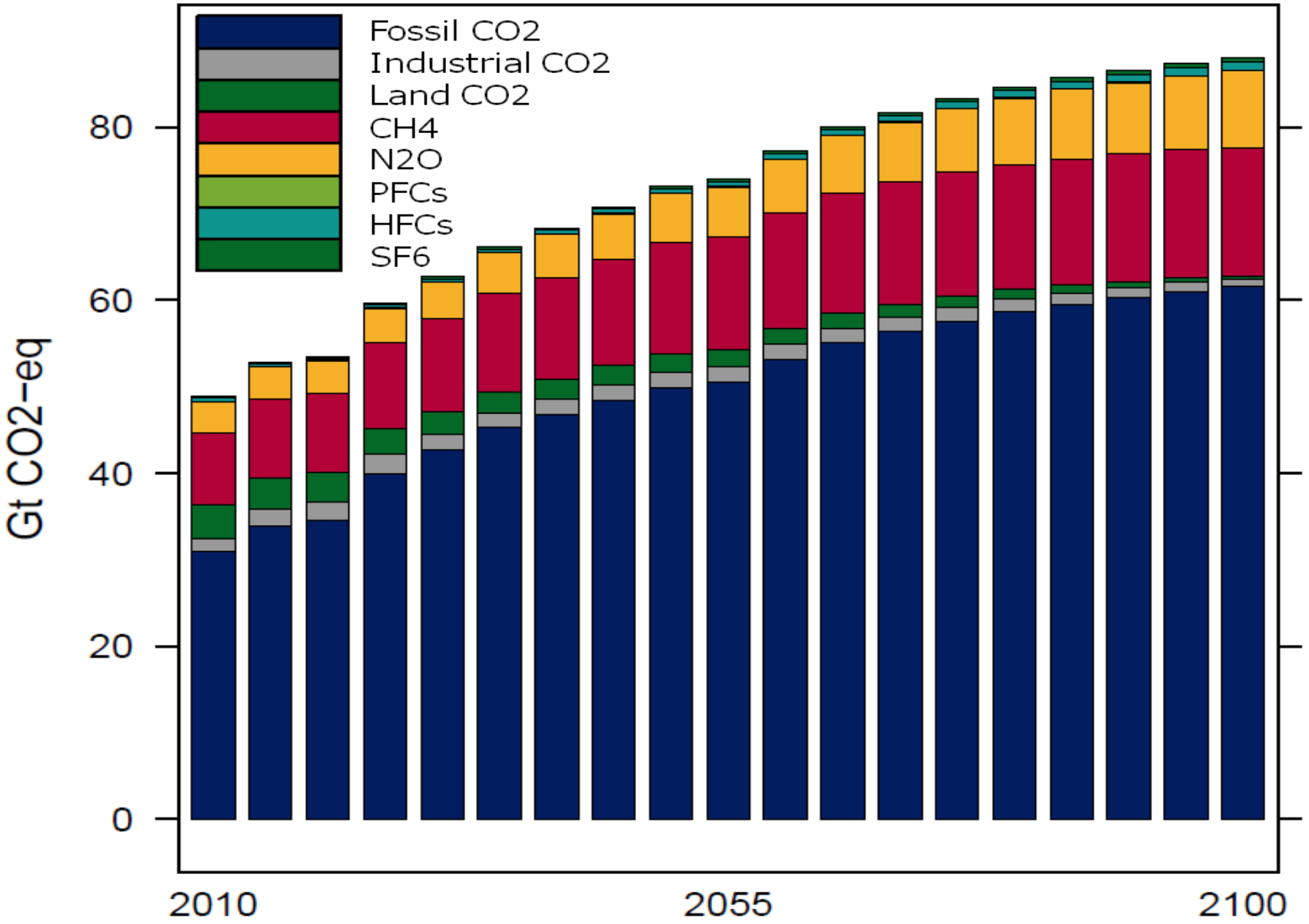
Black carbon (soot)
- Diesel engines,
- Biomass burning

Industrial gases
- HFCs (air conditioning, solvents)
- PFCs (electronics production, aluminum)
- SF_6 (Insulator in electrical equipment)

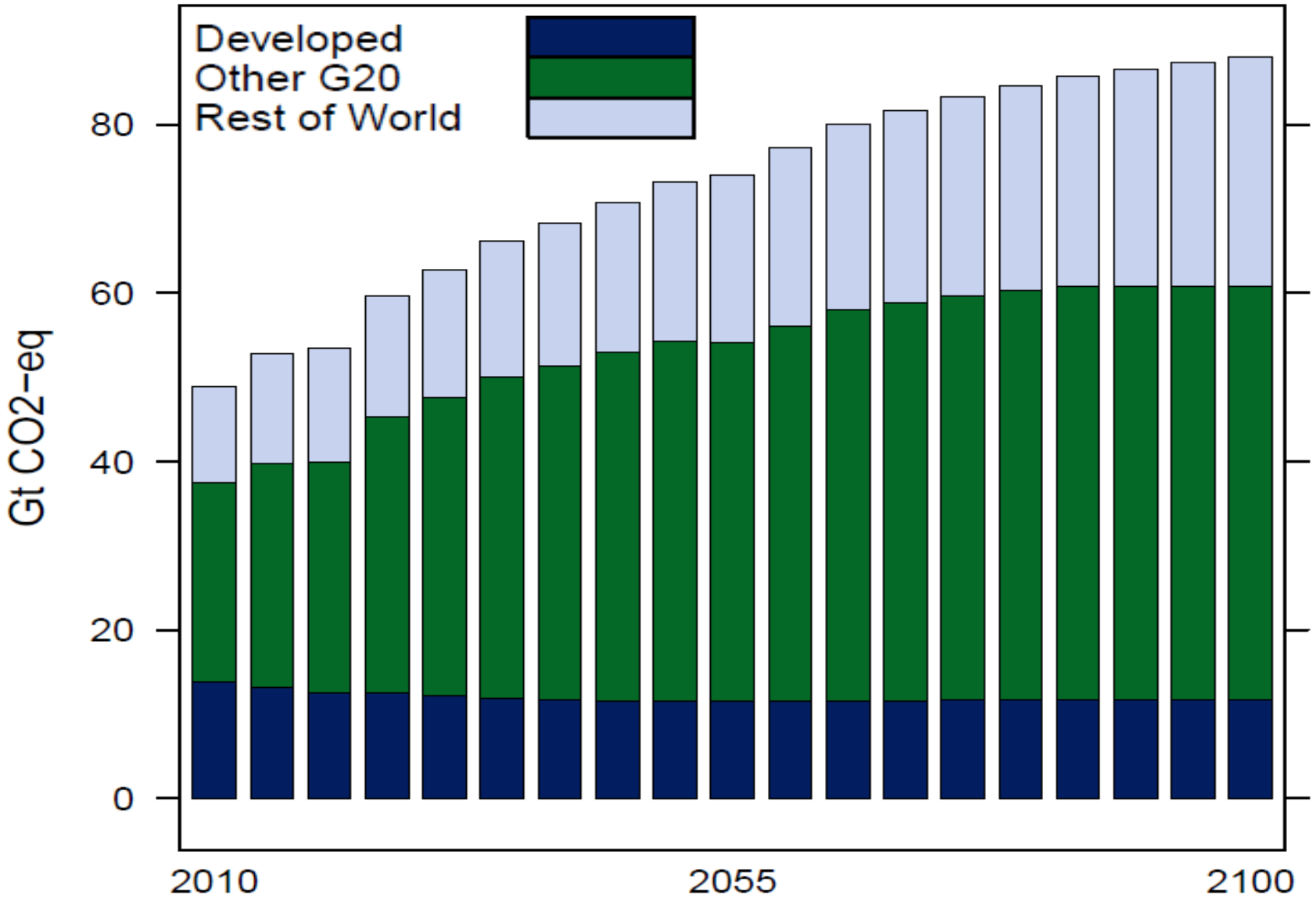
Global Energy Use



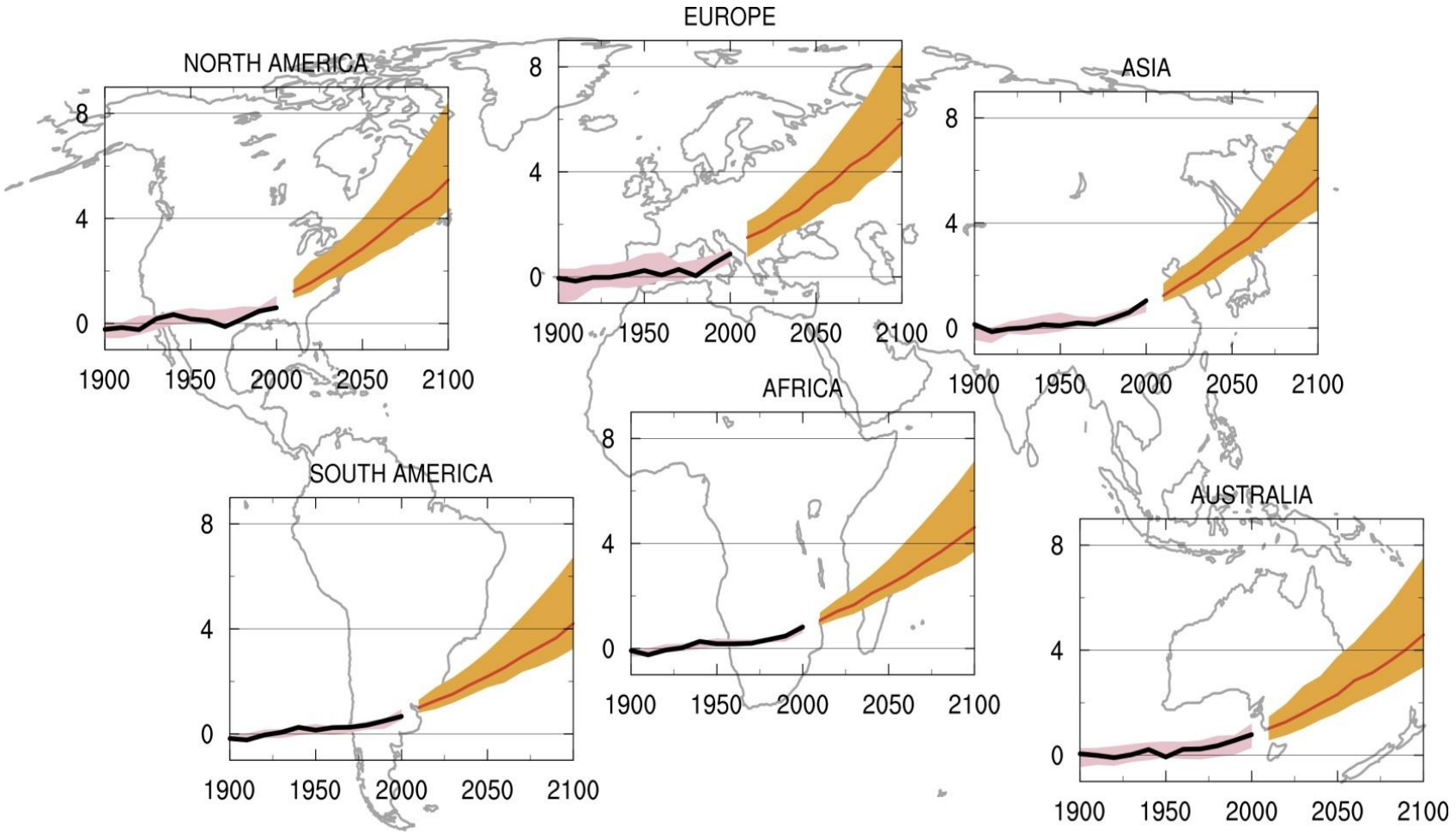
Sources of Global Greenhouse Gases



Greenhouse Gases by Major Groups



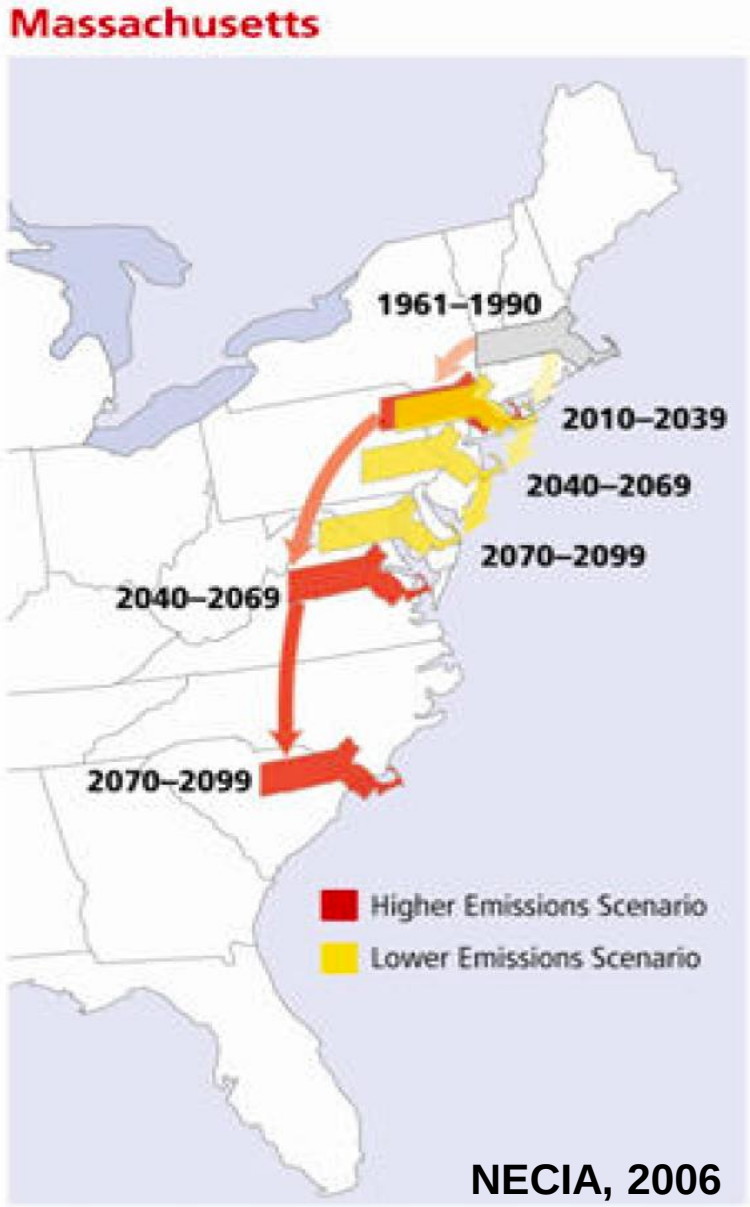
Projected Temperature Change



By 2100 temperature increases in North America, Europe, and Asia exceed those in Africa, Australia, and South America.

Effects of Climate Change

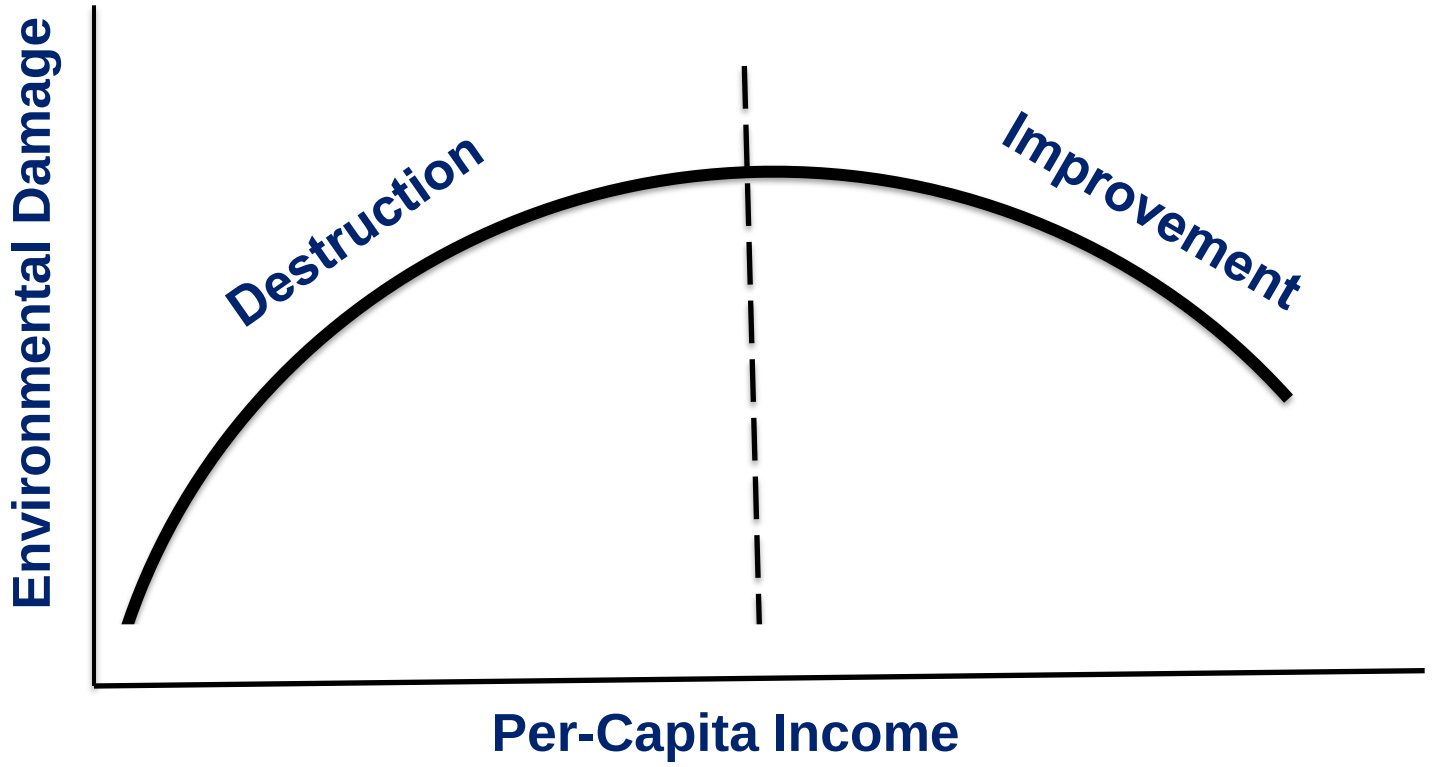
- Rising temperatures
- Changing rainfall
- Sea level rise
- Increased storminess



How Countries are Limiting CO_2 Emissions

- Tax CO_2 emissions
- Regulate energy-using devices
  - ✓ Cars & trucks
  - ✓ Appliances
- Encourage renewables
  - ✓ Wind & solar
  - ✓ Biomass
- Consumer information
  - ✓ Household efficiency
  - ✓ Product choice
- Support of global agreements

Helpful Dynamic: Growth Can Aid Environment



- With basic needs met, focus on environment
- Support for costly environmental controls
- Shift of the economy to less energy-intensive services

Thank you!

For more see

- **MIT Joint Program website (http://globalchange.mit.edu/)**
- **Intergovernmental Program on Climate Change (http://www.ipcc.ch/)**
- **United Nations Framework Convention on Climate Change (http://unfccc.int/2860.php)**