

Energy and Climate Change Mitigation



Learning Objectives

Define

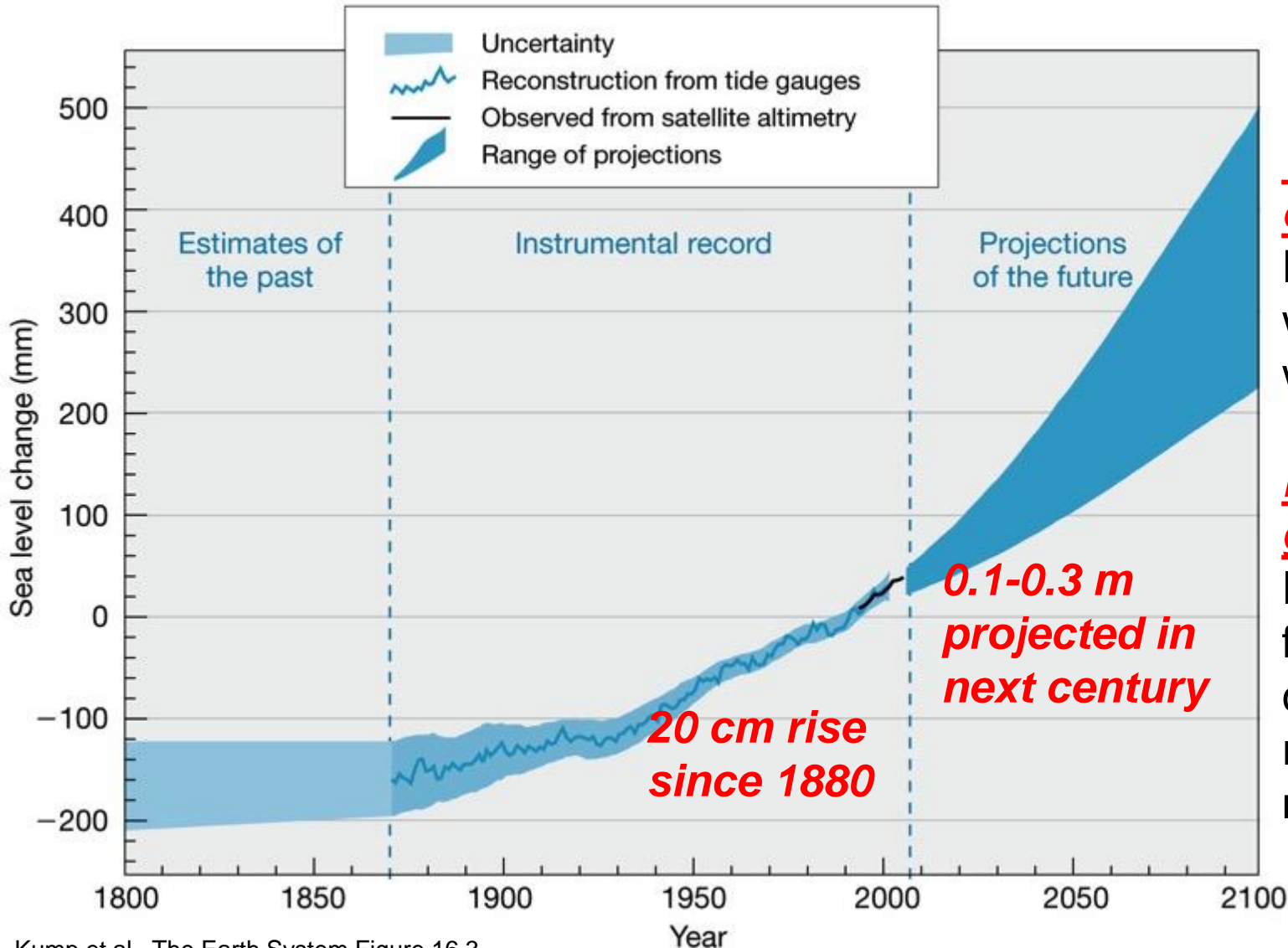
Thermal expansion, mountain glacier, Intergovernmental Panel on Climate Change (IPCC), alternative energy, (hydro)fracking, nuclear energy, wind power, hydropower, solar power, photovoltaic cells, geothermal energy, biomass-based fuels, ethanol, carbon sequestration, geoengineering, Kyoto protocol, Paris Agreement, carbon tax, carbon footprint

Know

- What is the projected range for sea level rise between now and 2100?
- What are pros and cons of current fracking practices in the US?
- What are five examples of alternative energy sources?
 - What are the pros and cons of each?

Sea Level Rise

Due to thermal expansion and mountain glacier melting

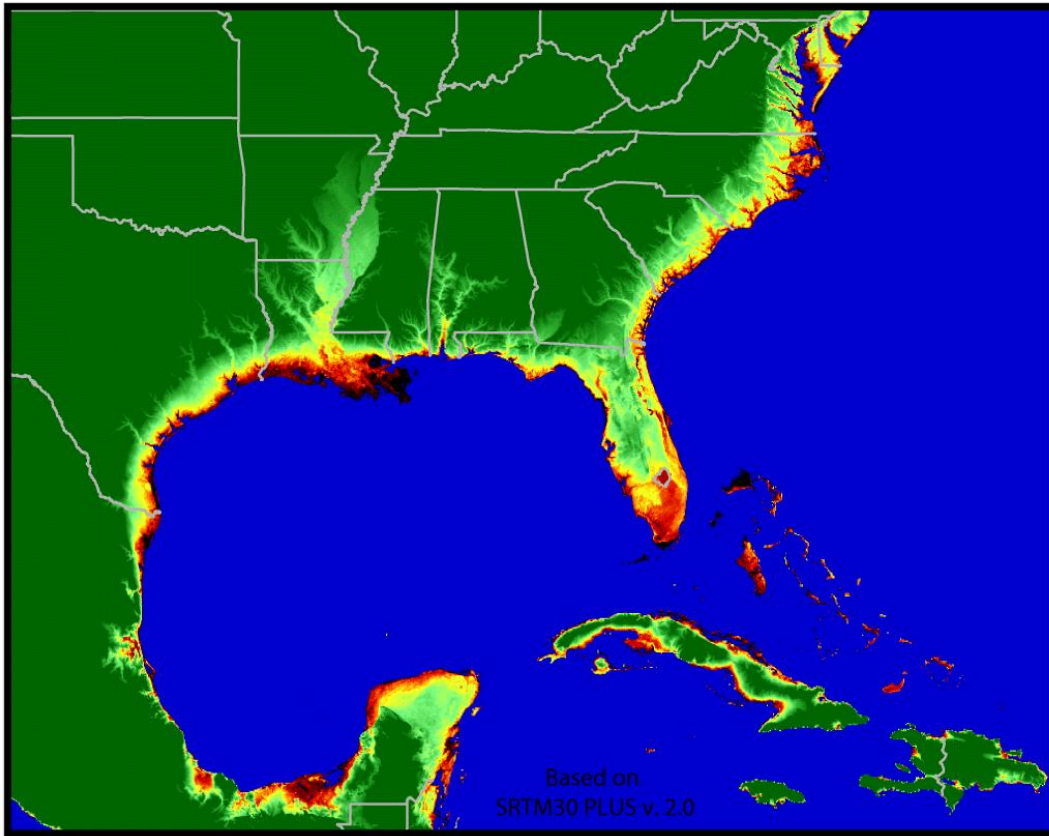


Thermal expansion:
Expansion of water as it warms

Mountain glaciers:
Ice fields formed on cold, upper reaches of mountains

Greenland ice sheet: 7 m sea level rise
Antarctic ice sheet: 60-70 m sea level rise

Sea Level Risks - US East Coast

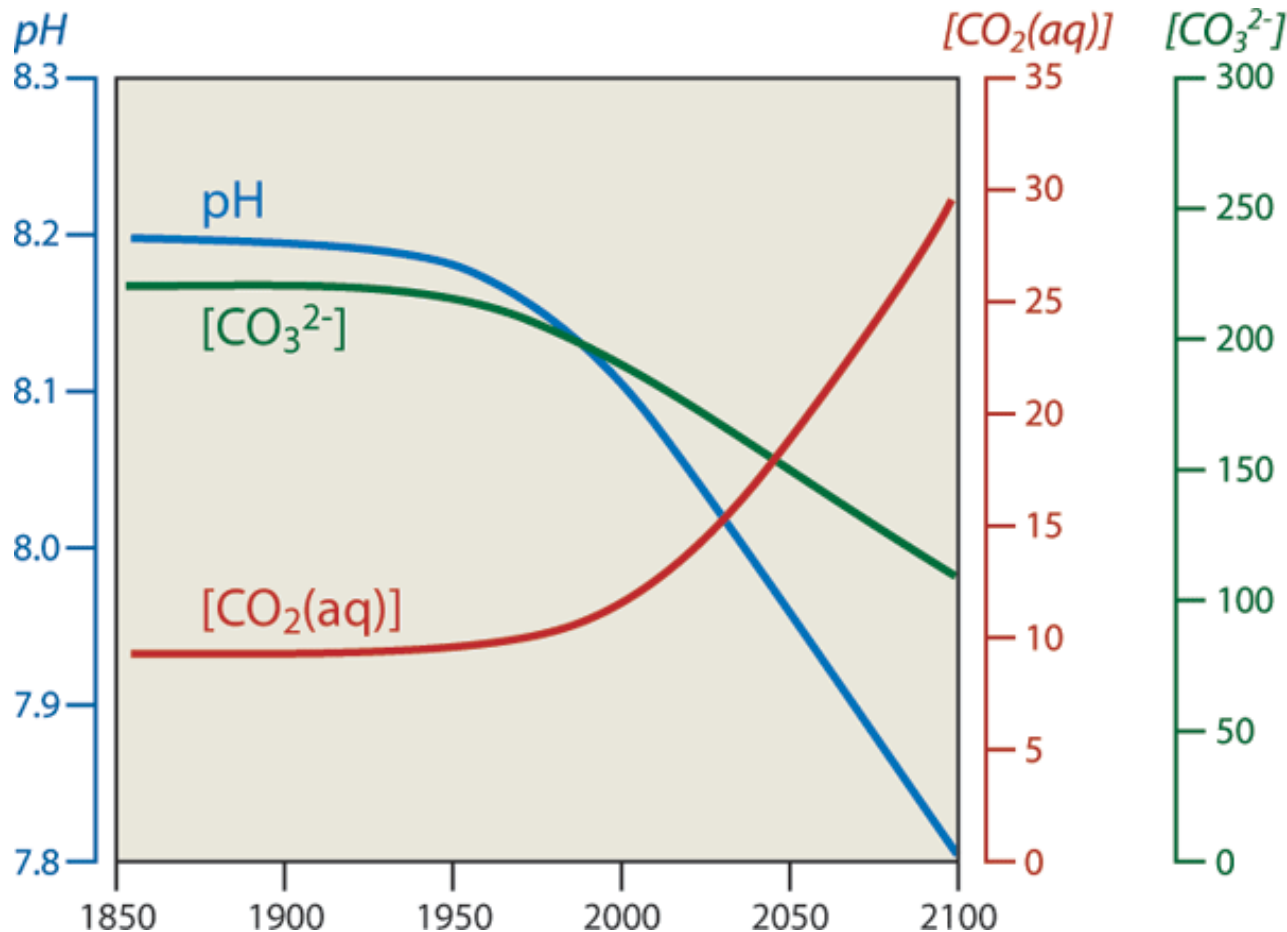


Sea level rise poses a serious threat to coastal regions, including many parts of the eastern seaboard



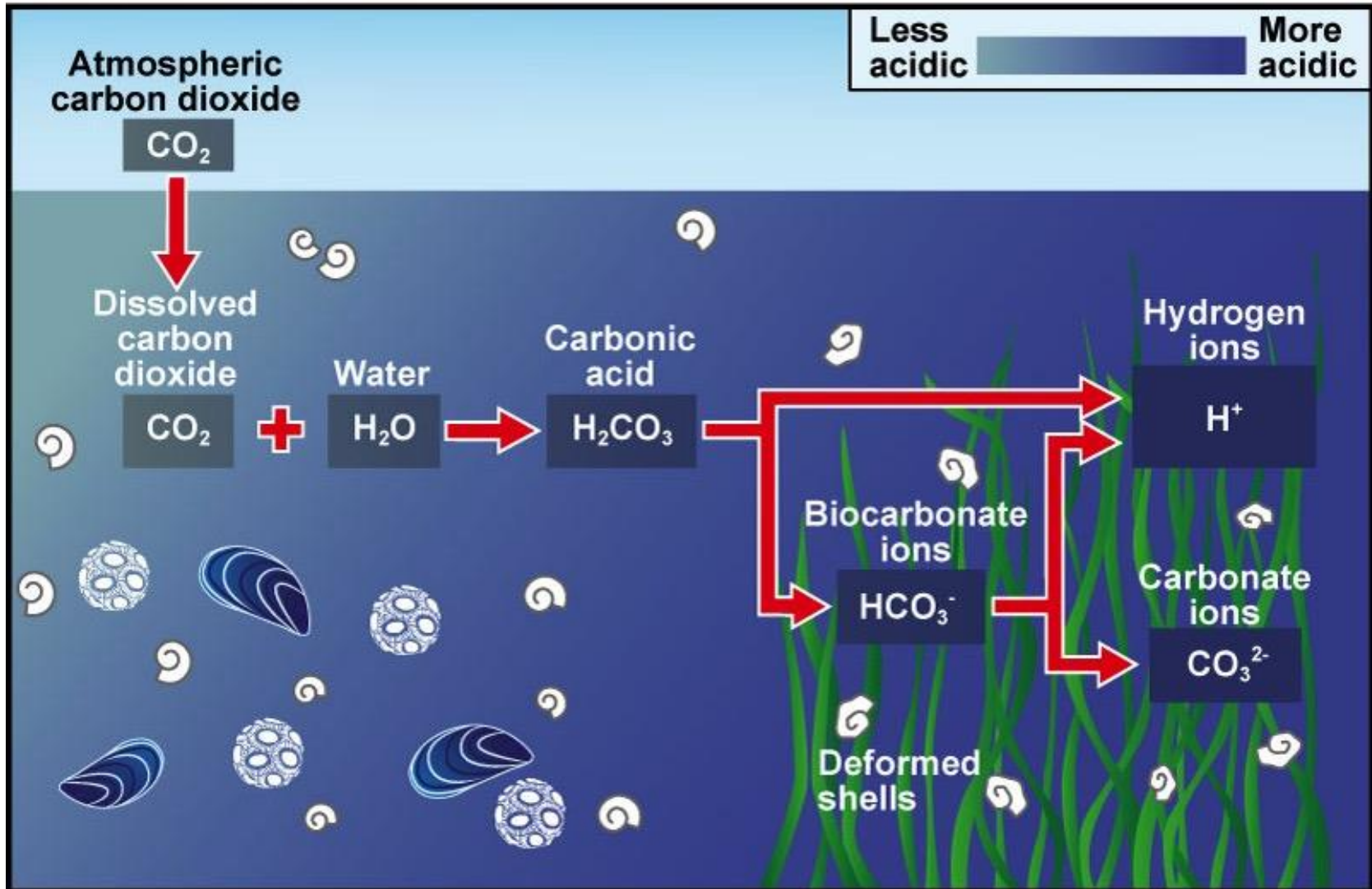
Ocean Acidification

Since Industrial Revolution, surface ocean water pH has dropped from 8.2 to 8.1, and is expected to fall below 8 in the middle of the 21st century.



This decreases concentration of carbonate anion, which makes it harder for marine life to build calcium carbonate shells

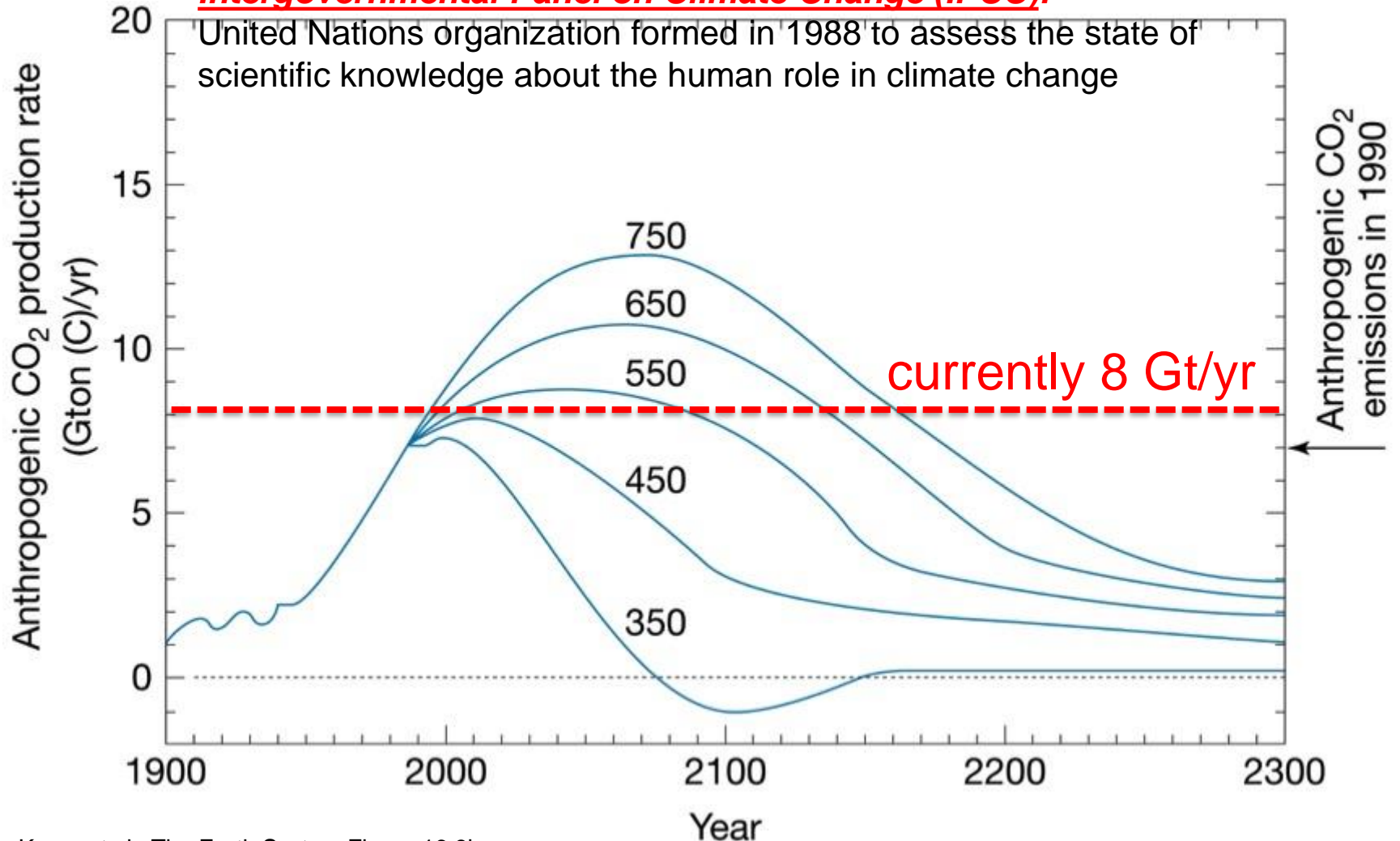
Ocean Acidification



Stabilization of CO₂ will require lowering emissions

Intergovernmental Panel on Climate Change (IPCC):

United Nations organization formed in 1988 to assess the state of scientific knowledge about the human role in climate change



Hydrofracking

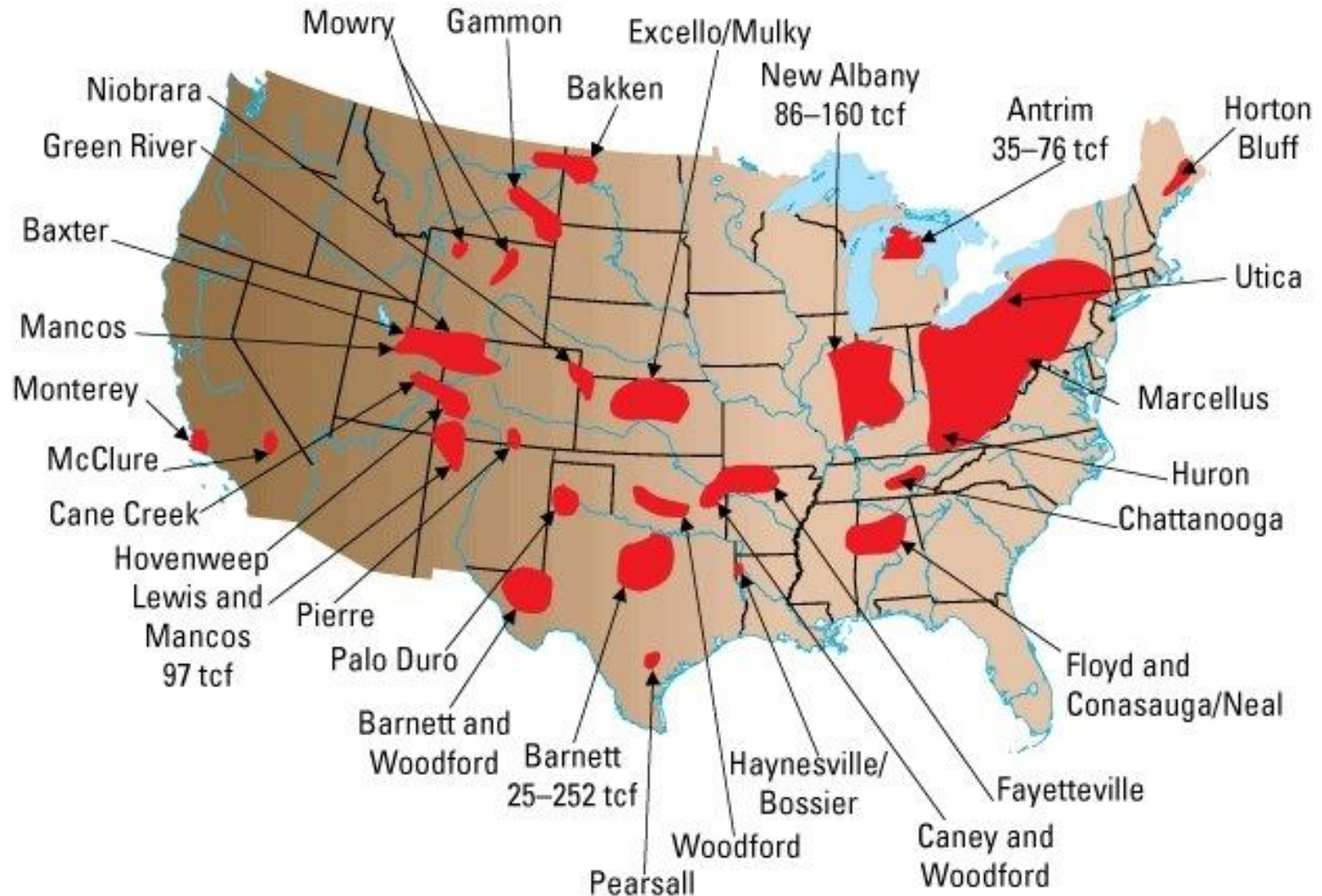
In the US, an increasing fraction of our energy comes from *(hydro)fracking*

- Hydraulic fracturing technique that uses large amounts of water, along with chemicals and sand, to extract gas and oil trapped in *shale*.
- Provides almost half of US oil production and two-thirds of natural gas production

What are the pros and cons of fracking?

<https://www.youtube.com/watch?v=Uti2niW2BRA>

Potential U.S. shale gas Resources



Nuclear Energy

- Produced from nuclear fission (splitting of atomic nucleus) of uranium atoms
- Must contain resulting radioactive waste

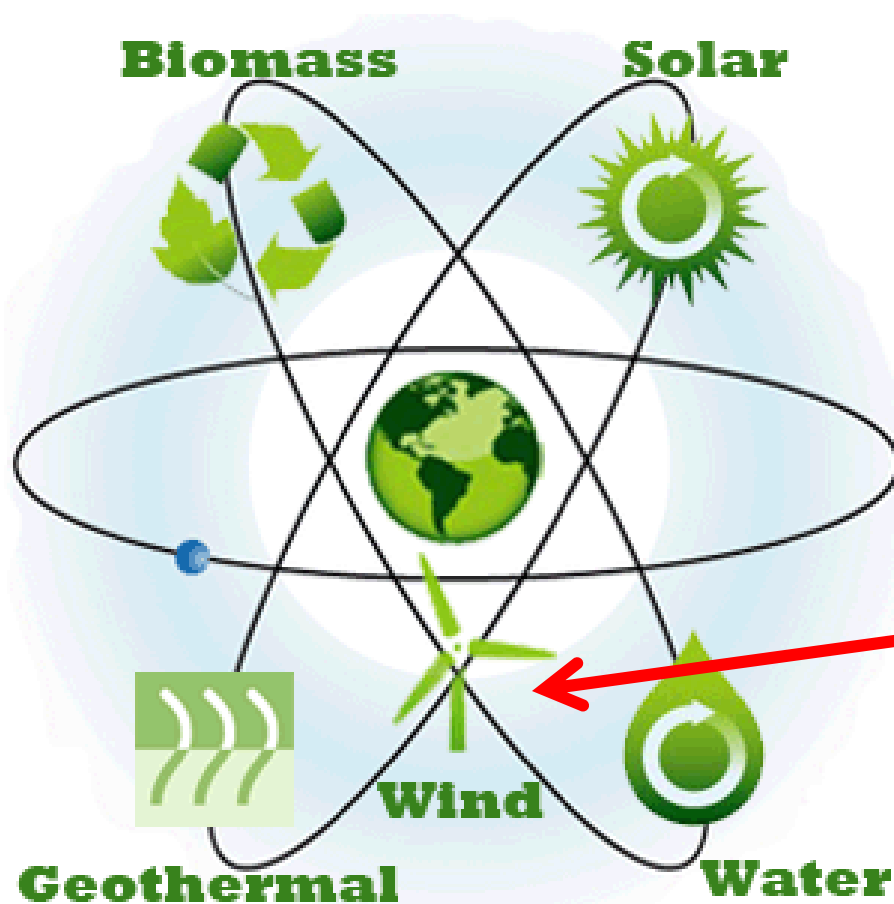


What are pros and cons of nuclear energy?



Alternative Energy

Renewable energy sources that do not emit CO₂



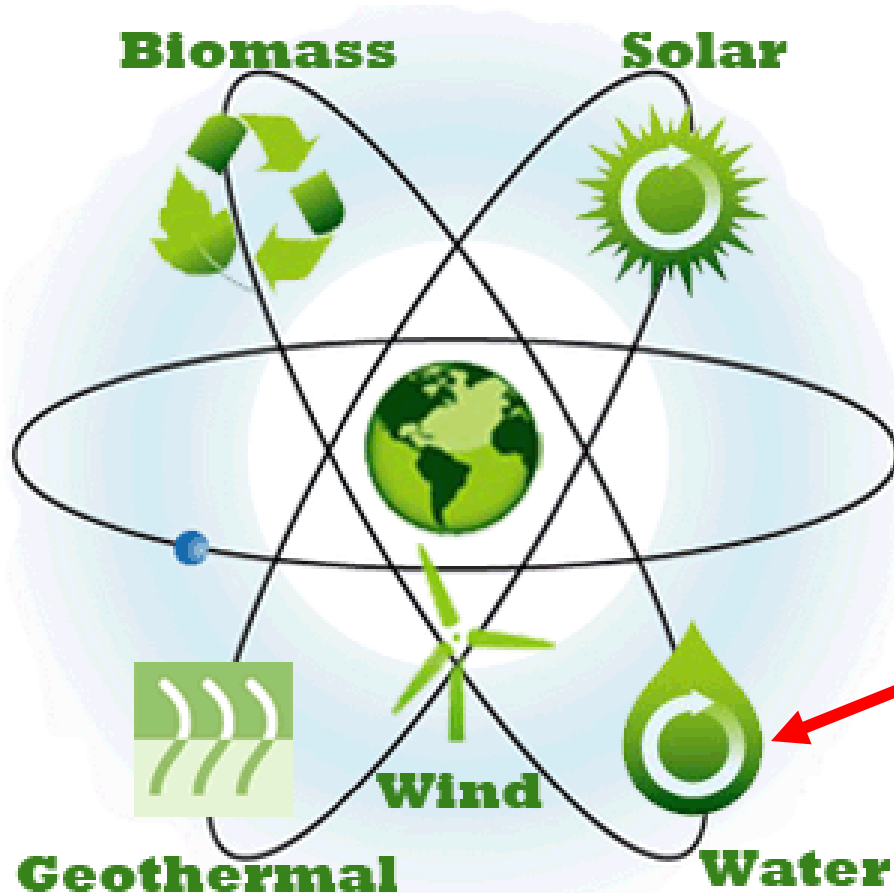
1) Wind power:

Use of air flow through wind turbines to mechanically power generators for electricity

What are pros and cons of each method?

Alternative Energy

Renewable energy sources that do not emit CO₂



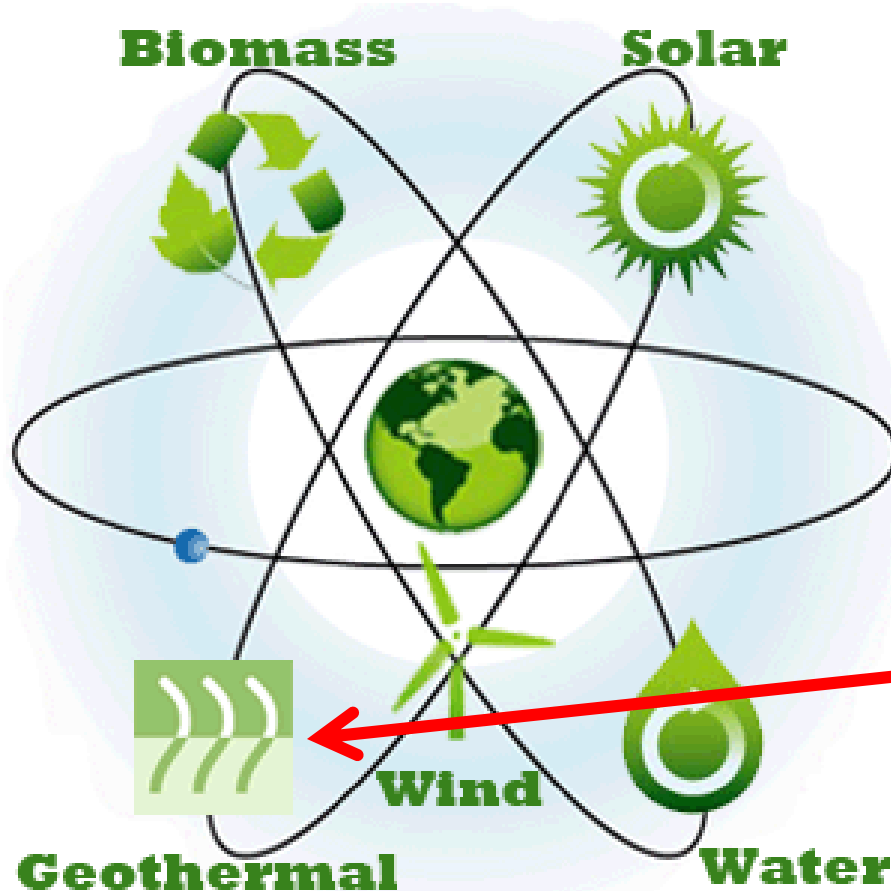
2) Hydropower:

Produces electricity by harnessing ocean tides or falling water (e.g. from a dam)

What are pros and cons of each method?

Alternative Energy

Renewable energy sources that do not emit CO₂

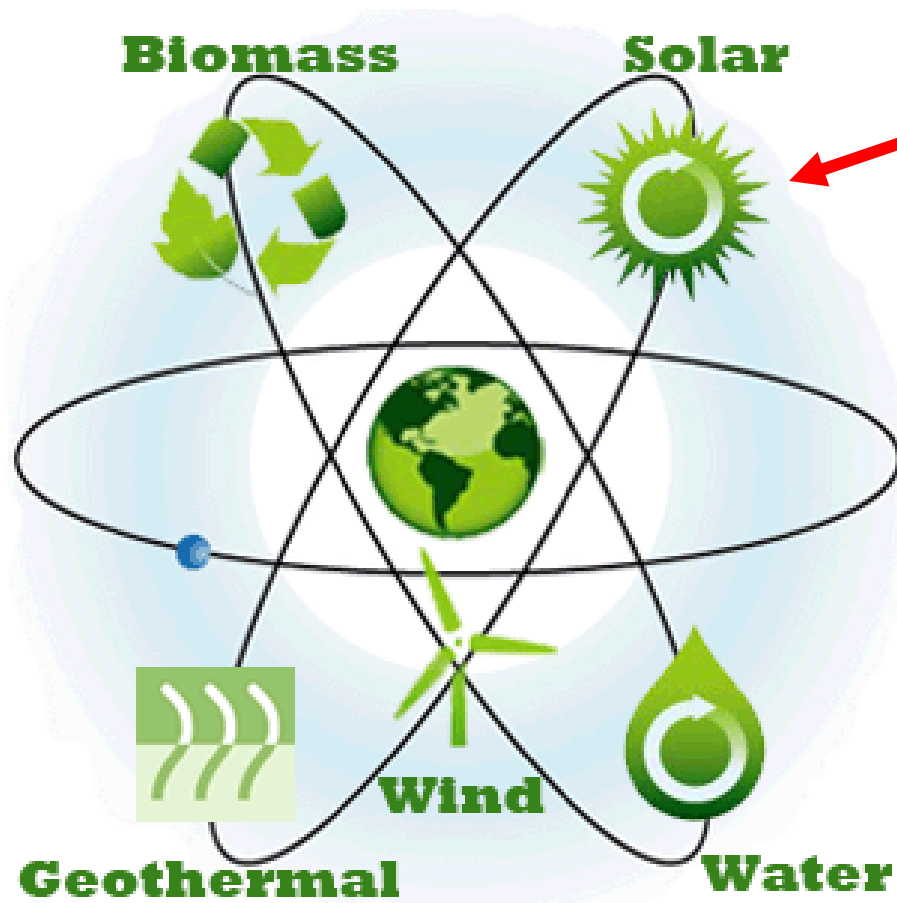


3) Geothermal energy: utilizes temperature gradients within the solid Earth to generate electricity

What are pros and cons of each method?

Alternative energy:

Renewable energy sources that do not emit CO₂



4) Solar power:

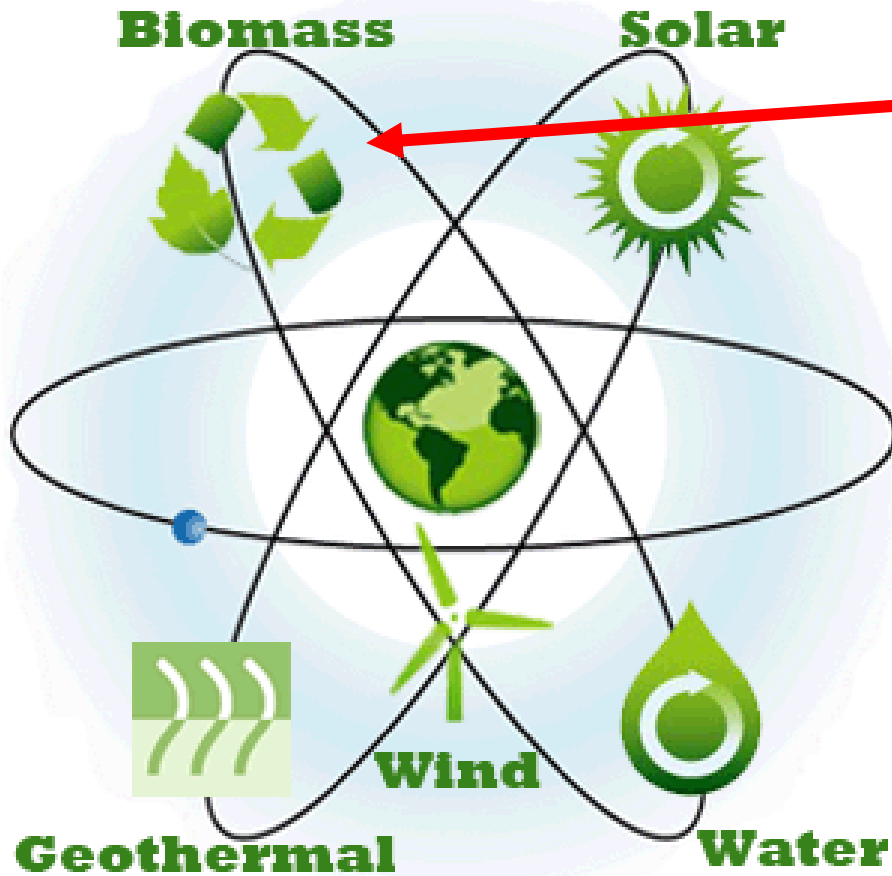
Conversion of sunlight into electricity using photo-voltaic cells, typically made of silicon



What are pros and cons of each method?

Alternative energy:

Renewable energy sources that do not emit CO₂



5) Biomass:

Liquid fuels, such as ethanol, from fast-growing plants, such as corn and sugarcane, which take up CO₂ emitted by burning

What are pros and cons of each method?



Mitigating Climate Change

Carbon sequestration: Trapping and burying CO₂ in rock deposits or deep ocean.

Geoengineering: Allowing greenhouse gases to accumulate while counteracting their effect by artificially cooling the climate (example: seeding stratosphere with sulfate aerosols).

What are the pros and cons of each?

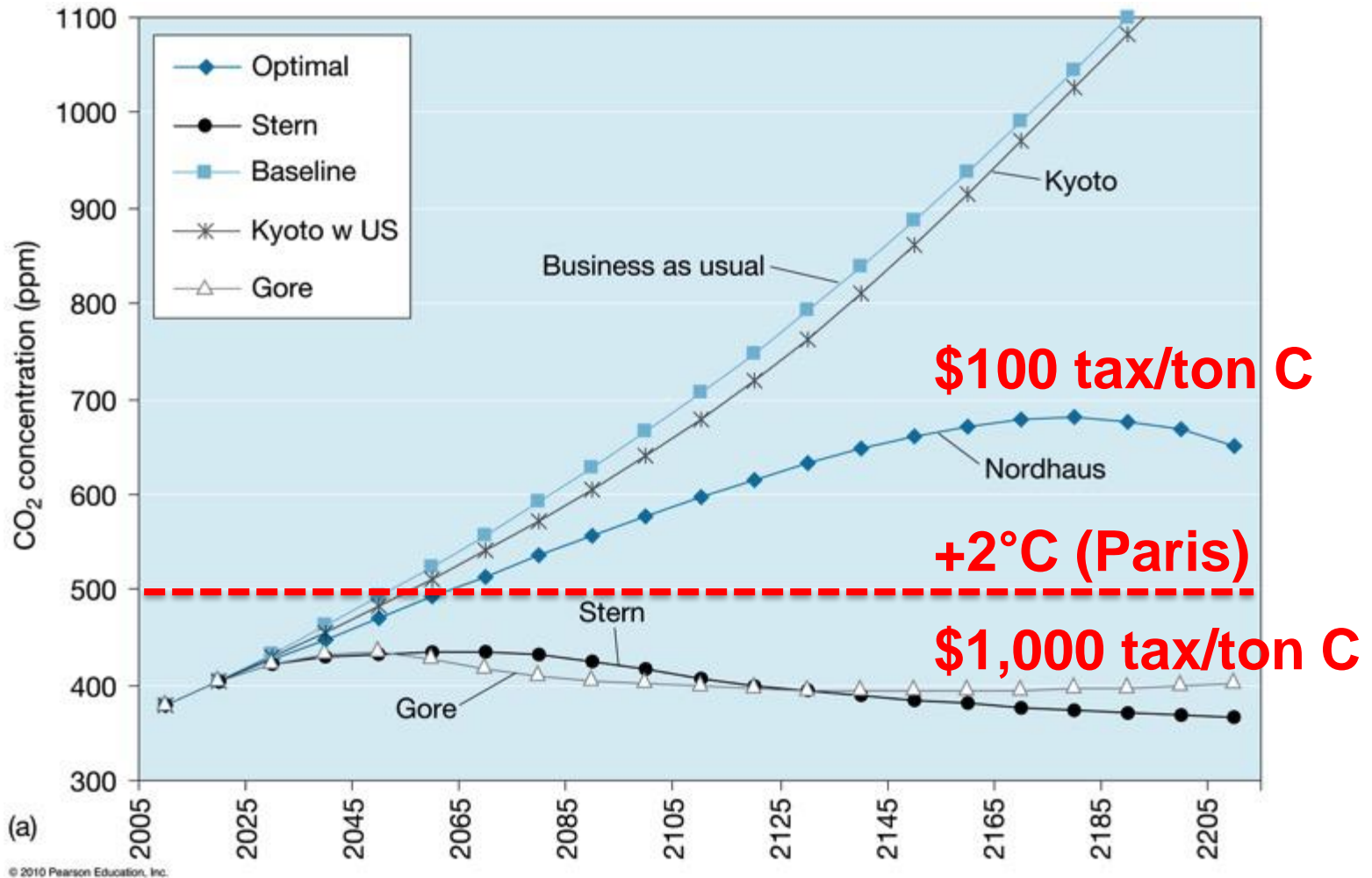
Climate Policy Agreements

Kyoto Protocol: 1997 international conference that called for treaty to roll back CO₂ emissions from developed countries to 5% below 1990 levels, never signed by USA.

Paris Agreement: 2015 consensus that calls for limiting greenhouse emissions to levels that keep temperatures from rising more than 2C above pre-industrial levels; opens for countries to sign on starting on Earth Day, Friday April 22, 2016

Carbon Tax

Tax imposed on any energy source that produces CO₂ in order to reduce emissions via economic means



(a) © 2010 Pearson Education, Inc.