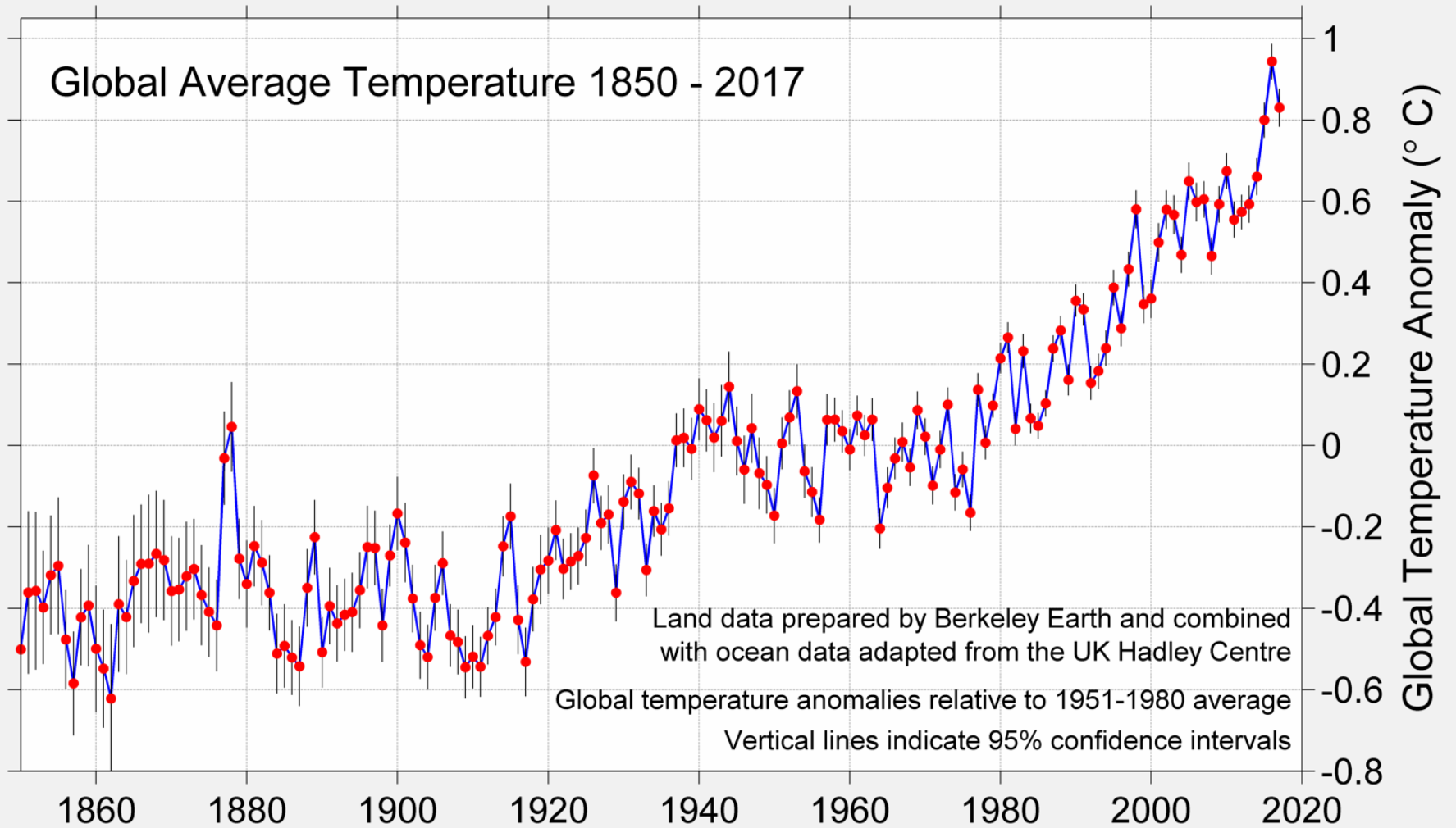


Solar Panel Electricity, Efficiency and Environmental Impacts

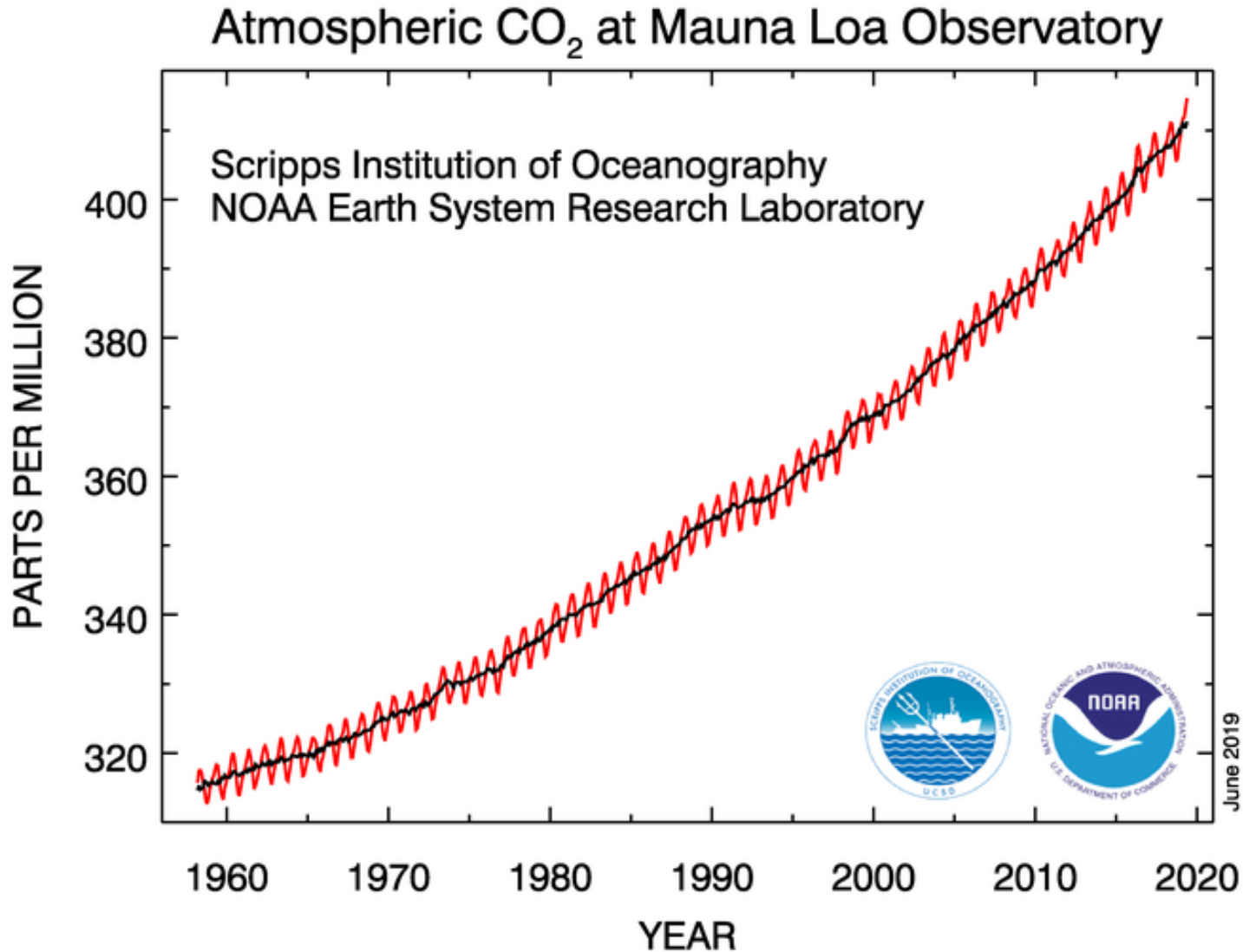
Lawrence S. Blumer

ABLE 2019

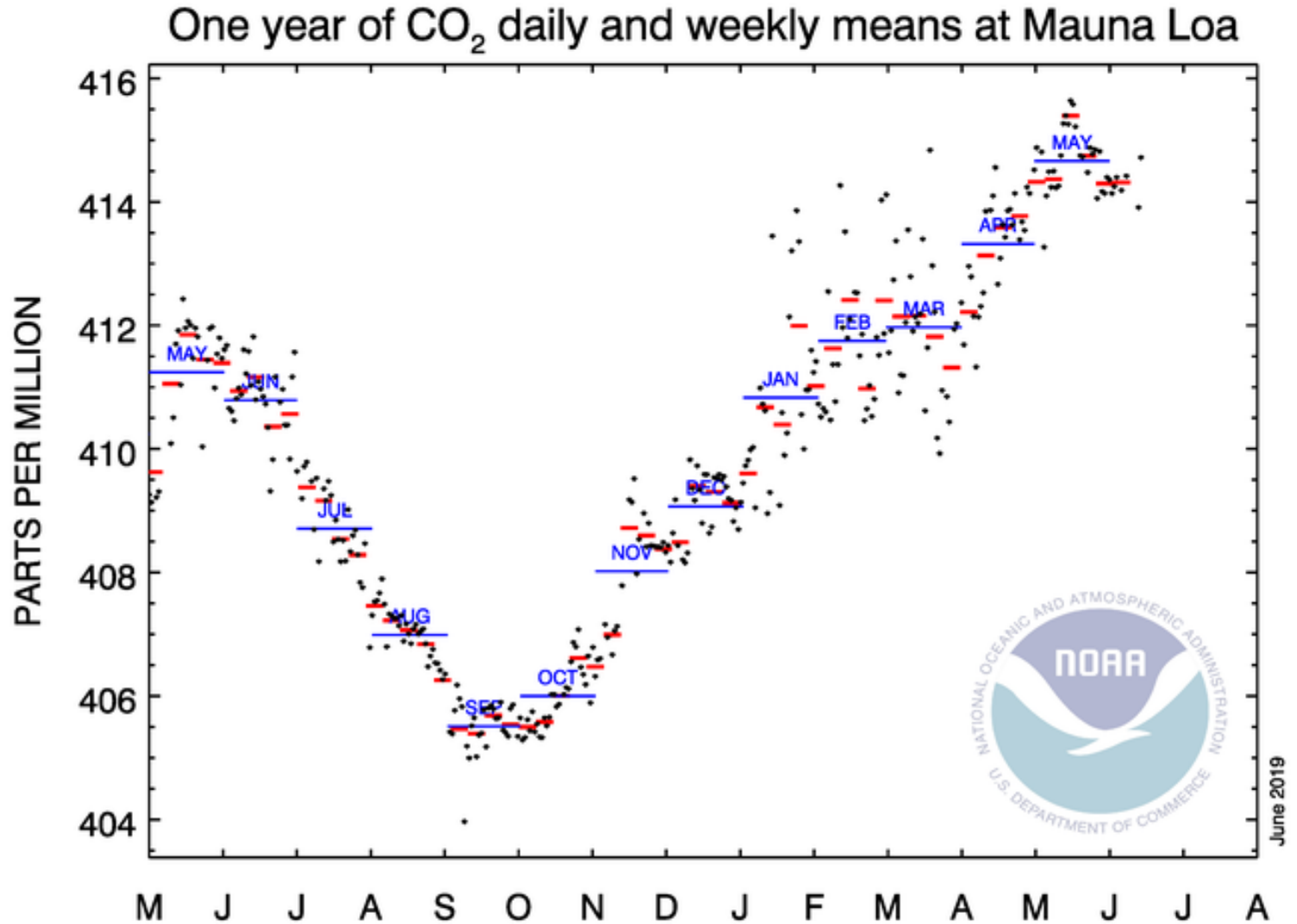
Climate is Changing



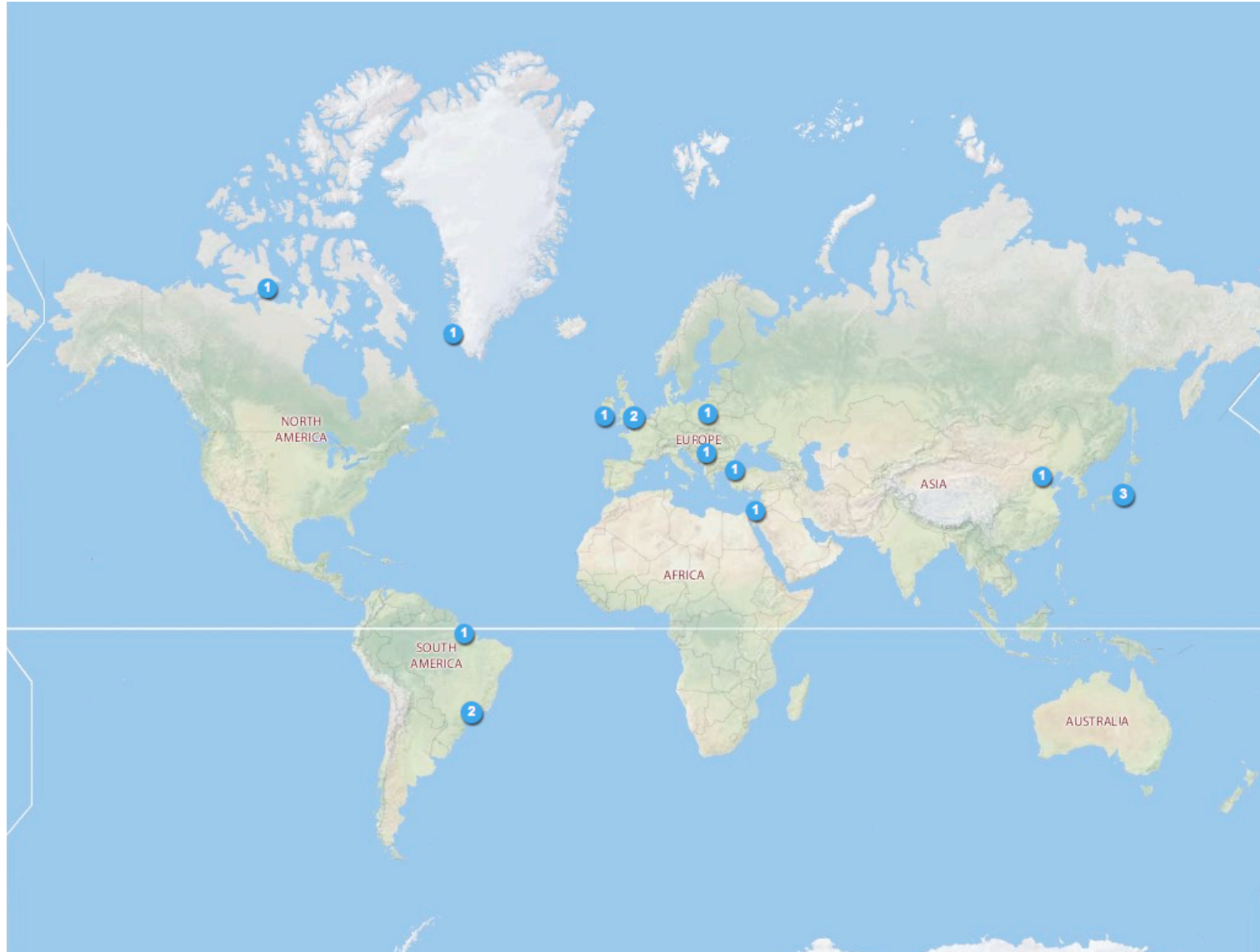
CO₂ Emissions Cause Global Warming



CO₂ Annual Cycle

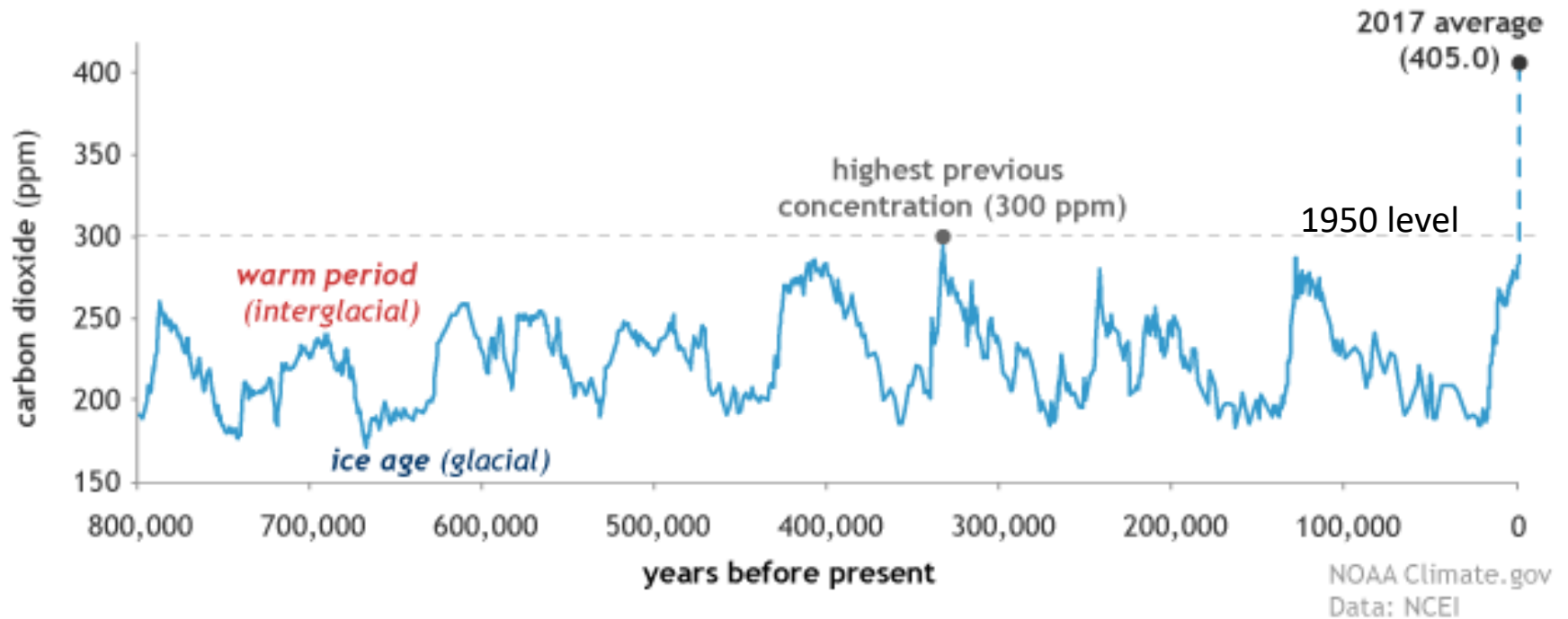


CO₂ Northern Hemisphere Seasonality



Geological Record

CO₂ during ice ages and warm periods for the past 800,000 years



Governments Responding

Paris Accord 2015

Kigali Accord 2016

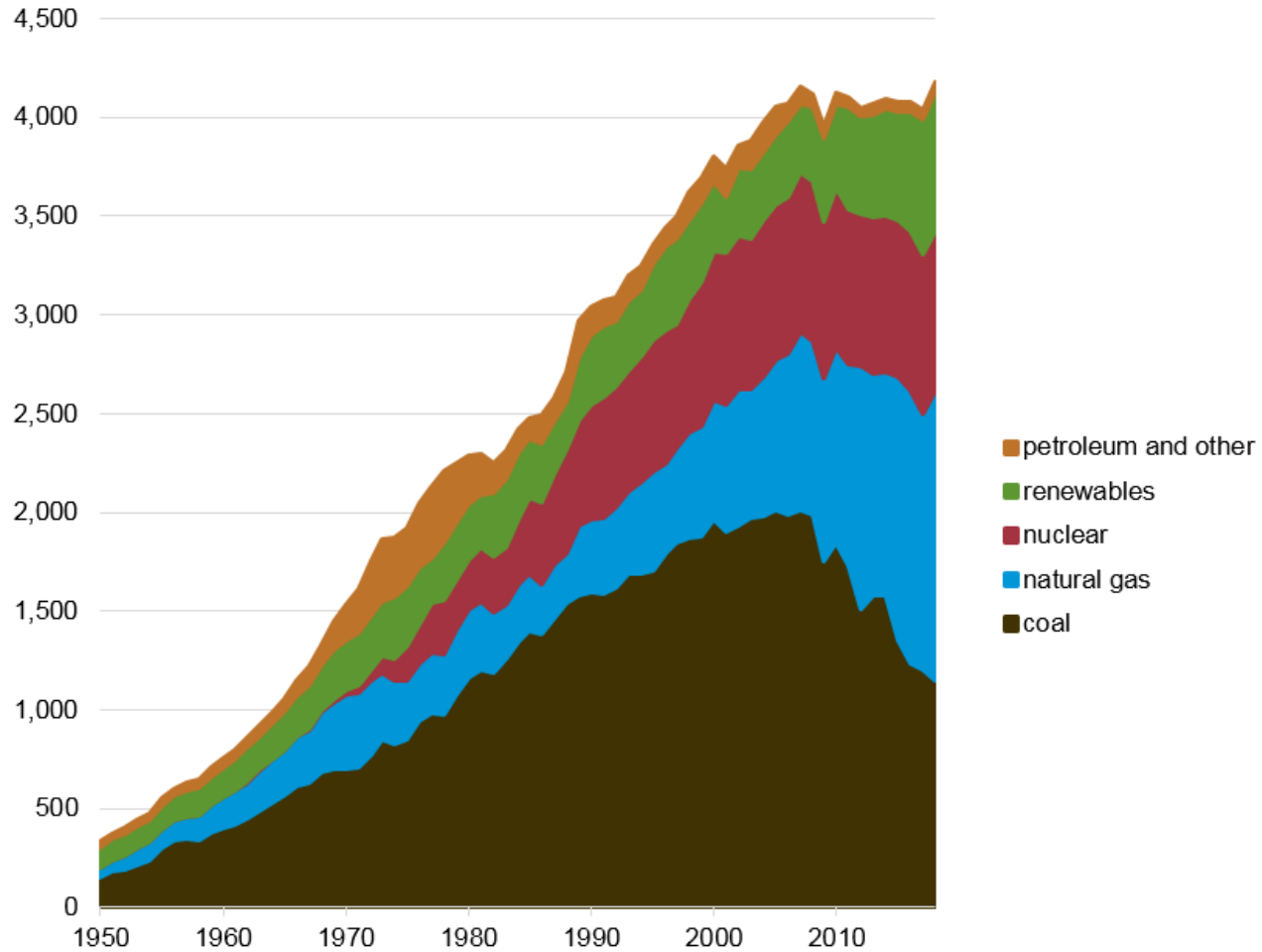
Reduce CO₂ outputs

Change electrical production

Reduce fossil fuel use

U.S. electricity generation by major energy source, 1950–2018

billion kilowatthours



Note: Electricity generation from utility-scale facilities.

Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 7.2a, March 2019



What are the alternatives to Fossil Fuels for Electricity Production?

Solar energy – solar panels

Wind energy – wind mills

Biomass energy – Biofuels

Tidal energy

Geothermal

Nuclear

Hydroelectric Dams

Advantages of Solar Panels

Solid State (no moving parts)

Scalable (one panel - massive array)

Efficient (?)

Flexible Installation

Easily Deployed

Questions

Does the angle of incidence influence the power output of a solar panel?

How efficient are solar panels?

Could solar panels realistically power a typical home?

Design an Experiment

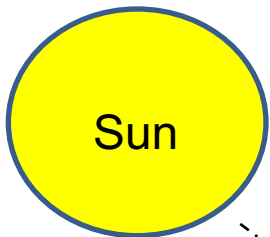
Null Hypothesis:

Alternative Hypothesis:

What will you measure?

How many times will you measure?

What additional information do you
need?



Sun

$$\theta = \arctan \frac{x}{y}$$

