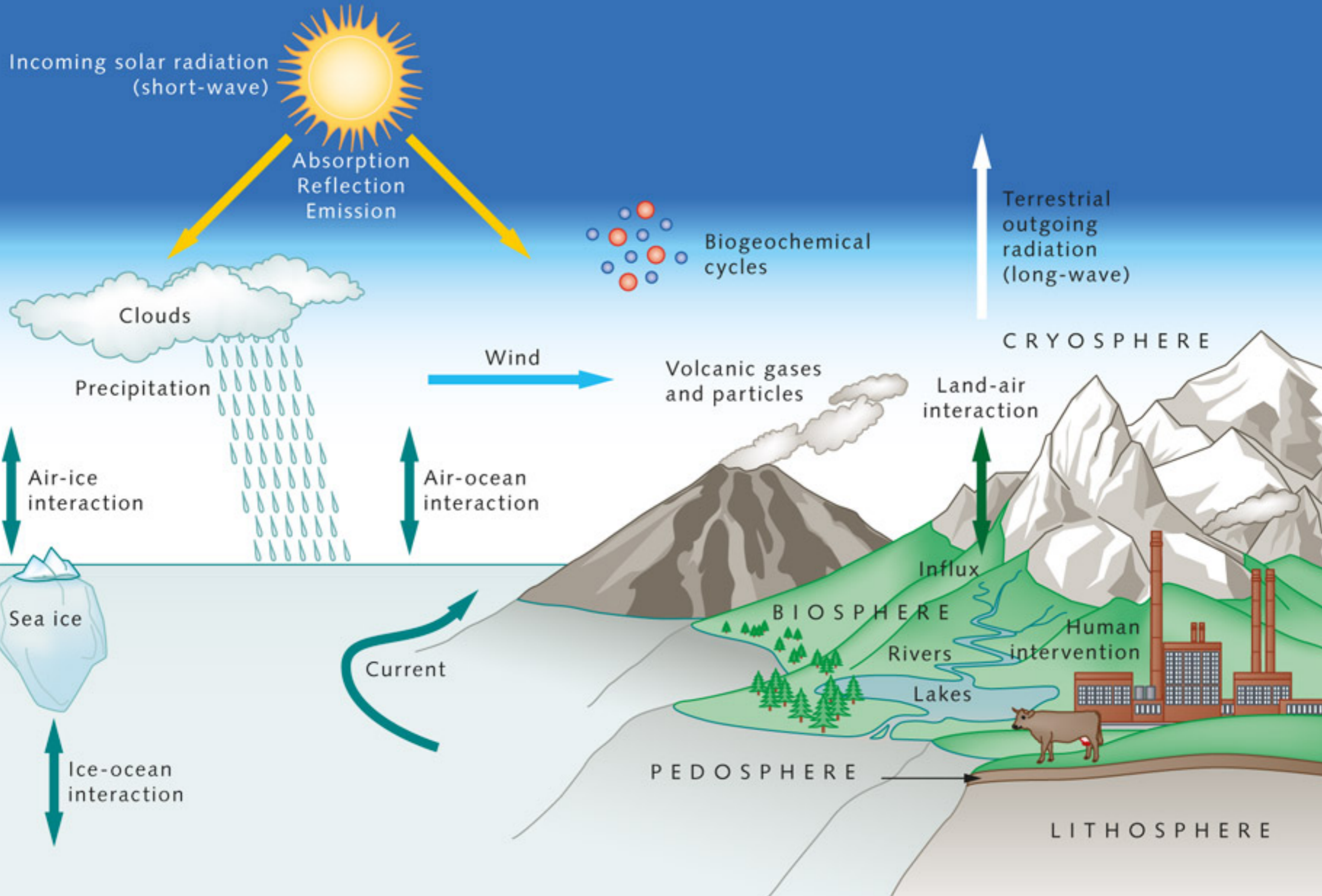


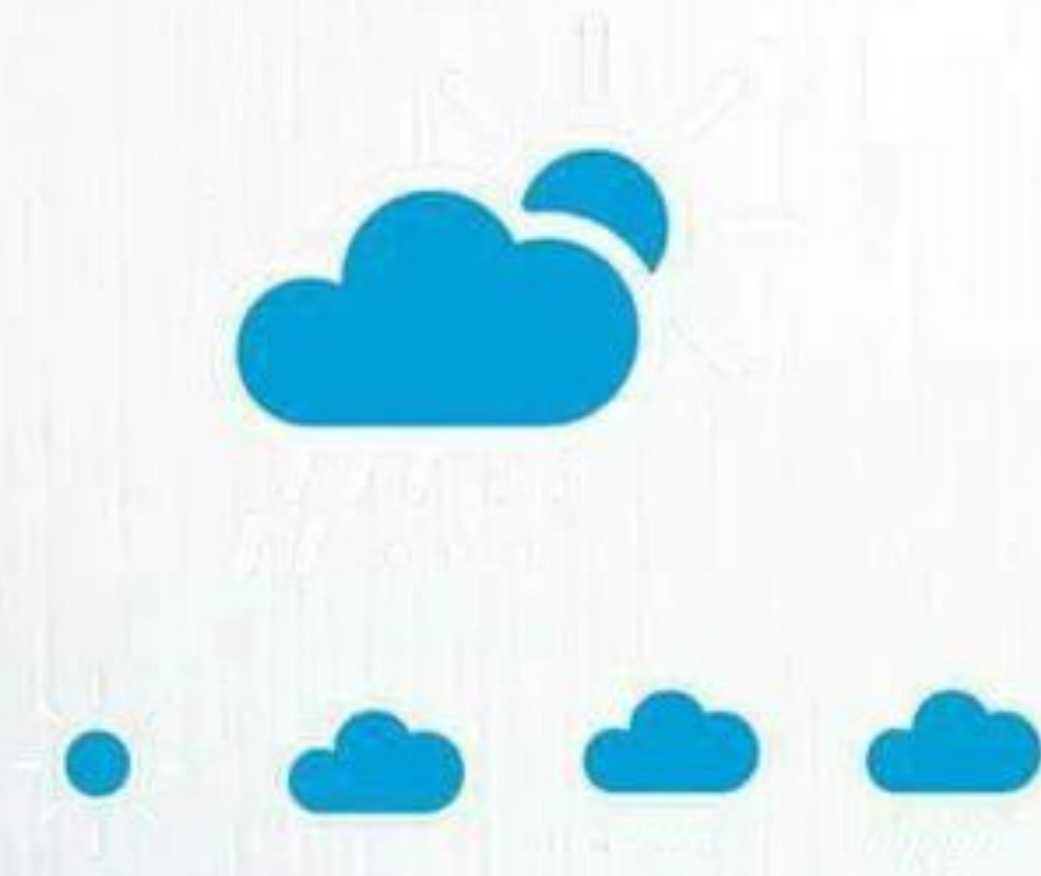
Climate Change?

1. What effects the planets climate?
2. Is the climate changing?
3. Is the climate getting warmer or colder?
4. Has the climate warmed or cooled in the past?
5. If it is changing what are the causes?
6. How does climate effect you?
7. Is the climate changing question a hoax?
8. How do we find the true answer?
9. What are the positives and negatives of all these questions?
10. What can be done to reduce the warming, if it's really occurring? If it's not warming would these actions be a waste of time?



Weather

Weather is the temporary condition of the atmosphere at a place.

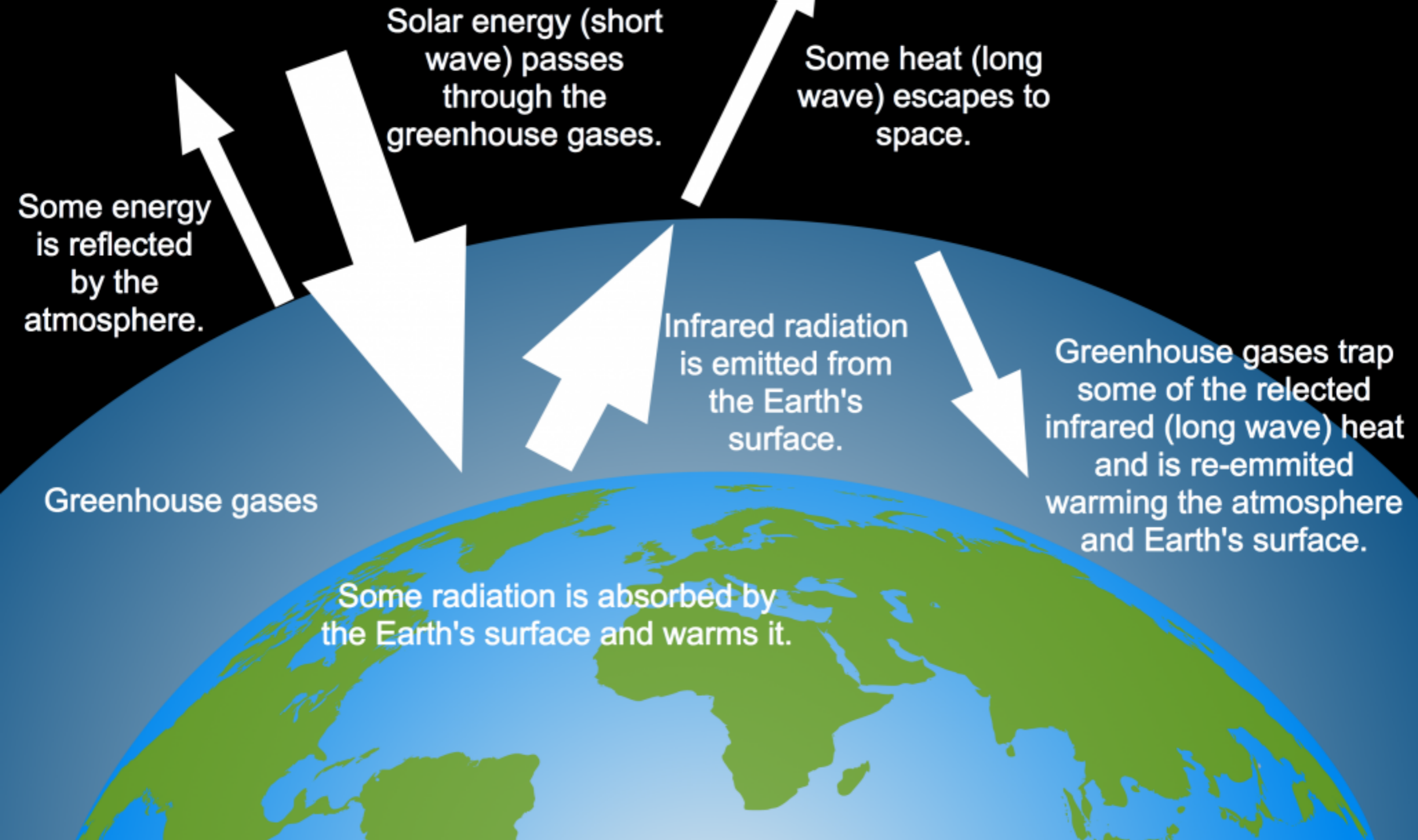


Climate

Climate is the overall average weather at a place over a period of time.

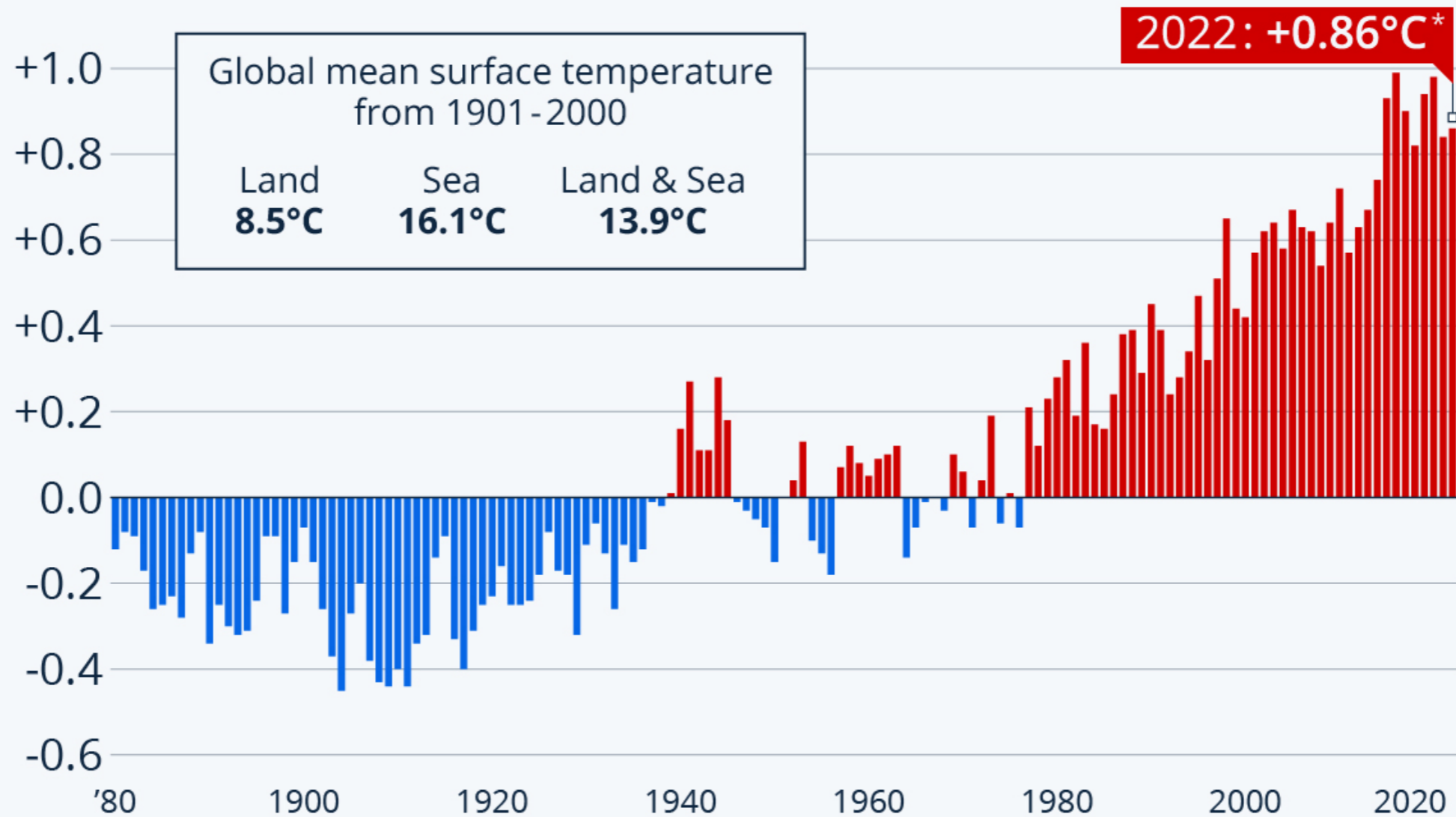


The Greenhouse Effect



The Last 8 Years Have Been the Warmest on Record

Global land and ocean surface temperature anomalies (degrees Celsius compared to the 20th century average)

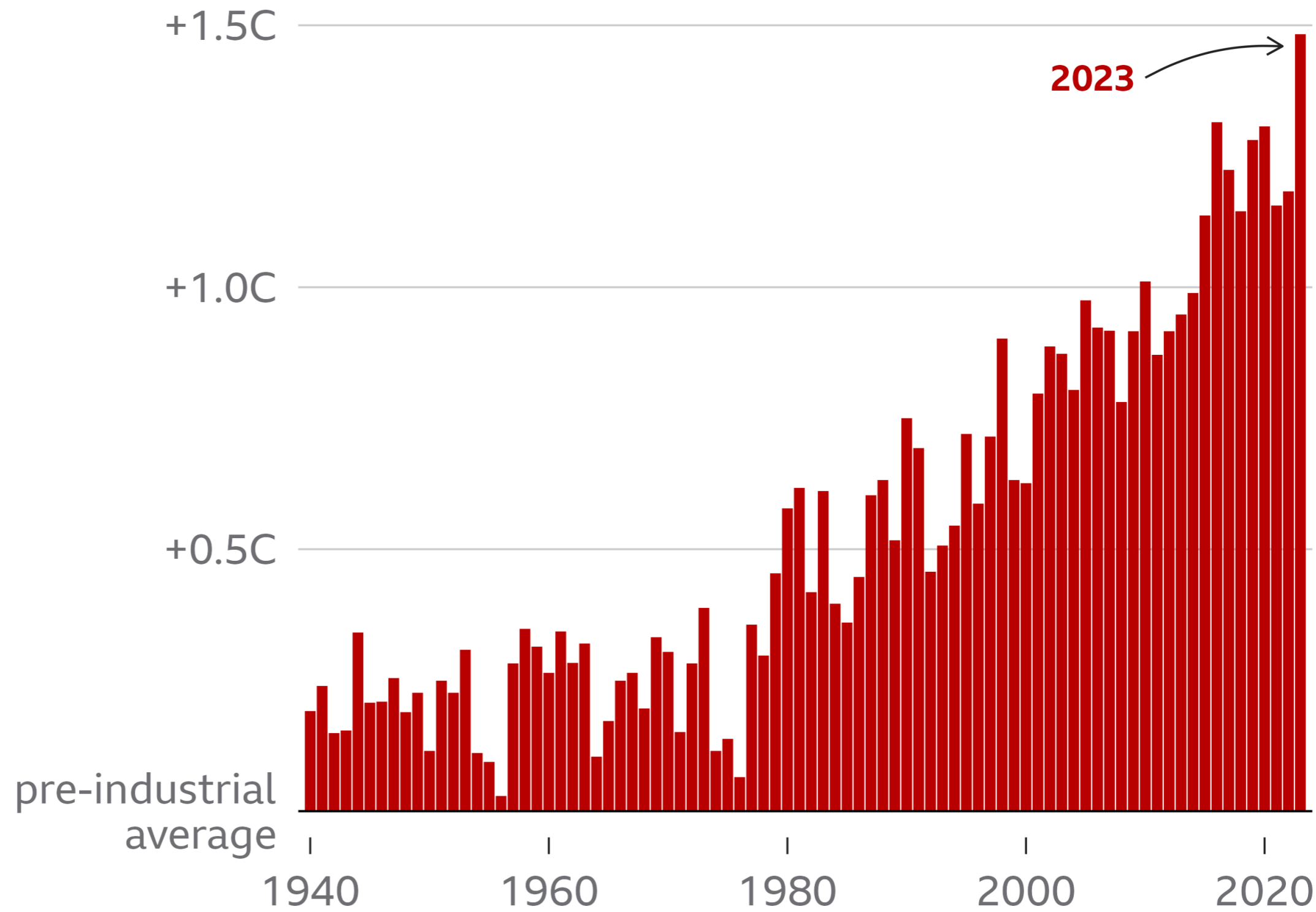


* 2022 figure refers to the temperature anomaly for January through September

Source: NOAA

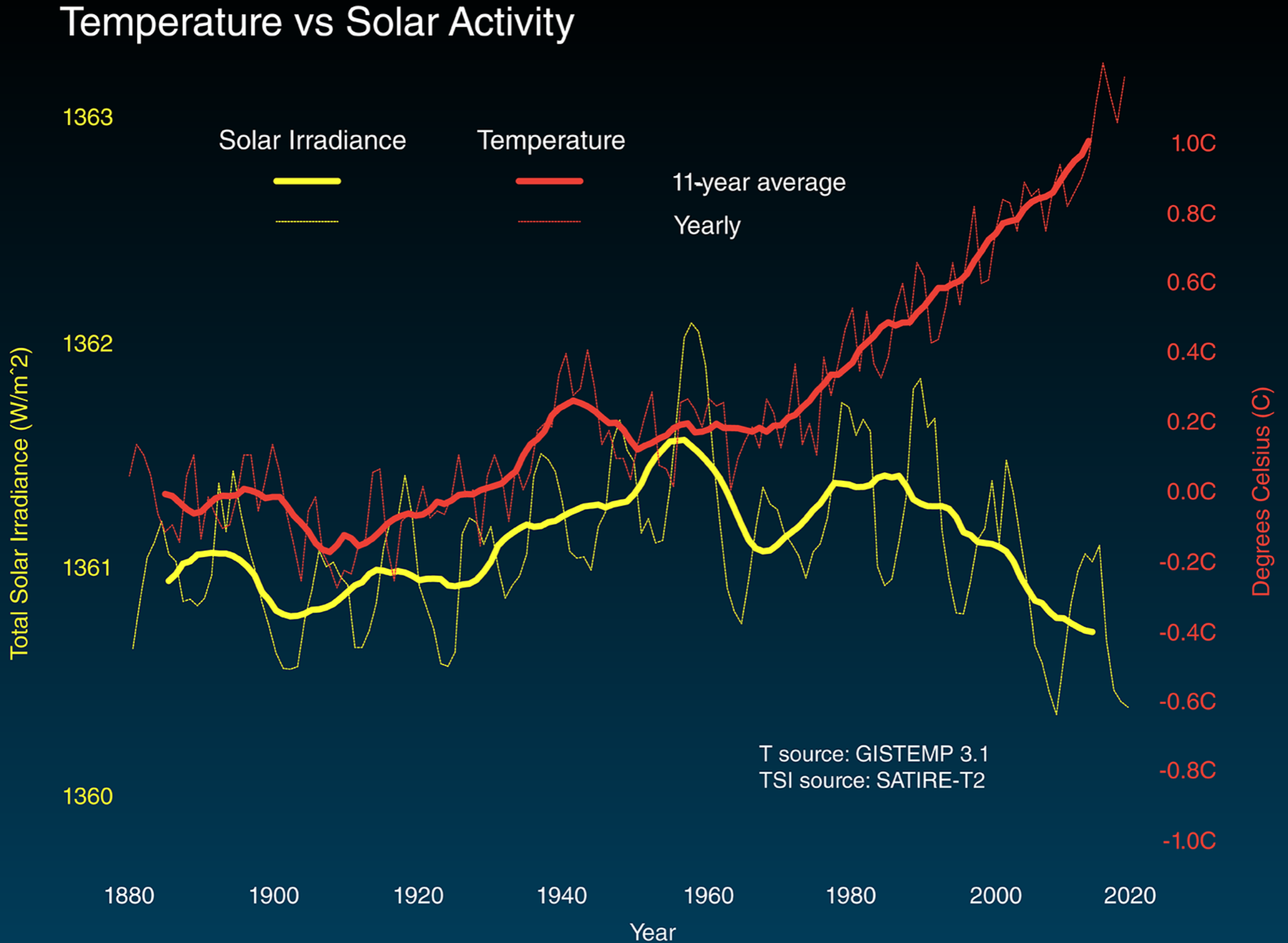


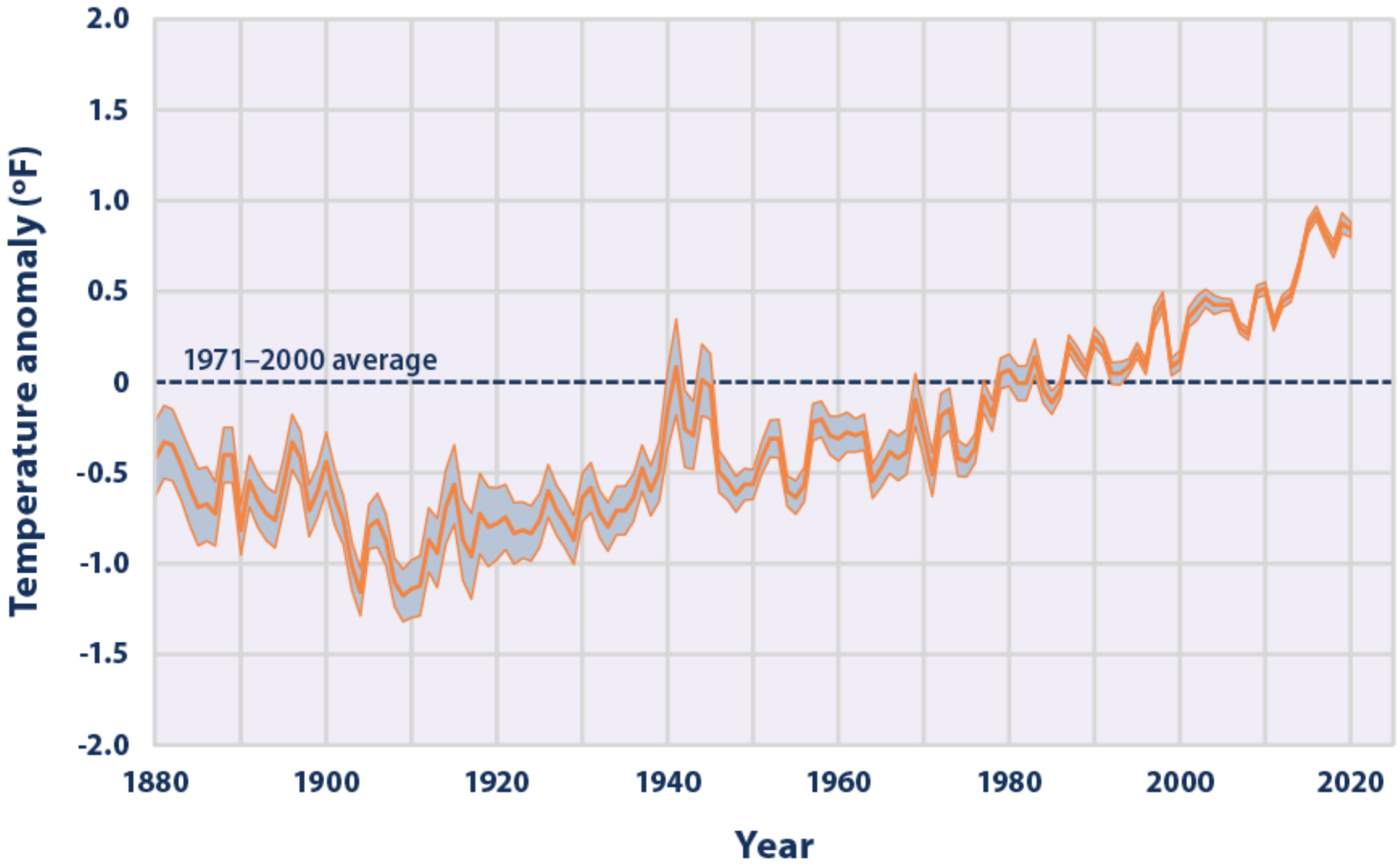
Global average temperature by year, compared with pre-industrial average (1850-1900)



Source: ERA5, C3S/ECMWF

Solar Irradiance= amt. electromagnetic radiation/unit of space

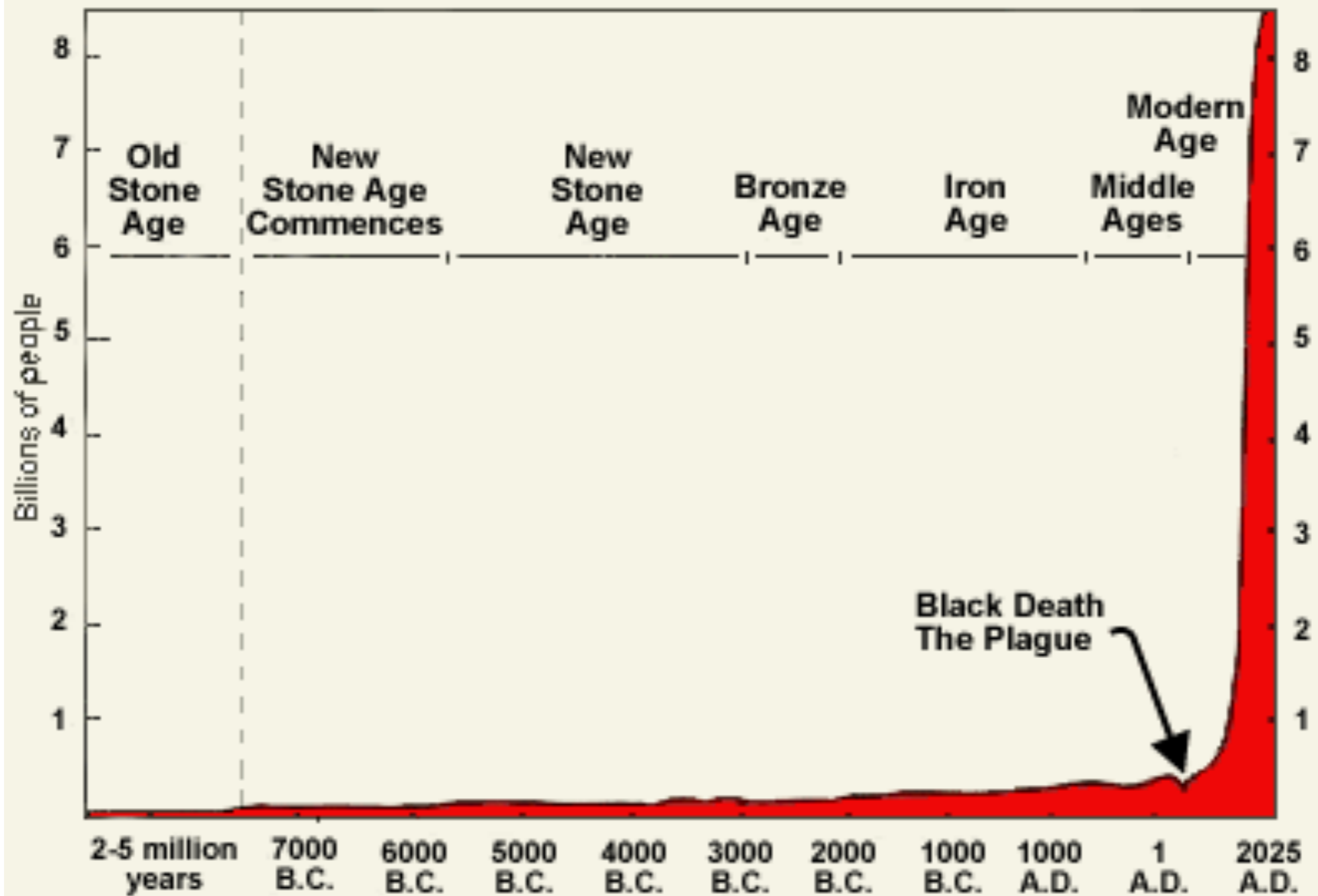




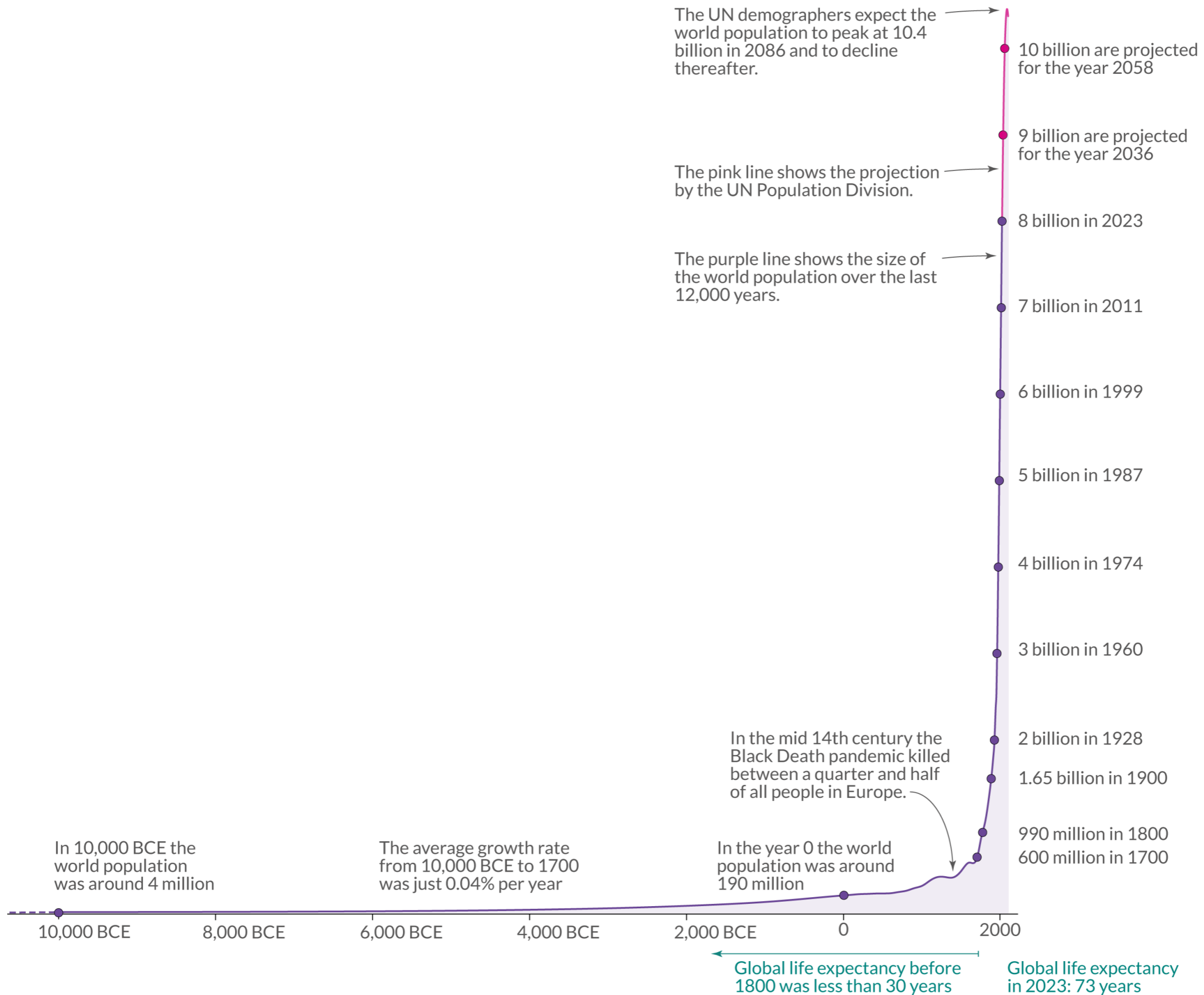
What do you think is the #1 cause of the climate getting warmer?

- Is it a natural process?
- Is it fluctuations in sun activity?
- Is it increase of greenhouse gases?
- Is it deforestation?
- Is it manipulation of data?
- Is it a hoax?
- Is it bad science?
- OR is it something else?

World Population Growth Through History



The size of the world population over the long-run

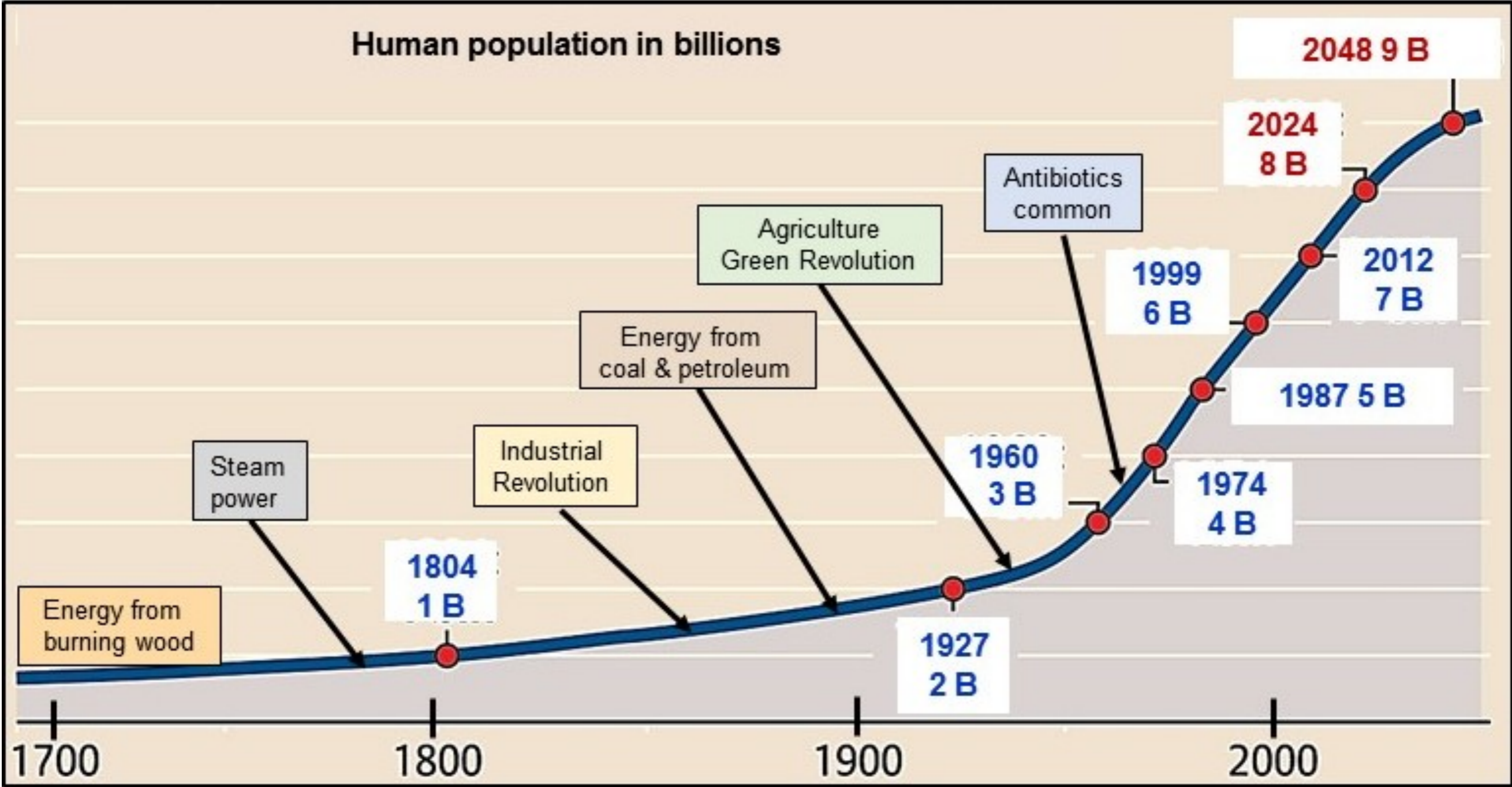


Based on estimates by the History Database of the Global Environment (HYDE) and the United Nations.

This is a visualization from [OurWorldinData.org](https://www.ourworldindata.org).

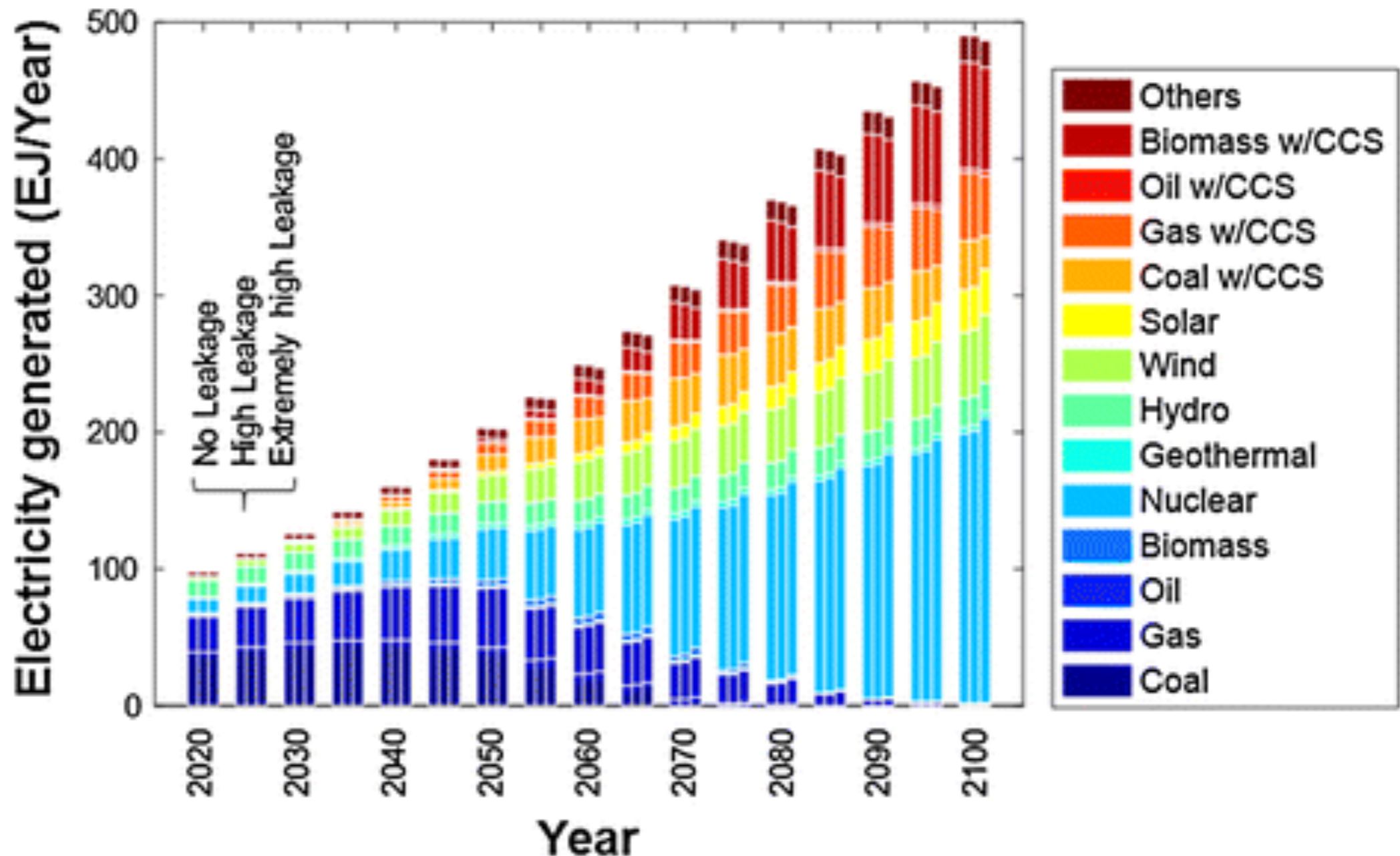
Licensed under [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) by the author Max Roser.

Human population in billions

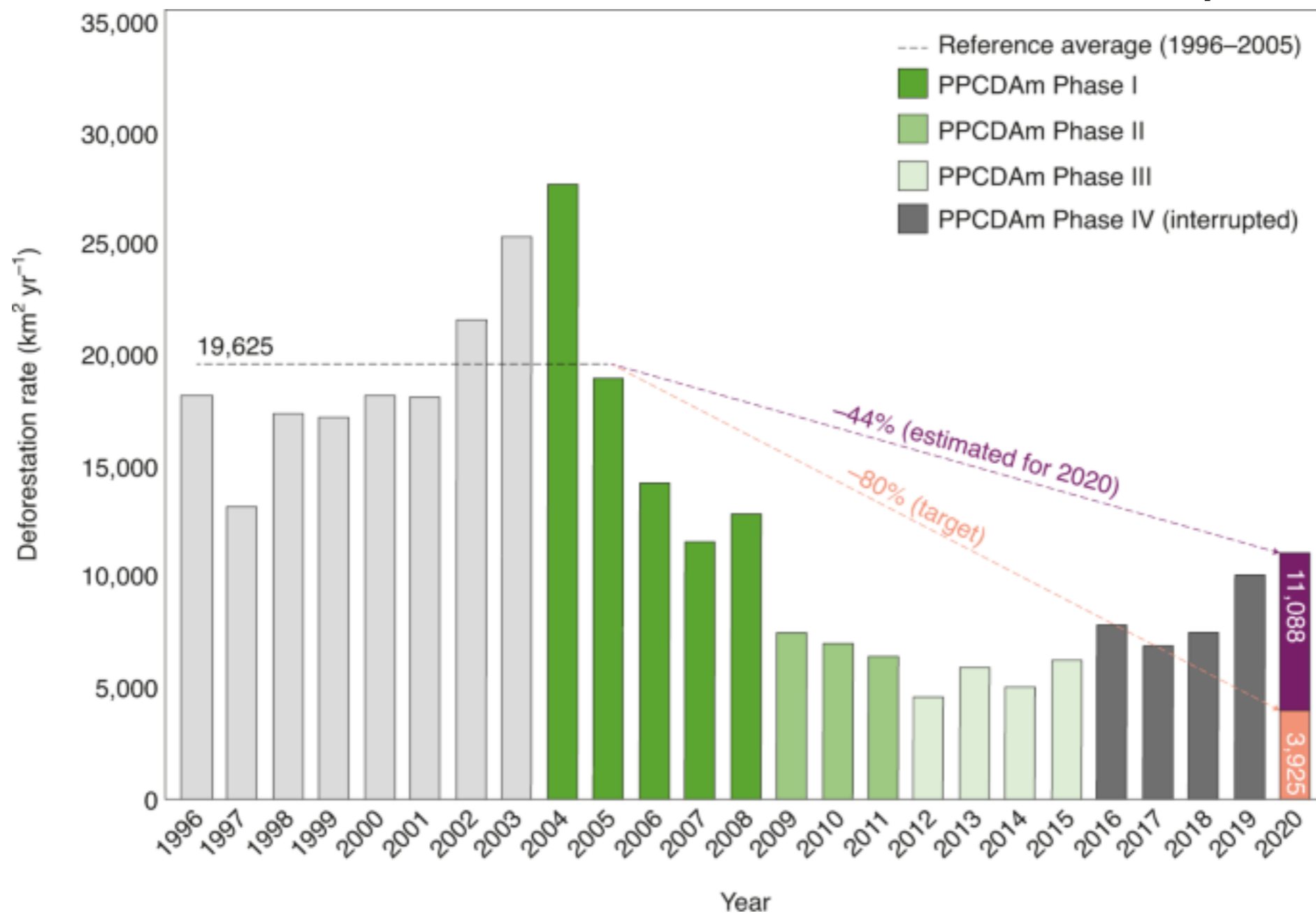


Factors Related to Population

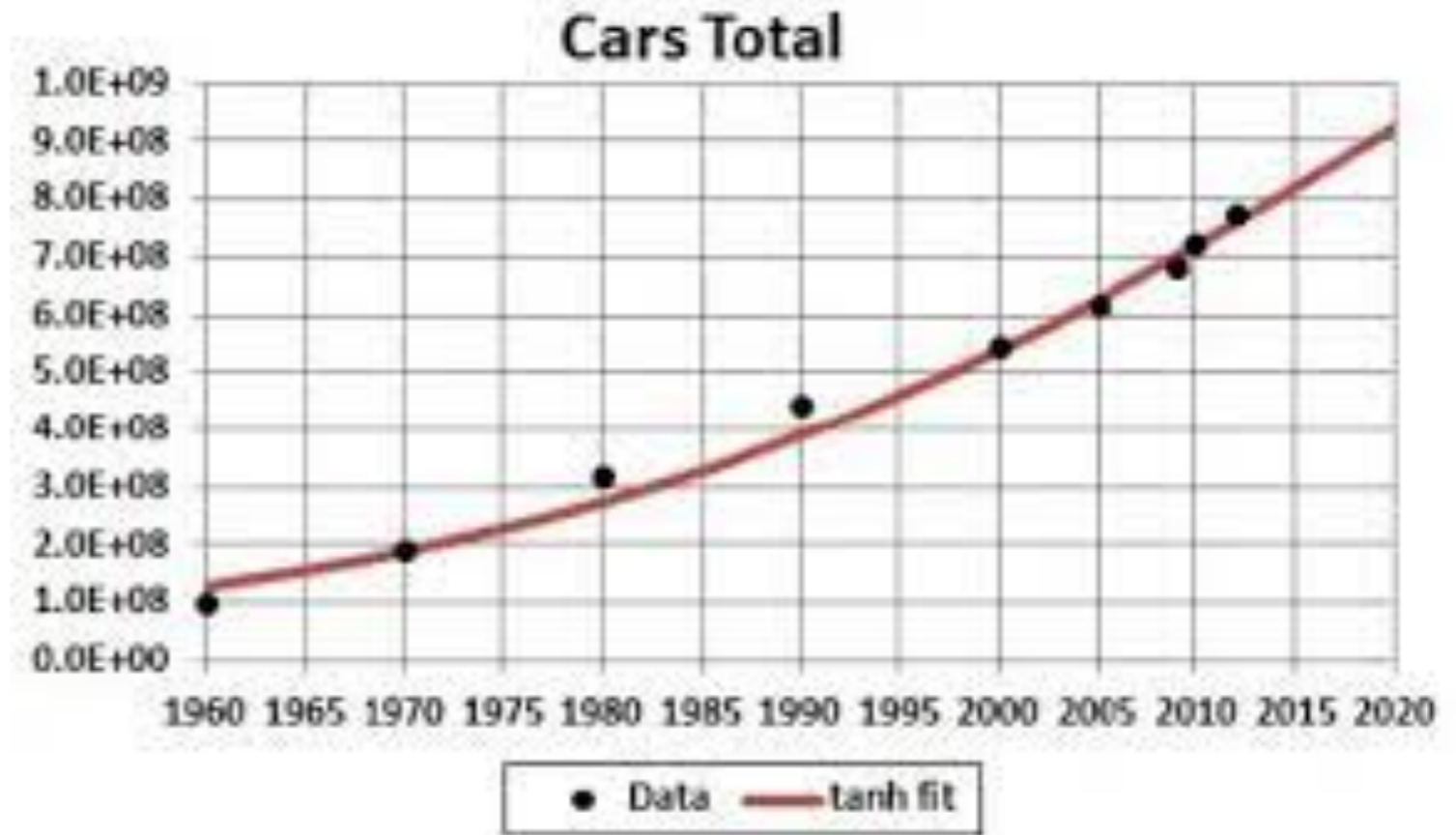
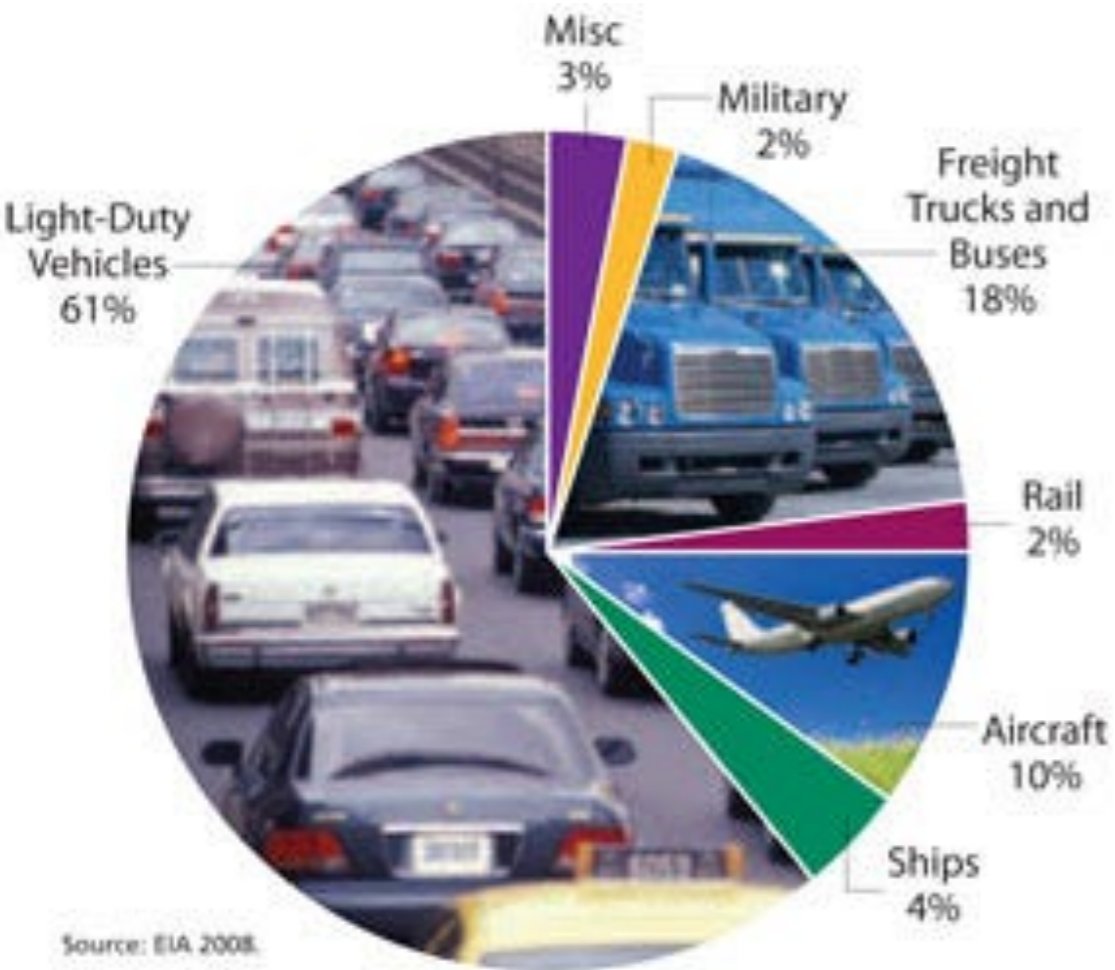
- Power Generation: Most electricity is generated by burning coal, oil, or natural gas producing carbon dioxide & nitrous oxide. As the population increases AND people around the world have more “stuff”, there will be more Green House Gases produced.



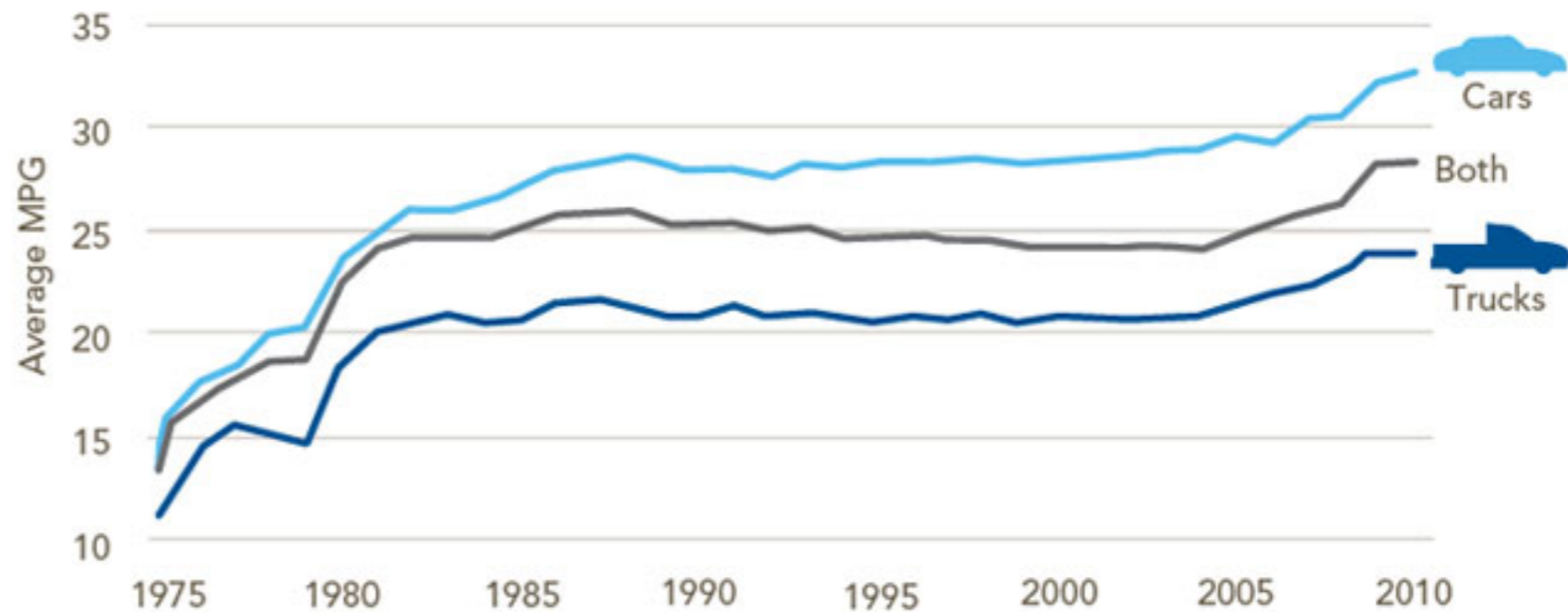
- Manufacturing: One of the largest contributors of Green House Gases. Each generation has at least twice as much “stuff” as the past generation. Manufacturing will increase even if population stabelizes.
- Deforestation: More population, higher standard of living, and more stuff translates into more need for wood products.



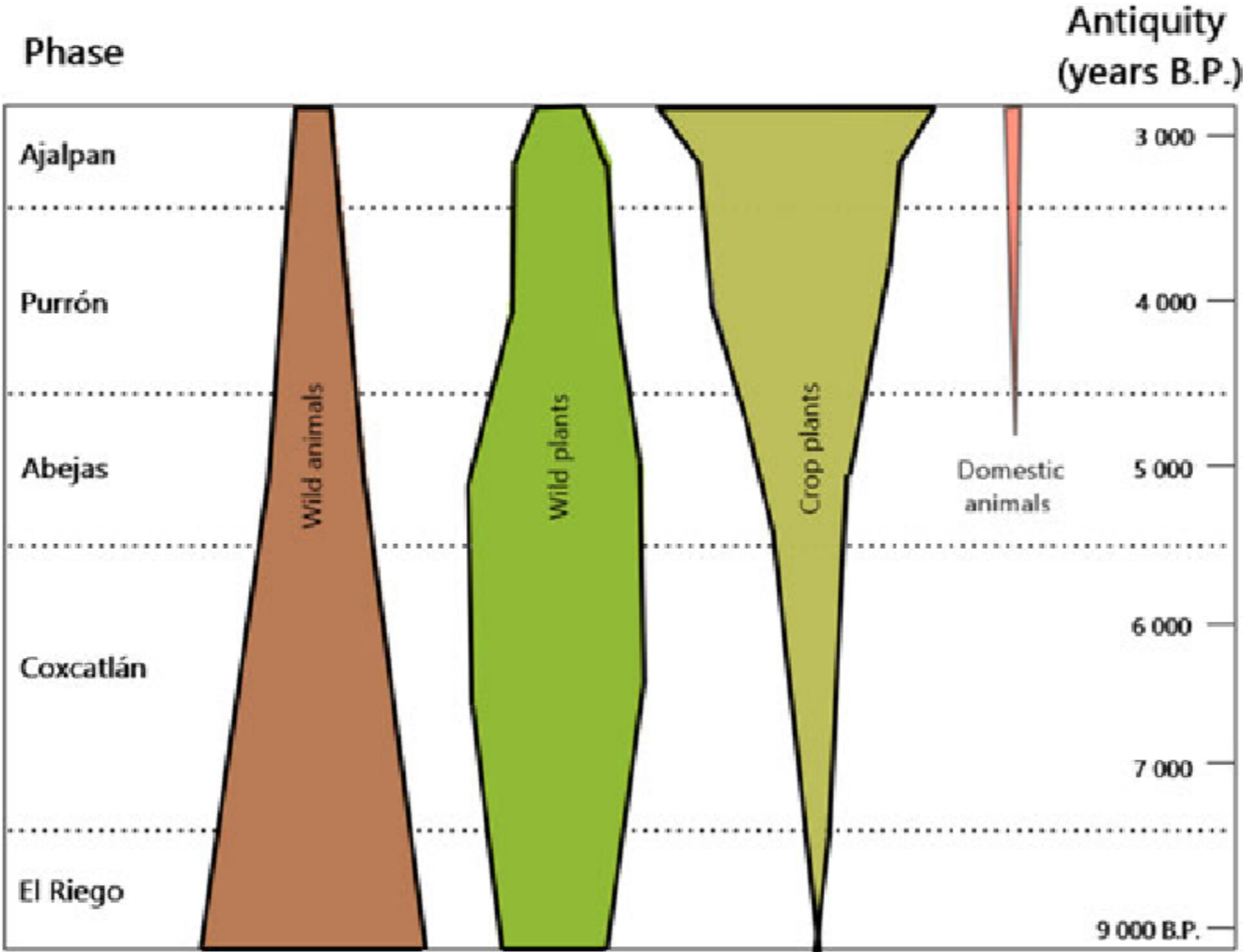
- Transportation: About 1/4 of all Green House Gases are generated by modes of transportation. Mileage on gas driven vehicles is reducing but the number of vehicles is increasing.



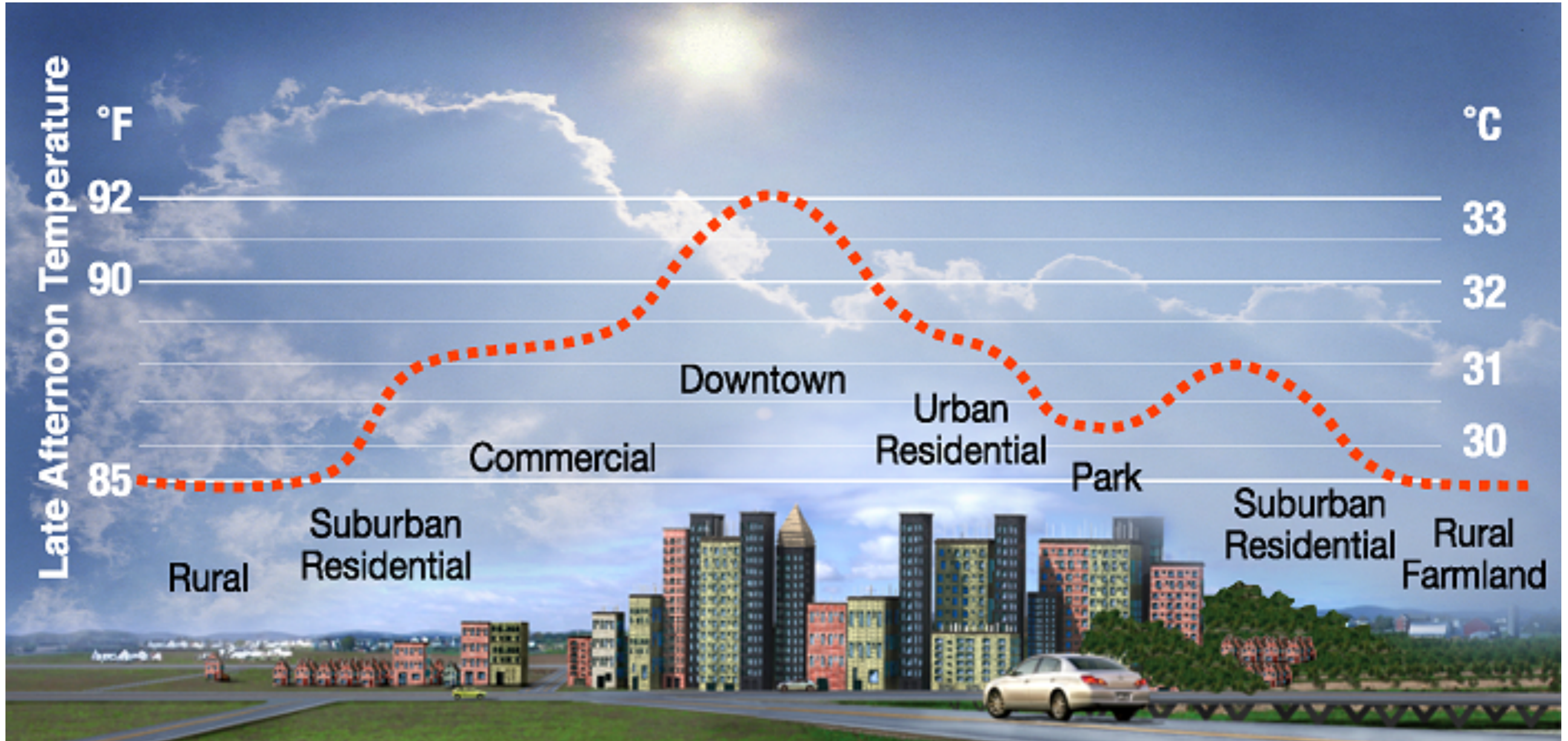
AVERAGE ESTIMATED FUEL ECONOMY BY MODEL YEAR



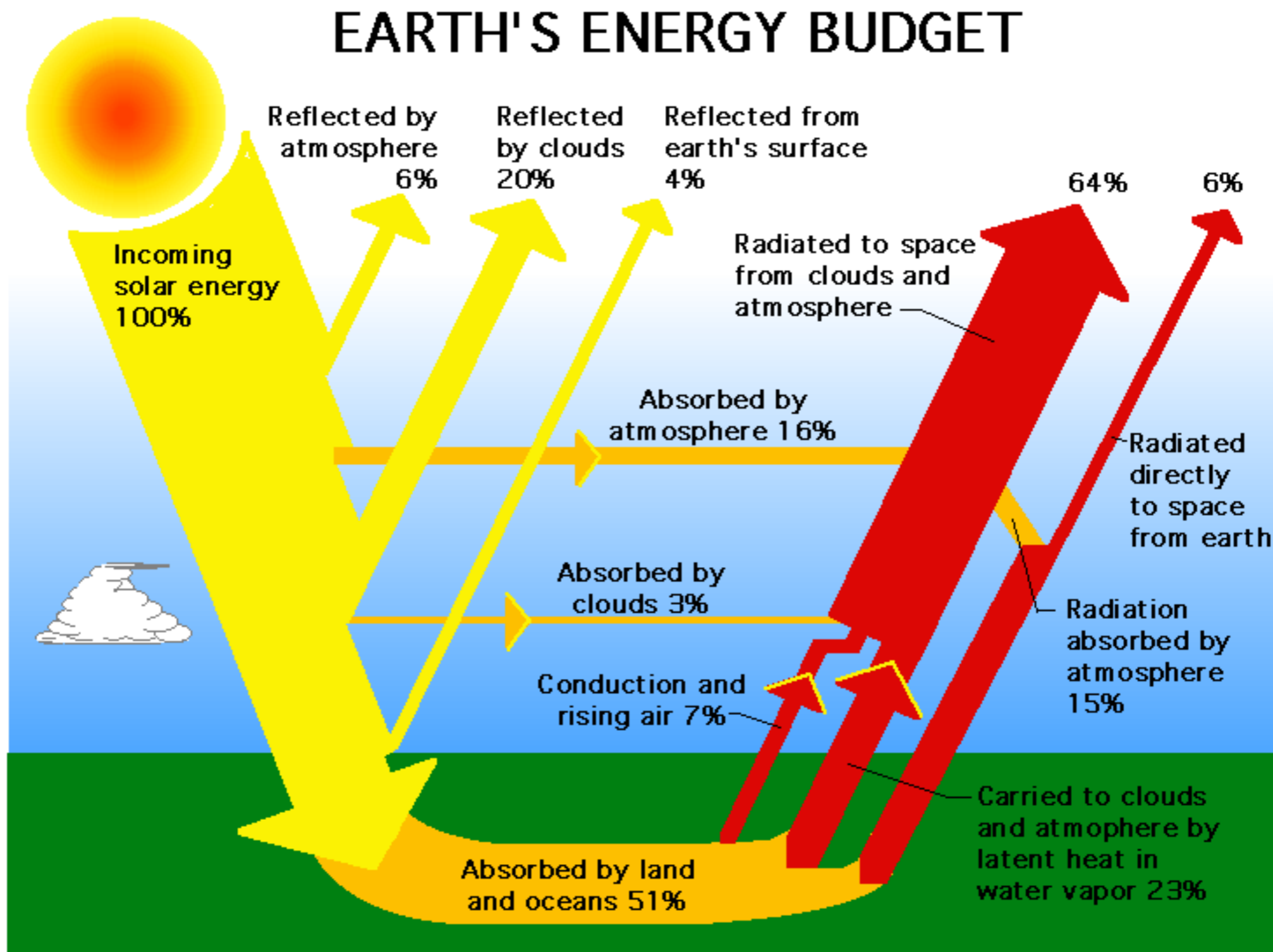
- Consumption: As countries become more developed their populations use more resources. Besides what was stated earlier, food needs to be added to the list. In the last 70 years the world's population has shifted their diet to include more meat. It takes a lot more energy and produces more Green House Gases to make meat as opposed to vegetables.



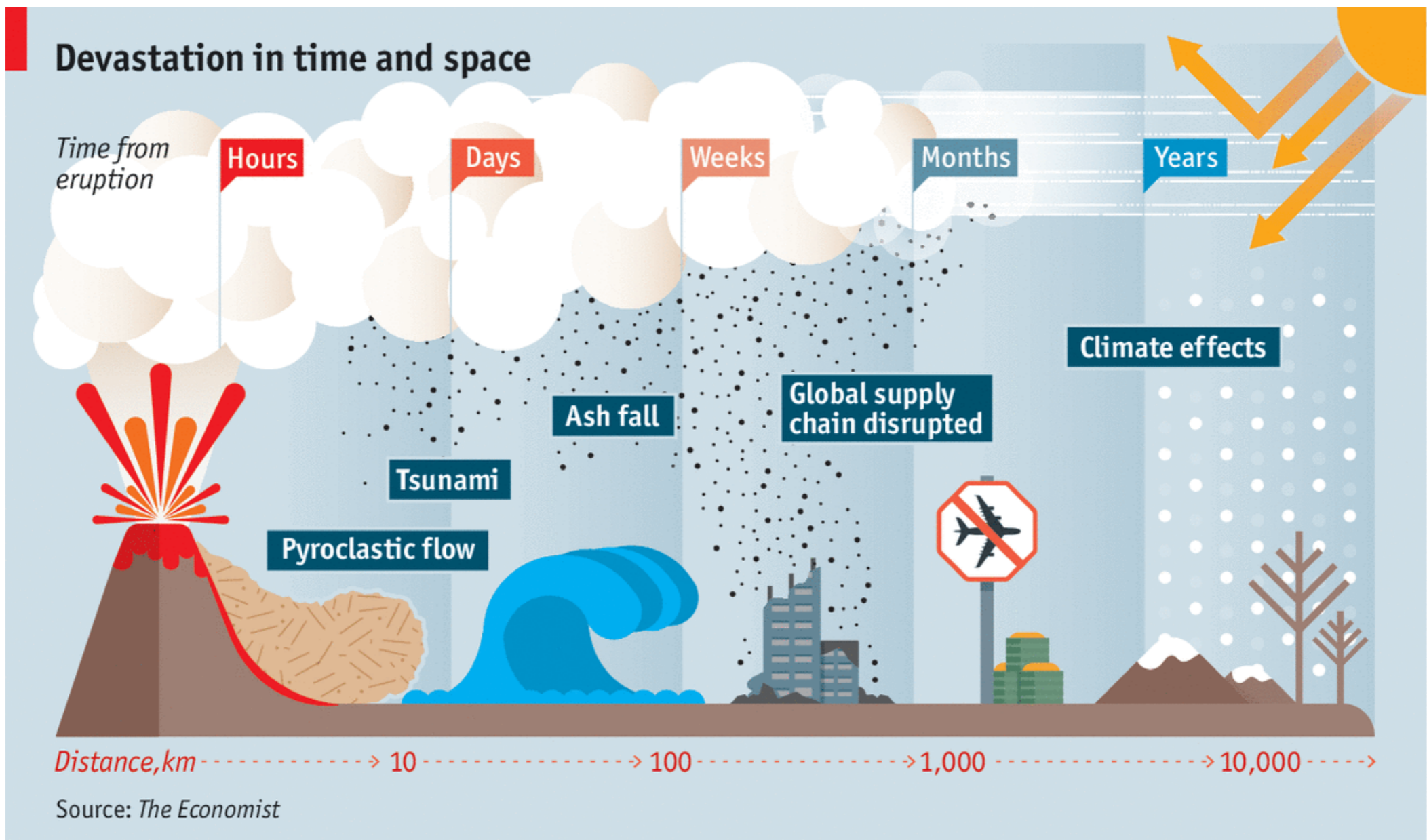
- Heat Sinks: Cities hold heat where forest reflect heat. When heat is not reflected back to space a warming occurs. You can visit just about any metro area and it is always warmer than the surrounding country side. More people, cars, buildings, etc.



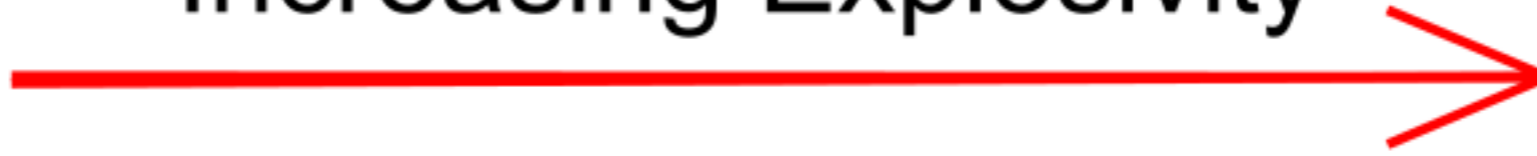
- Earth's Reflectivity: A number of factors reflect the sun's energy to level the earth's temps. Clouds, polar ice caps and glaciers, forests, bodies of water, elements in the atmosphere, and volcanic dust. Human activities reduce most of these factors and contribute to warming.



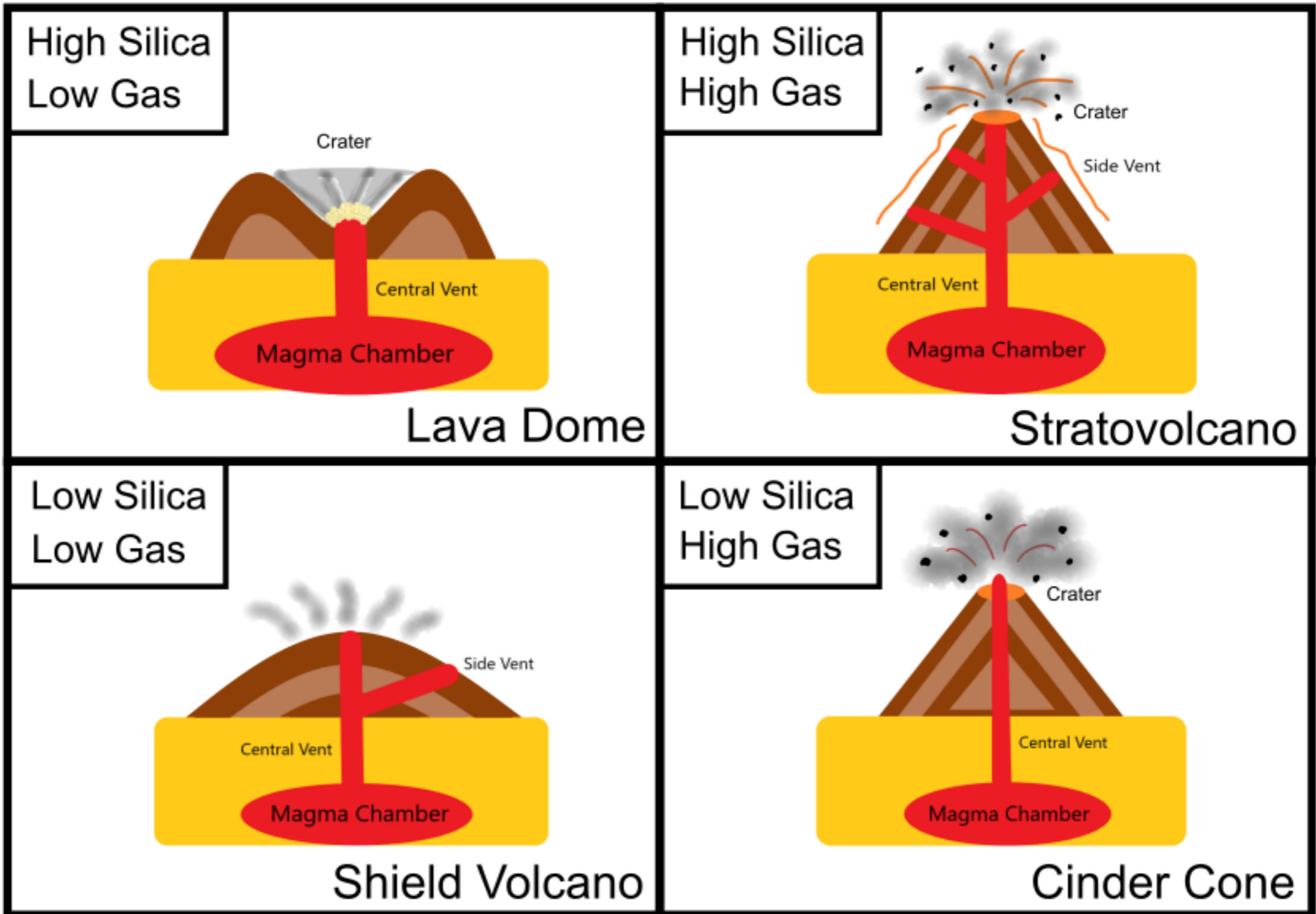
- **Volcanic Activity:** When a volcano erupts it will put a lot of water, other gases, and ash into the air. This reduces the amount of the sun's radiant energy entering the atmosphere. There has not been many large eruptions lately so more radiant energy is entering Earth. Humans don't control this but it is a natural factor.



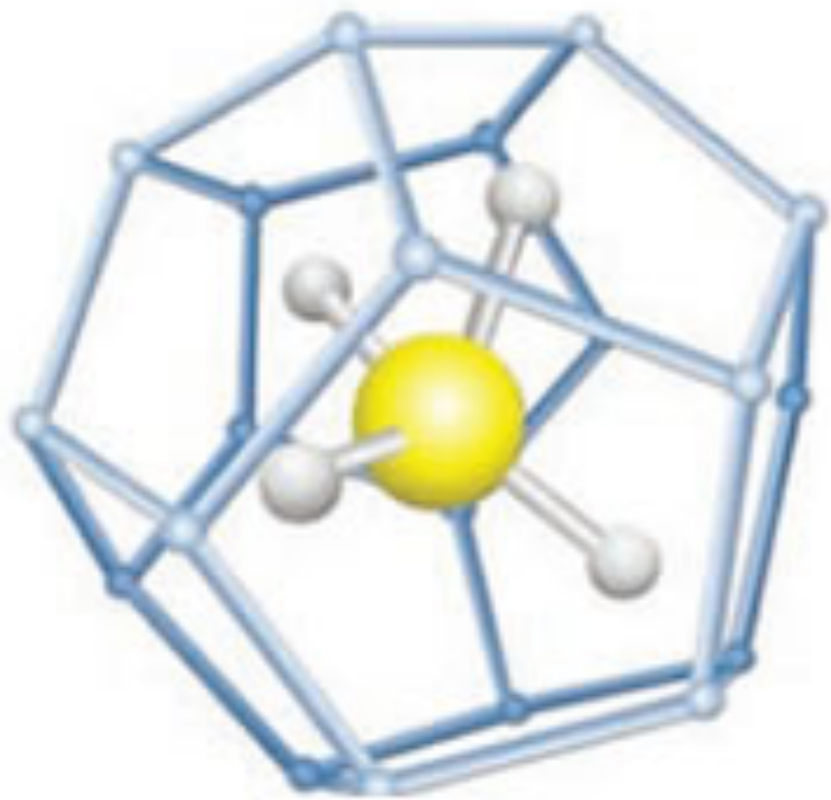
Increasing Explosivity



Increasing Viscosity

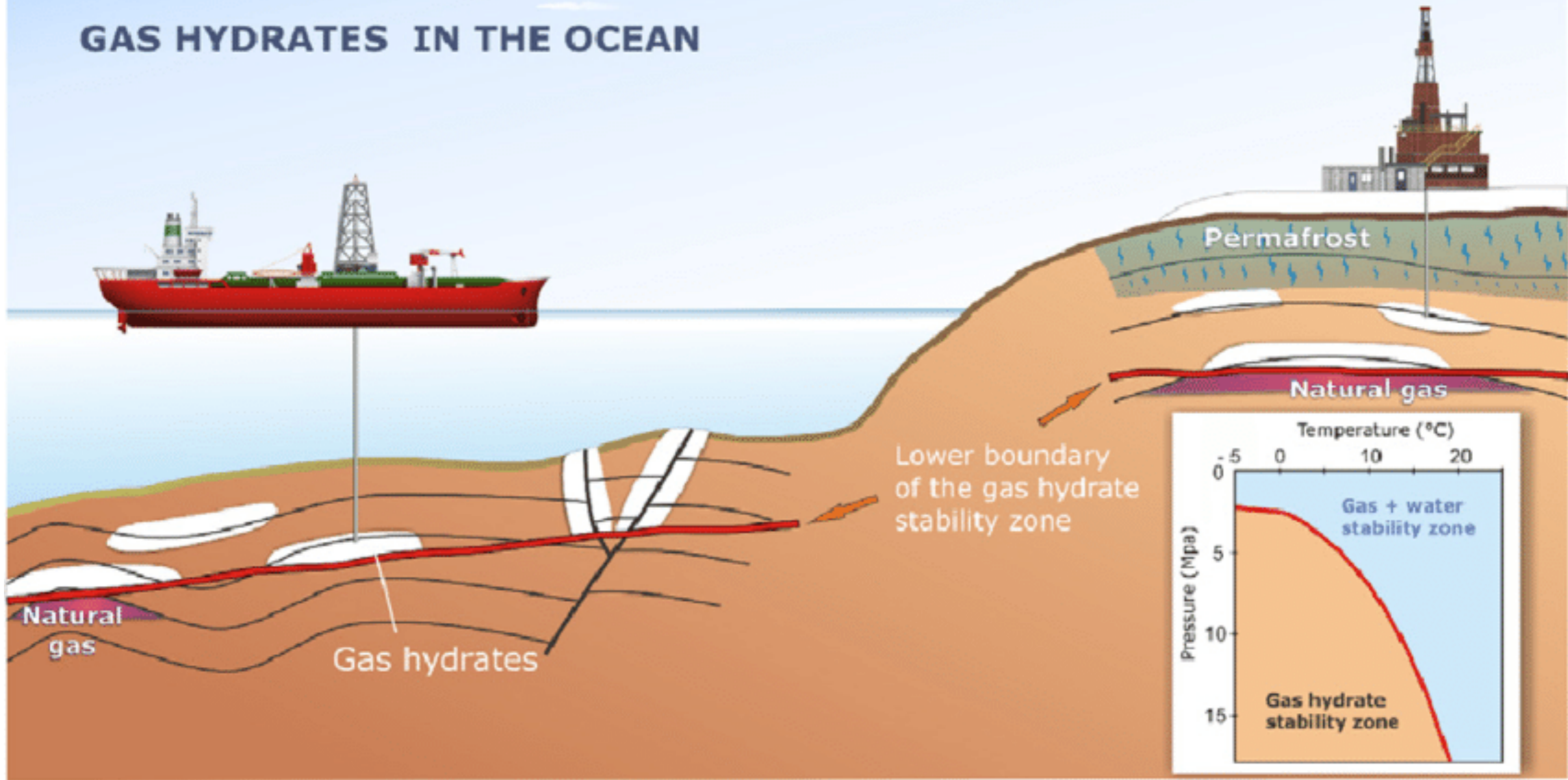


- Methane Release: In the earth's crust are methane molecules surrounded by frozen water molecules. It's called Methane Hydrate. Most methane come from decaying organics in the crust and is "frozen" with water at depths in the crust. As the climate warms and the ice melts, methane is released into the atmosphere as a Green house gas.



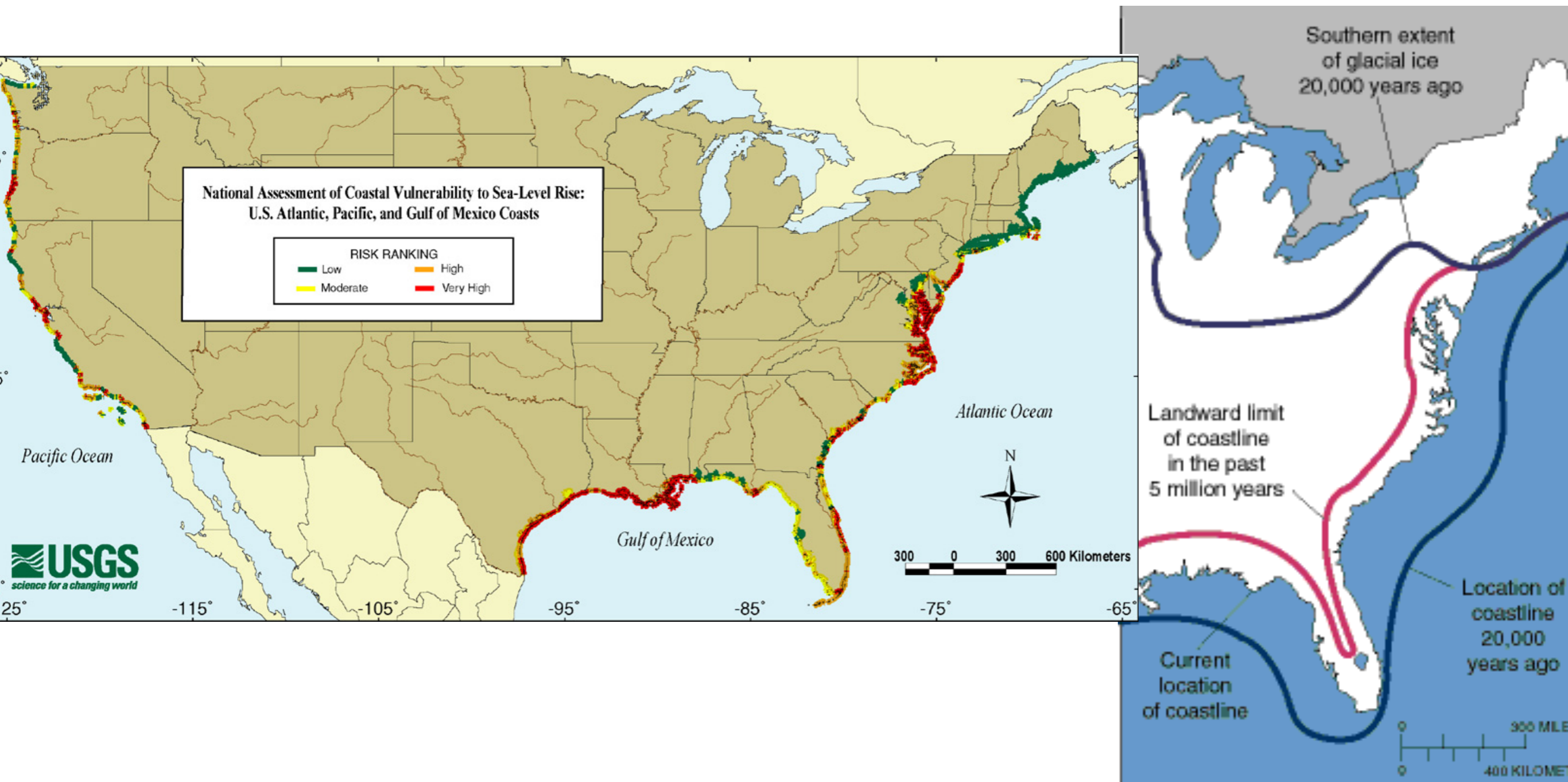
GAS HYDRATES IN PERMAFROST

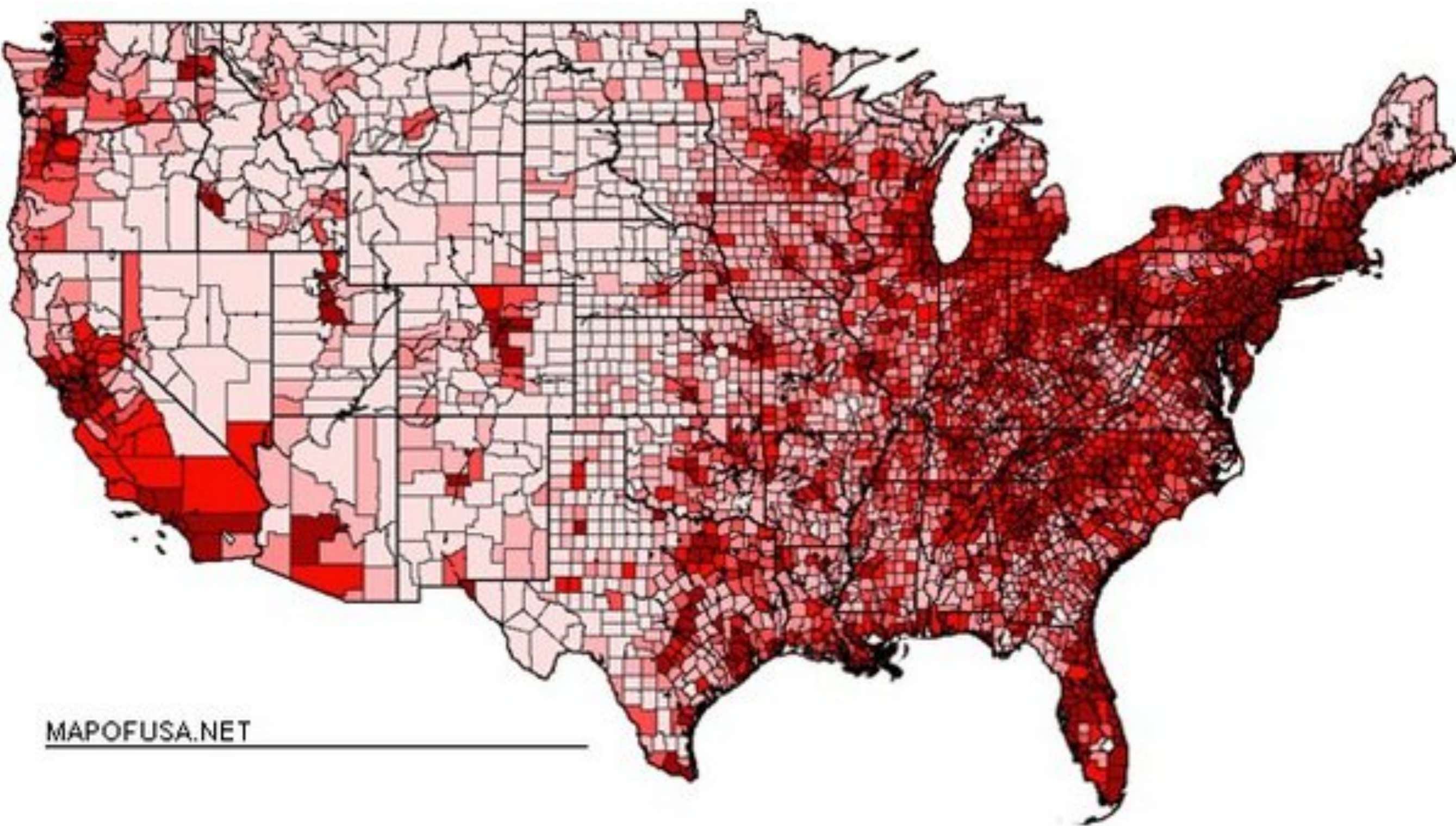
GAS HYDRATES IN THE OCEAN



Sea Level: Past, Present, & Future

- In the past 100 years, global temps have risen 1.8 F with sea level rising 6-8 inches (half of that amount since 1993). All indicators point to a faster rise in the future.





MAPOFUSA.NET

How Does Climate Change Effect You

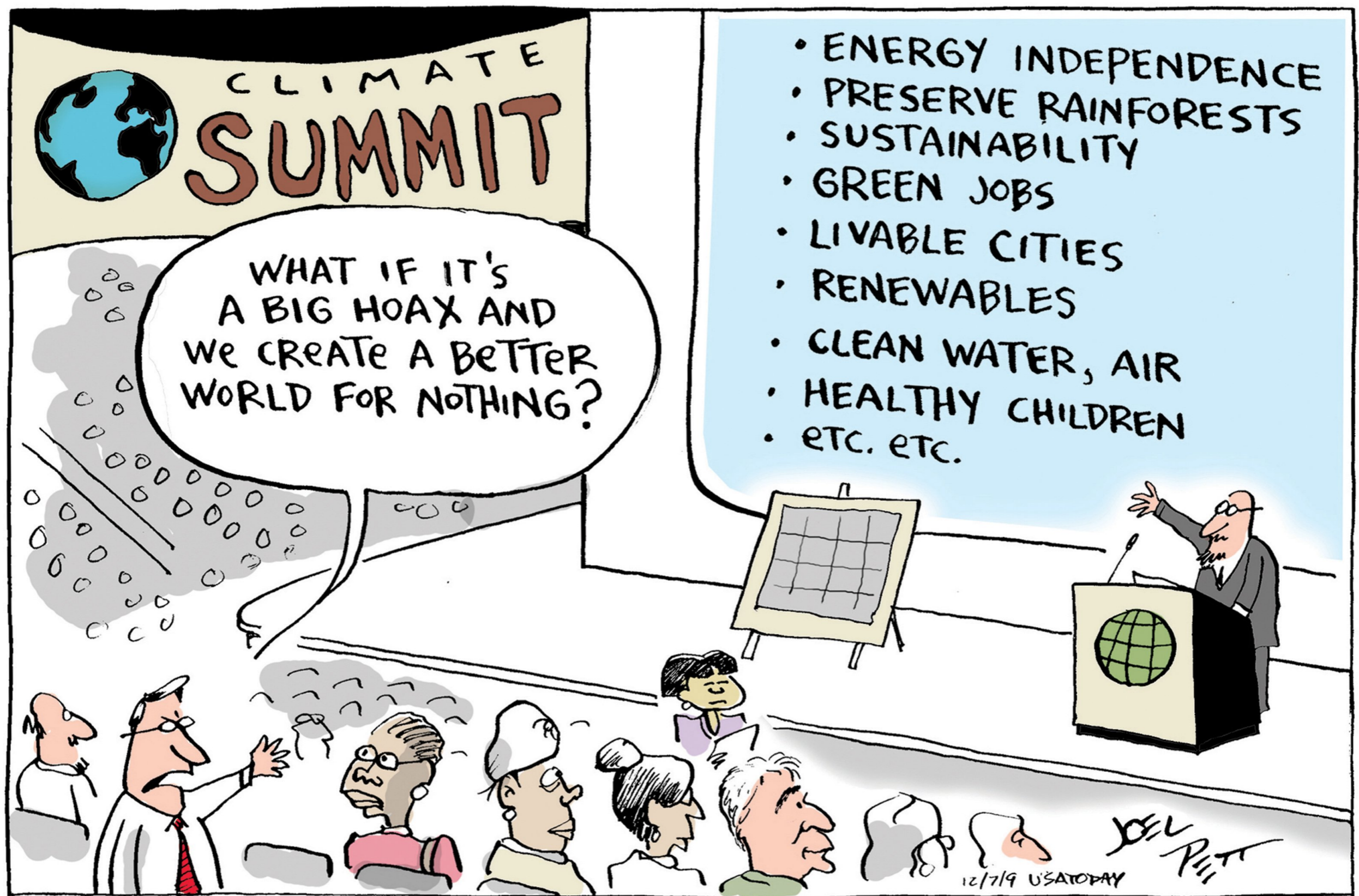
127 million people live in coastal counties in the US. If the climate is warming sea level will rise and those people will go somewhere. We will see more people moving away from counties that are not coastal. The following effects will follow.

- **Transportation:** More people on the roads means more traffic, more maintenance needed on roads, more accidents, more emissions, need to build or improve roads, etc.
- **Health:** When populations increase in an area (density) for living organisms (including humans), diseases are transmitted faster. Increase population = more pollution to water and air.
- **Costs:** With more demand for food, housing, etc. and less land to produce it, the costs will increase.
- **Environment:** More people & land needed for food & products will leave less land for wildlife habitat. Also, more storms.

Climate Change: Hoax or Real

- Pew Research did research and found the following:
 - 14% Climate is not warming
 - 26% Warming is a natural process
 - 46% Humans were the cause of warming
 - 14% Were not sure

There are many reasons for people having their opinions. The process is slow. Some people don't believe research, governments, news, and some people believe anything on social media. Some people don't follow the news or listen to one person or outlet. When one research is proven wrong, some people think all research is wrong. Some people don't think it's occurring until it effects them personally.



- This cartoon says everything. If we do the things to address climate change and it is a hoax, we will have a better place to live.

What Actions Can Be Done: Hoax/Not

- What can governments do: Have a Plan
 - Carbon: Create storage facilities
 - Nature based solutions: natural pest control & fertilization
 - Habitat protection: create habitats/corridors
 - Research: new methods to reduce warming
 - Rewards/Contest: prize money for efficiencies/methods
 - More efficient transportation: better mileage/new energy
 - More efficient farming: more crops/acre & less waste

Solutions For a Changing Climate

Technological solutions

Buildings

- New building materials
- Improved building insulation and heating/cooling

Disaster risk reduction

- Hazard mapping & monitoring
- Early warning systems
- Emergency response and recovery management

Agriculture

- New crop varieties & animal breeds
- Efficient irrigation
- Flexible farm management
- Food & storage preservation facilities

Engineered & built-environment solutions

Coasts

- Sea walls & coastal protection structures
- Flood & cyclone shelters

Urban

- Improved energy, transport & water infrastructure
- Power plant & electricity grid enhancements

Institutional solutions

Community

- National, regional & local adaptation plans
- Land zoning & building codes
- Insurance
- Education

Ecosystem-based solutions

Urban & Coasts

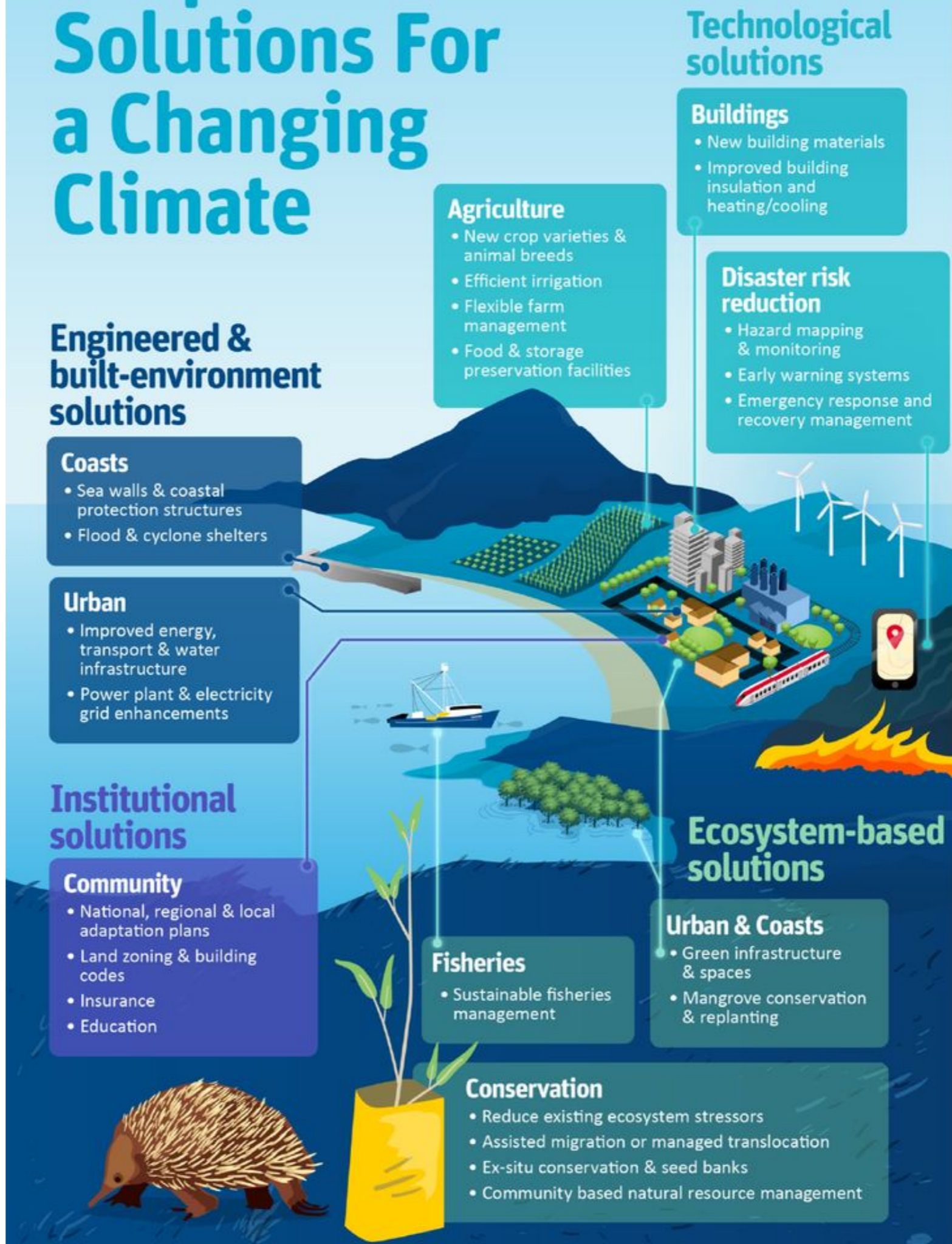
- Green infrastructure & spaces
- Mangrove conservation & replanting

Fisheries

- Sustainable fisheries management

Conservation

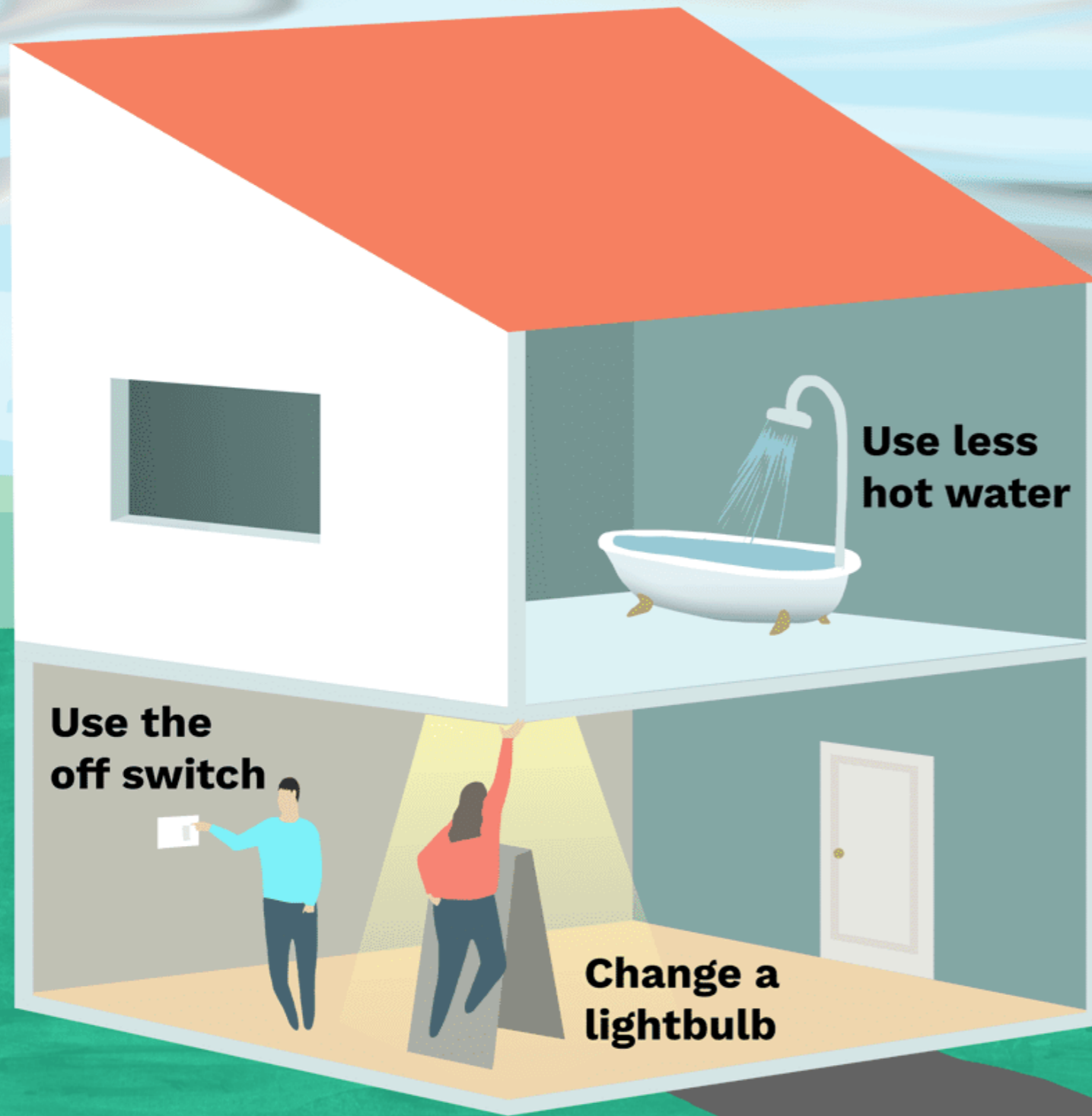
- Reduce existing ecosystem stressors
- Assisted migration or managed translocation
- Ex-situ conservation & seed banks
- Community based natural resource management



What Can You Do for Climate Change

- Become educated on the issue.
- Eat less meat and dairy.
- Reduce travel by consolidating travel.
- Reduce energy usage.
- Help create and protect green space.
- Reduce waste.
- Compost.
- Communicate your thoughts to your representatives.

How to Reduce Global Warming



What are + - of Our Climate Actions

- Positives:
 - Planet: A more stable weather system with less severe storms
 - Us: Healthier lives with less chance for epidemics
 - Environment: Diverse ecosystem that can withstand changes
- Negatives:
 - Money: It will cost everyone more for new programs
 - Penalties: There will have to be fines for wrong doings
 - Compliance: Some people or businesses will resist change and reduce the effectiveness of the processes

A Big Current Question: Electric or Not

- As we move to new fuels for transportation, which is better, gasoline, hydrogen, electric, or compressed natural gas?
- Gasoline: There is a lot of it, pretty inexpensive, and most cars use it. Produces greenhouse gases and nonrenewable.
- Hydrogen: Comes from water and produces no pollution. A lot of electricity is needed to make H₂, limited fuel spots.
- Electricity: No pollution from vehicle, less noise. More expensive to purchase, long “refueling”, electricity has to be produced, uses more rare materials, not as reliable as others.
- CNG: There are huge supplies, pretty cheap, safer than gasoline, produces very little pollution, can be used in regular car engines, car parts last longer. There is no infrastructure like gas stations however companies with trucks are starting to use this in place of diesel.

Minerals in ELECTRIC VEHICLES VS GAS CARS

Electric vehicles require a wider range of minerals for their motors and batteries compared to gas cars.

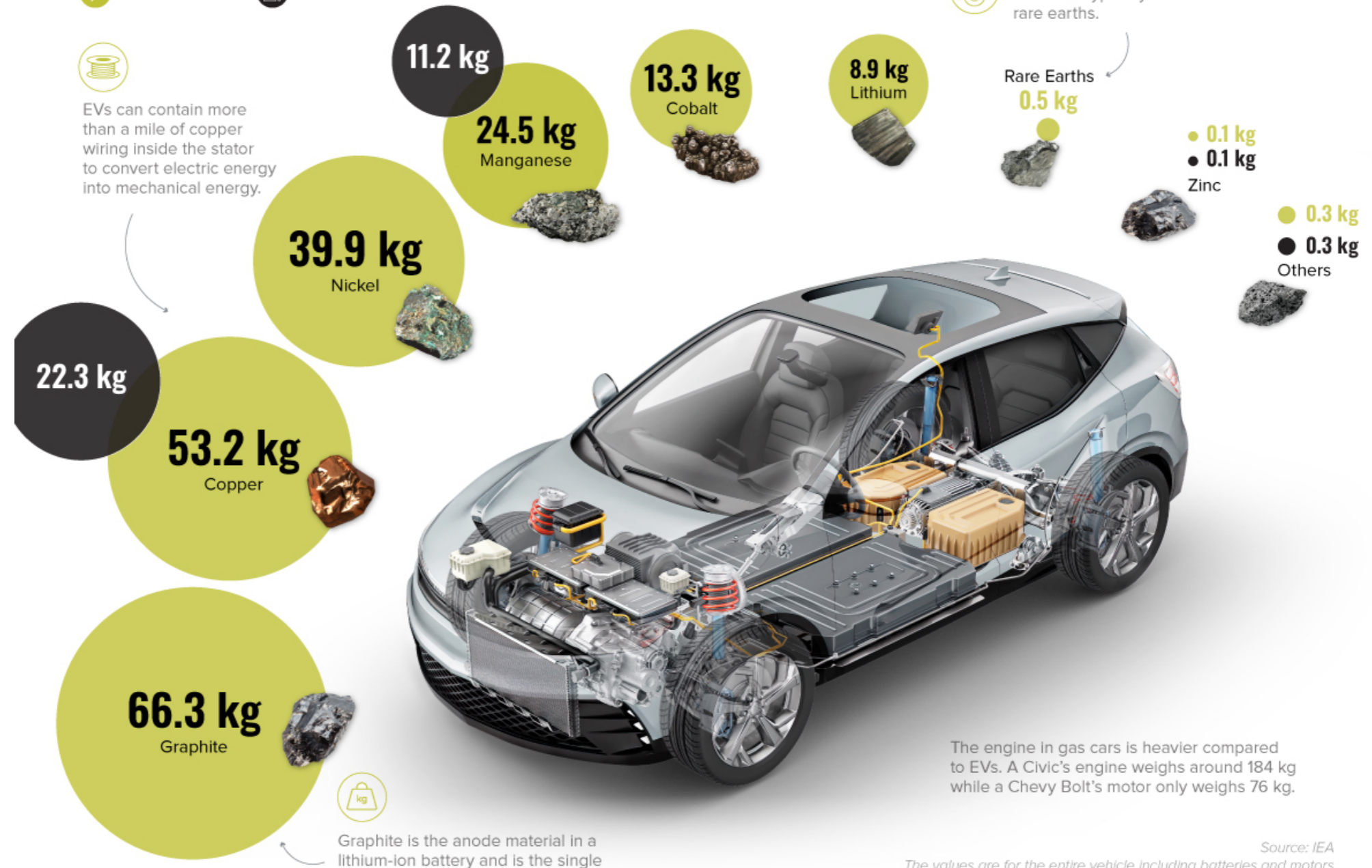
In fact, an EV can have 6 times more minerals than a gas car and be on average 340 kg heavier.

Mineral content kg/vehicle *Steel and aluminum not included.*

Electric Vehicle Gas Car



EVs can contain more than a mile of copper wiring inside the stator to convert electric energy into mechanical energy.



Many EV motors use magnetic materials typically made with rare earths.



Graphite is the anode material in a lithium-ion battery and is the single largest component by weight.

The engine in gas cars is heavier compared to EVs. A Civic's engine weighs around 184 kg while a Chevy Bolt's motor only weighs 76 kg.

*Source: IEA
The values are for the entire vehicle including batteries and motors.
The intensities for an electric car are based on a 75 kWh NMC (nickel manganese cobalt) 622 cathode and graphite-based anode.*

Natural “Disaster” Assignment

- Pick a disaster that occurs in nature. Your choices are tornadoes, wildfires, hurricanes/cyclones, earthquakes, landslides, volcanoes, lightning from thunder storm, floods
- Provide the name of which event you are presenting
- Have one picture/graphic of your event
- Have one picture of the effects on humans or human structure
- Explain the basics of how the event occurs
- Explain 2 ways humans can prevent, reduce, or survive the event you have chosen
- Please have this ready by next meeting

Exam 3 Review

- Name 3 types of Solar Energy
- Which type of Solar Energy did you use on your hot water heater? Explain how the sun heated the water.
- Explain the difference of the 2 types of solar thermal heating.
- When was photovoltaic energy discovered and by who?
- How does a photovoltaic cell produce electricity.
- List one type of solar energy, one positive and one negative of that energy form.
- Did you like or not the solar water heater and explain why.
- Tell us at least 1 good thing that your “disaster” does for earth
- PLUS Everything in slide #1 of this power point.