Human Impacts on the Environment

POPULATION CONNECTION

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We developed this PowerPoint to help clarify some of the main connections between population and climate change. We believe that including population dynamics into climate-related education and advocacy will help pinpoint further solutions that will make our climate interventions more successful — such as access to reproductive health care, family planning options, girls' education and gender equity.

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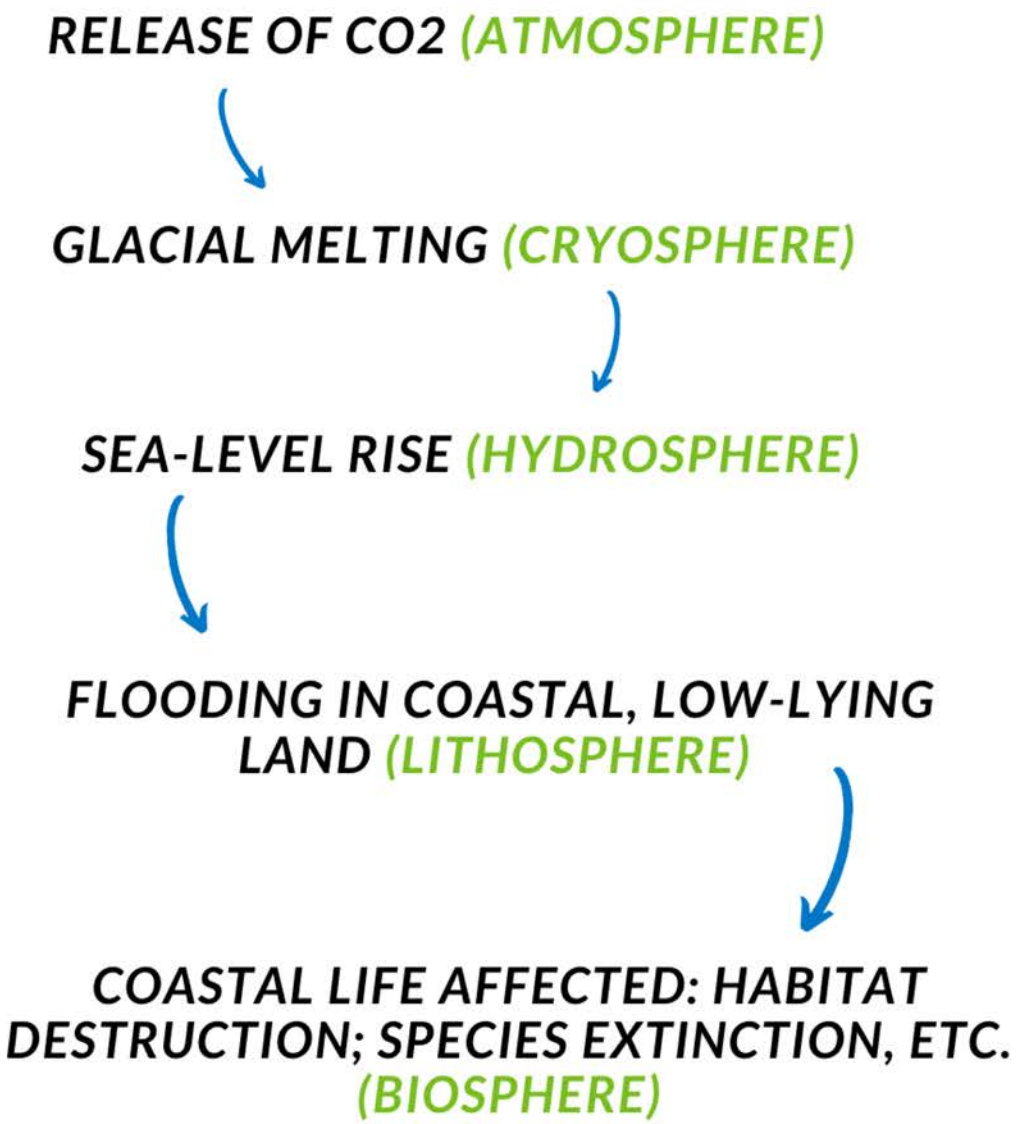
Outline

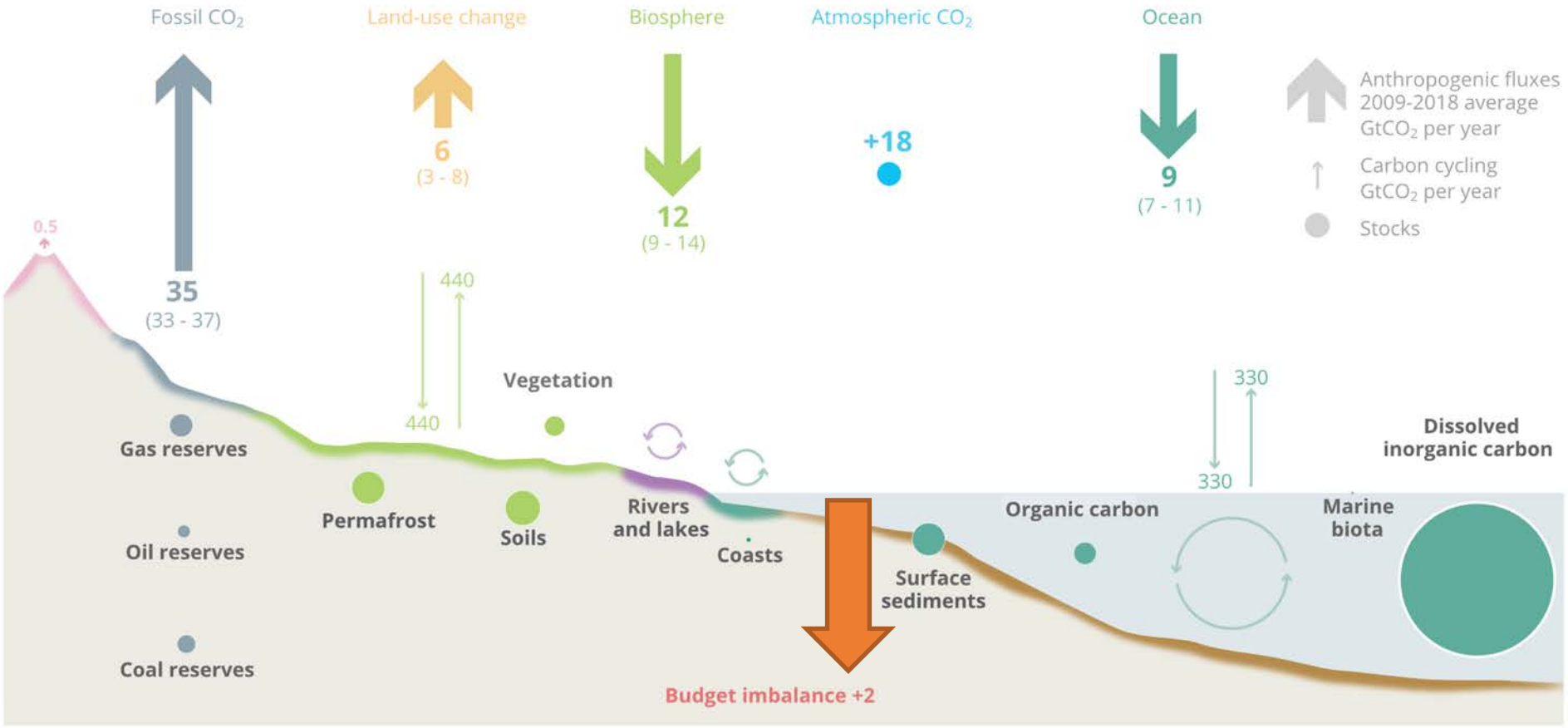
- Earth's Natural Systems
- Climate Change and Population
  - Current state of climate change
  - Future population projections
- Human Impacts on the Environment
  - Energy
  - Agriculture
  - Food security
  - Forestry
- Conclusions: IPCC Special Report – Warnings and Recommendations

Earth's five natural systems are interconnected and affect one another.

- **Air:** Atmosphere
- **Ice:** Cryosphere
- **Water:** Hydrosphere
- **Land:** Lithosphere
- **Life:** Biosphere



Altering of global carbon cycle from human activities, 2009-2018



Budget imbalance = difference between the estimated emissions and sinks

Source: Global Carbon Project 2019

Earth's Ecosystems

- Ecosystem services are the benefits that humans freely gain from the natural environment and working ecosystems.
- Examples:
  - Provision of food and water
  - Regulation of climate and disease
  - Support of nutrient cycles and oxygen production
  - Spiritual and recreational benefits

Source: National Wildlife Federation 2020
Photo by Sandy Millar on Unsplash

Earth's Ecosystems

- Sequester carbon and regulate climate
- Purify air
- Pollinate crops
- Provide clean water
- Allow for food production: arable land and fertile soil

The overall health of an ecosystem is influenced by a loss in biodiversity and other threats such as habitat loss, change, pollution, or invasive species.

Source: IPCC: Climate Change and Land 2019
Onions sprouting. Photo by Maarten van den Heuvel on Unsplash
Knutshoe, Norway. Photo by Red Hat Factory on Unsplash

"In one economic approach, the world's terrestrial ecosystem services have been valued on an annual basis to be approximately equivalent to the annual global Gross Domestic Product (GDP)."

- IPCC 2019

Source: IPCC: Climate Change and Land 2019
Photo by Markus Spiske on Unsplash

People, Land, and Climate

- Humans rely on the earth's natural systems for survival.
  - Human energy use influences natural ecosystems and can impact the ability of ecosystems to adapt to and recover from variability in the environment.
- Human use directly affects more than 70% of the global, ice-free land surface.
- Land provides the basis for ecosystem functions and services which sustain life and increase livelihoods and well-being.

Source: IPCC: Climate Change and Land 2019
Gordon Dam, Australia. Photo by Lode Lagrainge on Unsplash

Climate Change

- Since pre-industrial times (~1750), human activities have caused about 1.1°C of global warming.
- At current rates, global warming will likely reach 1.5°C between 2030 and 2052.
  - Warming at this level and above will cause increases in extreme weather, sea level rise, and large-scale ecological degradation.

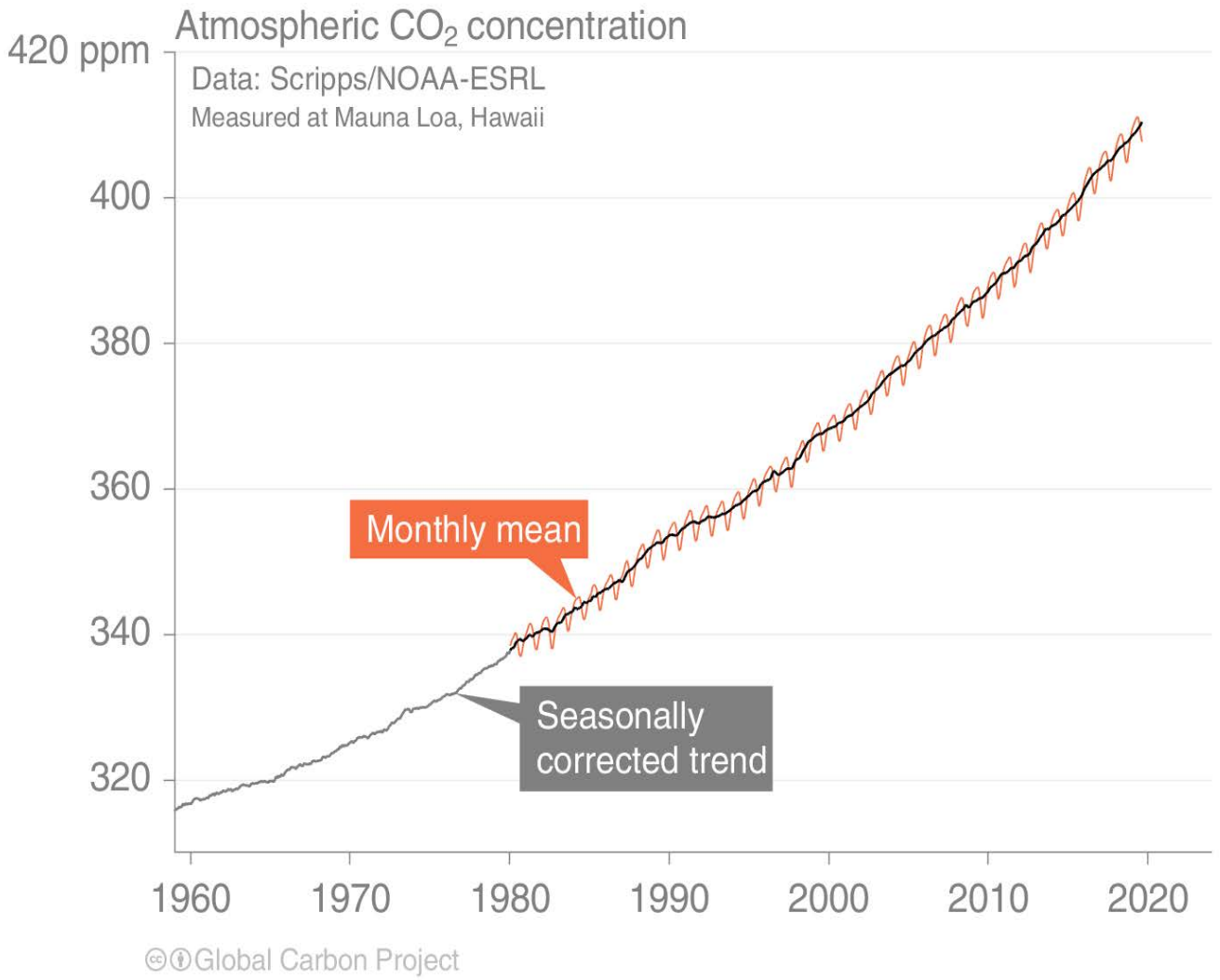
Source: IPCC 2019
Fridays for Future, Bonn, Germany. Photo by Mkia Baumeister on Unsplash

Climate Change

- Climate change is affecting weather, freshwater resources, oceans, and the many ecosystems and societies dependent on these natural systems.
- Climate change negatively affects agricultural production, availability of fresh water, clean air and human health.
- Human activities contribute to climate change through the release of billions of tons of CO_2 and other greenhouse gases each year.
  - The reliance on fossil fuels for transportation, energy, agricultural production, waste disposal, and manufacturing causes greenhouse gas emissions.
- Past and present-day emissions will affect the global climate for generations to come.

Source: World Bank, IPCC 2019

Global Atmospheric CO_2 Concentration



- Global CO_2 concentration increased by 30% from 1960 to 2020, from ~317ppm to 412ppm.
- 2016 was the first full year with with a CO_2 concentration above 400ppm.

Source: Global Carbon Project 2019

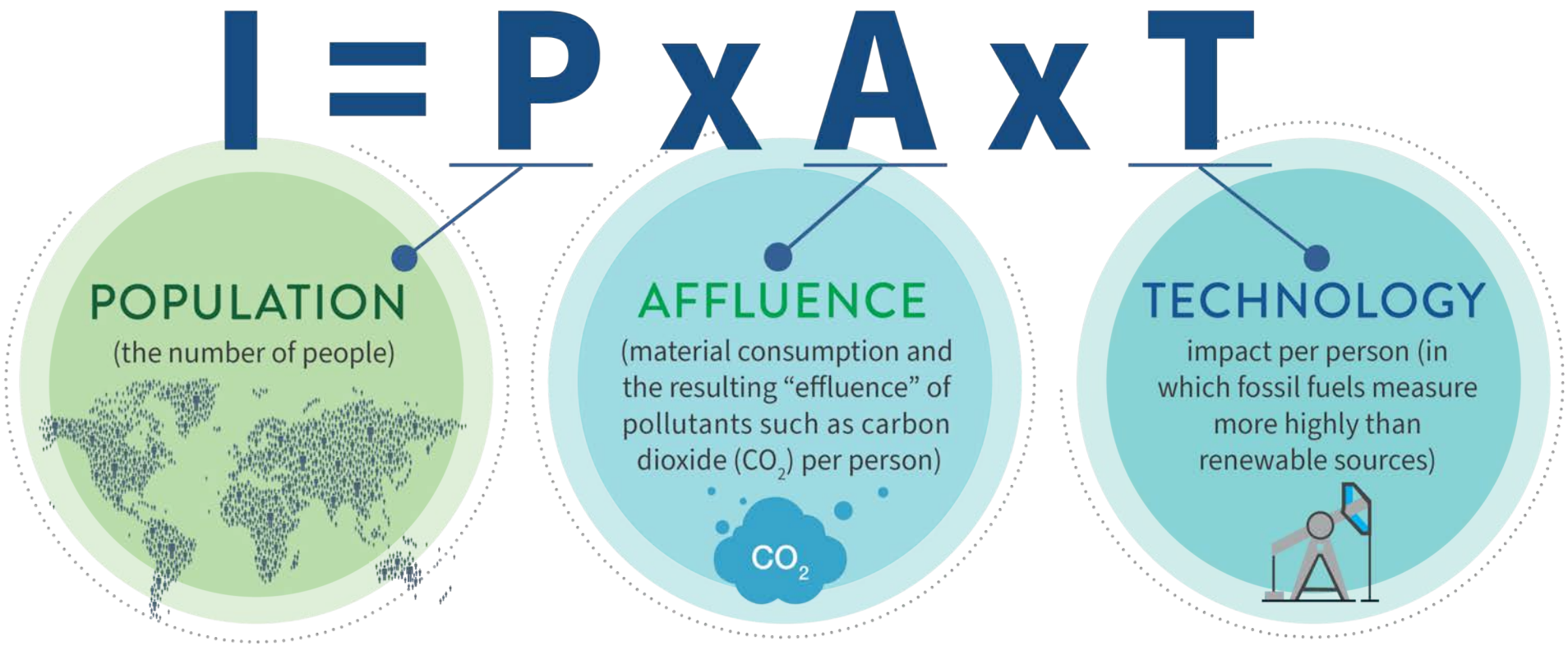
Climate Change and Population

- The growth of greenhouse gas emissions is linked to many factors, including:
  - Economic growth
  - Technological change
  - Human population trends
    - Each person causes emissions throughout their lifetime at varying levels and degrees. While affluent populations cause the most emissions, low-income populations are the most at-risk for climate impacts.
    - Greenhouse gas emissions also depend on population distribution, country, urban/rural residence, household size, age distribution, etc.

Source: IPCC 2019, UN Population Division 2019

Population and Greenhouse Gases

ENVIRONMENTAL IMPACT



Climate Change and Population

- The global population is projected to increase by 25% between 2020 and 2050, from 7.8 billion to 9.7 billion people.
  - This projection assumes a decline in fertility for countries where large families are still common, and continued reductions in mortality at all ages.
    - Meeting this projection will require large-scale increases in access to reproductive health care and other developmental investments like education.
    - Future population growth is highly dependent on the path that future fertility will take.

Source: UN World Population Prospects 2019 Highlights

Climate Change and Population

- The UN projects that the majority of future population growth will occur in middle and low-income countries.
  - Currently, 6 billion people, or 85% of the global population, live in emerging economies.
    - Emerging economies are rapidly industrializing → increasing anthropogenic emissions.
    - Population pressures increase the demand for finite resources and worsen climate risks.

Source: UN World Population Prospects 2019 Highlights

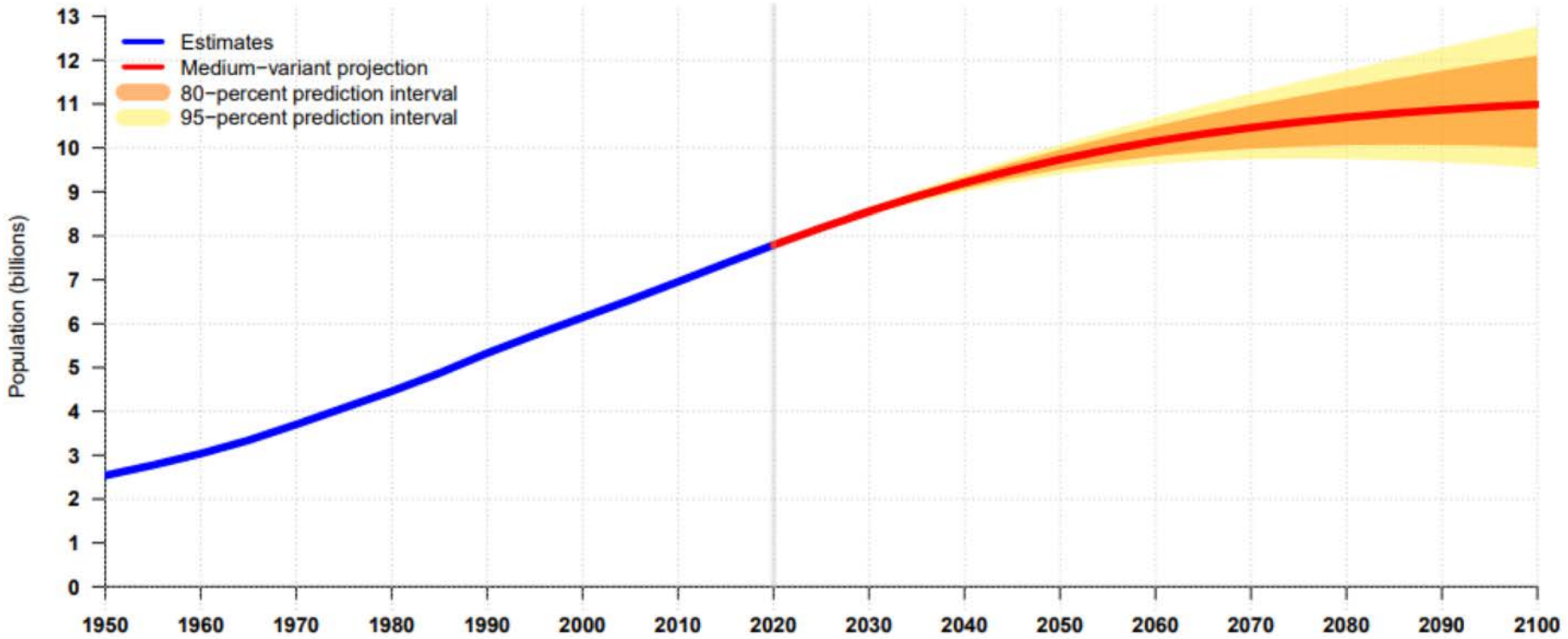
Climate Change and Population

- Future of population growth is uncertain and highly dependent on critical development initiatives related to gender equity and access to health services, in particular reproductive health care.
- The UN Population Division's population projections depend on a variety of fertility and mortality assumptions; therefore, they are not "predictions," but outcomes that would occur if different fertility and/or mortality rates were realized.

Source: Population Action International (PAI) 2012, UN Population Prospects 2019
Jerusalem, Israel. Photo by Tim Mossholder on Unsplash

The world's population continues to grow, albeit at a slower pace than at any time since 1950

Figure 1. Population of the world: estimates, 1950-2020, medium-variant projections, 2020-2100, with 80- and 95- percent prediction intervals



Source: UN Population Prospects 2019: Data Booklet

Human Impacts: Energy

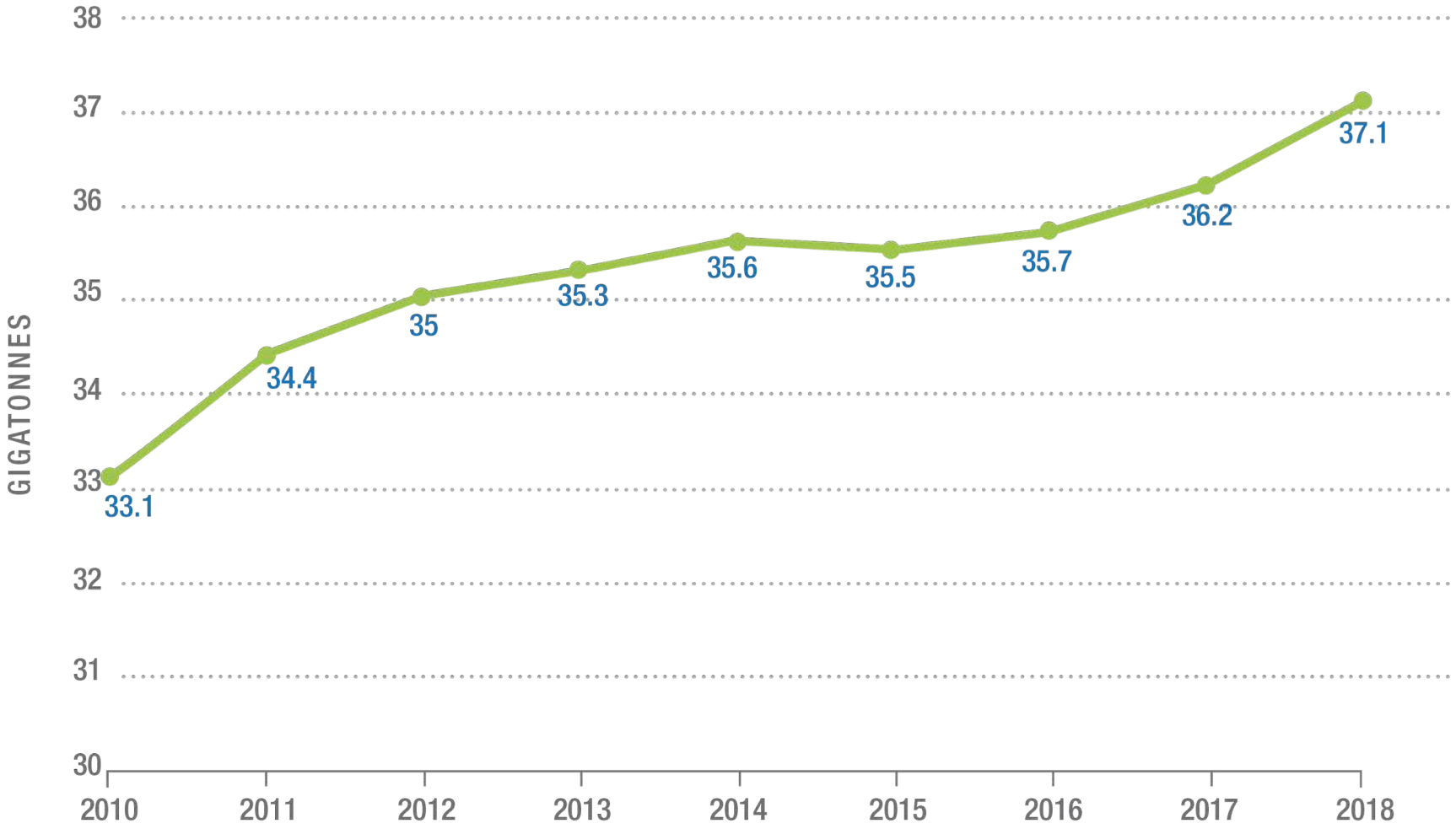
- The energy sector biggest contributor to anthropogenic greenhouse gas emissions globally.
  - Production of fossil fuels: oil, coal, natural gas
- Since 1800, global consumption of fossil fuels has increased by 1,300%.
- Current levels of CO_2, CH_4, and N_20 are at 146%, 257%, and 122% (respectively) of pre-industrial levels.

Source: United In Science, UN Climate Action Summit 2019

Silicon Valley Power, Santa Clara CA.
Photo by American Public Power Association on Unsplash

Carbon Dioxide Emissions are Rising

CO_2 emissions from fossil fuel energy sources



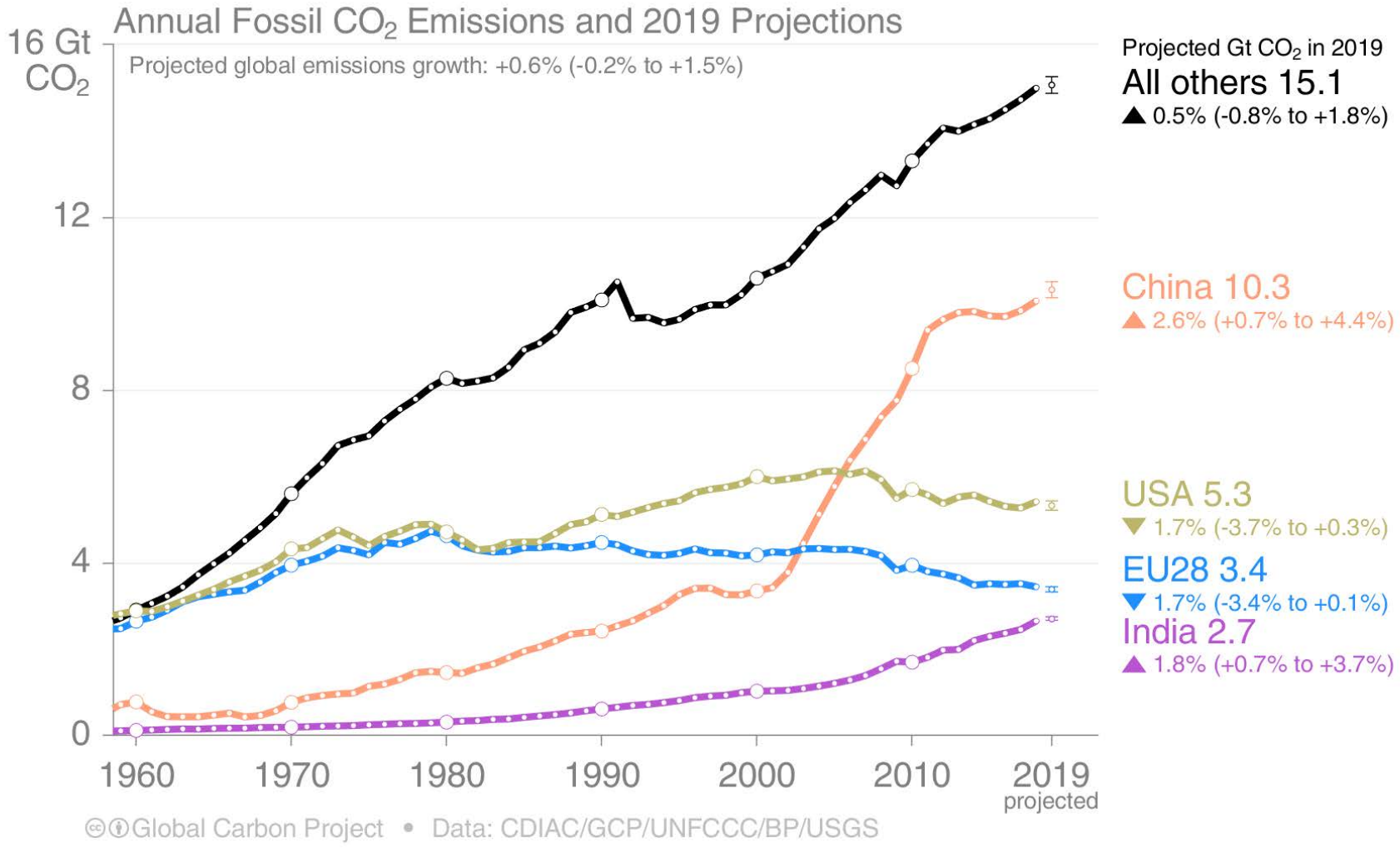
Source: Global Carbon Project 2018, World Resources Institute 2018

Human Impacts: Energy From Fossil Fuels

- Global CO_2 emissions have increased consistently over the last three decades and show no sign of peaking.
  - In 2017, emissions rose by 1.6%.
  - In 2018, emissions rose by 2.7%.
  - Emissions in China, India, and USA increased the most in 2018.
- Fossil CO_2 emissions were 62% higher in 2019 than in 1990.
  - Global fossil CO_2 emissions rose by 0.6% in 2019.
    - This growth is controlled by underlying changes in energy use at the country level.

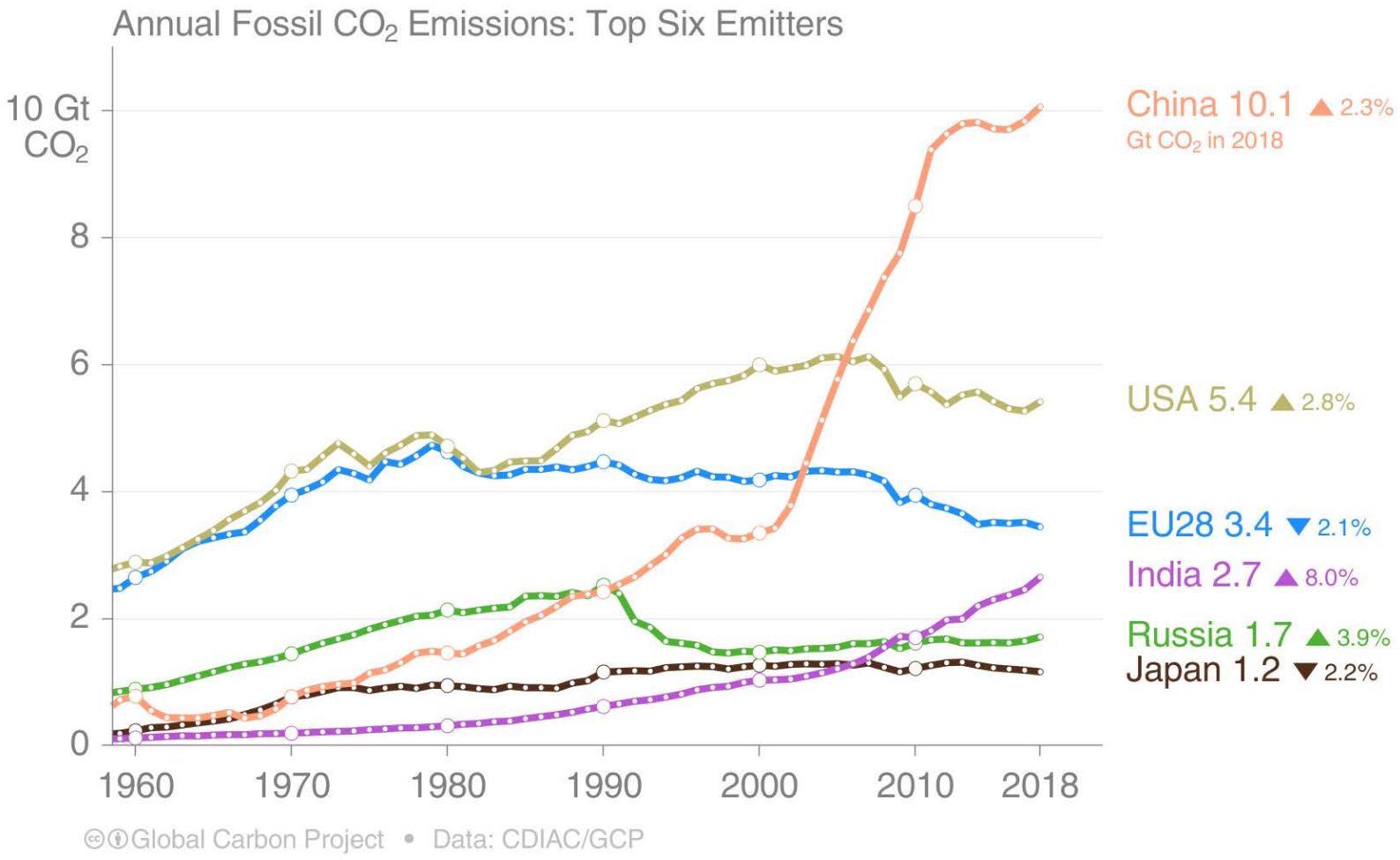
Source: Global Carbon Project 2019

Global Fossil CO_2 Emissions Rose in 2019



Source: Global Carbon Project 2019

The Top 6 Emitters

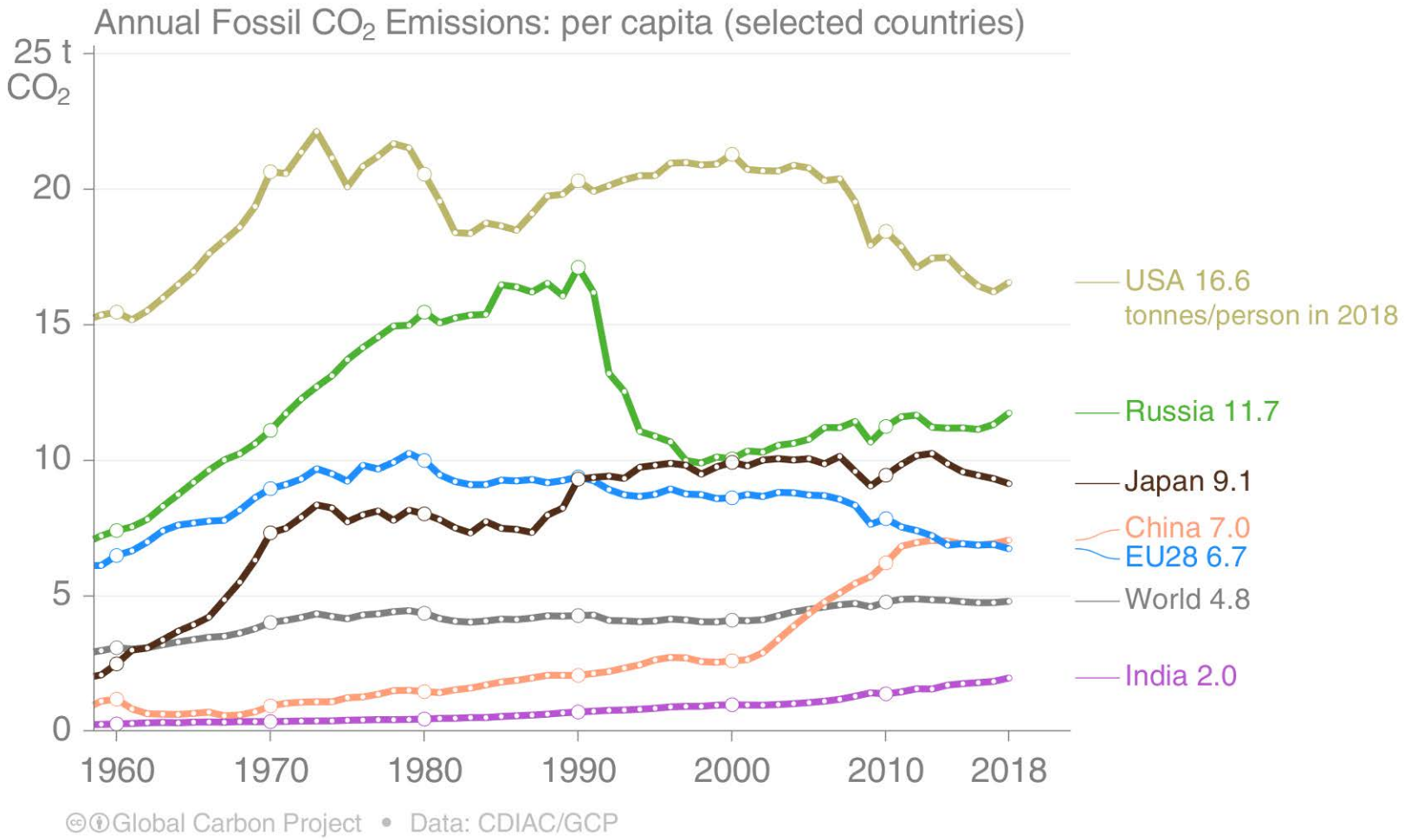


- The top 6 emitters in 2018 covered 67% of global emissions.

1. China	28%
2. USA	15%
3. EU28	9%
4. India	7%
5. Russia	5%
6. Japan	3%

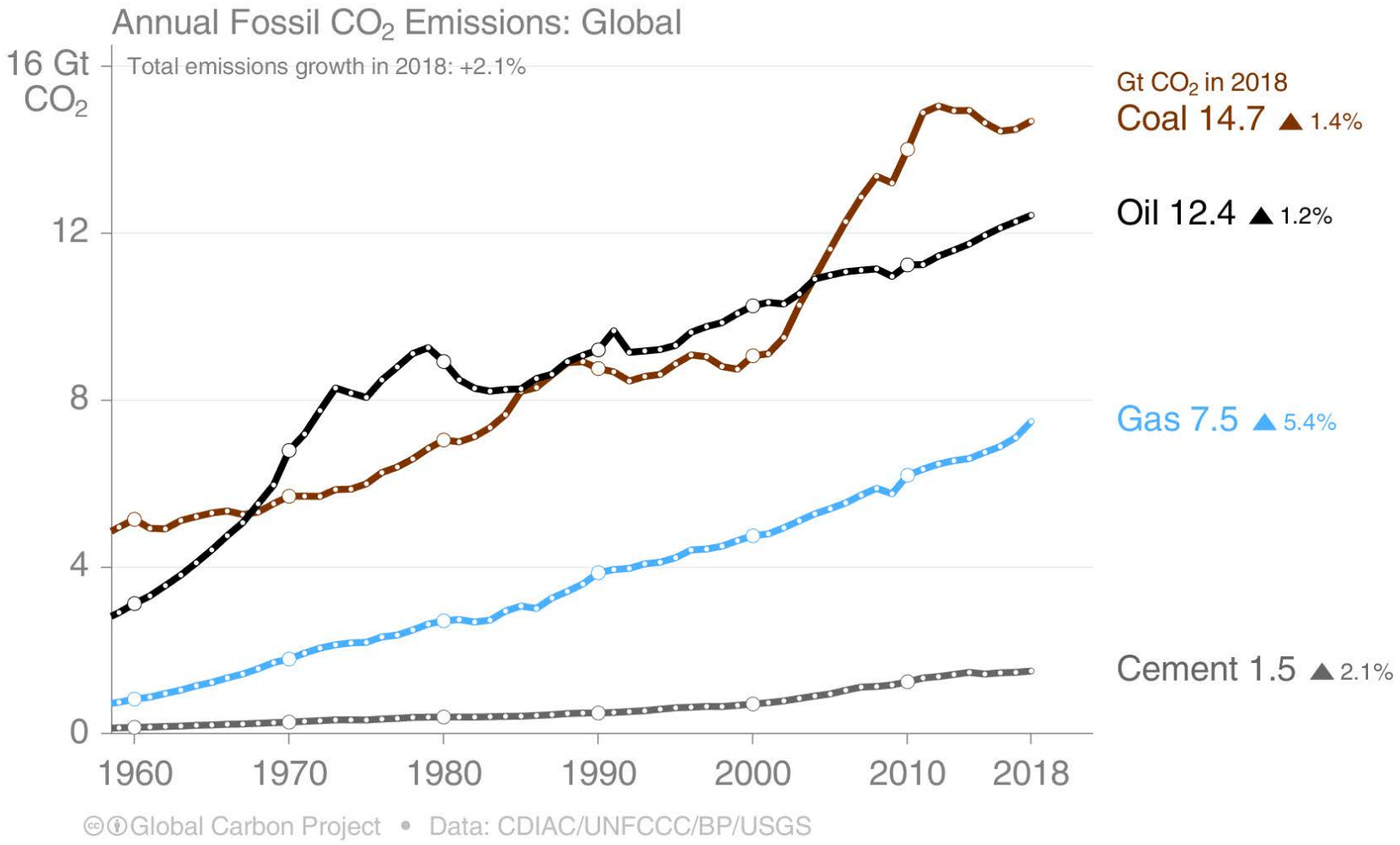
Source: Global Carbon Project 2019

Per Capita Emissions Vary Widely According to National Circumstance



Source: Global Carbon Project 2019

Global Fossil CO_2 Emissions by Source

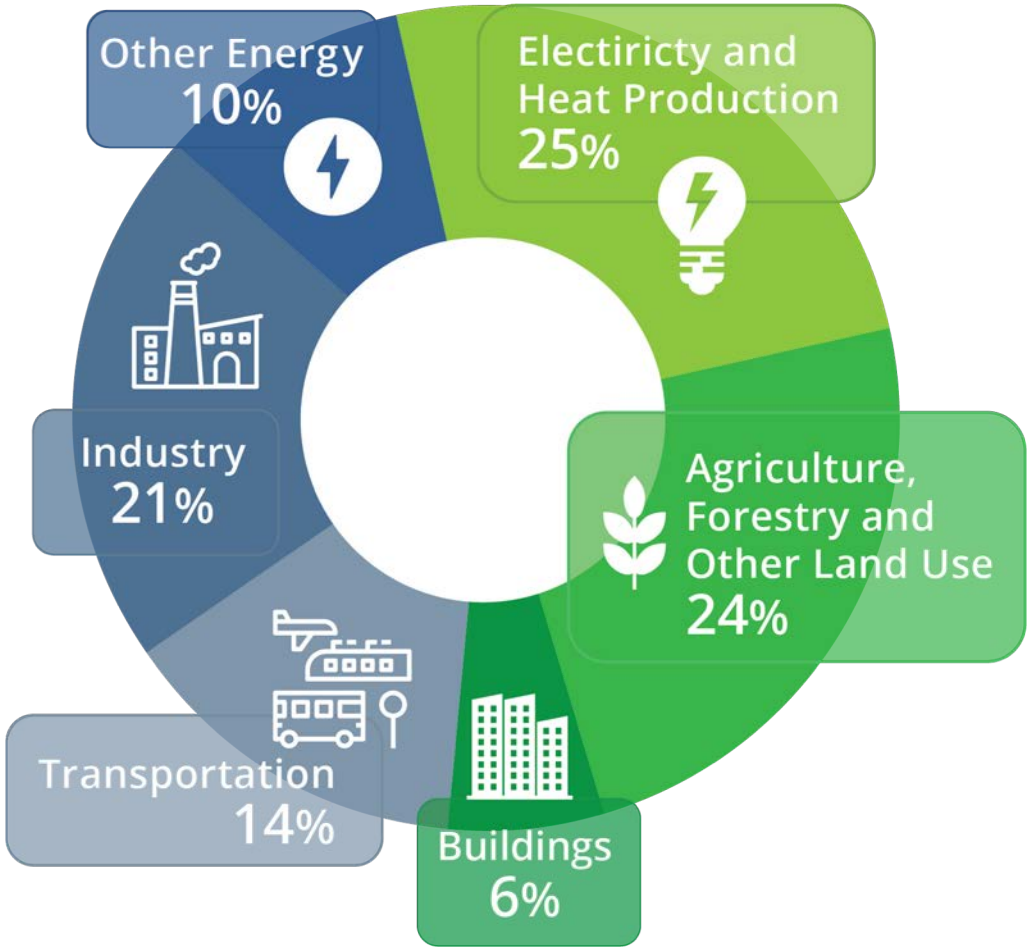


Share of global CO_2 emissions in 2018:

1. Coal 40%
2. Oil 34%
3. Gas 20%
4. Cement 4%
5. Flaring 1% (not shown)

Source: Global Carbon Project 2019

Global Greenhouse Gas Emissions by Economic Sector



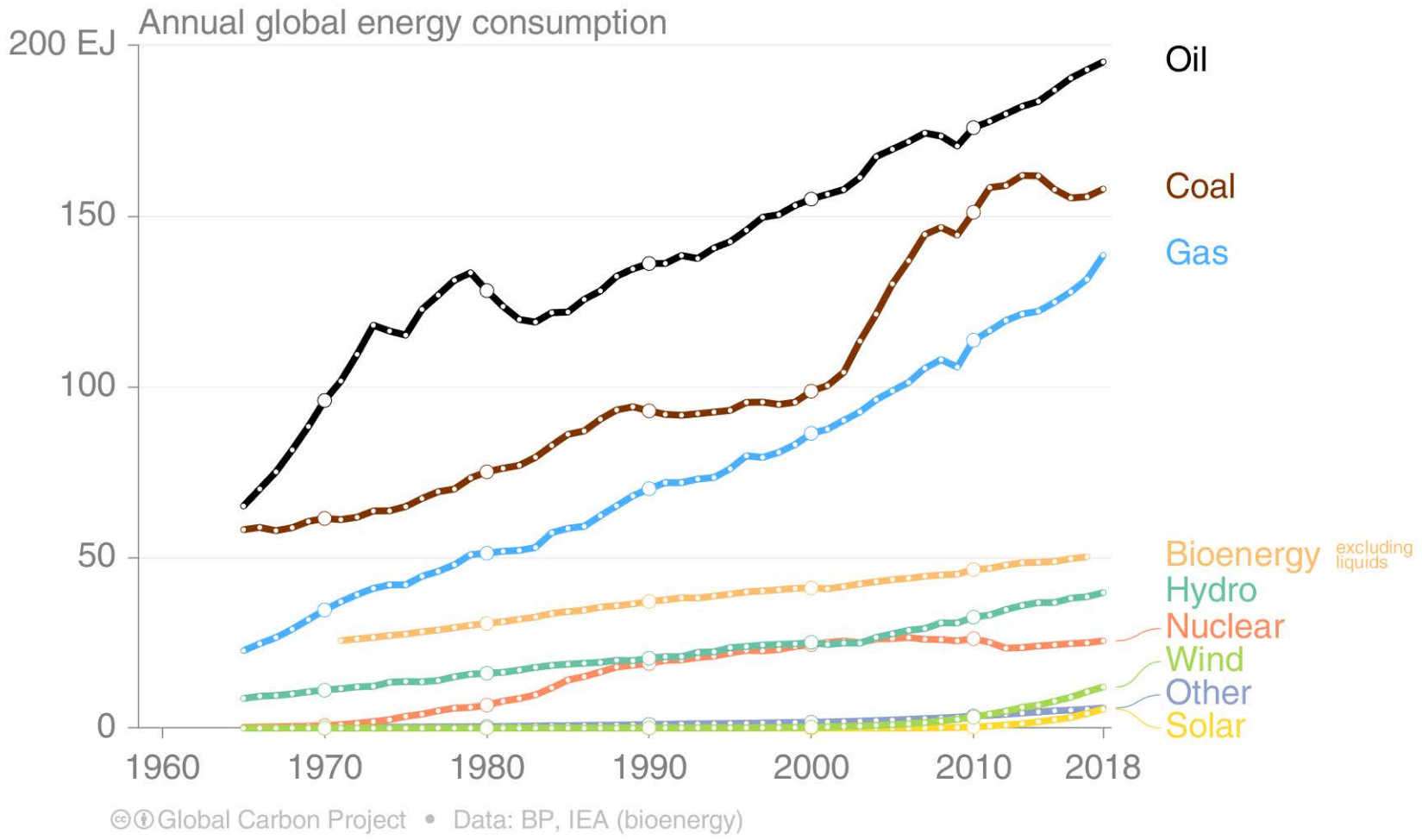
Source: Boden, T.A., Marland, G., and Andres, R.J. (2017). Global, Regional, and National Fossil-Fuel CO_2 Emissions.

Renewable Energy Sources

- Renewable energy sources, such as solar and wind power, are the least expensive options in heightening access to electricity, curbing air pollution, and reducing carbon emissions worldwide.
- Policies that incentivize fair and easy access to electricity from renewable sources and that increase renewables supply through improved energy technologies are linked both to combating global warming and increasing GDP.
- Yet, while large scale innovations in renewables are surging, fossil fuel use is still outpacing low-carbon sources.

Source: https://doi.org/10.1088/1748-9326/aaf303

Energy Use by Source



- Renewable energy is growing exponentially, but remains too low to offset growth in fossil energy consumption.

Source: Global Carbon Project 2018

Human Impacts and Climate Change: Agriculture

- Together with forestry, agriculture accounts for about 24% of global greenhouse gas emissions.
- Current industrial agricultural systems cause:
  - Deforestation
  - Land and soil degradation
    - 75% of nitrous oxide emissions come from nitrogen fertilizer
    - Biodiversity loss
  - Waste production (especially methane)

Source: United in Science, UN Climate Action Summit 2019

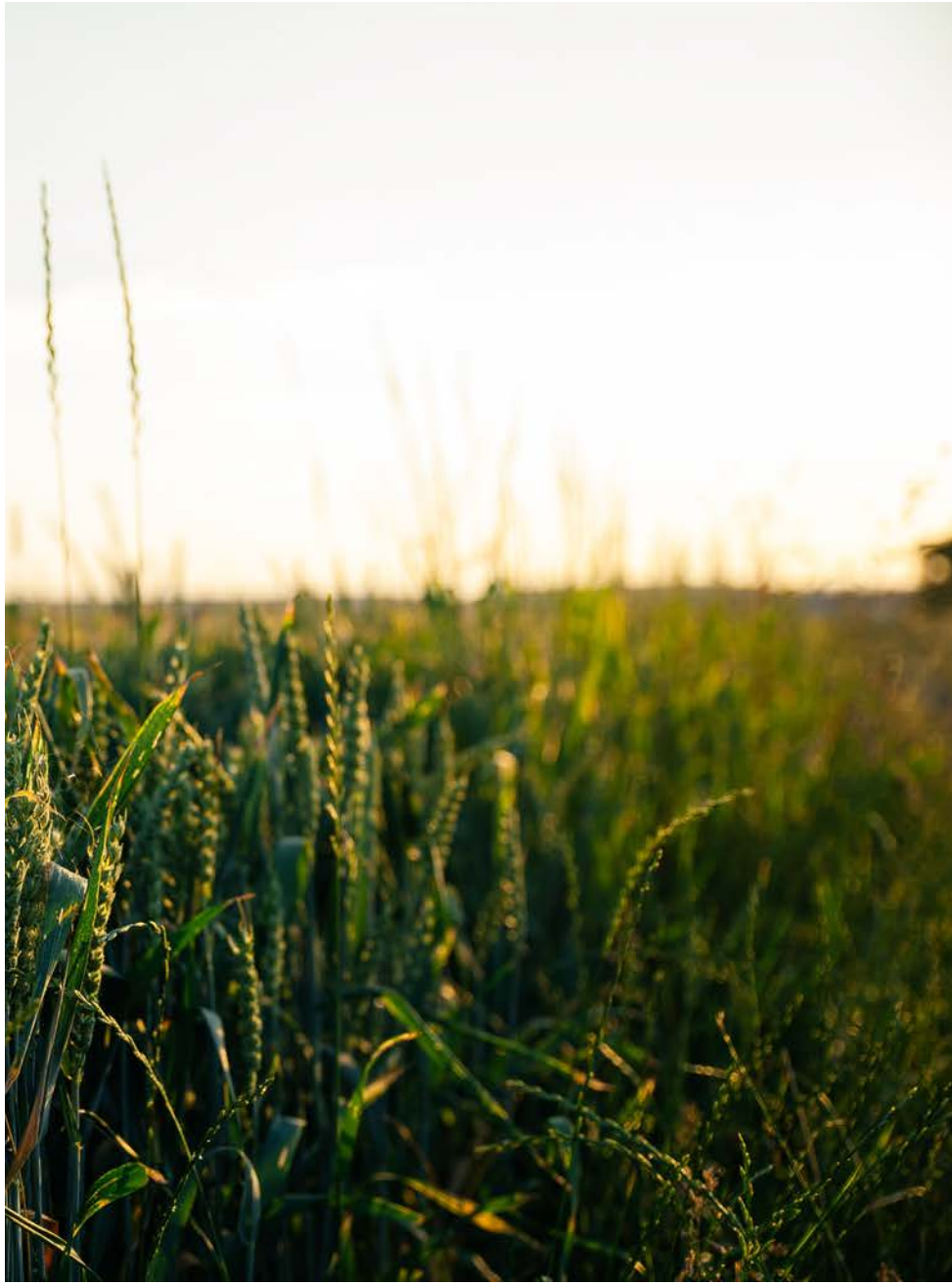
Political Economy of Agriculture

- Many countries use vast amounts of land to cultivate crops that are not consumed by humans, but rather used as feed for livestock.
  - U.S. uses 1.9 billion acres of land for agriculture.
    - 654 million acres are used as pasture for livestock.
    - 538 million acres are forested.
    - 391.5 million acres used to grow crops.
      - Of this cropland, only **one-fifth** is used for human consumption.
      - One-third of U.S. cropland is used for growing feed for livestock.

Source: IPCC, Climate Change and Land 2019
Cows in Burgundy, France. Photo by Stijn te Strake on Unsplash

Future of Agriculture

- The world's population will grow to around 9.7 billion people in 2050 — boosting agricultural demand.
  - Fulfilling increased demands on agriculture with existing farming practices will lead to more intense competition for natural resources, increase greenhouse gas emissions, and further deforestation and land degradation.
- Climate change is decreasing agricultural productivity, while industrial agricultural systems are fueling climate change.



Source: Food and Agriculture Organization of the United Nations 2017

Future of Agriculture

- According to the Food and Agriculture Organization of the United Nations (FAO), climate variability and extremes are negatively affecting all aspects of food security, including:
  - Availability
  - Access
  - Utilization
  - Stability
- Climate change affects disproportionately food-insecure regions, which threatens crop and livestock production, fish stocks, and fisheries.

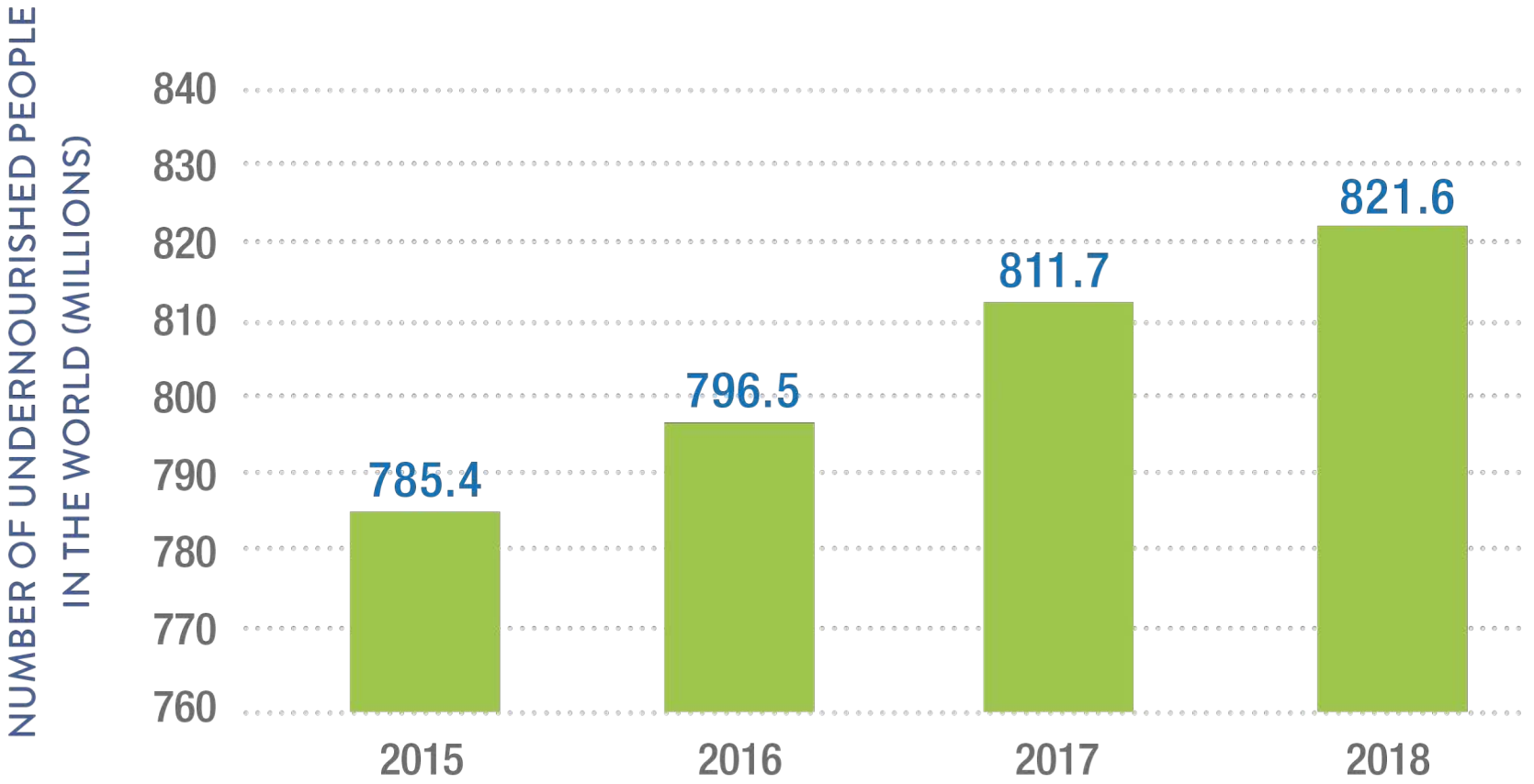
Source: Food and Agriculture Organization of the UN 2017

Global Food Security

- Impacts of climate change, such as flooding and droughts, are among the main drivers of global hunger.
  - While hunger and extreme poverty have been reduced globally since the 1990s, close to 1 billion people are still extremely poor.
  - Even where poverty has been reduced, glaring inequalities remain.
- About one in nine people globally suffers from chronic food deprivation.
- Close to 10% of the world's population (820 million people) suffer from severe food insecurity.
  - Sub-Saharan Africa remains the region with the highest prevalence of undernourishment.

Source: Bixby Center for Global Reproductive Health 2015, FAO 2017
Photo by Eduardo Prim on Unsplash

Global Food Insecurity Is Increasing



Number of undernourished people in the world, 2015-2018 (FAO, IFAD, UNICEF and WHO, 2019)

Source: UNEP, UN Climate Action Summit 2019

Population, Food Security, and Climate Change

- In order to feed a bigger, more urban and affluent population in 2050, FAO estimates that food production must increase by 50-70%.
- Annual cereal production must increase by 70%.
- Meat production will need to increase by over 75% to meet growing demand.
- Increases in agricultural production on this scale present challenges because of already existing environmental degradation and climate change, and because the world's most arable land is already in use.

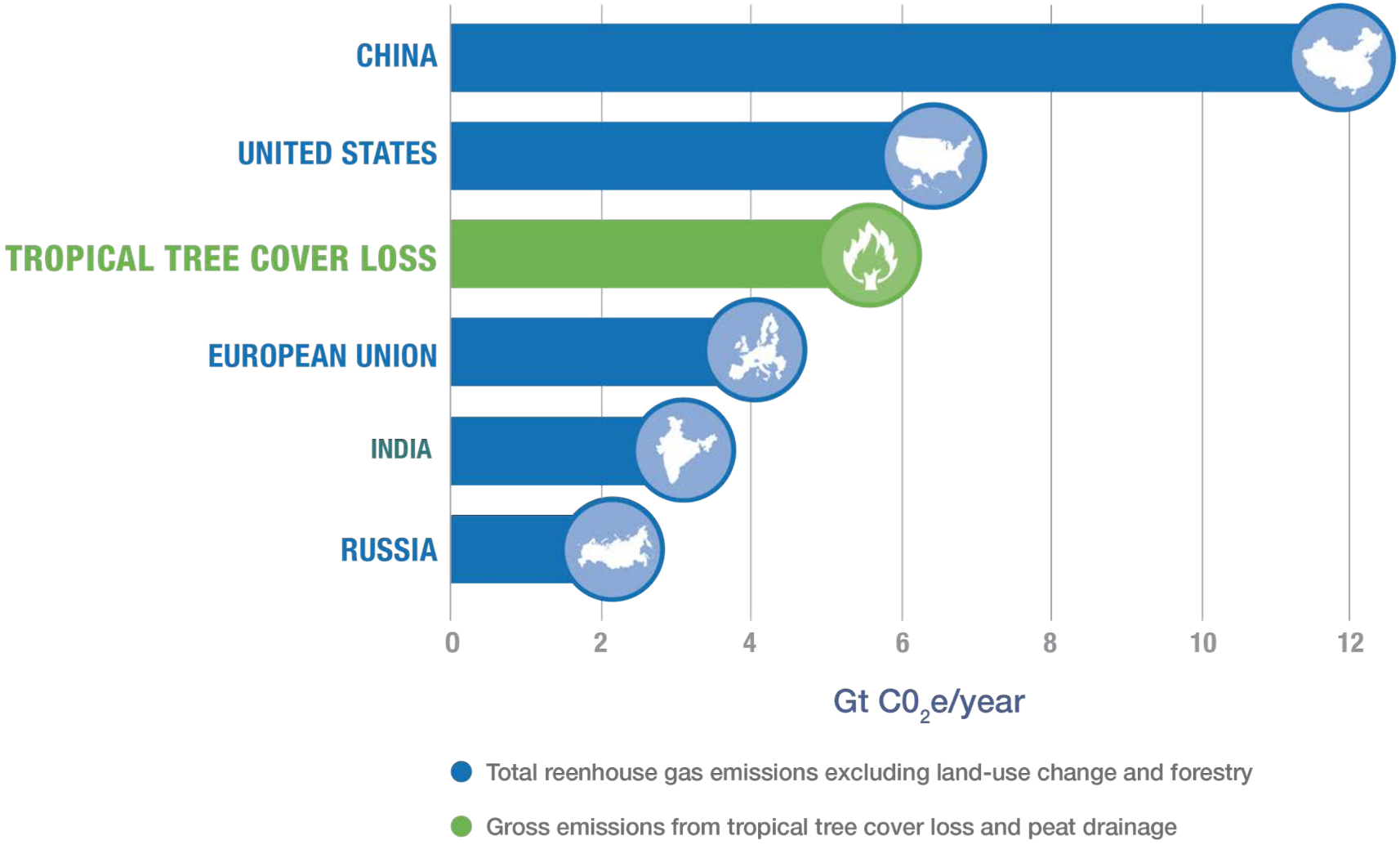
Source: The Bixby Center for Global Reproductive Health, 2015
New York City. Photo by Matthias Mullie on Unsplash

Deforestation

- Along with agriculture, deforestation is responsible for 24% of global emissions.
  - Tropical deforestation represents 8% of global greenhouse gas emissions.
- Plants, trees, and forests absorb CO_2 in the atmosphere and are thus vital for fighting climate change.
- According to the FAO, 18 million acres of forest — equal in size to the country of Panama — are lost each year.
- Human uses have caused the loss of about 46% of trees on earth.

Source: IPCC Report: Climate Change and Land 2019

If Tropical Deforestation Were a Country, It Would Rank Third in CO_2 Emissions



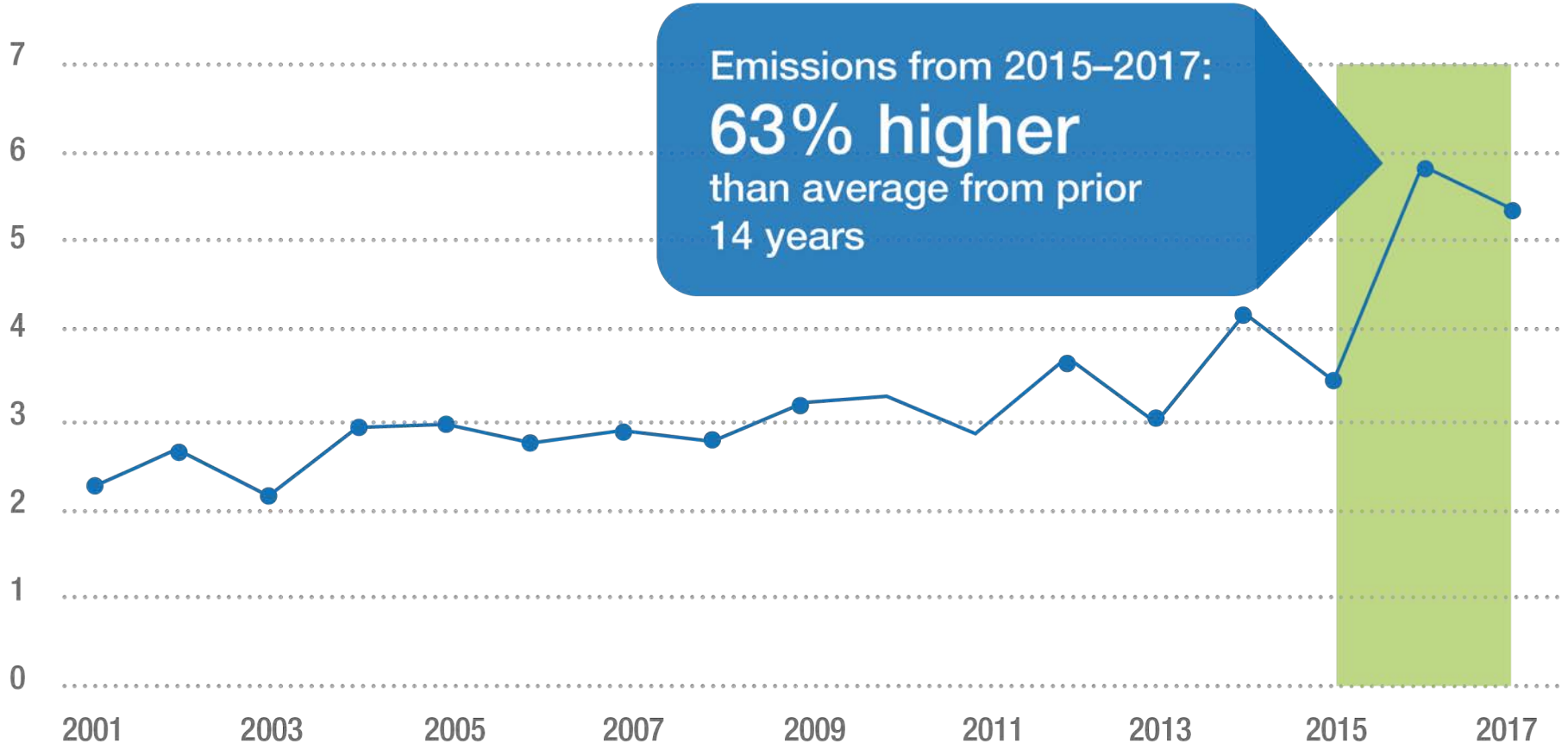
Source: Seymour & Busch 2016, World Resources Institute 2016

Deforestation

- Global deforestation is increasing.
  - Between 2015 and 2017, forest-related emissions were 63% higher than the average for the previous 14 years.
    - Emissions increased from 3 billion to 4.9 billion metric tons per year.
    - Global population growth contributes to this increase because of growing demand for commodity crops such as beef, soy, and palm oil. These processes involve clearing forests to create crop and rangeland.
- Between 2015 and 2017, annual CO_2 emissions from deforestation averaged 4.8 gigatons.
  - This means that tropical tree cover loss is now causing more emissions each year than 85 million cars would over their entire lifetime!

Source: World Resources Institute 2018

CO_2 Emissions From Tropical Tree Cover Loss



Note: Loss calculated at a 25% tree cover density

Source: World Resources Institute 2018

Growing Populations Increase Pressure on Forests

- Forests are vital for fighting climate change because they act as ‘sinks’ for carbon dioxide by sequestering and storing the gas.
- Deforestation worsens climate change by eliminating carbon sinks and through emissions from overharvesting and burning.
- Along with other economic, political, and ecological processes, population growth serves as an underlying cause of deforestation.
  - Increasing numbers will increase demand for food production and timber resources.

Source: Population Action International 2012

Ecosystem Restoration and Afforestation

- Natural systems such as forests and coastal mangroves efficiently pull carbon from the atmosphere and slow global warming.
- Afforestation, or the process of restoring forests by planting trees, is one vital aspect of slowing climate change.
  - Research shows that allowing saplings to grow on land that has been cleared would increase global forested area by one-third and remove 205 billion metric tons of carbon from the atmosphere.
    - **If this were realized, it would mean that over two-thirds of the 300 billion metric tons of human-caused carbon emissions would be removed from the atmosphere.**

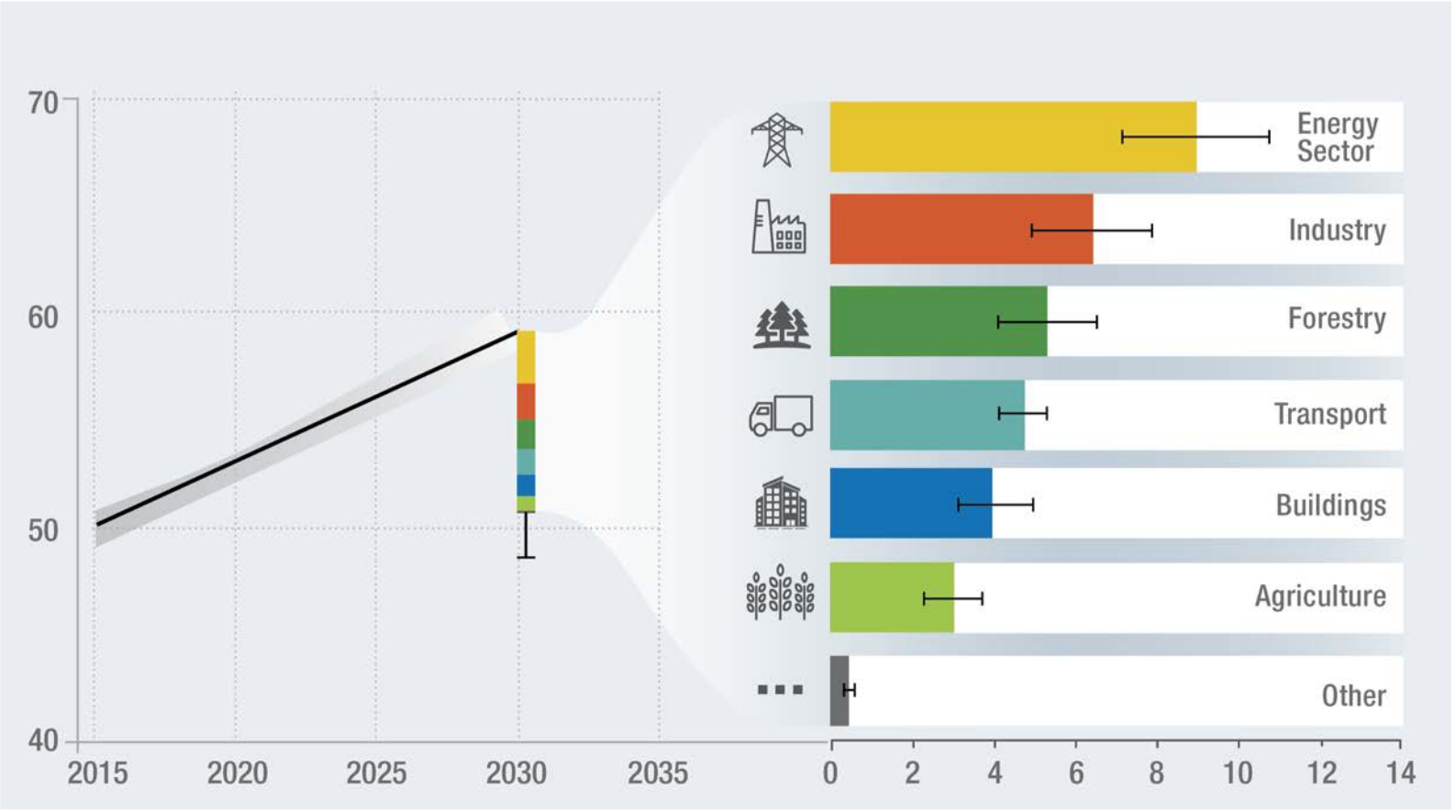
Source: World Resources Institute 2018
Photo by qinghill on Unsplash

Forests are capable of providing 23 percent of the climate mitigation needed before 2030

Despite this potential, afforestation accounts for less than 3% of climate mitigation funding

Source: Harris and Wolosin 2018, World Resources Institute 2018

Clean Energy + Renewables



Six abatement measures could bring the world on track to bridge the emissions gap in 2020

Solar & wind energy

- Feed-in tariffs
- Auctions
- Competitive electricity costs

Energy efficient appliances & passenger cars

- MEPS
- Labels
- Fuel economy standards
- $C0_2$ emission standards

Reforestation & reducing deforestation

- Land use planning
- Sustainable production
- Monitoring and verification

Source: United In Science High-level synthesis report, UNEP Emissions Gap Report 2017

Final Notes: IPCC Special Reports 2018-2019

- **Limiting the average global temperature rise to 1.5°C above pre-industrial levels would provide benefits and avoid significant risks.**
  - Climate change is already affecting people's health and livelihoods, ecosystems and wildlife habitats, and weather patterns all around the world.
  - Limiting warming to 1.5°C is not impossible but would require unprecedented transitions in all aspects of society.
  - There are clear benefits to keeping warming to 1.5°C compared to 2°C or higher. Every bit of warming matters.
  - Limiting warming to 1.5°C can go hand-in-hand with reaching other world goals such as achieving sustainable development and eradicating poverty.

Source: United In Science High-level synthesis report, UN Climate Action Summit 2019

Final Notes: IPCC Special Reports 2018-2019

- **There are things we can do to both tackle land degradation and prevent or adapt to further climate change.**
  - The land we are already using could feed the world in a changed climate and provide biomass for renewable energy, but it would require early, far-reaching action across several fronts.
  - Better land management supports biodiversity conservation.
  - Tackling this challenge requires a coordinated response.
  - Better land management can play its part in tackling climate change, but it cannot do it all.

Source: United In Science High-level synthesis report, UN Climate Action Summit 2019

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