10 Essential Facts about the Climate Crisis

Science For Peace

1. Greenhouse Gases

The atmospheric CO_2 concentration in 2020, worldwide, was almost 50% above the pre-industrial concentration (412 ppmv vs 280 ppmv, a 47% increase), the CH_4 concentration was almost three times the pre-industrial concentration (1875 ppb vs 675 ppb, a factor of 2.78 increase), and the N_2O concentration about 20% larger (330 ppb vs 275 ppb), and entire classes of artificial and powerful greenhouse gases have been created and added to the atmosphere. On current emission trajectories, the collective heat-trapping effect of these greenhouse gases by 2100 would be equivalent to that last seen 30-45 million years ago, when there was little if any ice anywhere on the planet.

2. Sources of Emissions

The major anthropogenic sources of CO_2 emissions are combustion of fossil fuels (85%) and deforestation (15%); the major sources of CH_4 emissions are leakage associated with the use of fossil fuels (28%), animal agriculture (enteric fermentation and manure, 27%), waste management of various kinds (23%), and rice paddies (11%); and the major source of N2O emissions is application of N fertilizer (67%). Full lifecycle analysis indicates that the food system is responsible for 25-42% of total CO_2-equivalent greenhouse gas emissions (as of 2010-2015) when weighted by the impact of emissions over a 100-year period, and by a larger fraction when weighted over shorter time periods. These emissions are largely due to the consumption of animal food products, making diet the single largest leverage point at an individual level. Twenty countries, mostly rich, are responsible for 80-85% of all emissions.

3. Rise in Temperatures

The global mean surface temperature (a composite of surface air temperature over land and ocean surface-water temperature) has increased by about 1.1°C during the last 120 years, while temperatures averaged over land areas only have increased by about 1.4°C, and parts of the Arctic have warmed by 2-3°C. On current GHG emission trajectories, the climate could warm by 3-6°C by 2100, relative to the early 1900s, making the climate warmer than at any time during the past 15-35 million years.

4. Sea Levels

Global mean sea level has risen by about 22 cm during the past 120 years, and is projected to increase to a total of 0.5-2.0 m rise by 2100. However, we may already be committed to a minimum sea level rise of 3 m over a period of several centuries, and warming anticipated this century under current trajectories could commit the world to an eventual sea level rise of 15-35 m.

5. Ocean Acidification

Absorption of anthropogenic CO_2 by the oceans, while reducing the accumulation in the atmosphere and the associated warming of the climate, is leading to acidification of the oceans and associated chemical changes. These changes will eventually have not only devastating impacts on the entire marine ecosystem, unless halted during the next few decades, but also potentially adverse feedbacks on climate itself.

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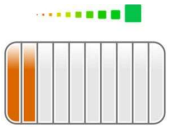
6. Goals



The climate crisis has arrived. There is no possibility of limiting the global mean warming to the much-touted 1.5°C target, and little chance of limiting the warming to 2.0°C. Scenarios that are supposedly compliant with these targets envisage overshooting the targets in mid-century and then dropping back to 1.5°C or 2.0°C by 2100. These scenarios assume that net greenhouse gas emissions will reach zero by mid-century, followed by large negative emissions. However, the negative emissions depend on unproven technologies with potentially adverse environmental side effects or require mammoth reforestation and the build-up of soil carbon ("natural climate solutions").

7. Green Energy

Breathtaking reductions in the cost of electricity produced from wind and solar energy, and in battery storage of electricity, have occurred during the past two decades. Wind and solar electricity are now the cheapest sources of electricity in many parts of the world. Further large cost reductions are anticipated.

8. Energy Efficiency

Dramatic improvements in the energy efficiency (or energy intensity) of buildings, appliances and consumer goods, transportation equipment, and industrial processes have occurred over the past two decades. Further efficiency improvements are possible with a sufficient push.

9. Future Energy Systems

Scenarios for 100% renewable energy systems, without nuclear energy or carbon capture and storage (except possibly in niche applications), and with minimal use of biomass energy, have been developed for many regions of the world, based on an hour-by-hour matching of energy supply and demand. Overall energy system costs are projected to be lower than for systems relying on fossil fuels or nuclear energy.

10. The Challenge

Two major transformations are required to reach net zero and, later, negative greenhouse gas emissions. First, decarbonization of the global energy system by limiting energy demand through a combination of technical efficiency measures and behavioural changes, accompanied by sufficient deployment of renewable energy sources, with storage, to reliably meet the residual energy demand. Second, dramatic reductions in the consumption of animal food products (beef and dairy in particular) in middle- to high-income countries, and leap-frogging from low-quality diets in low-income countries directly to nutritious plant-dominated diets, thereby directly reducing greenhouse gas emissions associated with animal agriculture and freeing up land that can be used to create negative emissions.