

Environmental laws

International laws and summits

Montreal Protocol (1987)

It was revised seven times, and ratified by 196 nations, the Montreal Protocol—officially known as the Montreal Protocol on Substances That Deplete the Ozone Layer—has been hailed as "perhaps the single most successful international agreement to date," by Kofi Anan, the former Secretary-General of the United Nations. In scientific terms, it phased out ozone-depleting substances, namely chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). This, in turn, prevents harmful ultraviolet radiation—invisible rays that are part of the sun's energy—from entering earth's atmosphere. In layman's terms, it got rid of a bunch of bad stuff used in everyday life; CFCs were found in air conditioning systems, fire control solvents and hair spray canisters. 1.5 million cases of skin cancer. 330,000 cancer deaths. 129 million cases of cataracts. That's a tally of human suffering the world is avoiding by implementing this treaty, according to the Institute for Governance & Sustainable Development.

Kyoto Protocol (1997)

The Kyoto Protocol is an international agreement that aimed to reduce carbon dioxide (CO₂) emissions and the presence of greenhouse gases (GHG) in the atmosphere. The essential tenet of the Kyoto Protocol was that industrialized nations needed to lessen the amount of their CO₂ emissions. Countries that ratified the Kyoto Protocol were assigned maximum carbon emission levels for specific periods and participated in carbon credit trading. If a country emitted more than its assigned limit, then it would be penalized by receiving a lower emissions limit in the following period. Developed, industrialized countries made a promise under the Kyoto Protocol to reduce their annual hydrocarbon emissions by an average of 5.2% by the year 2012. This number would represent about 29% of the world's total greenhouse gas emissions. Targets, though, depended on the individual country. This meant each nation had a different target to meet by that year. Members of the European Union (EU) pledged to cut emissions by 8% while the U.S. and Canada promised to reduce their emissions by 7% and 6% respectively by 2012.

The Paris Agreements (COP 21, 2015)

They were ratified by 189 countries which represent 96,98 % of emissions. They committed to drawing up long-term low greenhouse gas emission development strategies but to do so by taking into account the level of development and the specific needs of particularly vulnerable countries, and thus the different levels of responsibilities. The purpose was to hold the increase in global average temperature to well below 2°C above pre-industrial levels and to ensure that efforts are pursued to limit the temperature increase to 1.5 °C. To achieve this, the Paris Agreement stipulated that all countries shall review their contributions to reducing greenhouse gas emissions every five years.

In the UK

Hunting Act, 2004 : Using dogs to hunt mammals in the UK such as foxes, hare and mink is illegal due to the Hunting Act which was passed in 2004. Dogs are only allowed to be used to flush out these mammals for the purpose of being shot during a hunt.

Climate Change Act, 2008 : Established in 2008, the Climate Change Act is an environmental law designed to reduce carbon dioxide emissions in the UK. Binding targets have been set that will reduce these emissions from levels recorded in 1990 by at least 80% by 2050.

Energy Act 2020 : The Energy Act 2011 (last revision) relates to UK enterprise law which requires energy providers to meet certain energy efficiency requirements when providing energy to consumers. Obligations include carbon emissions reductions and home heating costs reductions.

In Australia

Environment Protection and Biodiversity Conservation Act (1999) : Australia's national environment law — makes it an offence for any person to take an action that is likely to have a significant impact on matters protected by the Act, unless they have the approval of the Australian environment minister. Protected matters are matters of national environmental significance as well as the environment of Commonwealth land. The eight matters of national environmental significance protected by the EPBC Act are: world heritage properties / national heritage places / wetlands of international importance (listed under the Ramsar Convention) / migratory species protected under international agreements / listed threatened species and ecological communities / Commonwealth marine areas / the Great Barrier Reef Marine Park / nuclear actions (including uranium mines). In simple terms, the act is used to assess whether a species or ecosystem has declined to a point that it requires protection and should therefore be listed as vulnerable, endangered or critically endangered. The legislation is supposed to guide the national recovery of species threatened with extinction, identify key threats to their survival and protect important habitat. The laws also determine whether developments such as mines, urban expansion and agricultural clearing should proceed. Developers are required to refer a project for assessment if they think it will have a significant impact on matters of national environmental significance. The environment department determines if the project requires an assessment under federal law, with the environment minister responsible for a final decision on whether a project is approved or deemed unacceptable.

In the US

Marine Protection, Research, and Sanctuaries Act, 1972 : Also known as the "Ocean Dumping Act" of 1972, the Marine Protection, Research, and Sanctuaries Act allows the EPA to regulate the dumping activities of industrial and municipal wastes into the oceans or other territorial waters of the United States.

The Energy Policy Act of 2005 is a federal law signed by President George W. Bush on August 8, 2005, at Sandia National Laboratories in Albuquerque, New Mexico. The act, described by proponents as an attempt to combat growing energy problems, changed US energy policy by providing tax incentives and loan guarantees for energy production of various types.

The Green New Deal (2019) is an environmental policy that was first proposed on February 7, 2019 by both Rep. Alexandria Ocasio-Cortez (D-NY) and Sen. Ed. Markey (D-MA). The main goal of the legislation is for the United States "to switch to 100% renewable energy in 10 years"[58] or by 2030. In addition to addressing environmental concerns associated with climate change, the Green New Deal aims to "fix societal problems like economic inequality and racial injustice" by ensuring that everyone has access to education, clean water, and employment with benefits. It also strives to make every building energy efficient. This call to end fossil fuels and build green jobs created a lot of controversy and met strong opposition. Trump has acknowledged that that human activity contributes to climate change "to an extent," but also said "science doesn't know" recently. Trump and Pence want to keep fossil fuels in the energy conversation both to appeal to those workers and to keep the U.S. relevant as a gas and oil exporter. Mike Pence, making similar charges to those of President Trump, said at the VP debate, "They [Biden-Harris] want to bury our economy under a \$2 trillion Green New Deal. [They] want to abolish fossil fuels, and ban fracking, which would cost hundreds of thousands of American jobs all across the heartland." Although Joe Biden has refused to fully endorse the Green New Deal, his running mate, Kamala Harris was an original sponsor. Harris, however, says she fully supports the Biden climate plan. Called "A Clean Energy Revolution," the plan has many of the same goals as the Green New Deal but on a less ambitious time frame and at lower cost. For example, the Green New Deal aspires to net-zero greenhouse gas emissions and 100% clean, renewable energy sources by 2030. Biden's plan achieves that goal by 2050. The Green New Deal is estimated to cost about \$93 trillion to implement. The proposed Biden plan would involve a Federal government investment of \$1.7 trillion and private sector, state, and local buy-in of about \$5 trillion.

Climate activism

Extinction Rebellion is a global environmental movement which was born in May 2018 and the stated aim of which is to use nonviolent civil disobedience to compel government action to avoid tipping points in the climate system, biodiversity loss, and the risk of social and ecological collapse. In November 2018, five bridges across the River Thames in London were blockaded as a protest. In April 2019, Extinction Rebellion occupied five prominent sites in central London: Piccadilly Circus, Oxford Circus, Marble Arch, Waterloo Bridge, and the area around Parliament Square. A number of activists in the movement accept arrest and imprisonment. A youth wing—XR Youth—of Extinction Rebellion had formed by July 2019. In contrast to the main XR, it is centred around consideration of the Global South and indigenous peoples, and more concerned with climate justice.

Fridays For Future is a movement that began in August 2018, after 15-year-old Greta Thunberg and other young activists sat in front of the Swedish parliament every schoolday for three weeks, to protest against the lack of action on the climate crisis. She posted what she was doing on Instagram and Twitter and it soon went viral. It rapidly grew into an international movement of school students (in many countries also university students) who skip classes, mainly on Fridays, to participate in demonstrations to demand action from political and economical leaders, to limit climate disaster, and for the fossil fuel industry to transition to renewable energy.

Prometheanism is a term popularized by the political theorist John Dryzek to describe an environmental orientation which perceives the Earth as a resource whose utility is determined primarily by human needs and interests and whose environmental problems are overcome through human innovation. In contrast with other environmental perspectives, Prometheanism prioritizes human interests and needs over those of ecosystems (as with deep ecology) or the individual needs of creatures.

Radical environmentalism : Radical environmentalism is a grassroots branch of the larger environmental movement that emerged from an ecocentrism-based frustration with the co-option of mainstream environmentalism. It is more uncompromising and takes more direct, radical action.

Examples :

- Green Peace : They resort to radical actions as a means to get media exposure.
- Earth First! is a radical environmental advocacy group that originated in the Southwestern United States. It was founded on April 4, 1980. Today there are Earth First! groups around the world including in Australia, Belgium, Canada, the Czech Republic, France, Germany, India, Ireland, Italy, Mexico, the Netherlands, Nigeria, New Zealand, the Philippines, Poland, Slovakia, Spain, the United Kingdom, and the United States.

Eco-terrorism is an act of violence committed in support of environmental causes, against people or property. Eco-terrorism is often defined as the use of violence carried out to further environmental policy change. Eco-terrorists are willing to inflict emotional and physical distress on their victims if they believe it will further their environmental goals. This more radical version of environmental action is illegal, as compared to its more moderate forerunner of eco-activism which is not illegal and would be classified as a form of civil disobedience and uses protests, sit ins and other civil actions to effect environmental change. Eco-terrorism can also include sabotage in the name of the environment, which is illegal as this includes crimes against property which could lead to harm to humans.

Climate Justice is a term used to frame global warming as an ethical and political issue, rather than one that is purely environmental or physical in nature. This is done by relating the causes and effects of climate change to concepts of justice, particularly environmental justice and social justice. Climate justice examines concepts such as equality, human rights, collective rights, and the historical responsibilities for climate change.

Current concerns

Los Angeles Rated Most Susceptible to Natural Disasters, According to FEMA Data

The Smithsonian Magazine, by Elizabeth Gamillo, January 8, 2021

The report explains how damaging hypothetical, extreme weather scenarios would be and does not represent how frequently devastation actually occurs

California has been ravaged by wildfires and droughts in recent years, with over 500,000 acres scorched in the 2020 fire season alone. New data suggests Los Angeles County is the most at risk for climate-related disasters out of 3,000 counties analyzed in the United States, according to a federal risk assessment released in last fall.

The National Risk Index is an online tool created by the Federal Emergency Management Agency (FEMA) that rates counties by their likelihood of facing 18 different natural disasters and how devastating the aftermath would be in each location, reports Dharna Noor for Gizmodo. Each county's rating is primarily ranked by how much economic damage would occur if a natural disaster were to strike and does not represent the how frequently residents encounter any given disaster, reports NBC Los Angeles.

A county's socioeconomic status and the ability to recover from a disaster increases its risk value, so population-dense cities like New York and Philadelphia have high scores. Cities like these are less prepared for a natural disaster and contain expensive infrastructure. Urban areas are also home to more citizens living in poverty who don't have the resources to recover from the devastation quickly.

University of Washington risk expert Himanshu Grover tells the Associated Press's Seth Borenstein that the FEMA index is "a good tool, a good start," but points out that some rankings seem to downplay how regularly occurring or seasonal disasters affect the communities that face them most.

While Los Angeles county has high risk ratings for heat, drought and wildfire, some counties have ratings that don't make as much sense. For example, if urban counties in Pennsylvania, New York, or New Jersey were to face a tornado, recovery from the destruction would be more challenging than in rural counties in south-central states that make up "tornado alley," AP News reports. But counties in these three East Coast states rank as riskiest for tornadoes while Oklahoma counties—where tornadoes happen regularly—is ranked 120th on the list.

"It's that risk perception that it won't happen to me," FEMA's Mike Grimm tells the Associated Press. "Just because I haven't seen it in my life doesn't mean it won't happen."

David Ropeik, a retired Harvard risk communications lecturer and author, told AP News that risks are always shifting because of climate change, and the National Risk Assessment does not account for this data either.

FEMA's Grimm states that the risk rankings are based on calculations from 80 experts over the past six years with the goal of empowering communities to be more resilient. They can help update emergency operations, educate homeowners, and inform how long it would take a community to recover from even an unlikely disaster.

What natural disasters cost the global economy in 2020

<https://qz.com/>, by Tim McDonnell, December 29, 2020

Covid-19 is clearly the crisis that defined 2020, but millions of people were forced to grapple with natural disasters alongside the pandemic. A Biblical deluge of record-breaking Atlantic hurricanes, devastating wildfires, floods, and even locust storms added up to one of the world's most damaging and expensive years of natural disasters in the last half-century.

According to a Dec. 15 analysis by the reinsurance giant Swiss Re, global economic losses from natural disasters amounted to \$175 billion this year. Of that, \$76 billion were insured, the fifth-highest total since 1970. With some notable spikes in 2005 (Hurricane Katrina) and 2017 (Harvey, Irma, and Maria), average annual insured losses have risen steadily in the last few decades, up from \$7.4 billion, adjusted for inflation, in 1979. That's the result of three main factors: Rising property values in developing countries, increasing insurance coverage in developed countries, and climate change driving more frequent and severe storms and wildfires across the board.

This year, the most expensive series of events was the Atlantic hurricane season, according to a Dec. 28 report from the UK-based nonprofit Christian Aid, with a record 30 named storms, 12 of which made landfall in the US. The figures below capture insured losses only; the full scale of damage is much higher.

Most expensive disasters of 2020

Insured losses only

Country or region	Disaster	Cost ▼
US, Central America	Atlantic hurricane season	\$40 billion
China	Floods	\$32 billion
US	West Coast wildfires	\$20 billion
India, Sri Lanka, Bangladesh	Cyclone Amphan	\$13 billion
India	Floods	\$10 billion
East Africa	Locust swarms	\$9 billion
Europe	Windstorms Ciara and Alex	\$6 billion
Australia	Bushfires	\$5 billion
Japan	Kyushu floods	\$5 billion
Pakistan	Floods	\$2 billion

Quartz | qz.com | Data: Christian Aid

'Sliding towards extinction': koala may be given endangered listing as numbers plummet

The Guardian, by Lisa Cox, September 25, 2020

The species is among 28 animals being assessed for potential upgrade of their threat status, federal government says

The koala is being considered for official listing as endangered after the summer's bushfire disaster and ongoing habitat destruction on the east coast forced the government to reconsider its threat status.

The iconic species, which is currently listed as vulnerable under national environment laws, is among 28 animals that could have their threat status upgraded, the federal environment minister, Sussan Ley, said on Friday.

The greater glider, which had 30% of its habitat range affected by the bushfire crisis, is also being assessed to determine whether it should move from vulnerable to endangered, while several frog and fish species, including the Pugh's frog and the Blue Mountains perch, are being considered for critically endangered listings.

Several Kangaroo Island species, including the Kangaroo Island crimson rosella and Kangaroo Island white-eared honeyeater, are among birds being assessed for an endangered listing.

Ley has asked the threatened species scientific committee to complete its assessments by October next year.

The koala assessment will apply to the combined populations of New South Wales, Queensland and the ACT, where more than 10% of the population was affected by bushfire. Koalas on the east coast are also under multiple other pressures due to continued habitat destruction, drought and disease.

Environmental groups, which nominated the species for an endangered listing, said already severe populations declines had been made worse by the 2019-20 bushfire disaster.

"We welcome prioritisation for the koala but also hope the process can be sped up and the koala listed as endangered before October 2021," said Nicola Beynon of Humane Society International.

Josey Sharrad, of the International Fund for Animal Welfare, said koalas on Australia's east coast were "sliding towards extinction" and immediate action was needed to bring the species back from the brink.

A recent NSW parliamentary inquiry found koalas would be extinct in the state by 2050 without urgent intervention to protect habitat and help the species recover.

Ley said on Friday that because of the ongoing effects of the bushfires, the government would introduce additional nomination processes for the listing of threatened species over the next two years on top of the annual nomination process.

The 28 species included on the finalised priority assessment list for formal assessment in the 2020 period include two reptiles, four frogs, seven fish, six mammals and 12 birds, bringing the total number of species currently being assessed to 108.

After a species makes the priority list, it is assessed by the scientific committee, which then makes a recommendation to the minister regarding its threat status.

"This process is critical in ensuring threatened species are given strategic protection, are eligible for targeted funding and that awareness is raised about the issues impacting them," Ley said.

A recent interim report from a review of Australia's conservation laws found governments had failed to protect Australia's unique wildlife and the environment was in unsustainable decline.

The government currently has a bill before the parliament to devolve decision-making powers under national environmental laws to the states.

The fight against climate change should focus on reaching positive climate tipping points www.fastcompany.com, January 10, 2020

Over the last few years, the planet has blown past or come dangerously near to climate tipping points—irreversible levels of damage that then also create even more warming. But just as there are moments of no return that tip us over into climate disaster, the inverse exists as well. On the path to climate recovery, there are benchmarks that could set off a cascading series of technological advancements that would rapidly cut our carbon emissions.

One tipping point will come if we reach a point where coal isn't just less profitable, but actually losing profits, write the authors of a new paper on these positive tipping points in the journal *Climate Policy*. Then, a series of environmental benefits will follow. It would pave the way for more renewable energy use, decarbonizing power generation around the world. With cheaper, cleaner power, it becomes even easier to decarbonize transportation, heating, and cooling.

Another potential tipping point is electric vehicle development. When EVs cost the same to manufacture as conventional-fuel cars, then EV production will go up, and as production increases, costs will get even cheaper. With more investment and production, electric batteries will become both better and more affordable (such economies of scale have helped drop the price of solar panels), benefiting the power sector and helping to decarbonize everything that relies on battery use.

Both of these tipping points feed into each other, notes Tim Lenton, director of the Global Systems Institute at the University of Exeter and coauthor of the paper, via email. "Cheaper renewable electricity makes electrified transport even cheaper (as well as cleaner)," he says. "Going the other way, an EV revolution means batteries get much more abundant and much cheaper—and that helps with the renewable electricity revolution—to balance out uneven supply and demand for renewables. That's a reinforcing feedback between the sectors and tipping points."

These tipping points won't happen on their own without policy interventions. But in some places, those policies are already in place, triggering "positive tipping points at national scales," Lenton says. Norway has a tax system that makes EV models cheaper than

similar gas-powered cars, sparking a national tipping point for EV manufacturing. Globally, electric vehicles account for about 2 to 3% of new car sales. In Norway, they make up 54%. If more governments—particularly China, the EU, and California, which together are responsible for half the world's car sales—used similar incentives to boost EV sales, the resulting change in consumer behavior would push them over their own tipping points in manufacturing and battery advancements.

Similarly, the United Kingdom has a policy to prompt a power tipping point: a carbon tax. That, along with the carbon price set by the EU Emissions Trading Scheme, has helped Great Britain cut its proportion of electricity generated by coal from 40% to 3% in six years. China, Japan, and South Korea finance most of the new coal plants globally, and right now there's no incentive for them to stop, the paper notes, since if one pulls out of that market, another country will step in. But if they decide together to stop, the cost of coal could rise around the world, prompting more renewable energy use, and decarbonizing power globally.

It's too late to tackle climate change "incrementally," the researchers write (Lenton cowrote the paper with Simon Sharpe, a deputy director in the U.K. Cabinet Office's unit preparing for the next global climate meeting, COP26). Instead, these tipping points offer a different approach to climate mitigation. "We need to go from a trend of increasing greenhouse gas emissions to net-zero greenhouse gas emissions within about 30 years—that requires a massive acceleration in the rate of change of decarbonization of the global economy," Lenton says.

These tipping points will accelerate that decarbonization, and Lenton thinks they aren't far away. "I think we are close to global tipping points for electric vehicles and for renewable power—but they are by no means inevitable (yet)," he says. "We need key actors to come together in instigating the tipping, and that's why we've written the paper—to show how this could happen and who could make it happen."

Ripple effects of climate change being seen in Arizona and Florida

<http://m.lasvegassun.com>, January 11, 2021

Stories from one very dry place and another very wet one show how the ripple effects of climate change can take unexpected and damaging turns.

The dry place is Phoenix, where the Arizona Republic reported last week about ecological problems being caused by, of all things, seabirds.

Specifically, the culprits are two varieties of cormorants, migratory birds which before global warming spent a few months wintering in Phoenix before heading south to warmer temperatures. Now, though, thousands of the birds are living in Phoenix year-round: Climate change has driven up the temperature in winter months to a point where the animals are comfortable.

Cormorants, a federally protected species, also like the city because it offers dozens upon dozens of artificial water bodies in suburban neighborhoods and at golf courses. Many of those lakes and ponds are surrounded by trees in which the birds can roost, and are stocked with fish, the main component of their diet.

So what's the problem with having these birds around 12 months of the year?

It starts with them doing a number on fish stocks, which has eroded the water quality in lakes and ponds. A cormorant can eat as much as a pound of fish per day, which has decimated fish populations despite increases in fish stocking.

And because many species of fish eat aquatic plant life, having fewer of them has resulted in proliferation of algae and weeds. That, in turn, has led to an explosion in flies and other insects, which breed in the brackish water.

"In the summers, you can't even sit out on your patio because a hundred flies will swarm you," a resident of one Phoenix suburb told the Republic. "This is a totally new issue for all of us living here."

Meanwhile, the birds' defecation has altered soil chemistry in the areas where they've concentrated, killing ground vegetation and diminishing the health of tree stands.

Is this a major ecological problem? Not on the scale of the intense hurricanes or droughts being caused by climate change, but it does show how global warming can set off chain-reaction situations with wide-ranging effects.

And keep in mind, the bird invasion was brought on by only a slight change in winter temperatures: the average over the past 30 years is just 2.5 degrees higher than it was during the preceding 30 years.

Then there's the wet place, Florida. In the Sunshine State, you might expect that the greatest dangers of climate change would be increasingly strong hurricanes or sea-level rise that threatens to leave huge swaths of developed coastal areas uninhabitable.

But experts are increasingly worried about another potentially devastating outcome: the loss of vast amounts of drinking water that support millions of Floridians.

The main culprit here is the rise in ocean levels, which is pushing saltwater further inland. That seawater is seeping into aquifers through porous limestone bedrock and also pushing into freshwater basins. Most notably, there's a serious threat of saltwater contamination in the Biscayne aquifer, a 4,000-square-mile shallow basin that provides drinking water to several million people in Miami and elsewhere in South Florida.

Combined with deleterious effects of agriculture — overpumping of water and toxic runoff — the threat of seawater contamination prompted the Florida Department of

Environmental Protection to sound a warning this past spring that “existing sources of water will not adequately meet the reasonable beneficial needs for the next 20 years.”

In Nevada, of course, we’re dealing with our own problems related to climate change, notably the drought that is increasingly stressing our water supply, and temperature increases that have sparked a rise in heat-related deaths.

But whether it’s an explosion in bird populations or freshwater contamination or increasingly intense heat waves, these signs all point to the need to urgently address climate change.

Nevada has significant great strides in that respect in recent years, including when voters overwhelmingly approved a ballot question in November to adopt renewable energy standards. And with President-elect Joe Biden soon to take office, a reversal of President Donald Trump’s destructive climate policies will begin this month.

But it’s imperative to keep pressing. There’s no predicting exactly what ripple effects might be on the horizon if global warming isn’t curbed, or how much damage they will cause.

The state of the climate in 2021

BBC, by Isabelle Gerretsen, January 11, 2021

After the turbulent year of 2020, BBC Future takes stock on the state of the climate at the beginning of 2021.

From unprecedented wildfires across the US to the extraordinary heat of Siberia, the impacts of climate change were felt in every corner of the world in 2020. We have come to a “moment of truth”, United Nations Secretary General Antonio Guterres said in his State of the Planet speech in December. “Covid and climate have brought us to a threshold.”

BBC Future brings you our round-up of where we are on climate change at the start of 2021, according to five crucial measures of climate health.

1. CO2 levels

The amount of CO2 in the atmosphere reached record levels in 2020, hitting 417 parts per million in May. The last time CO2 levels exceeded 400 parts per million was around four million years ago, during the Pliocene era, when global temperatures were 2-4C warmer and sea levels were 10-25 metres (33-82 feet) higher than they are now.

“We are seeing record levels every year,” says Ralph Keeling, head of the CO2 programme at the Scripps Institution of Oceanography, which has been tracking CO2 concentrations from the Mauna Loa observatory in Hawaii since 1958. “We saw record levels again this year despite Covid.”

The effect of lockdowns on concentrations of CO₂ in the atmosphere was so small that it registers as a "blip", hardly distinguishable from the year-to-year fluctuations of the carbon cycle, according to the World Meteorological Organization, and has had a negligible impact on the overall curve of rising CO₂ levels.

"We have put 100ppm of CO₂ in the atmosphere in the last 60 years," says Martin Siegert, co-director of the Grantham Institute for climate change and the environment at Imperial College London. That is 100 times faster than previous natural increases, such as those that occurred towards the end of the last ice age more than 10,000 years ago.

"If we keep tracking the worst-case scenario, by the end of this century levels of CO₂ will be 800ppm. We haven't had that for 55 million years. There was no ice on the planet then and it was 12C warmer," says Siegert.

2. Record heat

The past decade was the hottest on record. The year 2020 was more than 1.2C hotter than the average year in the 19th Century. In Europe it was the hottest year ever, while globally 2020 tied with 2016 as the warmest.

Record temperatures, including 2016, usually coincide with an El Niño event (a large band of warm water that forms in the Pacific Ocean every few years), which results in large-scale warming of ocean surface temperatures. But 2020 was unusual because the world experienced a La Niña event (the reverse of El Niño, with a cooler band of water forming). In other words, without La Niña bringing global temperatures down, 2020 would have been even hotter.

The exceptionally warm temperatures triggered the largest wildfires ever recorded in the US states of California and Colorado, and the "black summer" of fires in eastern Australia. "The intensity of those fires and number of people being killed is truly significant," says Siegert.

3. Arctic ice

Nowhere is that increase in heat more keenly felt than in the Arctic. In June 2020, the temperature reached 38C in eastern Siberia, the hottest ever recorded within the Arctic Circle. The heatwave accelerated the melting of sea ice in the East Siberian and Laptev seas and delayed the usual Arctic freeze by almost two months.

"You definitely saw the impact of those warm temperatures," says Julienne Stroeve, a polar scientist from University College London. On the Eurasian side of the Arctic Circle, the ice did not freeze until the end of October, which is unusually late. The summer of 2020 saw sea ice area at its second lowest on record, and sea ice extent (a larger measure, which includes ocean areas where at least 15% ice appears) also at its second lowest.

As well as being a symptom of climate change, the loss of ice is also a driver of it. Bright white sea ice plays an important role in reflecting heat from the Sun back out into space, a bit like a reflective jacket. But the Arctic is heating twice as quickly as the rest of the world – and as less ice makes it through the warm summer months, we lose its reflective protection. In its place, large areas of open dark water absorb more heat, fueling global warming further.

Multi-year ice is also thicker and more reflective than the thin, dark seasonal ice that is increasingly taking its place. Between 1979-2018, the proportion of Arctic sea ice that is at least five years old declined from 30% to 2%, according to the IPCC.

"White ice reflects a lot of energy from the Sun and helps slow the rate of global warming," says Michael Meredith, a polar researcher at the British Antarctic Survey. "We are accelerating global warming by reducing the amount of Arctic sea ice."

The loss of ice is believed to be disrupting weather patterns around the world already. According to the Grantham Institute, it is possible – though not conclusively shown – that 2018 Arctic conditions provoked the "Beast from the East" winter storm in Europe in 2018 by altering the jet stream, a current of air high in the atmosphere.

"Temperature difference between the equator and poles drives a lot of our large-scale weather systems, including the jet stream," says Stroeve. And because the Arctic is warming faster than lower latitudes, there is a weakening of the jet stream.

"Everything is interconnected. If one part of the climate system changes, the rest of the system will respond," says Stroeve.

4. Permafrost

Across the northern hemisphere, permafrost – the ground that remains frozen year-round for two or more years – is warming rapidly. When air temperatures reached 38C (100F) in Siberia in the summer of 2020, land temperatures in several parts of the Arctic Circle hit a record 45C (113F), accelerating the thawing of permafrost in the region. Both continuous permafrost (long, uninterrupted stretches of permafrost) and discontinuous (a more fragmented kind) are in decline.

Permafrost contains a huge amount of greenhouse gases, including CO₂ and methane, which are released into the atmosphere as it thaws. Soils in the permafrost region, which spans around 23 million square kilometres (8.9 million square miles) across Siberia, Greenland, Canada and the Arctic, hold twice as much carbon as the atmosphere does – almost 1,600 billion tonnes. Much of that carbon is stored in the form of methane, a potent greenhouse gas with a global warming impact 84 times higher than CO₂.

"Permafrost is doing us a big favour by keeping that carbon locked away from the atmosphere," says Meredith.

Thawing permafrost also damages existing infrastructure and destroys the livelihoods of the indigenous communities who rely on the frozen ground to move around and hunt. It is thought to have contributed to the collapse of a huge fuel tank in the Russian Arctic in May, which leaked 20,000 tonnes of diesel into a river.

5. Forests

Since 1990 the world has lost 178 million hectares of forest (690,000 square miles) – an area the size of Libya. Over the past three decades, the rate of deforestation has slowed but experts say it isn't fast enough, given the vital role forests play in curbing global warming. In 2015-20 the annual deforestation rate was 10 million hectares (39,000 square miles, or about the size of Iceland), compared to 12 million hectares (46,000 square miles) in the previous five years.

"Globally forest areas continue to decline," says Bonnie Waring, senior lecturer at the Grantham Institute, noting that there are big regional differences. "We are losing a lot of tropical forests in South America and Africa [and] regaining temperate forests through tree planting or natural regeneration in Europe and Asia."

Brazil, the Democratic Republic of the Congo and Indonesia are the countries losing forest cover most rapidly. In 2020, deforestation of the Amazon rainforest surged to a 12-year high.

An estimated 45% of all carbon on land is stored in trees and forest soil. "Soils globally contain more carbon than all plants and atmosphere put together," says Waring. When forests are cut down or burned, the soil is disturbed and carbon dioxide is released.

The World Economic Forum launched a campaign this year to plant one trillion trees to absorb carbon. While planting trees might help cancel out the last 10 years of CO₂ emissions, it cannot solve the climate crisis on its own, according to Waring.

"Protecting existing forests is even more important than planting new ones. Every time an ecosystem is disturbed, you see carbon lost," she says.

Allowing forests to regrow naturally and rewilding huge areas of land, a process known as natural regeneration, is the most cost-effective and productive way to capture CO₂ and boost overall biodiversity, according to Waring.

As well as showing how much the climate has changed already, these five climate indicators also point the way to the solutions that can curb global warming to safer levels by the end of the century.

As Guterres noted in his December State of the Planet speech, "Let's be clear: Human activities are at the root of our descent towards chaos. But that means human action can help solve it."

7 climate change projects that are changing the game

www.bighink.com, by Matt Davis, March 27, 2020

While there's plenty to be worried about, it's important to remember that we're making progress, too.

It's easy to feel hopeless when it comes to the climate. The news is full of stories on how the next century will see unbearable heat waves, impossibly strong hurricanes, flooded cities, an ice-free Arctic, and global temperatures reaching up to an average of 10 degrees Celsius hotter than they already are. But despite how terrible this feels, it's important to remember that the appropriate response is to leap into action, not to be paralyzed by despair. To supply some optimism and show that humanity isn't totally screwed, here are 7 climate change projects that are changing the game.

1. Carbon Engineering Ltd's negative-emissions plant

One of the biggest challenges to combatting climate change is the lack of incentive (aside from the destruction of the planet, that is). When looking at the astronomical profits of the oil and gas industries, it's clear that reducing humanity's reliance on oil and gas will take some serious incentivization.

That's where Carbon Engineering comes in. The Canadian company intends to build a commercial-scale negative-emissions facility using funding from a variety of investors, including Bill Gates. These people didn't invest entirely out of the goodness of their hearts; they did so to make a profit.

The facility will suck CO₂ out of the atmosphere to either store it underground, where it can't affect the atmosphere anymore, or to convert it into carbon-neutral fuel. What's more, this will happen at a rate of \$100 per ton of CO₂, the benchmark at which negative-emissions technology is considered to be cost effective.

2. Disney's new solar facility

As one of the largest entertainment corporations in the world, Disney has set itself an impressive goal: It intends to half its emissions by 2020. When you're talking about the emissions produced by a corporation worth \$171.7 billion, that's pretty significant.

As an initial step towards this goal, Disney recently opened a 270-acre, 50-megawatt solar facility in Florida. Disney expects that this plant will produce enough energy to operate two of its four theme parks in central Florida and cut its greenhouse gas emissions by 57,000 tons per year. As an industry leader, their solar plant is likely a harbinger of more facilities across the United States — and world, for that matter.

3. Harvard's SCoPEX project: Dimming the sun

Short for the Stratospheric Controlled Perturbation Experiment, SCoPEX's controversial goal is to spray calcium carbonate — the same stuff in your antacid tablets — into the sky to observe its effects in the stratosphere, with the ultimate goal of observing whether it can reflect sunlight back into space.

This might seem familiar for those of you who have watched the movie *Snowpiercer*. In that film, the fictional chemical CW-7 is sprayed into the atmosphere to reverse climate change, ultimately cooling the planet too much and sending it into an apocalyptic Ice Age.

Fortunately, the Harvard researchers don't plan on coating the planet in calcium carbonate — since this is real life, and not a film, they'll perform controlled experiments using just a few hundred grams of the material. There are still concerns about what effects there could be, however; for one, even if a large-scale deployment of calcium carbonate would effectively reflect sunlight and cool the planet, it would still be a temporary solution.

Still, plants would also receive less sunlight and since calcium carbonate just isn't present in the stratosphere, nobody can really predict what side effects it might cause up there. Nevertheless, it's a valuable experiment that may show us a promising — albeit last-ditch — solution.

4. The spread of electric cars

In the U.S., transportation accounts for 28 percent of the country's greenhouse gas emissions. But not only do most major car companies now offer electric vehicles as part of their product lines, Tesla and other companies are focusing solely on producing electric cars. In February of 2019, Amazon invested \$700 million in a Tesla competitor called Rivian, which plans to commercially release electric pick-up trucks in 2020. Tesla, too, is planning a release for 2020: a fully electric semitractor trailer.

These developments mean that the non-electric sectors of the transportation market are disappearing. Of course, none of this matters if there isn't the infrastructure there to support these cars. Fortunately, companies such as ChargePoint are installing charging stations across the country. As of this writing, ChargePoint has installed a little over 62,000 charging stations located across the globe.

5. The Environmental Business Initiative

It's rare that a big bank does anything as a force for good, but that's what Bank of America is doing with its Environmental Business Initiative. Part of what has made climate change projects so difficult to get going is the anxiety they produce in investors. This makes sense; a lot of climate change projects are new and use technologies not yet tested at large scales, risk factors that scare investment away. What's more, it's not always clear how an investor will make their money back.

Fortunately, Bank of America has invested \$96 billion to date in a variety of sustainable businesses and promises to invest another \$125 billion. The bank essentially invented the concept of green bonds, a type of security specifically reserved for climate and environmental projects.

6. The Green New Deal and growing political understanding

Addressing such a widespread and multifaceted threat like climate change will require a commensurately widespread and multifaceted climate policy. Although the Green New Deal was rejected in the U.S. Senate in March 2019, the mere fact that it existed at all is cause for optimism.

The future of climate change policy may not exactly match the ambitious Green New Deal, which aimed to make the U.S. energy system 100% renewable, to revamp the electrical grid into a "smart" grid, and overhaul the transportation system, among other goals. But it will certainly resemble it. Polls show that just 14.7 percent of Americans disagreed with the Green New Deal as a whole, a level of support that many politicians are responding to.

7. The promise of nuclear fusion

Nuclear power has always been a hot-button topic for environmentalists, and it was notably left out of the Green New Deal plan. If done right, nuclear fission plants can provide sustainable energy with minimal waste, but the problem is that they are not typically done right. Fission plants are expensive, complicated, and the repercussions of building a faulty one or failing to follow protocol are severe. Although the waste they do produce doesn't contribute to climate change, they are extremely toxic, must be carefully handled and stored, and can remain toxic for several thousands of years.

Nuclear fusion, on the other hand, doesn't carry the risk of a meltdown, produces waste whose radioactivity is short-lived, and it has the potential to produce unbelievable amounts of energy. Although fusion remains a hypothetical source of energy, we're getting closer and closer every year.

One nuclear fusion company, Tokamak Energy, recently heated hydrogen to 15 million degrees Celsius, briefly producing hydrogen plasma in a significant milestone on the way to fusion energy. Specifically, Tokamak Energy intends to heat hydrogen plasma to 100 million degrees Celsius in order to produce fusion energy. If its future ventures are successful, Tokamak Energy intends to deploy the world's first commercial nuclear fusion reactor by 2030. And they're not alone. Fusion experiments are taking place in countries such as France, Germany, and China, all of which have been making significant progress.

No one project will be the answer to the Earth's climate problems. But when taken together, they form a picture of the future that isn't quite so grim as we might believe today.