Image credit: Annie Spratt on Unsplash

CLIMATE CHANGE A REPORT

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05 2025

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Executive summary

“Climate change refers to long-term shifts in temperatures and weather patterns.”

United Nations, https://www.un.org/en/climatechange/what-is-climate-change

Global temperatures have risen by about 1.1 °C since the late 19th century, driven mainly by human activities like burning fossil fuels and deforestation. This extra heat is already changing weather patterns and pushing up sea levels.

Today, many places experience more intense heatwaves, heavier rainfall, longer droughts and faster melting of ice. These changes harm crops, disrupt water supplies, damage buildings and roads, and affect health—especially for people in hot, dry or low-lying areas.

If greenhouse-gas emissions continue at current rates, warming is likely to pass 1.5 °C above pre-industrial levels within the next two decades. Even small temperature increases make extreme weather more common, raising risks to food production, freshwater availability and coastal communities.

To limit warming to around 1.5 °C, global CO_2 emissions must drop nearly in half by 2030 and reach net zero in the early 2050s, alongside cuts in methane and other gases. Key steps include switching quickly to renewable energy, improving energy efficiency, protecting and restoring forests, and using methods to remove carbon from the air.

Alongside cutting emissions, countries need to strengthen infrastructure, agriculture and health systems so they can cope with the changes already underway. Much more funding -especially for vulnerable regions- and stronger international cooperation will be essential to put these measures in place.

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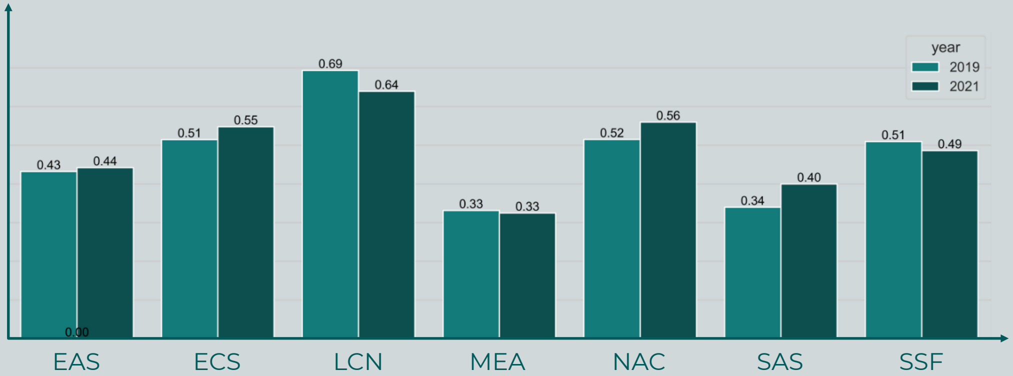
CLIMATE CHANGE
THE PERCEPTION

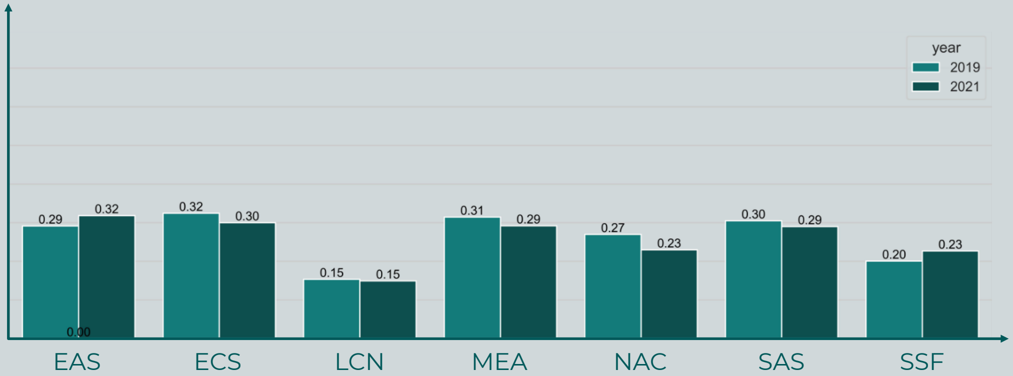
Is it real?

PERCEPTION BY REGION

Climate change as a serious threat

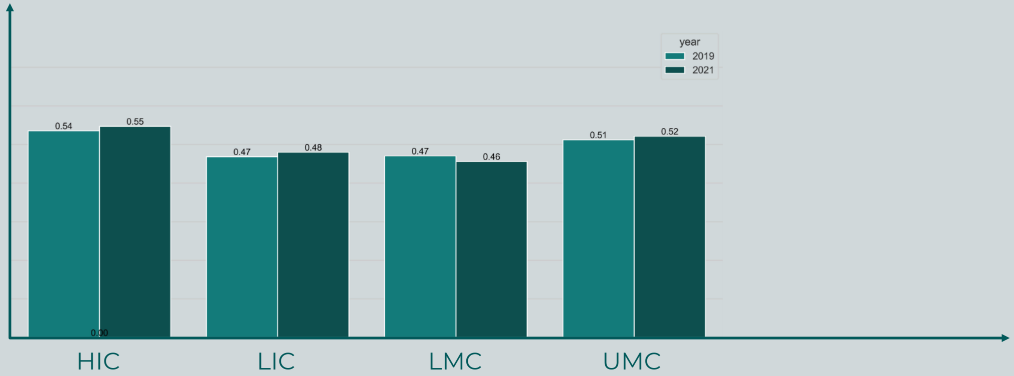


Climate change as somewhat a serious threat

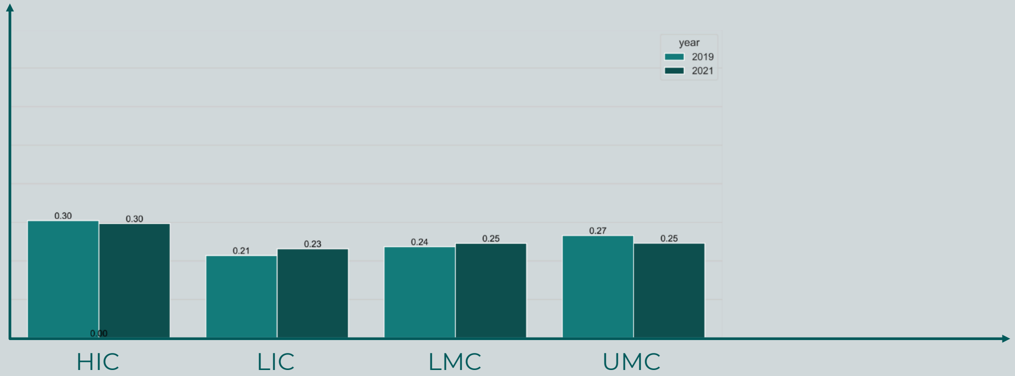


PERCEPTION BY INCOME LEVEL

Climate change as a serious threat



Climate change as somewhat a serious threat



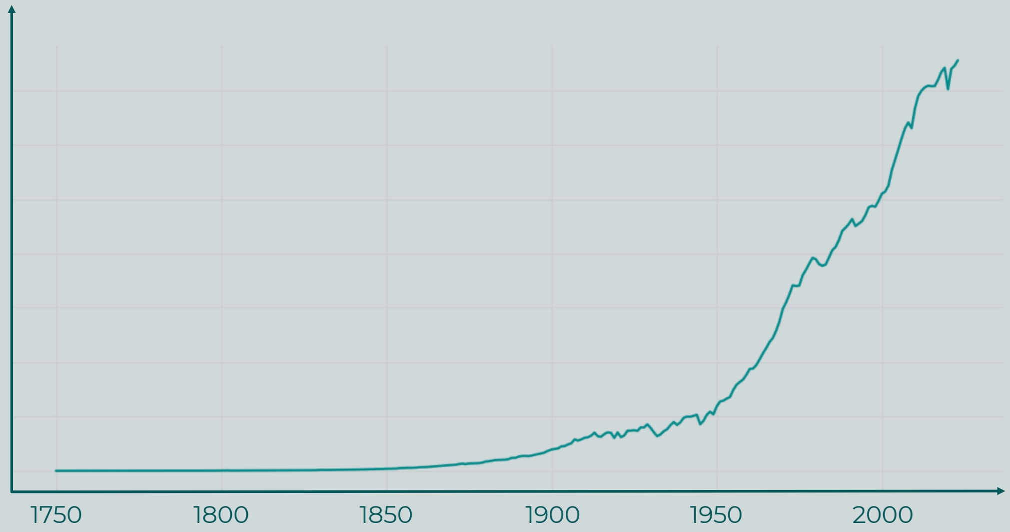
Perceptions of climate change as a serious threat held steady from 2019 to 2021, hovering above 50 percent in high- and upper-middle-income countries and around 46–48 percent in lower-income groups. Regionally, Latin America & the Caribbean led concern despite a five-point drop, while North America and Europe & Central Asia each rose four points and South Asia climbed six points to 40 percent.

Meanwhile, the share of people calling it only “somewhat serious” fell most in North America and Europe, suggesting that growing numbers there have shifted into the “serious threat” camp, even as moderate concern edged up in East Asia & Pacific and Sub-Saharan Africa.

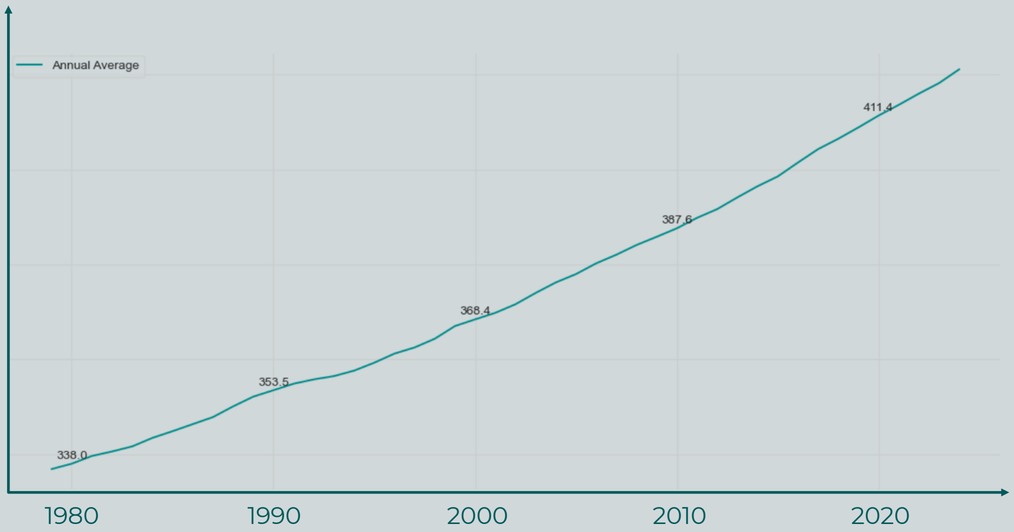
CLIMATE CHANGE
THE EFFECTS

Climate Change: Where we stand

Global CO2 emissions (1750 - Today)



Global CO2 concentration (1980 - Today)



Back in 1979, our annual CO_2 emissions sat at roughly 19.6 billion tonnes, and the atmosphere held about 337 ppm of CO_2. Over the next four decades, emissions surged almost relentlessly -by 2020 we were burning through about 35.1 billion tonnes of carbon dioxide each year, nearly an 80 percent leap. Meanwhile, the leftover CO_2 that didn't get absorbed by oceans, soils, and vegetation quietly accumulated in the air, pushing concentrations up to around 411 ppm- a 22 percent increase since '79.

What's remarkable is how closely those two lines track one another. Statistically, annual emissions and atmospheric concentration over this period correlate at about 0.99, meaning almost every extra tonne we dump into the air shows up in the global average almost immediately. The imbalance between what we emit and what the natural world can absorb explains why the concentration climbs more slowly: sinks remove some CO_2, but the surplus remains, year after year.

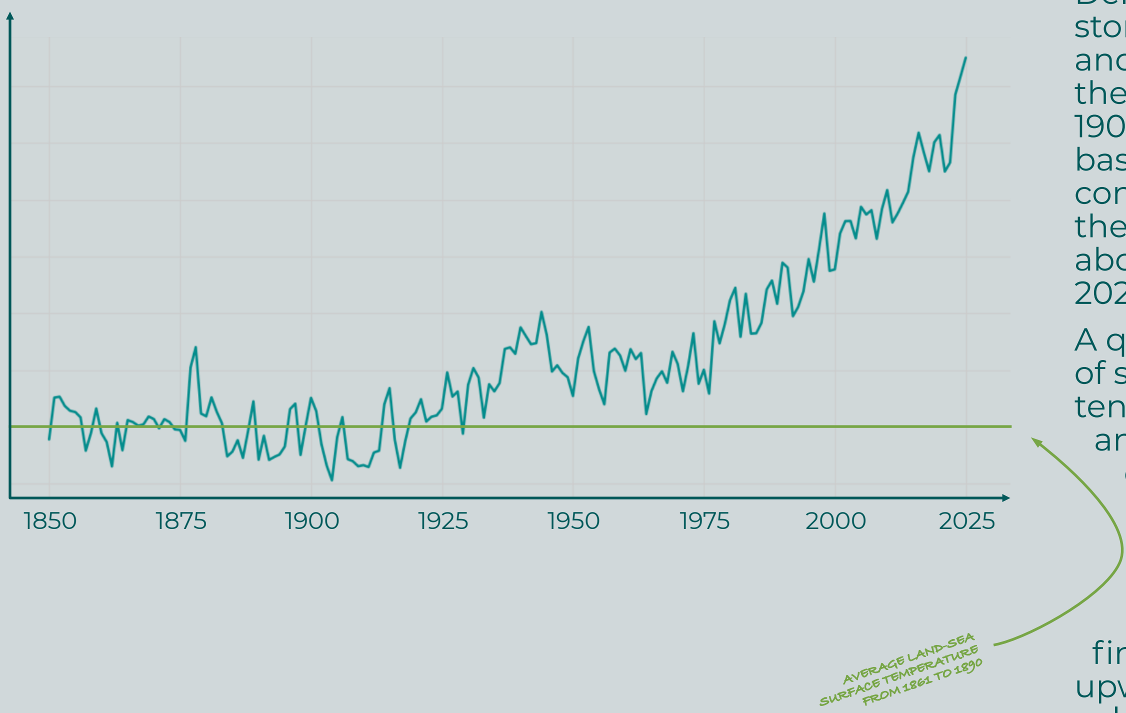
This tight coupling has a simple, powerful implication: whenever we cut emissions -whether by shifting to renewables, improving energy efficiency, or protecting carbon-rich ecosystems -we directly slow the growth rate of atmospheric CO_2. It doesn't take decades for those cuts to register; the effect is visible in concentration trends almost right away. In other words, emissions reductions are the only real lever we have to cap and eventually bring down the global CO_2 level.

If we're serious about stabilizing our climate, we need to treat emissions like a tap we can turn down. Every fraction of a percentage we reduce this year translates into a slightly quieter rise -if not a pause- in atmospheric CO_2 tomorrow. The data make it crystal clear: solving the CO_2 problem means curbing our output at the source.

CO_2 presence

Climate Change: Where we stand

Global temperatures anomaly (1850 - Today)

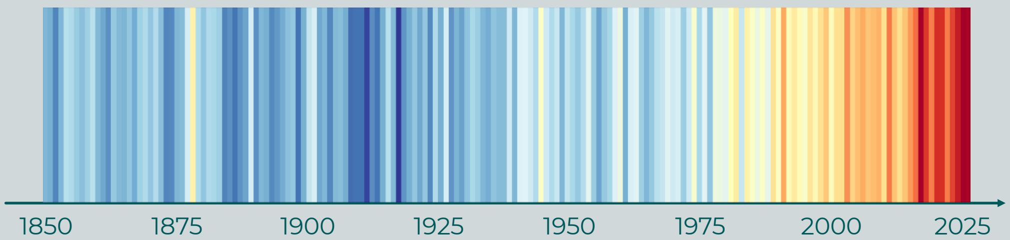


Delving into the figures behind those warming-stripes, the story that comes out of the analysis is both recognizable and unsettling. Throughout 1850 through the early decades there is all plenty of gentle wobbles around the zero line - 1904 actually being a bit about 0.24 °C below the 1861–1890 baseline- before it properly gets moving upwards. If we consider every ten-year period, the 1850s group at +0.04 °C, the 1890s at around -0.06 °C, and by the 2010s you're at about +1.10 °C, up to about +1.37 °C in the early part of the 2020s.

A quick linear fit performed across that range gives a slope of some 0.0066 °C/yr -so maybe some 0.066 °C warmer per ten years- with a correlation coefficient of 0.84, pointing to an exceedingly clear trend upward. The high point in this data climbs to roughly +1.63 °C in the latest entry (2025), though our stripes chart cuts off at 2023, where the reds are already very deep.

If we look at the warming-stripes chart itself -that is, those pleasant blues giving way to weak yellows and finally blazing reds- it's exactly that accelerating pull upwards in the year-to-year anomalies that we are seeing in color. Each stripe is a single data point, and all of them together demonstrate just how abruptly we've moved from a world of moderate cool-to-warm variation into one of continuous, extensive warming. The visual rhythm of the chart mirrors the numbers: glacial paces to begin with, then an unambiguous sprint toward increasingly warm years.

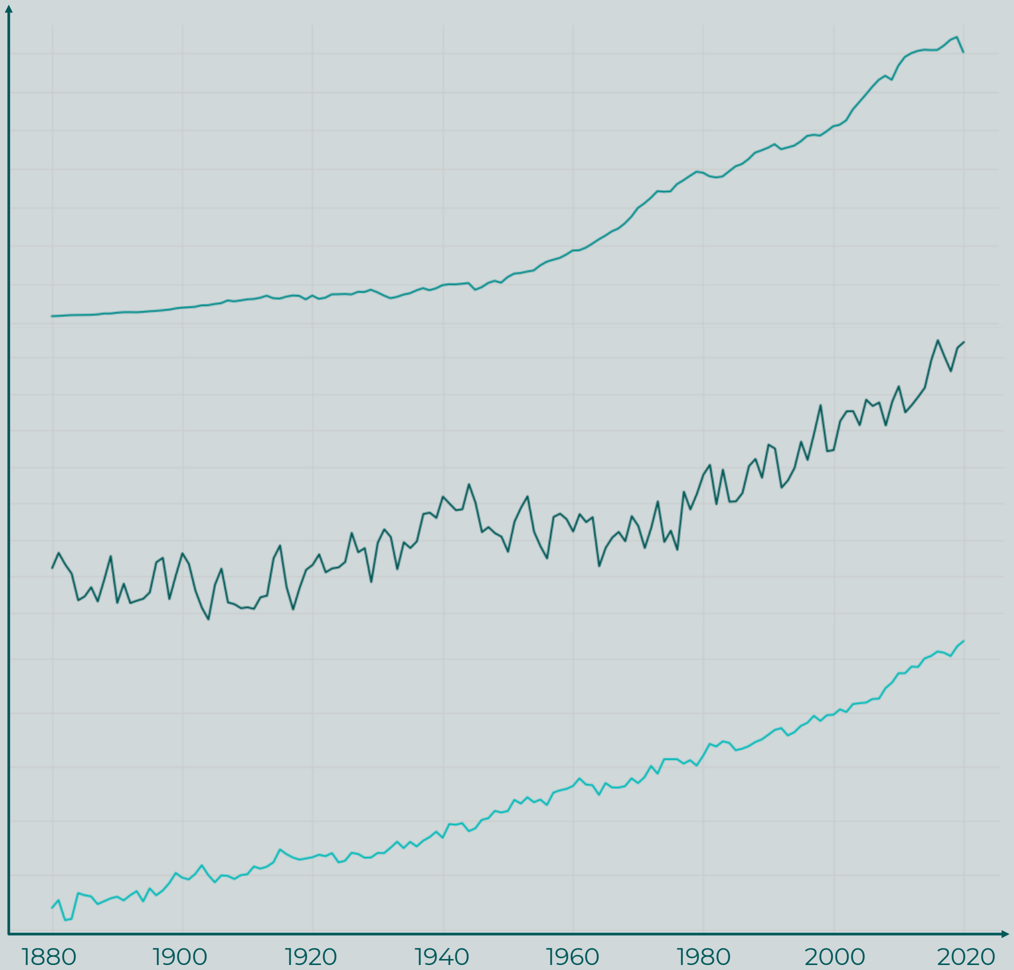
Warming stripes (1850 - Today)



Temperatures

Climate Change: Where we stand

Correlation between CO2 emissions, temperatures anomaly and sea level (1880 - Today)



	CO_2 emissions	Temperatures anomaly	Sea level
CO_2 emissions	1,000	0,919	0,969
Temperatures anomaly	0,919	1,000	0,923
Sea level	0,969	0,923	1,000

Pearson correlation matrix

Picture the late 19th century, circa 1880: industrial activity was still in its early days, yearly CO_2 emissions were still under one billion tonnes, temperature fluctuations only crept slightly above or below the long-term norm, and sea level rested close to 180 mm below the present-day benchmark. As we move through decades of growing factories, cars, and energy use, those emissions rise steadily into the tens of billions of tonnes. This accumulation of greenhouse gases within the atmosphere sends one unmistakable message: mean global temperatures rise - initially, higher than half a degree Celsius anomaly, later higher than a full degree in more recent history- and the oceans respond in similar manner, going up by something of the order of a quarter of a meter.

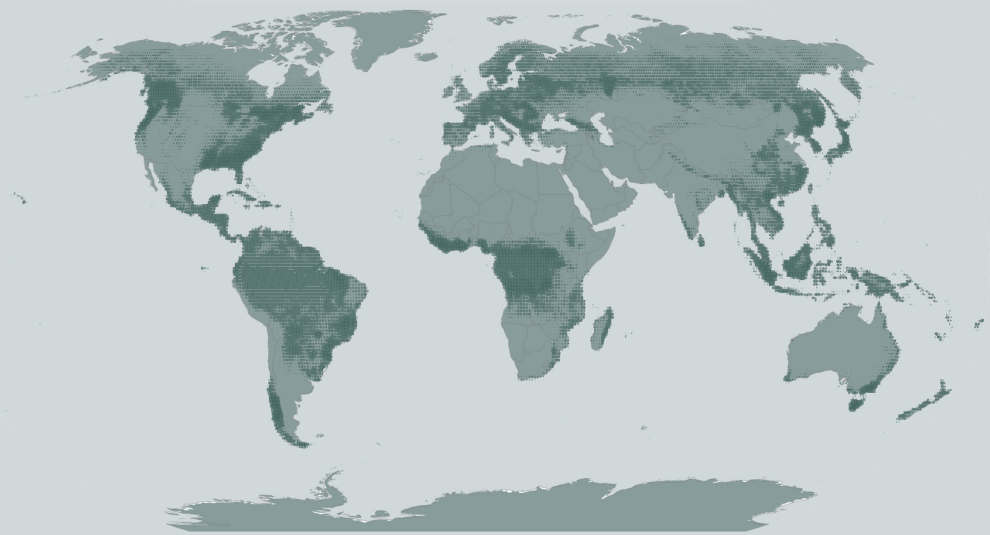
When the variables are treated numerically, their interrelatedness is clear. The sea level correlation coefficient with year is 0.985, very precisely showing that sea-level change has proceeded nearly in lockstep with the passage of time. No less revealing, CO_2 emissions correlate with sea-level rise at 0.969, emphasizing the physical link between increasing atmospheric carbon -through enhanced thermal expansion and glacial melting- and increasing ocean surfaces. Temperature anomaly, on the other hand, has correlations of approximately 0.919 with CO_2 emissions and 0.923 with sea level, confirming its role as a key intermediary: as emissions accumulate, the atmosphere warms, and as the atmosphere warms, the oceans adjust.

Looking over a span of 141 years, this trio of variables creates a coherent picture: the expansion of human industry increases atmospheric CO_2, which leads to global warming, which manifests as seas rising. These correlation coefficients are not abstract figures; they tell of the inherent correspondences that typify modern-day climate change, reminding us that each increment of carbon emissions, each tenth of a degree warming, and each millimeter rise in sea levels are pages of the same continually unfolding story -a story that continues to be read with each next reading of emissions and temperature.

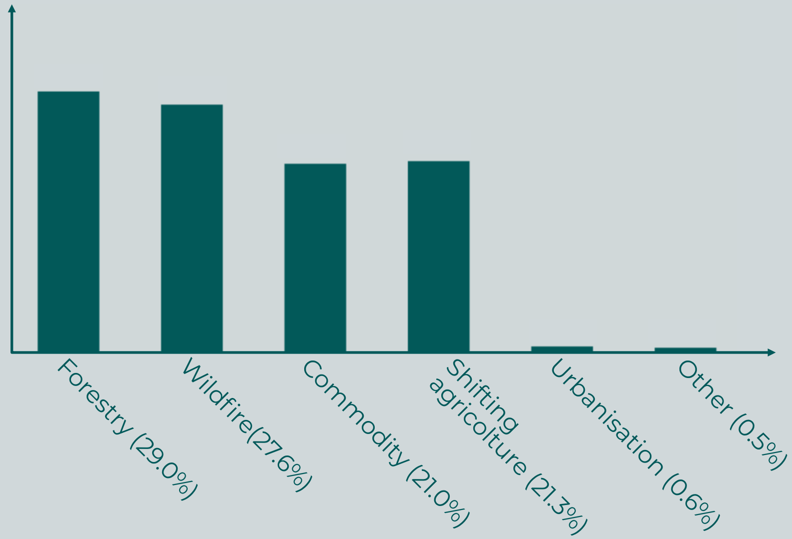
CLIMATE CHANGE
THE LEADING CAUSES

Climate Change: The leading causes

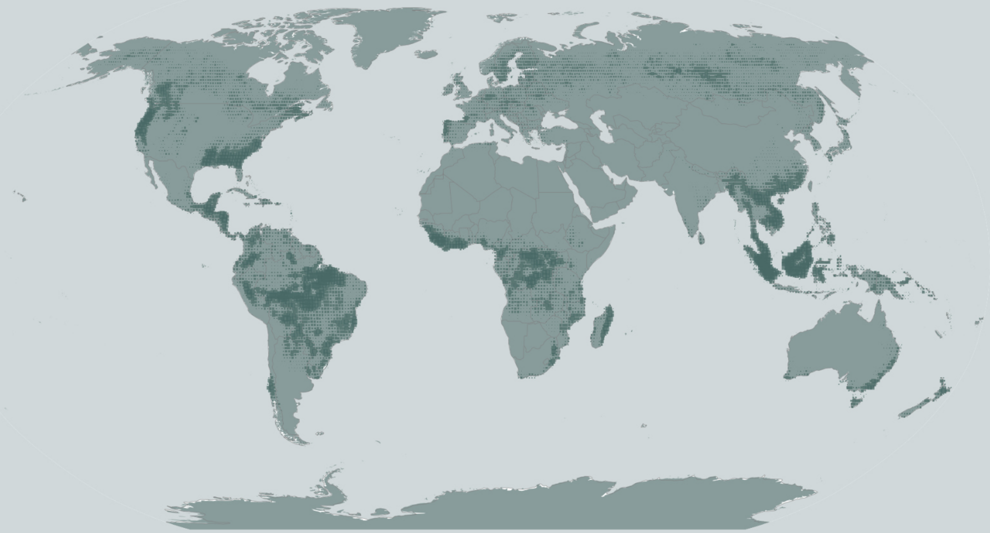
Average annual forest greenhouse gas removals (2001 - 2021)



Average annual forest greenhouse gas removals (2001 - 2021)



Average annual forest greenhouse gas emissions (2001 - 2021)



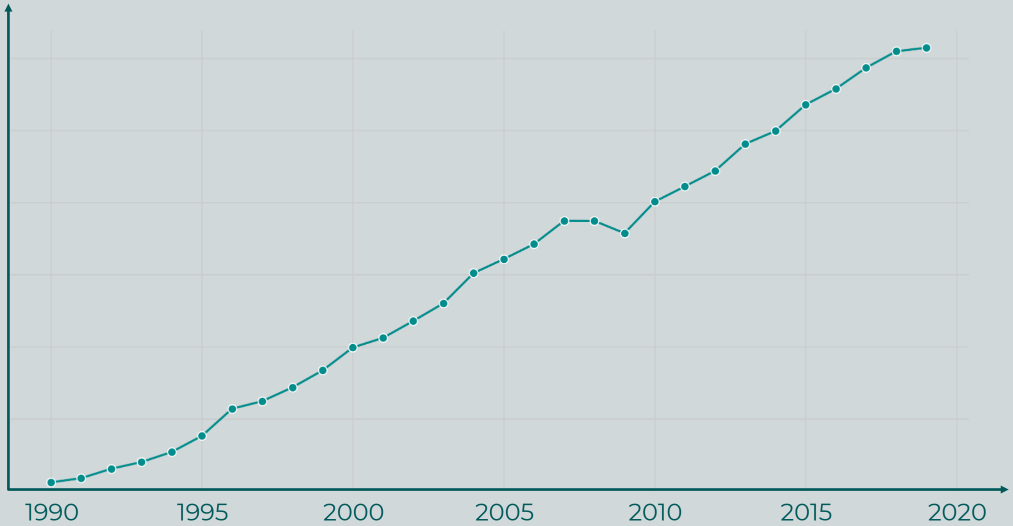
Looking at the annual numbers, forests emit about 8.4 billion units of carbon but remove some 15.6 billion, leaving us with a net sink of roughly 7.3 billion. Most of that comes from temperate forests in the Northern Hemisphere (around 6 billion), while the tropics contribute about 1.4 billion and the Southern Hemisphere about 1.2 billion.

When we look at what's eating into that tree cover, forestry operations top the list at 29 percent, closely followed by wildfires at 27.6 percent; commodity-driven agriculture and shifting cultivation each account for about 21 percent, with urban growth and unknown causes making up the rest. Tackling logging impacts, improving fire management, and curbing agricultural clearance would go a long way toward bolstering forests' role as a carbon sink.

Deforestation

Climate Change: The leading causes

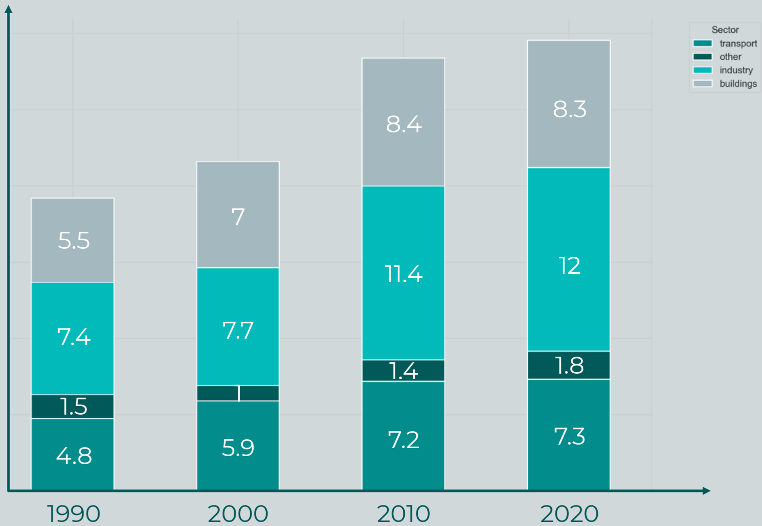
Yearly transport CO2 emissions (1990 - 2019)



When you look at the NO_2 and $PM_{2.5}$ charts, the impact of the COVID lockdown around "day zero" really jumps out: the actual measurements dive well below what the forecasting models would normally predict, and they stay suppressed for weeks. But if you zoom out and check the global emissions tables, you're reminded that those gains were fleeting - transport CO_2 climbed steadily from about 4Gt in 1990 to over 7Gt in 2019, and even today transport still makes up roughly a quarter of all production-based CO_2 (with industry at around 41 percent and buildings about 28 percent).

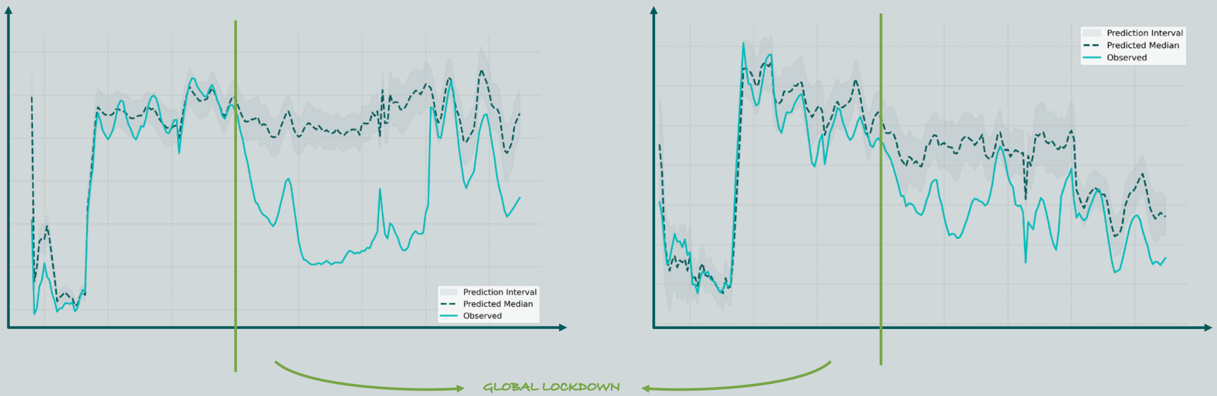
In other words, the sharp air-quality wins during lockdown are tantalizing proof of what cutting vehicle and freight activity can do, but lasting change will demand deeper shifts -electrifying fleets, boosting public transit, rethinking how we move goods and people- so that clean air isn't just a temporary side effect of a crisis.

CO2 emissions by sector (1990 - 2020)



Air pollution anomalies relative to NO2

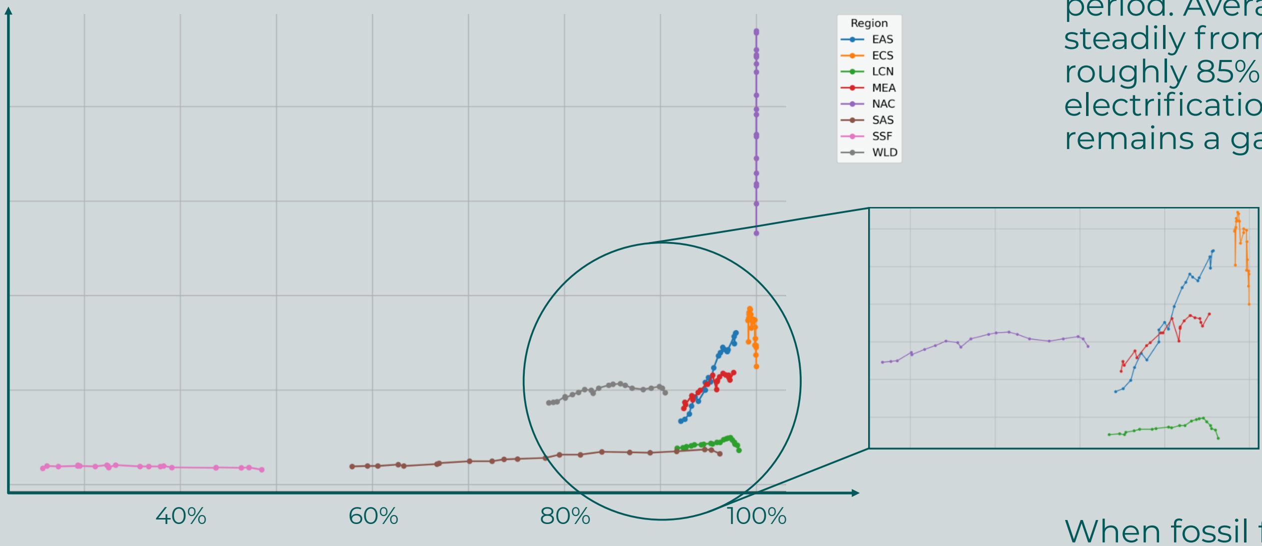
Air pollution anomalies relative to PM2.5



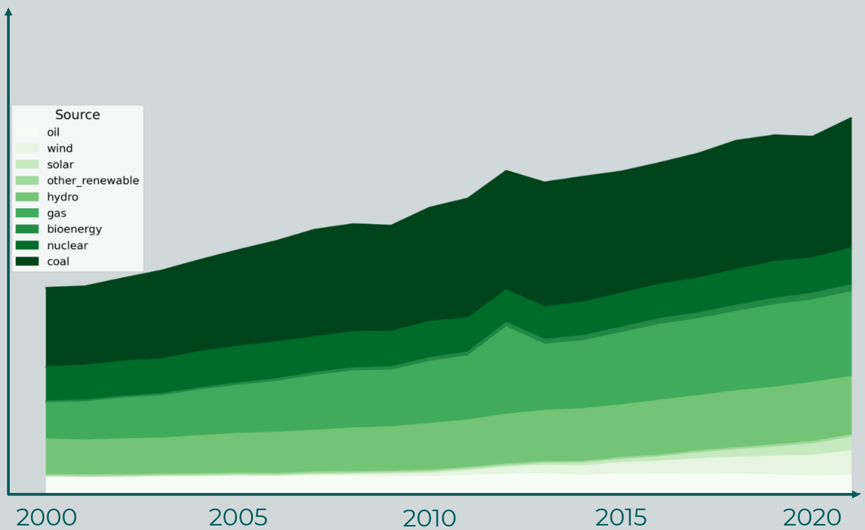
Transportation

Climate Change: The leading causes

Emissions per capita Vs. Access by Region (2000 - 2010)



Electricity generation sources (2000 - 2020)



The analysis reveals several clear trends over the 2000–2021 period. Average electricity access across all countries climbs steadily from around 70% at the turn of the millennium to roughly 85% by 2021. That upward trajectory reflects electrification efforts in developing regions, though there remains a gap before universal access is achieved.

Per-capita emissions from the electricity sector rise in tandem with early access improvements, growing from about 1.2 units in 2000 to a peak near 1.6 units around 2010, before leveling off and slightly declining to about 1.5 units by 2021. The coupling of emissions with access suggests that expanding grids initially leaned on fossil generation, but emissions intensity has begun to moderate as cleaner sources enter the mix.

When fossil fuels (coal, oil and gas) are aggregated and compared against renewables (wind, solar, hydro, bioenergy and other renewables), fossil-based generation retains dominance in the early 2000s. From 2005 onward, renewable output accelerates sharply, overtaking fossil growth rates by the mid 2010s. Although fossil generation still accounts for the bulk of global supply, the renewable curve's steeper slope points to its rising role in curbing emissions over time.

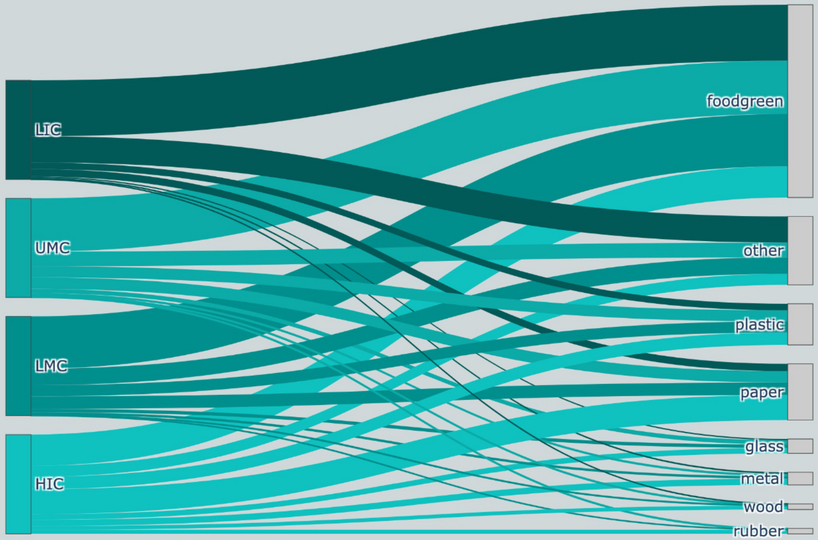
The chart of Emissions per capita Vs. Access yields a correlation coefficient of 0.72. This positive relationship indicates that regions with lower access often have lower emissions per capita -reflecting both limited consumption and reliance on modest, sometimes off-grid, solutions- while well-electrified economies tend to generate more emissions per person. However, the flattening of emissions alongside continued access growth in recent years hints at decoupling driven by renewables and efficiency gains.

Overall, initial electrification phases that increase emissions, followed by a maturation stage where cleaner generation technologies expand rapidly enough to stabilize or reduce per-capita emissions even as access nears saturation.

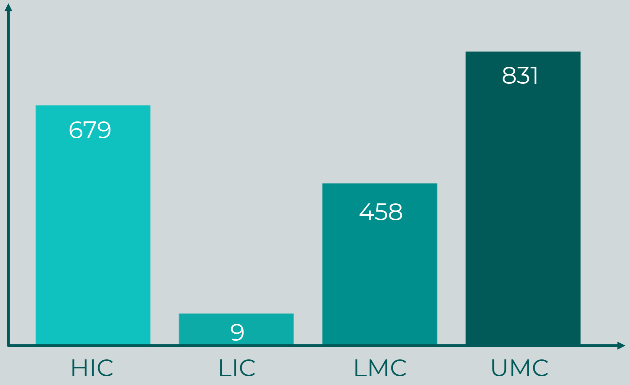
Energy production

Climate Change: The leading causes

Waste composition by Income level

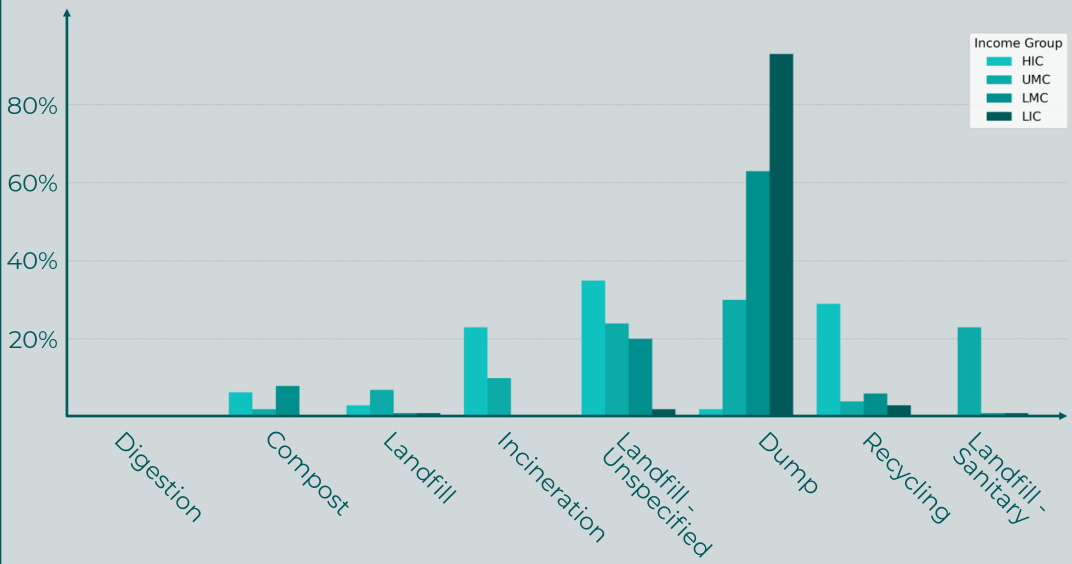


Waste production by Income level



Upper-middle- and high-income countries together produce over two-thirds of global municipal solid waste, with about 830 million tonnes from upper-middle-income and 680 million tonnes from high-income economies annually. Lower-middle-income nations generate roughly 460 million tonnes, while low-income countries contribute under 100 million tonnes.

Waste treatment by Income level



As income rises, waste shifts from predominantly organic in poorer regions -where low-income countries send more than 93 percent of refuse to open dumps- to a more mixed stream in richer ones, where organics fall to around 31 percent and paper, plastic, metal, and glass gain share. High-income areas recycle nearly 29 percent and compost or digest over 6 percent, supplementing these with engineered landfills and incineration. In contrast, middle- and low-income countries rely heavily on uncontrolled dumping and low-tech landfills, recycling under 7 percent and composting under 3 percent.

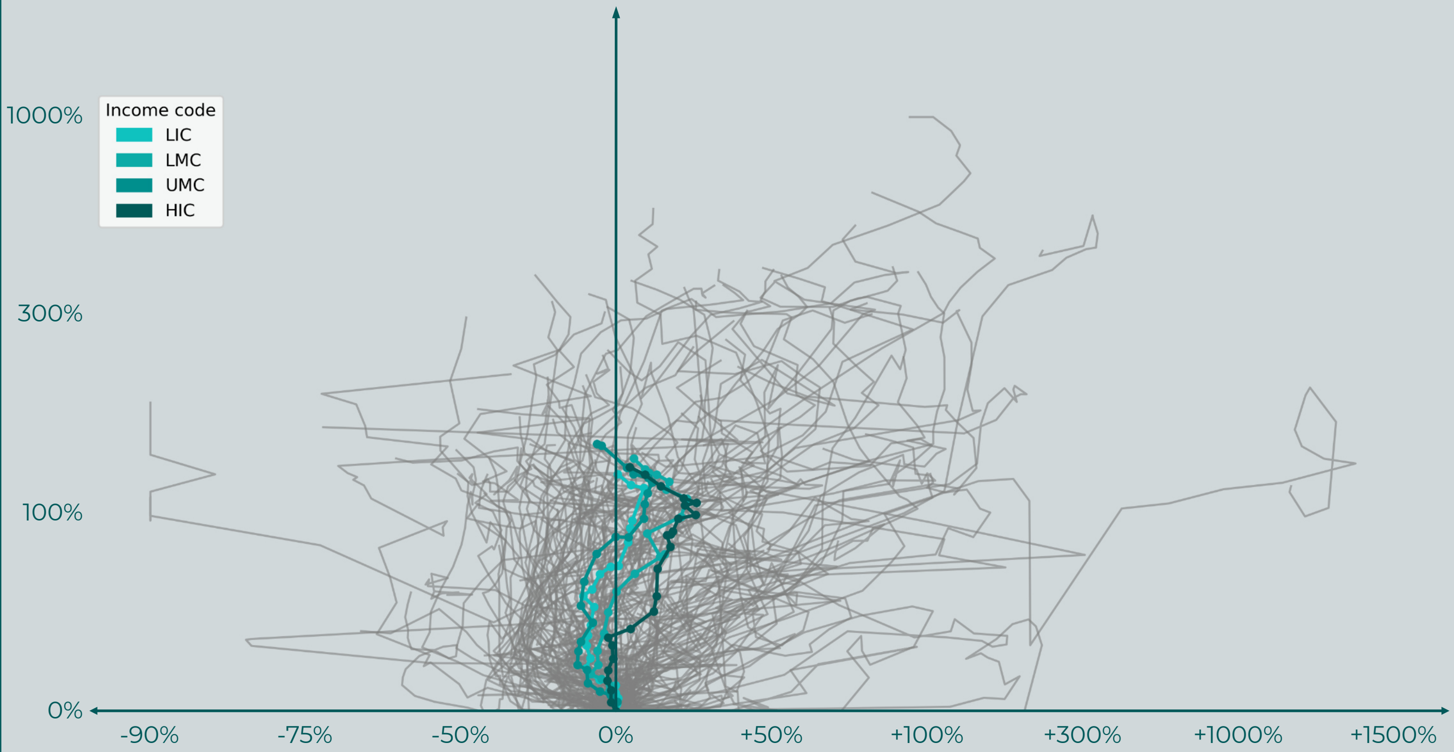
This disparity increasesv environmental and health risks in less-developed regions -through methane emissions and disease vectors- while advanced systems in wealthier nations better capture resources but still depend on landfills and incineration. Closing the gap requires expanding basic collection and sorting in poorer areas, scaling up recycling and composting where feasible, and refining waste-to-energy and circular-economy strategies in high-income settings to match treatment methods with local waste compositions.

Waste management

Climate Change: The leading causes

(Un)sustainable growth

Growth in natural capital per capita and GDP per capita (1996 - 2018)



Looking at the sustainable growth data divided by income group, there is a clear pattern: wealthier countries are better at growing their economies without heavily damaging their natural resources.

High-income countries (HIC) tend to grow steadily while keeping environmental losses minimal. Their median trend hovers around zero for natural capital change -suggesting they've found ways, through policies or technology, to grow without draining resources.

Upper-middle–income countries (UMC) grow faster but pay a higher environmental price. Their GDP rises sharply, but so do natural capital losses, showing a stronger dependence on resource extraction and land use to fuel development.

Lower-middle–income countries (LMC) show the most dramatic economic growth -and the steepest drops in natural capital. This pattern is typical of rapid industrialization driven by agriculture, mining, and logging, with limited ability to manage the environmental fallout.

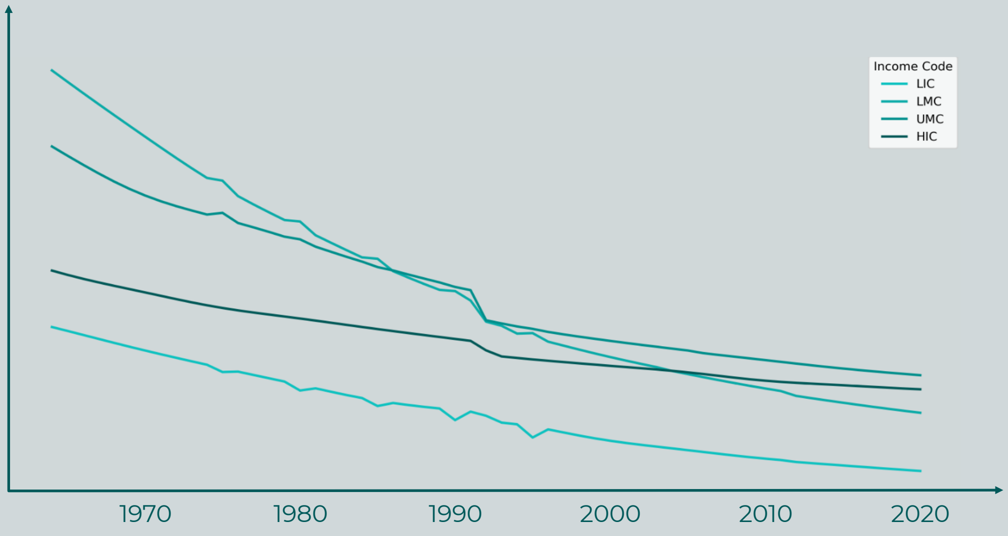
Low-income countries (LIC) grow more slowly but still face major losses in natural assets. Their growth paths are more volatile, reflecting deeper challenges: limited access to funding, tech, and infrastructure, and a reliance on resource-heavy livelihoods.

Across all groups, the ideal scenario -growing GDP without harming the environment- is mostly achieved by high-income nations. As incomes drop, countries tend to trade nature for output. This points to different needs: wealthier nations can drive innovation and finance green projects, middle-income countries need better infrastructure and regulation, and low-income countries need targeted support to grow sustainably from the start.

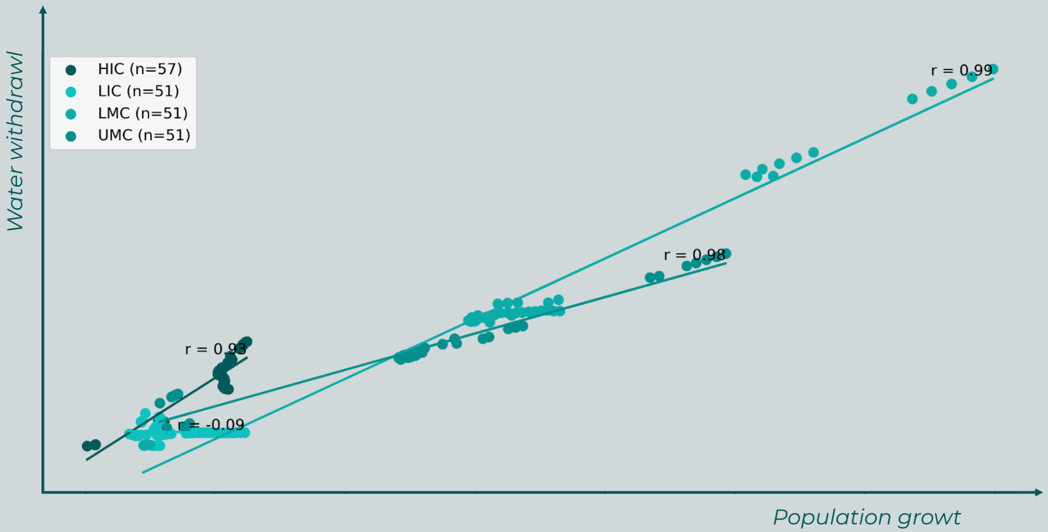
CLIMATE CHANGE THE IMPACT ON US

Climate Change: The impact on us

Per capita water access by income group (1965 - 2020)



Correlation between population growt and water withdrawl (1975 - 2020)



Examining per-person water withdrawals across income groups reveals a pronounced upward trajectory: low-income countries report roughly 5.000 m³ per capita per year, lower-middle-income economies about 4.150 m³, upper-middle-income nearly 10.000 m³ and high-income close to 10.000 m³ as well. This pattern yields a strong positive Pearson correlation of approximately 0.83 between income tier and individual water use, despite a slight anomaly in which low-income averages edge out lower-middle figures, likely reflecting reporting quirks in the smallest cohort.

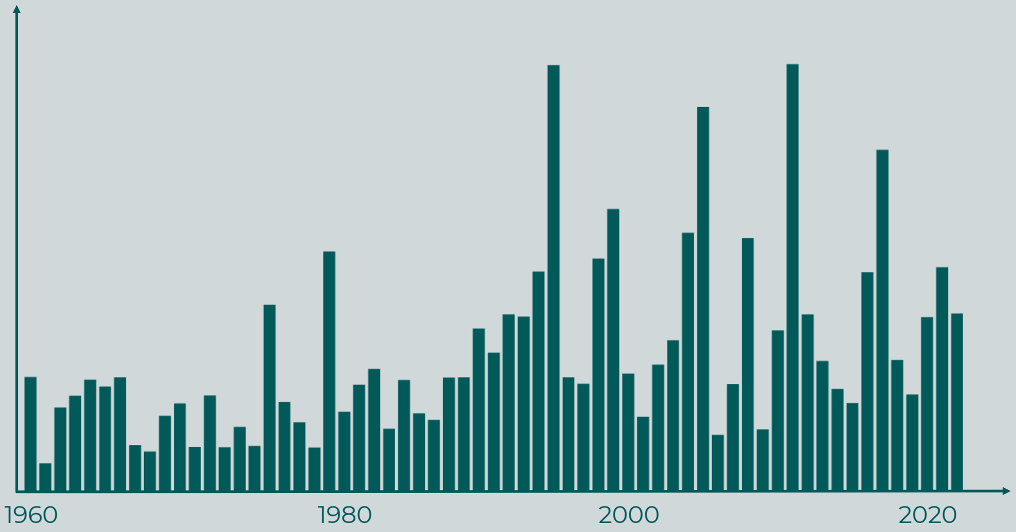
When total withdrawals are aggregated, demographic scale reshuffles the ranking. Lower-middle-income countries lead by a wide margin with 38.4 billion m³ in 2020, followed by upper-middle at 26.6 billion and high-income at 16.2 billion; low-income withdrawals remain modest at 3.9 billion. Here the link between wealth and absolute volume weakens (r≈0.22), as populous emerging markets eclipse wealthier but less populous nations.

Recasting aggregate volumes on a per-person basis brings the wealth gradient back into focus. High-income regions average about 737 m³ per capita when their totals are normalized, more than four times the 159 m³ observed in low-income countries; both middle-income tiers cluster near 520 m³. This conversion strengthens the income–use relationship further, with a Pearson coefficient of roughly 0.93 connecting income status to per-person withdrawal of group aggregates.

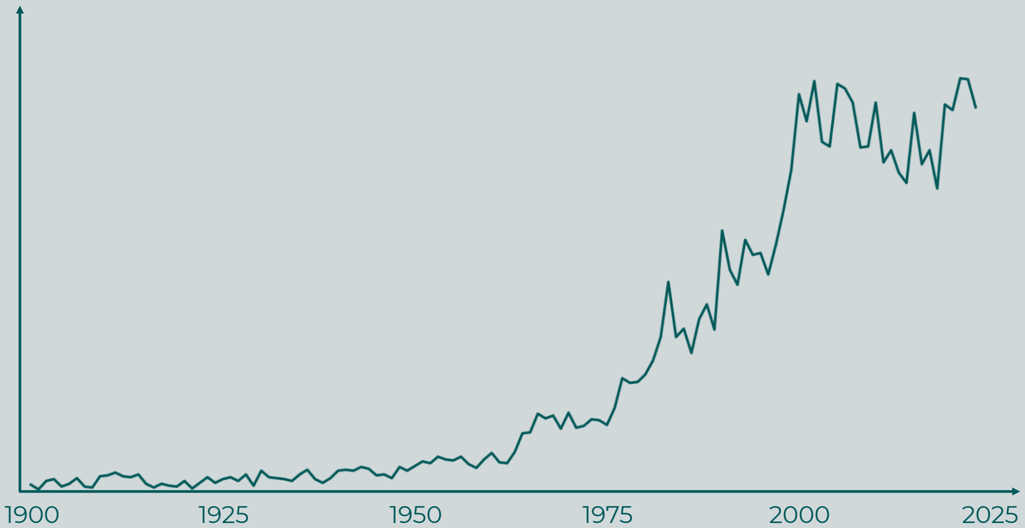
Together, these facts point to a dual challenge for water-management policy: while economic development reliably drives higher individual consumption, the aggregate demand of large, lower-income populations can rival or exceed that of richer nations. Effective strategies must therefore balance per-capita stewardship with the demographic forces shaping total water withdrawals.

Climate Change: The impact on us

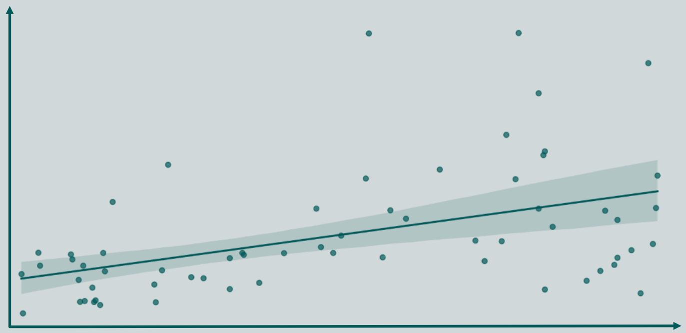
Economic Damages as Share of GDP (1960–2022)



Number of Disasters (1900–2023)



Disaster count vs. Economic damage share



Analysis of global disaster trends from 1960 through 2022 reveals a clear and sustained rise in the number of recorded events alongside an increasingly heavy economic burden. In the early 1960s, fewer than fifty disasters were documented each year; by 2021 the annual count had surged to 441. This upward trajectory reflects both improvements in global disaster monitoring and a genuine intensification of extreme weather, seismic and hydrological events. Over the same period, the share of world GDP lost to disasters climbed from below 0.05 in 1961 to peaks around half a percent, with particularly sharp spikes in years marked by catastrophic singular events.

The scatterplot comparing annual disaster counts to the proportion of GDP lost yields a moderate positive correlation of 0.463, indicating that years with more disasters tend to correspond with greater economic damage. Yet this relationship is not perfectly linear, as illustrated by the contrast between 2011 and 2021, which saw the highest number of disasters but a lower share of economic impact (0.26 %). Such divergences underscore the outsized influence that a handful of extremely destructive events can have on economic totals.

Taken together, the data suggest that while increased disaster frequency is a significant driver of rising economic losses, the severity and context of individual events remain critical. Policymakers and risk managers should therefore balance investments in broad-based disaster preparedness with targeted strategies to reduce vulnerability to the most catastrophic hazards.

Natural disasters_economic damages

Glossary

Greenhouse Gases (GHGs)

Gases in Earth's atmosphere—like carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases—that trap heat radiating from the planet's surface, driving the greenhouse effect.

Greenhouse Effect

The natural process by which greenhouse gases absorb infrared radiation emitted by Earth and re-emit it back toward the surface, keeping the planet warmer than it would be without an atmosphere.

Carbon Footprint

The total amount of greenhouse gases (typically expressed in CO_2-equivalents) emitted directly and indirectly by an individual, organization, product, or activity over a specified period.

Climate Change Mitigation

Actions to reduce or prevent the emission of greenhouse gases, such as switching to renewable energy, improving energy efficiency, or protecting and enhancing carbon sinks.

Climate Change Adaptation

Adjustments in natural or human systems in response to actual or expected climatic stimuli, aimed at moderating harm or exploiting beneficial opportunities (e.g., building flood defenses, altering agricultural practices).

Carbon Sink

Natural or artificial reservoirs (forests, soils, oceans, carbon capture technologies) that absorb more carbon from the atmosphere than they emit, helping to offset GHG emissions.

Radiative Forcing

The change in energy flux (Watts per square meter) in the Earth-atmosphere system due to factors such as greenhouse gases, aerosols, or land-use changes; positive forcing warms, negative forcing cools.

Global Warming Potential (GWP)

A measure of how much heat a greenhouse gas traps in the atmosphere over a specific time period (commonly 100 years), relative to CO_2 (which has a GWP of 1).

Climate Tipping Point

A critical threshold at which a small perturbation can qualitatively alter the state or development of a climatic system, potentially triggering self-reinforcing feedbacks (e.g., collapse of major ice sheets).

Biography

Website

https://ourworldindata.org/

https://www.worldbank.org/ext/en/home

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