

Briefing · July 2024

Unnatural disasters: The connection between extreme weather and fossil fuels

Key points:

- Rising temperatures have increased the likelihood and intensity of extreme weather events, and individual extreme weather events can now be directly attributed to the effects of climate change.
- Fossil fuels are responsible for around 70% of carbon dioxide emissions that lead to climate change since the industrial revolution, with the rest resulting from farming and deforestation. One third of fossil fuel emissions since 1965 have been caused by the output of just 20 fossil fuel firms.
- Fossil fuel companies have known about their impact on climate change for decades while proactively working to oppose climate action.
- Litigation is increasingly being used to hold fossil fuel companies accountable for their impacts on the basis of climate science connecting extreme weather events to their emissions, and claims they misled the public in denying responsibility for climate change.
- Profits of fossil fuel firms over a 30-year period stand at more than USD 21 trillion – are more than a quarter larger than the damages related to climate change they are estimated to be responsible for, calculated at USD 15 trillion.
- Reducing supply and demand of fossil fuels is necessary to limit global temperature rise and its impact on extreme weather events. Most of the technologies needed are available and already cheaper or close to it.
- Progress in decarbonising energy systems and transportation show it is possible to phase out fossil fuels.

Explaining extreme weather

Rising global temperatures impact the frequency and intensity of extreme weather events outside the boundaries of natural variability. While not the sole cause of the intensification of extreme weather, recent events such as heatwaves, droughts and floods would not have happened at the same frequency and intensity without the fossil fuel-driven influence on climate change.

More than [500 attribution studies](#) have linked individual extreme weather events to climate change. Attribution science compares [models of a world with and without increased greenhouse gas emissions](#) using observed climate data to assess the extent to which climate change impacts extreme weather.

These [studies](#) have confirmed that heatwaves are now stronger and more likely due to human-caused climate change. Studies have also shown that climate change has driven

the occurrence of compound events, including [simultaneous heatwaves](#) and [floods](#), which have been particularly damaging to people and crops in affected regions.

With nearly [20 years of attribution studies](#) to refer to, and evidence on the [physical science behind climate change](#), it is now possible to link many extreme weather events to climate change [without undertaking a dedicated study](#) on a specific event (Table 1).

A larger proportion of attribution is certain in the Global North due to [limited data in the Global South](#), where climate impacts are felt more severely. Researchers warn this may lead to [underestimating the role of climate change in data-poor regions](#).

Table 1: Attributing climate change impact on extreme weather event based on body of research

Event*	Attribution confidence	Detail	Caveat	Attribution study data
Heatwave	Certain globally	More intense/likely due to climate change	n/a	37% of global heat-related deaths in recent decades have been attributed to climate change.
Floods	Certain in some regions	Rainfall-based floods are now more intense/likely due to climate change	Coastal flooding is generally rising due to sea level rise, (unrelated to rainfall-based floods).	A 1-in-10-year rainfall event now occurs 1.3 times every 10 years and is 6.7% wetter.
Droughts	Certain in some regions	More intense/likely due to climate change	There are many factors other than climate change impacting drought intensity, e.g. water management.	The probability of a 1-in-100 year drought has increased three-fold due to climate change.
Wildfires	Certain in some regions	More intense (i.e. larger burned area)/likely due to climate change	Limited data. Human influences like forest management/negligence are important factors.	In southern China, extreme wildfires in 2019 were made over 7 times more likely from climate change.
Tropical Cyclones	Low certainty	Number of cyclones has not increased but climate change has created more intense cyclones through rainfall, sea level rise and warmer oceans.	Limited data. Individual cyclone intensities are not currently higher because of climate change.	Rainfall from Atlantic coast hurricanes in the past 20 years were 4-15 times more intense due to climate change causing over USD 500 billion in damages.
Heavy Snow	Low certainty	Extreme cold is now less likely/intense due to climate change.	Snowfall and polar vortices changes are not yet clear.	

Source: World Weather Attribution guide: Reporting on extreme weather and climate change - A guide for journalists, Heatwave attribution study • Tropical cyclones attribution study: In the North Atlantic, total rainfall from Hurricanes, Katrina, Irma, Maria, Harvey, Dorian and Florence were all made more intense (by between 4% and 15%) by climate change.

*Floods attribution certain in: Europe, Asia, C/E North America, NW/NE South America, S Africa, N Australia.

Droughts attribution certain in: Europe, the Mediterranean, S (W/C) Africa, C/E Asia, S Australia, W North America, NE South America, New Zealand.

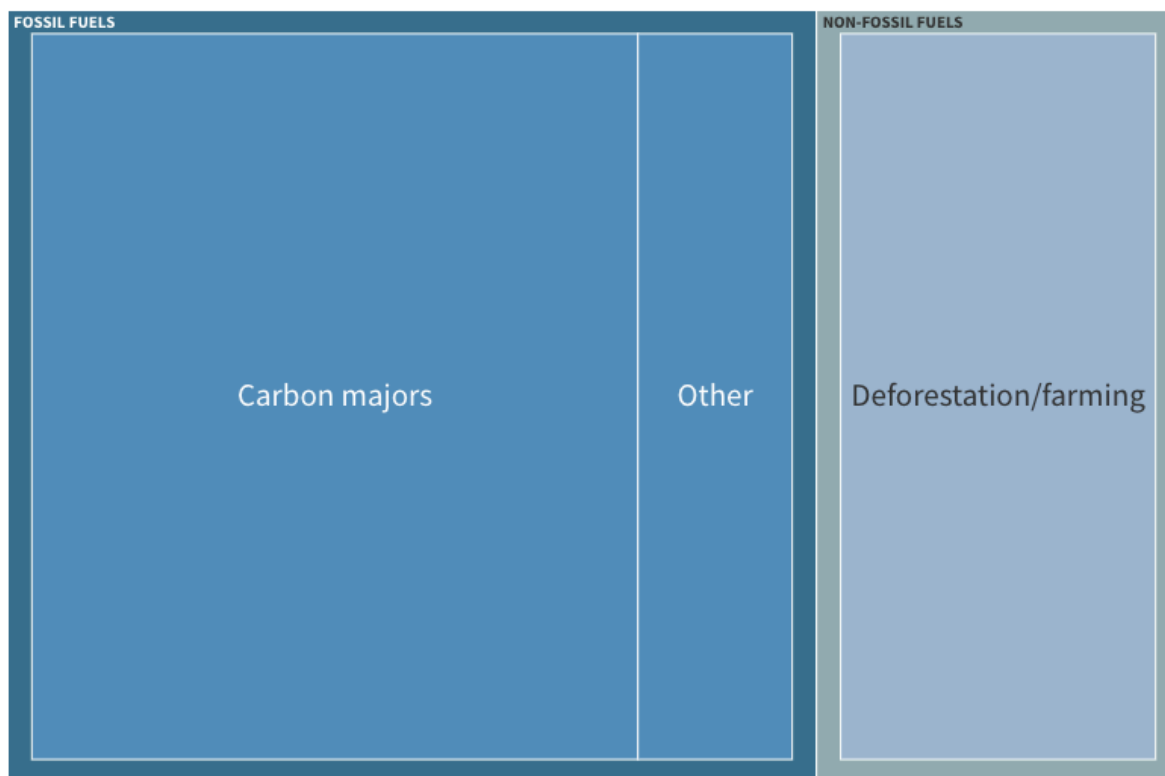
Wildfires attribution certain in: S Europe, N Eurasia, US, Australia, S China.

Fossil fuels are responsible for bulk of global warming

Climate change is caused by the emission of greenhouse gases which absorb energy, slow heat loss to space and act as a blanket [trapping heat in the atmosphere](#). Human-caused greenhouse gas emissions get released into the atmosphere through [burning fossil fuels \(coal, oil and natural gas\)](#), [deforestation and farming](#).

Fossil fuels account for around [69% of global carbon dioxide emissions since the industrial revolution](#). Of this, 80% is the output of the [Carbon Majors](#).¹

Fig 1: Total carbon dioxide emissions by source, 1850-2021 (% total)



Source: ESSD: Global Carbon Budget 2023, InfluenceMap: The Carbon Majors Database, The Global Carbon Project • Data for the contribution of the carbon majors 2021 is the most recent year where data is available across datasets.



In 2018, researchers reported that just [20 fossil fuel companies](#) were responsible for over a third of global carbon dioxide (CO₂) and methane emissions – 480 billion tonnes of CO₂ equivalent – since 1965, when it is documented that the environmental impacts of fuels were known to industry leaders.

Without significant efforts to stop burning fossil fuels, we risk exceeding the Paris Agreement target of 1.5 degrees celsius, which will increase the prospect of earth systems reaching a climate tipping point, catalysing [large and often irreversible changes to the climate](#). The United Nations Environment Programme's (UNEP) 2023 production gap report found that [more than double](#) the amount of fossil fuel production is planned in 2030 than would be consistent with limiting warming to 1.5 degrees celsius.

¹Carbon Majors is the name applied to 122 large oil, gas, coal and cement firms whose production data has been tracked from the start of the industrial revolution in 1854..

Living with the impacts of climate change: Who foots the bill?

The impacts of an increasingly warming world and the extreme weather events that come with it are experienced globally, but are particularly onerous for low-income countries. Research has found that “global warming has very likely exacerbated global economic inequality”. GDP per capita in tropical countries has [fallen by a quarter](#) since the 1960s relative to a world without climate change. Globally, a 1 degrees celsius increase in temperature could lead to a [12% decline in GDP](#).

The [polluter pays principle](#) is a widely accepted practice of placing the responsibility of negative externalities² onto emitters, that is the fossil fuel companies whose products emit greenhouse gas. The principle can be applied through different approaches. One approach is a “carbon price”, which is leveraged through policy instruments such as a [carbon tax](#) or [emissions trading system](#). Other approaches can include windfall taxes on excessive profits and [legally mandated payments](#) to cover loss and damage costs.

Based on the social cost of carbon (using an estimate of [USD 185 per tonne](#)), climate science and policy think tank [Climate Analytics](#) finds that the “dirtiest dozen” Carbon Majors are responsible for around USD 15 trillion in economic damages for production between 1985 to 2018, a period in which they earned USD 21 trillion in profits.³

The profits of fossil fuel companies are such that earnings in 2022 of seven of the largest carbon majors – including Aramco, ExxonMobil and Shell – were almost twice the calculated damages for that year, at USD 497 billion against USD 260 billion. And earnings continue to grow. In the aftermath of the 2022 gas crisis, Saudi Aramco’s CEO claimed the company had “[probably the highest net income ever recorded in the corporate world](#)”, with operational cash flow of USD 186 billion.

² A [negative externality](#) is when one party incurs the costs of a negative effect resulting from actions taken by another. In the last 20 years, moves have been taken to impose the costs of externalities on the producer

³ The methodology conservatively estimates that [producers are responsible for one third of damages caused by fossil fuels](#)’ greenhouse gas emissions.

Table 2: Estimated climate damages linked to emissions from the 12 highest-emitting (MtCO₂e) fossil fuel companies and their respective financial gains (2020 USD trillions), 1985-2018

Company	Financial gain	Climate damages	Emissions 1985-2018 (MtCO ₂ e)
Saudi Arabia: Aramco	5.40	2.80	
Russia: Gazprom	2.90	2.20	
Iran: National Iranian Oil Co.	2.40	1.40	
ExxonMobil	1.20	1.20	
Mexico: Pemex	1.20	1.10	
Shell	0.90	1.10	
BP	0.70	1.00	
Chevron	0.60	0.90	
China: PetroChina	1.30	0.90	
United Arab Emirates: ADNOC	1.70	0.70	
Venezuela: Petroleos de Venezuela	1.10	0.70	
Kuwait: Kuwait Petroleum Corp.	1.40	0.60	

Source: Carbon majors' trillion dollar damages, Carbon majors dataset • Emissions data for ADNOC, Petroleos and Kuwait Petroleum was limited.

Legal routes to hold fossil fuel companies accountable

While research continues linking the emissions of the fossil fuel industry to estimates of monetary climate damages, the approach of holding the industry accountable is being put into practice through legal routes. More and more legal connections are being made between extreme weather and the fossil fuel industry, litigating and legislating to demand payments for loss and damage.

Legislating polluter pays

In May 2024 the US state of Vermont, hit by extensive flooding in 2023, [passed a law](#) that aims to force the fossil fuel industry to pay into a fund for climate damages that have hurt public health, agriculture, housing and other areas. The state could collect money from companies that emitted more than 1 billion tons of CO₂ around the world from 1995 to 2024.

Those companies with a certain threshold of business activity in Vermont would be charged according to their percentage of global emissions, with the funds to be used to rebuild and upgrade infrastructure such as stormwater drainage systems, roads and bridges. Other states [reportedly considering a similar approach](#) include Massachusetts, Maryland and New York.

Litigating loss and damage

According to the LSE Grantham Research Institute on Climate Change and the Environment, liability for damages sustained in extreme weather events based on the polluter pays principle is an area of growing climate litigation. It cites the ongoing case *Municipalities of Puerto Rico v. Exxon Mobil Corp.*, which makes “[extensive arguments about the ‘compounded losses’](#) sustained by Puerto Rican communities as a result of Hurricane María in 2017 and Hurricane Fiona in 2022” to argue that fossil fuel companies are liable for losses incurred during these storms as well as ongoing economic impacts.

In May 2022, after a seven-year investigation into whether 47 of the world’s largest fossil fuel companies in the world had violated the human rights of Filipinos, the Philippines Commission on Human Rights [found](#) that climate change is a human rights issue and that the world’s largest fossil fuel companies knew about the impacts of climate change and attempted to obstruct efforts to address climate change.

A [case](#) filed in 2015 by a Peruvian farmer against RWE, one of Germany's largest electricity producers which has used coal-burning power stations, alleges the power company is liable for climate damages in Peru caused by a melting glacier. The case appears to be nearing conclusion, though no verdict has been issued as of mid-2024.

Alongside this there are [over 20 lawsuits](#) from [states and municipalities](#) in the United States seeking damages for extreme weather events from large oil companies for allegedly concealing their own scientific knowledge about climate change and thus deceiving the public about the danger of global warming caused by their products.

There is momentum building in this area. In June 2024 California's attorney general announced it was [seeking](#) damages from large oil companies under a new state law that allows the administration to claim profits earned by companies that violated unfair competition and false advertising laws.

And in the same month, the Supreme Court asked the US solicitor general for its opinion on whether a legal case from [Hawaii suing the oil industry](#) for deceptive advertising can be heard under federal or state law. In 2023 the Hawaii state supreme court ruled the case could go to trial under state law, but this was appealed by the oil industry, including companies such as ExxonMobil and Chevron. The final decision on where to try the case could lead to the other 20+ lawsuits going to trial.

Fossil fuel industry awareness of climate change and opposition to action

There is a growing body of evidence that the fossil fuel industry knew decades ago that the burning of fossil fuels was a driver of climate change. Newly [released documents](#) indicate the oil industry funded climate change research as early as 1954. [Shell's](#) scientists internally warned about the dangers of [climate change](#) in the 1980s, according to media reports.

Peer reviewed academic research has found that [Exxon](#) knew about climate change in the 1970s but continued to make public statements regarding climate science that were in direct contradiction to its own scientific data, which closely matched global warming

forecasts of independent academic and government models. Other studies find that [Total](#) also knew about climate change in the [1970s](#) but engaged in denial of climate science in the 1980s and 1990s.

Despite its early knowledge about climate change, the fossil fuel industry has used a range of strategies to oppose government-led efforts to reduce greenhouse gas emissions for decades. One of the most well known was to fund and promote the denial of climate change as an urgent threat that needs addressing.

Trade associations in particular have lobbied to undermine the conditions that would have enabled rival green technologies to flourish. In the United States and Europe new evidence shows [oil and gas industry trade associations](#) have [lobbied since the 1960s](#) to delay the uptake of solar and wind energy, and electric vehicles. In Asia the fossil fuel industry has [pressured](#) the Japanese government to prioritise fossil fuel technologies such as coal, LNG and ammonia co-firing. In the US the [oil industry is suing the federal government](#) for emission standards that seek to advance the adoption of clean technologies.

Research by the [US Senate](#) into the scale of this agenda culminated in a May 2024 hearing to discuss the oil and gas industry's "Campaign of Climate Denial, Disinformation, and Doublespeak". Based on internal documents from industry firms, the staff report found that:

- Historically fossil fuel companies “understood since at least the 1960s that burning fossil fuels causes climate change and then worked for decades to undermine public understanding of this fact and to deny the underlying science”.
- There has been a shift in emphasis as “the industry’s outright denial of climate change has evolved into a green-seeming cover for its ongoing covert operation – a campaign of deception, disinformation, and doublespeak waged using dark money, phony front groups, false economics, and relentless exertion of political influence – to block climate progress”.
- For example, the industry has put resources into portraying natural gas as a clean green fuel “while internally acknowledging that there is significant scientific evidence that the lifecycle emissions from natural gas are as harmful to the climate as coal and are incompatible with scientific emissions reduction targets”.
- One tactic has been to “privately lobby – either directly or through their trade associations – against pro-climate legislation and regulations that they publicly claimed to support”.

Fossil fuels must be phased out to slow temperature rises

The world’s preeminent authority on climate change science – the UN’s Intergovernmental Panel on Climate Change (IPCC) – has [stated clearly](#) that global greenhouse gas emissions need to peak before 2025 and be reduced by 43% by 2030. Fossil fuel companies are moving slowly or obstructing climate action. Government policies to reduce supply and demand of fossil fuels would be required to achieve this reduction.

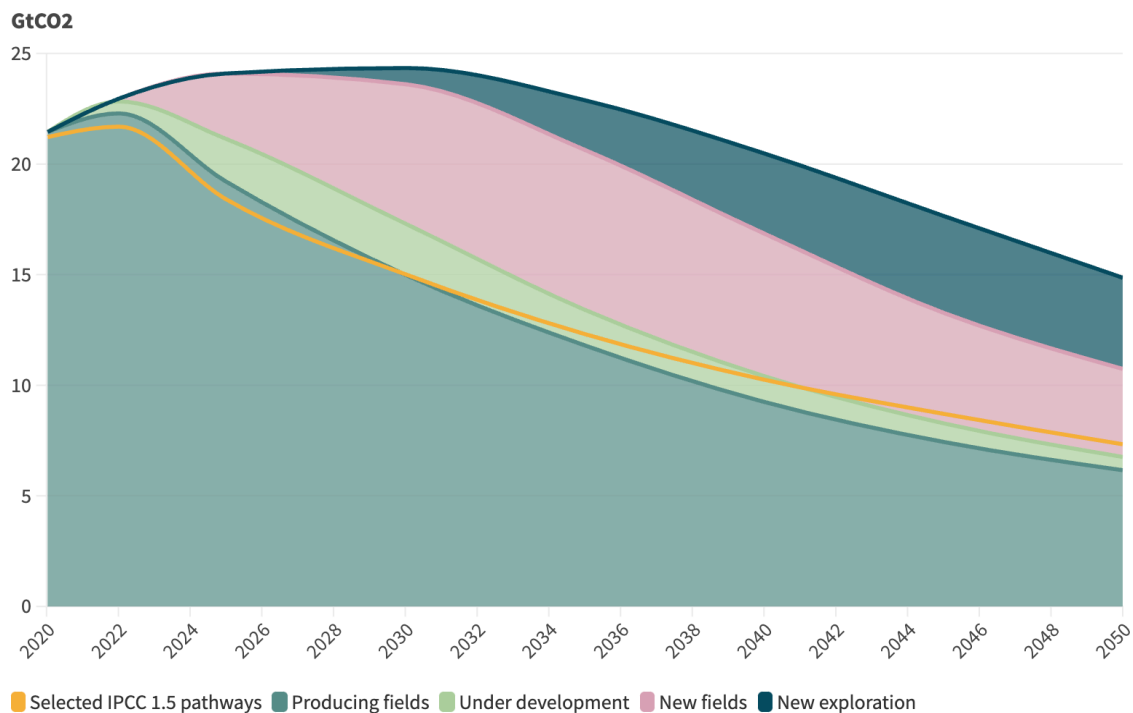
Reducing supply of fossil fuels

The contribution of fossil fuels to global warming was finally recognised by all countries at COP28 where nations [agreed](#) to “Transitioning away from fossil fuels in energy systems, in a just, orderly and equitable manner, accelerating action in this critical decade, so as to achieve net zero by 2050 in keeping with the science”.

[Action needs to be taken on fossil fuel supply](#) to stay inside the 1.5°C carbon budget threshold. To achieve this, [almost 40%](#) of already developed reserves of oil, gas and coal

needs to stay in the ground and new fields should not be opened. Looking ahead, the International Institute for Sustainable Development finds that by 2030 [oil production needs to fall by 15% and gas production by 30%](#) (compared to 2020 levels) to stay within the 1.5°C budget, based on the International Energy Agency’s (IEA) Net Zero Emissions by 2050 (NZE) scenario.

Fig 2: Oil and gas production from new and existing fields vs a 1.5°C aligned pathway



Source: IISD - Navigating Energy Transitions: Mapping the road to 1.5°C
Data extracted using Automeris.io, which produces estimated data based on published graphs.



Some countries are already leading the way in this area. Colombia has [stopped approving new exploration licences](#) for oil, gas and coal since 2023. In Europe, France, Ireland, Spain and Denmark have [banned the exploration and extraction](#) of fossil fuels. These countries, alongside sub-national administrations such as the Canadian province of Quebec and the US state of Washington, have joined together to create the [Beyond Oil & Gas Alliance](#), which advocates for more countries to follow their lead in reducing production towards a just, equitable and managed phase out. Another approach being championed by a number of national governments, cities and civil society leaders is the [Fossil Fuel Non-Proliferation Treaty](#).

Reducing demand for fossil fuels

Alongside supply measures, demand for fossil fuels must be curtailed and replaced with other technologies. The [IEA Net Zero Roadmap](#) recommends achieving the following milestones:

- By 2025 no new sales of fossil fuel boilers
- By 2030 increasing renewables capacity threefold, all new buildings are zero-carbon ready and 60% of global car sales are electric
- By 2035 no new internal combustion engine car sales and net zero emissions electricity in advanced economies

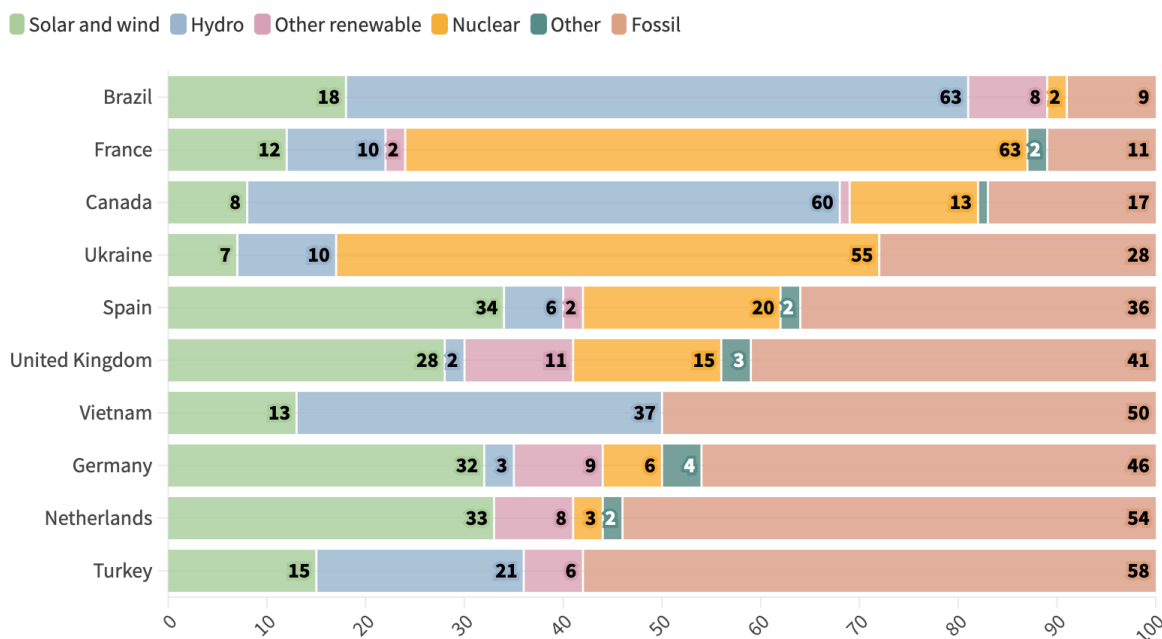
Along these lines, governments have acted to reduce future demand by announcing they will phase out the sale of internal combustion engine vehicles and water heaters. [According to the IEA](#) 20 countries have announced they will ban the sale of internal combustion engine vehicles. There are also a growing number of EU countries that have committed to phase out the sale of fossil fuel powered [water heaters](#).

Governments are deepening policies to reduce demand for fossil fuels, including by accelerating the use of solar and wind energy for electricity generation through subsidies, enabling access to land, and research and development to increase efficiencies and lower costs. This has been a factor in the [tumbling costs](#) of solar panels, wind turbines and batteries that have helped make solar and wind energy some of the [cheapest options for new electricity generation](#). Together these have contributed to the increasing share of renewable energy in electricity generation in a number of countries. In 2023 global renewable capacity additions reached almost 510 GW, which is the [fastest growth rate](#) in the last two decades.

In the European Union ever more ambitious directives on the [binding renewable energy target](#) (currently at 42.5% by 2030) are contributing to the rising use of renewable energy. This has increasingly displaced fossil fuels for electricity generation, resulting in a [24% reduction in emissions](#) from power plants across the bloc in 2023.

Advances in reducing the use of fossil fuels can be seen in the generation mix across a number of high-consumption countries. The [Energy Institute](#) tracked generation across 21 countries that collectively account for 80% of global consumption and found that of the ten most decarbonised electricity systems, 40% generate less than a third of their power from fossil fuels. In Brazil, that figure falls to less than 10%. Germany, the Netherlands and Spain generate roughly a third of electricity from solar and wind power.

Fig 3: Top 10 decarbonised electricity systems among high-consumption countries



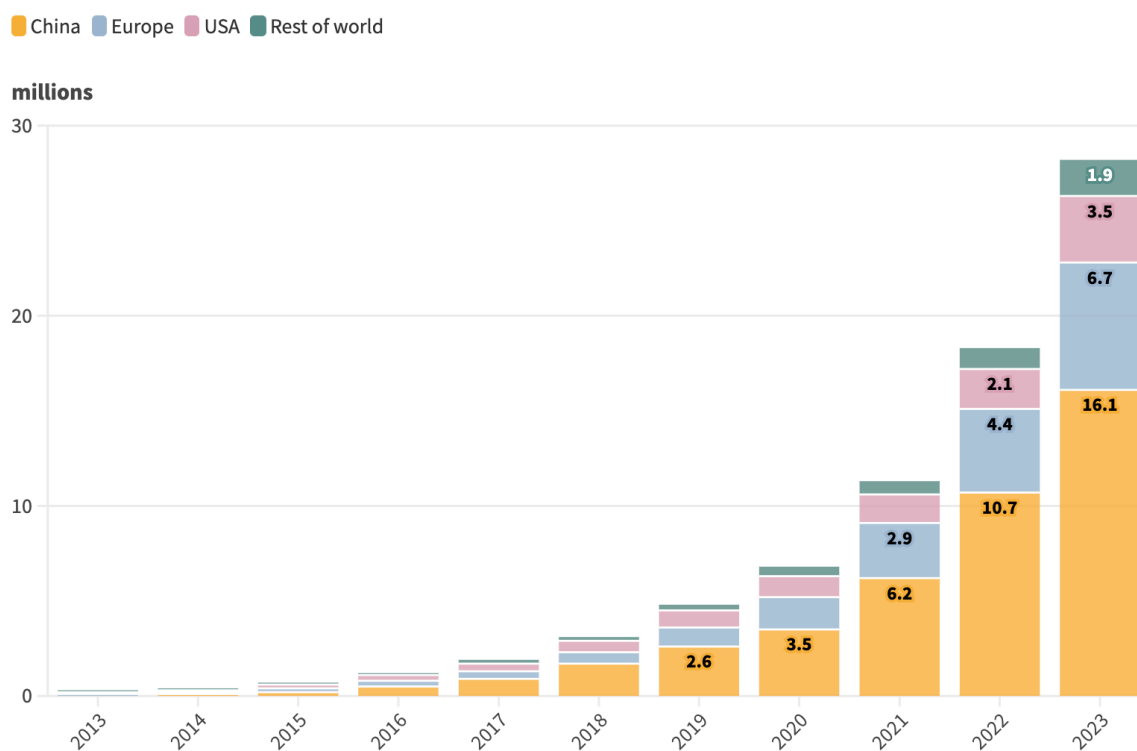
Source: Adapted from Energy Institute



China in particular has vastly accelerated its use of renewable energy, although the significant size of China's energy use means that it still relies heavily on fossil fuels. Between 2014 and 2023 China's solar capacity [increased from](#) 28 GW to close to 610 GW and wind energy from 96 GW to 4,441 GW. To give an idea of the scale of this shift, in 2023 China commissioned the same amount of solar PV [as the rest of the world](#) did in 2022. This meant that by 2023 China [accounted for 14%](#) of installed solar PV capacity globally.

In the area of transportation, policies such as [subsidies in China](#) and stricter [auto emissions standards](#) and [tax credits](#) in the US through the [Inflation Reduction Act](#) (which also apply to clean energy and buildings), promote the use of electric vehicles (EVs) to [reduce oil demand](#). This has led [to a jump in the number](#) of EVs from around 300,000 in 2013 to just over 28 million in 2023. Globally, the sales of EVs [displaced](#) around 0.9 million barrels per day (Mb/d) of oil in 2023, when total oil demand [grew](#) by 2.1 Mb/d.

Fig 4: Global electric vehicle sales by region, 2013-2023



Source: IEA



Looking ahead, another area of focus are the reforms needed to reduce the size of global [fossil fuel subsidies](#), which amounted to over USD 1.5 trillion in 2022, according to the Organisation for Economic Cooperation and Development (OECD) and International Institute for Sustainable Development (IISD).

Reducing the scale of worsening extreme weather events

The impacts of climate change are set to worsen as global temperatures rise. Extreme weather events are likely to continue to get more frequent and more severe as a result. Climate science is clear that fossil fuels, and the emissions from the largest fossil fuel companies, are responsible for these changes. Only reducing the supply and use of fossil fuels can limit the rise in global temperatures and the extent to which these impacts worsen.