

WAVE ENERGY IN SCOTLAND

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This is the Mocean Energy Blue X prototype, a new technology to harness the power of waves. It is a hinged raft which captures wave energy and turns it into green electricity. It is currently being tested off Orkney.

Wave energy is the world's largest untapped source of renewable energy which, if harnessed, could meet 10% of global electricity demand by 2050.

Source: Mocean Energy

WAVE POWER RESEARCH

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8 new projects were launched in the UK in 2021 to develop cutting-edge new wave energy technologies, with the Energy Minister Anne-Marie Trevelyan saying 'our coastline and the power of the seas around us offers huge potential for clean renewable energy'



Source: UKRI Projects to unlock the potential of marine wave energy © Nick Baker

39 WAYS TO SAVE THE PLANET

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39 Ways to Save the Planet is the landmark BBC radio programme which offers 39 ideas to combat climate change. Go to www.bit.ly/RGS39WAYS

There are plenty of solutions to the climate crisis.
Listen to the Radio 4 series and access our
teaching resources at www.rgs.org/resources

OFFSHORE WIND

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The UK already has the largest installed capacity of offshore wind in the world, with around 10GW in operation off our coasts.

In October 2020, the government set the target of achieving 40GW of wind power energy by 2030, promising that it will produce 'enough electricity to power every home in the country'.

Offshore wind energy is one of the country's prized industrial success stories, and it will form a substantial part of the future UK energy mix.

Source: Gov.uk press release New plans to make UK world leader in green energy

Photo by Nicholas Doherty, on Unsplash, of the Rampion wind farm, Sussex

PEAT-FREE COMPOST

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Peatlands act as an important global carbon store.

Covering only 3% of the planet's land, they contain around 25% of global soil carbon, which is twice as much as the world's forests.

In spite of their importance in the fight against climate change, peatlands continue to be cleared and drained, and peat is still used in some composts. Search *Should I buy peat-free compost?* to learn more

Source: Peatlands keep a lot of carbon out of Earth's atmosphere, Julie Loisel, The Conversation. Photo by Gabriel Jimenez on Unsplash

ELECTRIC MOUNTAIN

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Dinorwig power station in Wales is also known as 'Electric Mountain'. It is comprised of 16km of underground tunnels below Elidir mountain and reversible turbines.

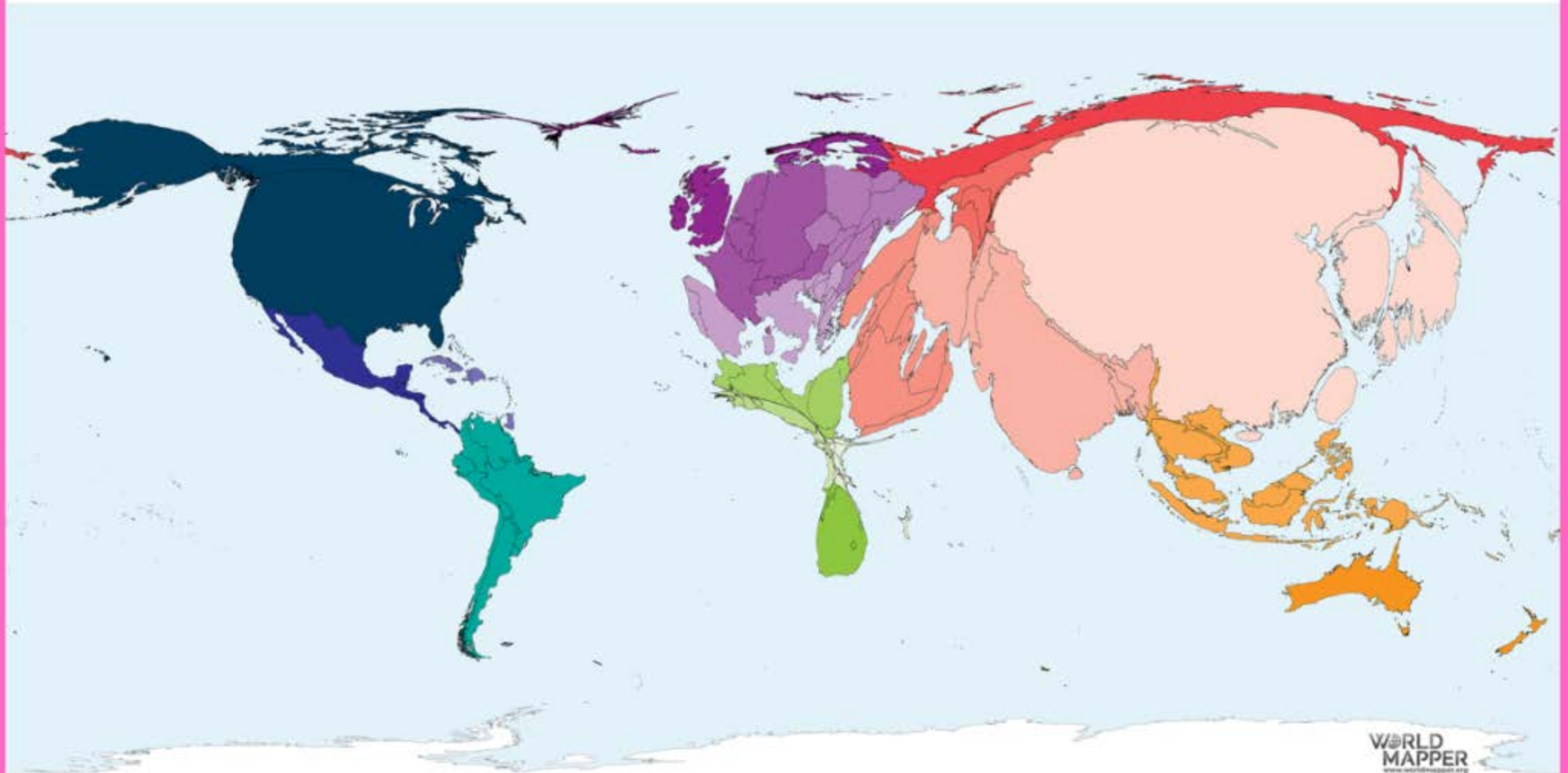
Six units pump water from the lower reservoir, using off-peak electricity, back up to Marchlyn Mawr. When it is released, energy is created by the downflow which is then directed through high-pressure shafts to create electricity.

Source: Electric Mountain Photo by DJ Taylor Shutterstock ID: 576747460

CARBON DIOXIDE EMISSIONS IN 2015

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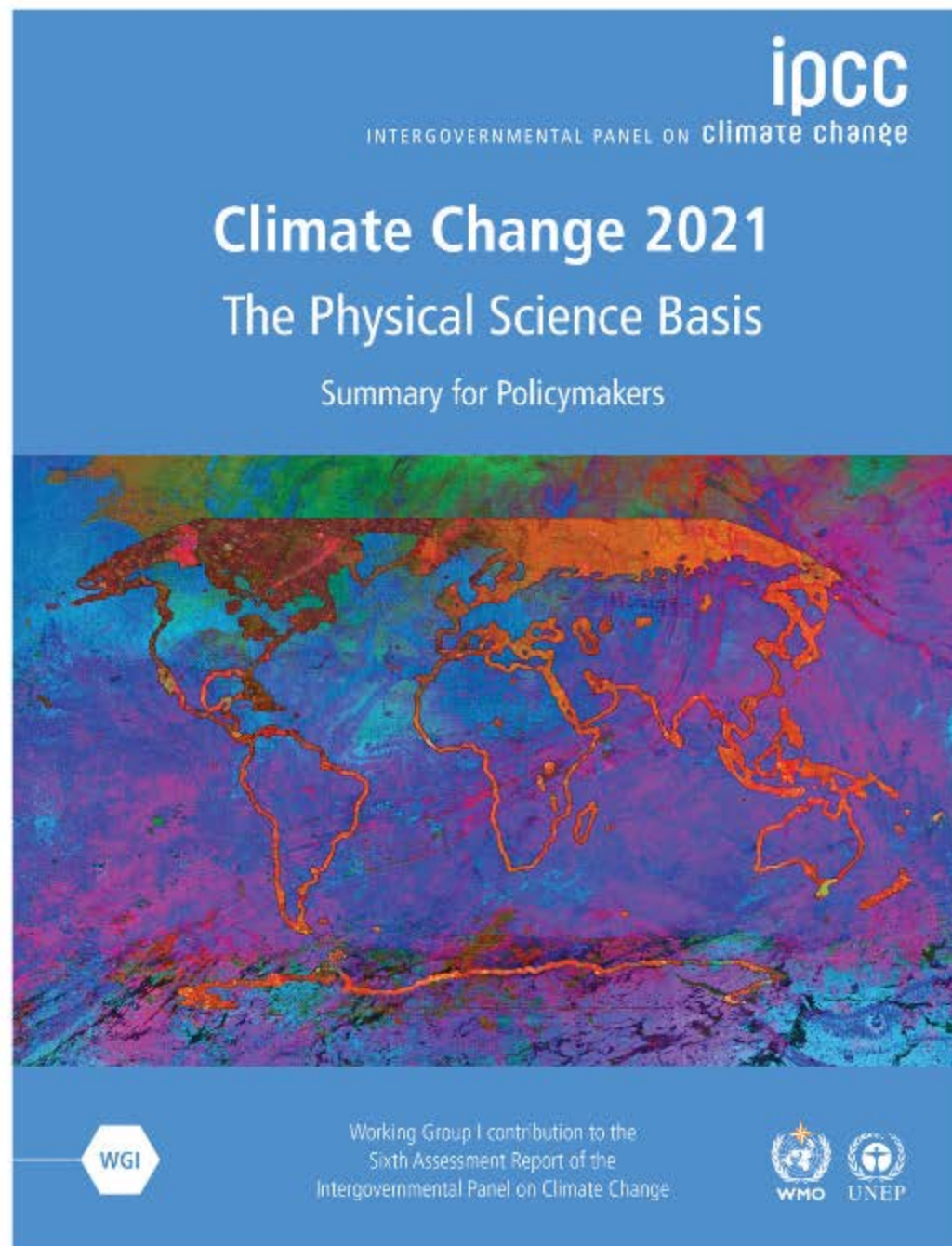
Since 1990, much of the increase in global carbon dioxide (CO₂) emissions has come from emerging countries i.e. China and India. The developed world is also responsible for historic CO₂ emissions, through past fossil fuel use and industrial processes, from the start of the Industrial Revolution, circa 1880 onwards.

Source: Worldmapper Carbon dioxide emissions 2015

THE IPCC REPORT

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Have you downloaded the Regional fact sheets or
looked at the Interactive atlas?

AGRICULTURE

Climate change may have a positive effect in the UK due to longer cultivation periods and fewer frosts. However, these gains will be outweighed by the negative impacts of increased temperatures, reduced rainfall, and increased frequency of extreme events.

Investment in adaptive management and new technology will be needed, for example, to tackle future water stress.

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Source: Identifying future risks to UK agriculture, Cranfield University

HARNESSING HYDROELECTRIC POWER

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After the large-scale development of hydroelectric power (HEP) in the UK in the 1950s and 1960s there are very few opportunities left to use this technology at scale.

However, small-scale hydro resources could be exploited, such as this old watermill in the Cotswolds.

There is a remaining viable hydro potential of 850 to 1550 megawatts in the UK.

Source: Harnessing hydroelectric power GOV.UK Photo by Mick Haupt

ICE LOSS

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Between 2002 and 2020, Antarctica shed approximately 150 gigatons of ice per year, with significant ice mass loss on the West Antarctic Ice Sheet. This has caused global sea level to rise by 0.4 millimetres per year



Source: Data from NASA's GRACE satellite Photo by Jeremy Goldberg

TIDAL POWER IN SCOTLAND

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The Orbital O2 is a tidal-powered turbine which produces renewable energy. It was launched in July 2021 and is expected to revolutionise how we view tidal energy. It is the most powerful tidal turbine in the world and is capable of generating electricity for 2,000 homes over 15 years

Source: BBC news Photo courtesy of Orbital Marine Power

ELECTRIC CARS

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The transport sector represented 15% of the UK's total GHG emissions in 2018, compared with around 8% in 1990. Transport is now the largest source of pollution in the UK.

Electric vehicles (EVs) are growing in popularity; the UK government has committed to ending the sale of new petrol and diesel vehicles by 2030. Currently there are around 239,000 EVs on UK roads

Source: UK Environmental Accounts: 2020 Photo by Michael Fousert

SEA LEVEL RISE

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No matter what we do, based on current trends, sea levels will continue to rise. The thing in our control is – by how much.

On Monday the IPCC released their 6th climate report. It warns that under current scenarios, the seas could rise above the likely range, rising up to 2m by the end of this century and up to 5m by 2150. Extreme sea level events will increase from one per century to between one or two per decade by 2050

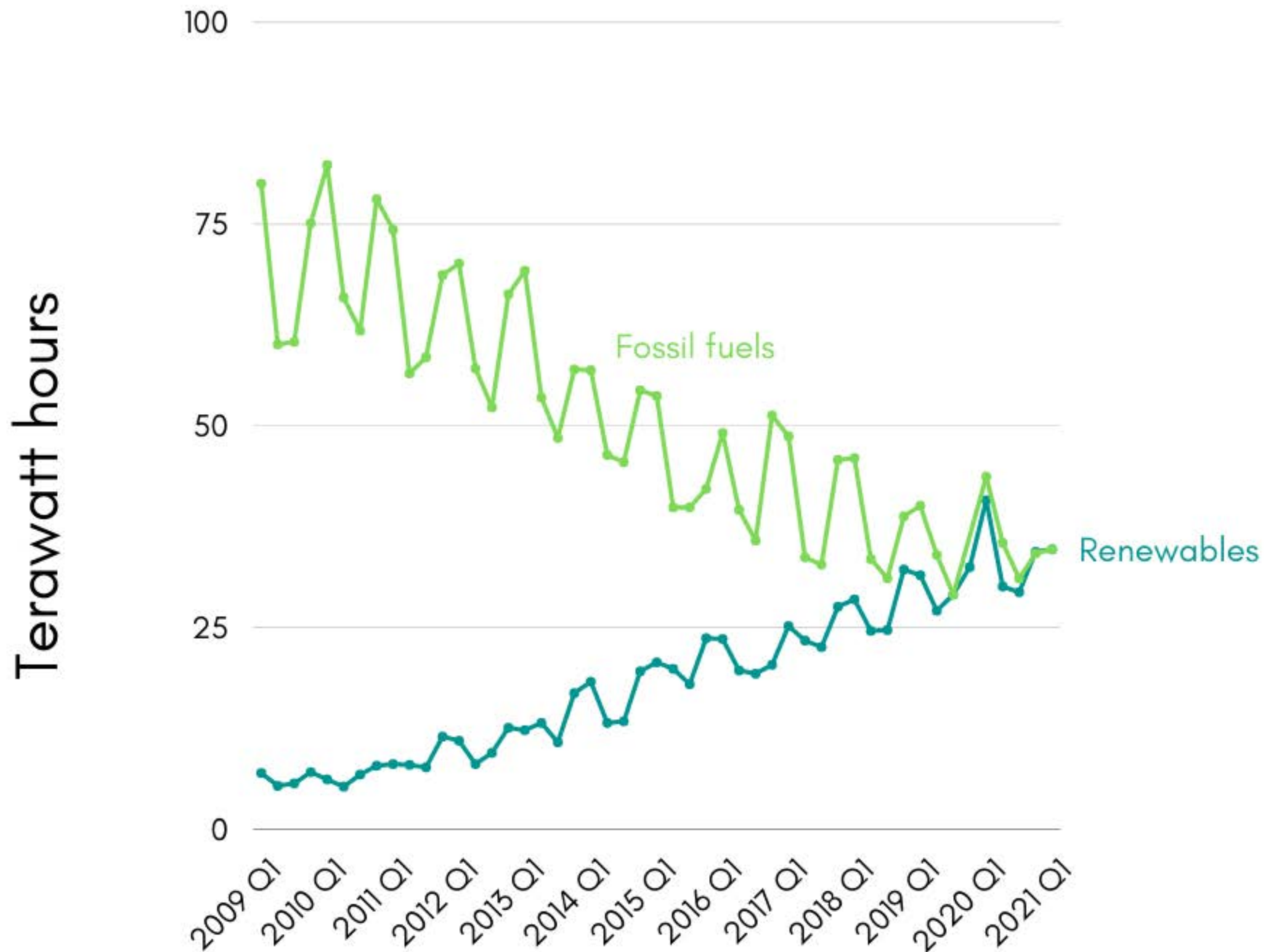
Source: BBC news Climate change: Five things we have learned from the IPCC report

UK ELECTRICITY GENERATION

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Renewables versus fossil fuels in the UK



Source: Carbon Brief UK renewables generate more electricity and UK Energy Statistics

WHAT IS CLIMATE CHANGE?

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The Earth's climate naturally changes. However, since the latter part of the 19th century, human activity has caused a rapid rate of change. Our planet is warming as a result of damaging human behaviour, such as the burning of fossil fuels and deforestation, which increase the concentration of greenhouse gases in the atmosphere, trapping heat.

Methane (CH_4) is the most potent of the greenhouse gases, while carbon dioxide (CO_2) is the primary greenhouse gas emitted through human activity.

Even with the current climate policies, global average temperature is still going up, and we could be heading for a temperature rise of more than 3°C , compared to pre-industrial levels, by 2100.

HEAT DOMES

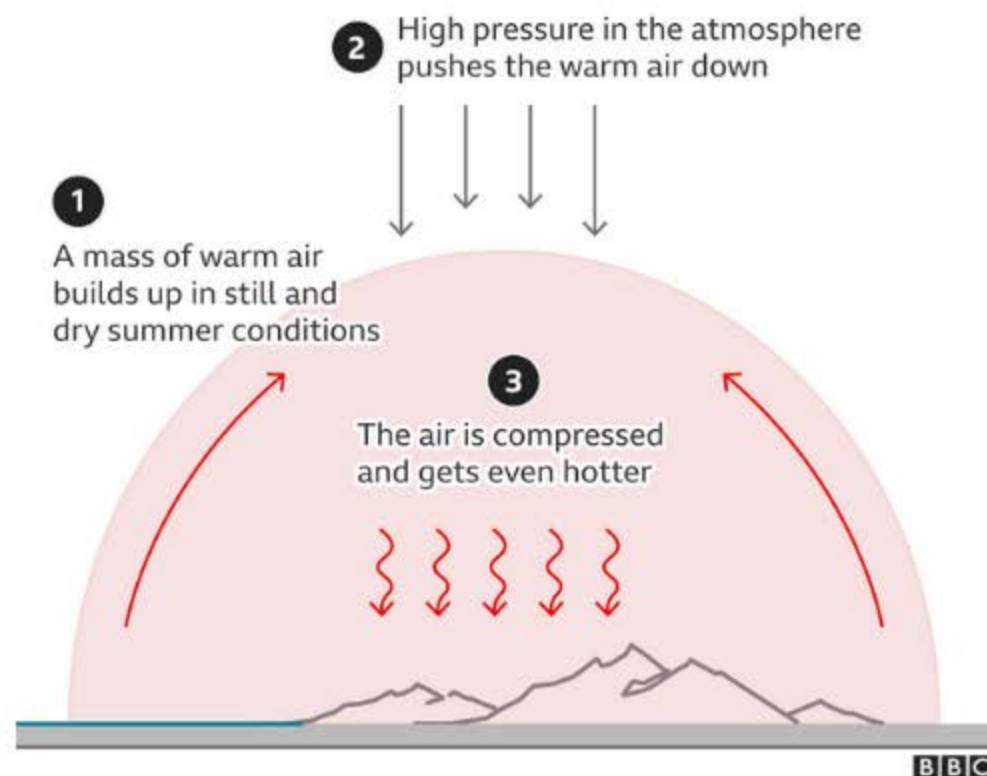
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Population exposure to heat is increasing due to climate change. Last week parts of Canada suffered from a huge record-breaking 'pressure-cooker' heatwave. Go to www.rgs.org/schools/teaching-resources/the-canadian-heatwave to learn what a heat dome is.

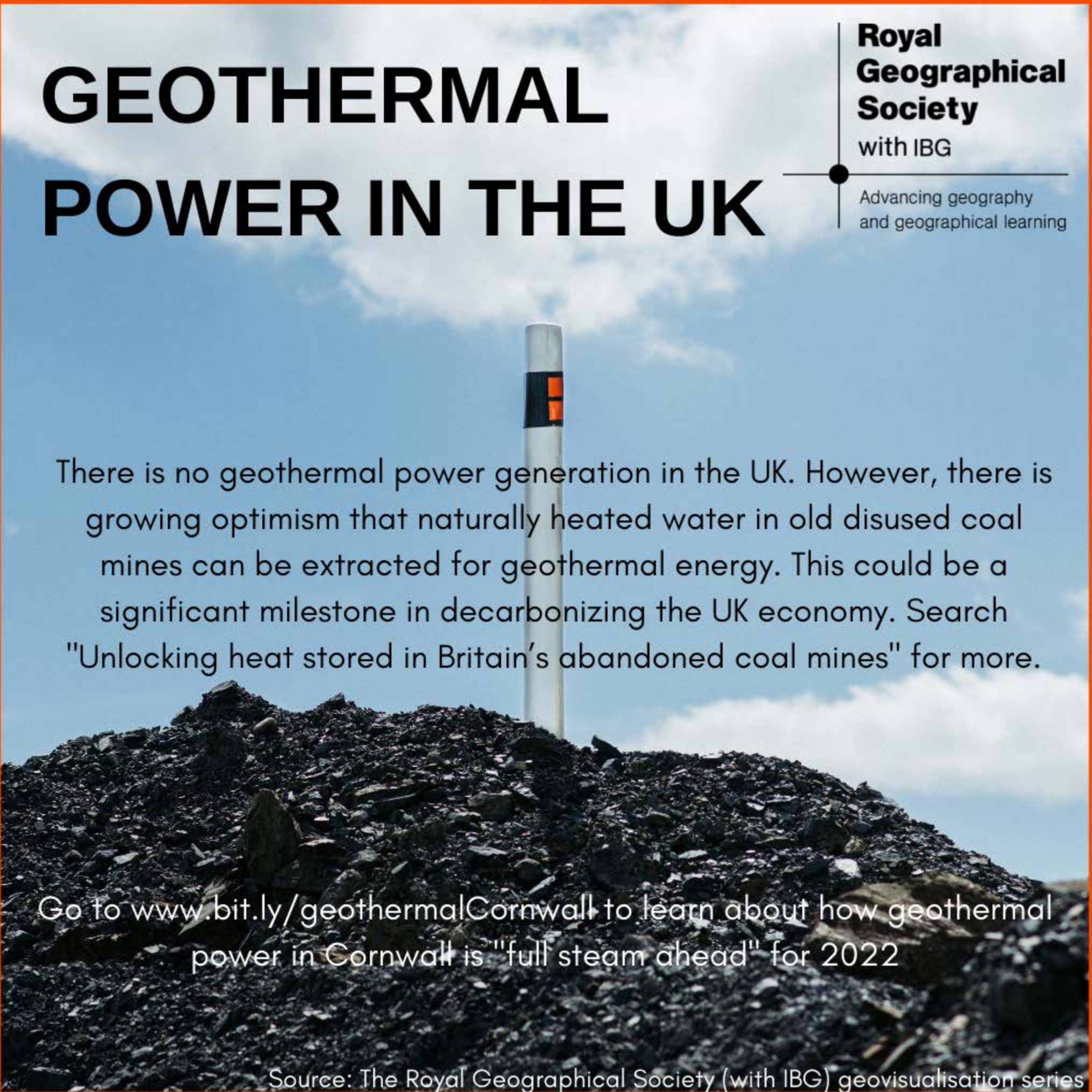


Source: www.bbc.co.uk/news/world-us-canada-57665715 © BBC

GEOHERMAL POWER IN THE UK

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There is no geothermal power generation in the UK. However, there is growing optimism that naturally heated water in old disused coal mines can be extracted for geothermal energy. This could be a significant milestone in decarbonizing the UK economy. Search "Unlocking heat stored in Britain's abandoned coal mines" for more.

Go to www.bit.ly/geothermalCornwall to learn about how geothermal power in Cornwall is "full steam ahead" for 2022

Source: The Royal Geographical Society (with IBG) geovisualisation series

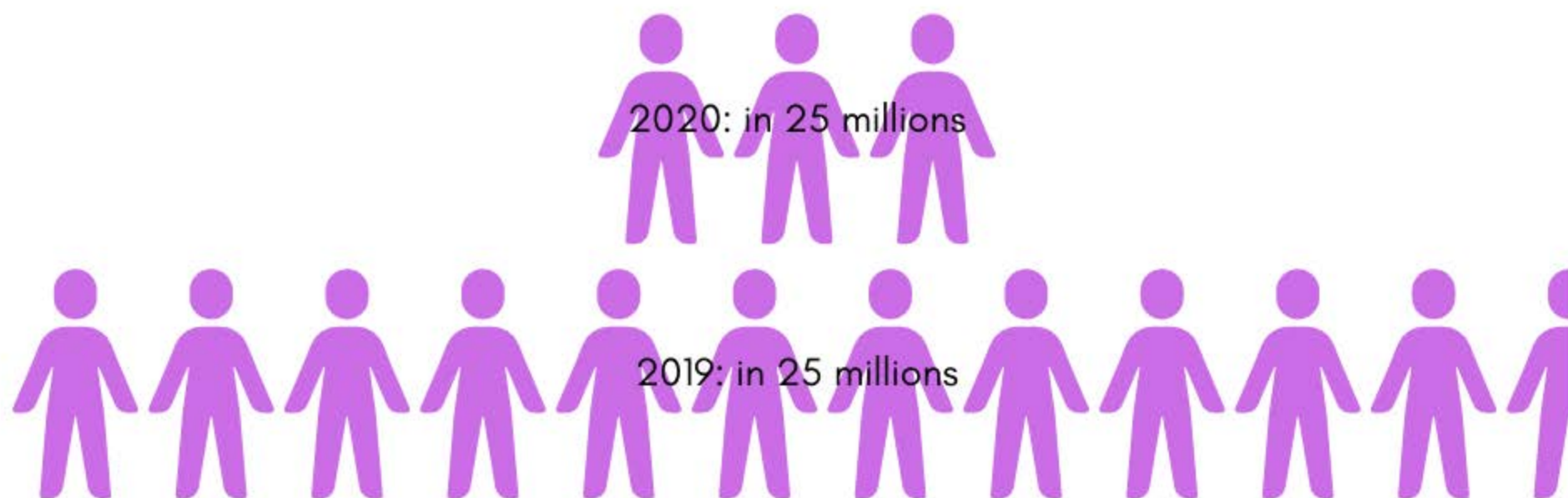
AVIATION EMISSIONS

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Balancing the need and desire to travel against reducing a personal carbon footprint is something we should all consider. Aviation is a significant source of nitrogen oxides and carbon dioxide and is a threat to government emissions targets. Globally, aviation emissions dropped by 10% during the pandemic according to the journal Nature Climate Change.


Passenger numbers through UK airports plunged by 75.2% from 296 million in 2019 to only 73 million in 2020 due to COVID-19.



ICE SHEETS

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Over a 23-year study period (from 1994 to 2017) there has been a 65% increase in the rate of ice loss. Dr Thomas Slater warns that "ice sheets are now following the worst-case climate warming scenarios"

Source: Global ice loss increases at record rate, University of Leeds Photo by 66 north

WATER STRESS

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By mid-century water demand in England will outstrip reserves from the combination of a growing population and potentially shrinking supply.

In March 2021, Emma Howard Boyd, Chair of the Environment Agency, warned that there is not enough infrastructure in place to store water from heavier wetter winters for the drier summers we are now experiencing

UK 40°C HEAT WARNING

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40°C heat in the UK is expected once every 100 to 300 years.

However, a new study by the Met Office Hadley Centre has now forecast that a medium emissions scenario could raise the likelihood to once every 15 years by 2100, with an extremely high scenario bringing 40°C heat once every 3.5 years.

SE England is likely to bear the brunt of increasing extreme heat; this BBC graphic, shows the hottest day on record, 25 July 2019.

UK record high temperatures



EXTINCTION RISK

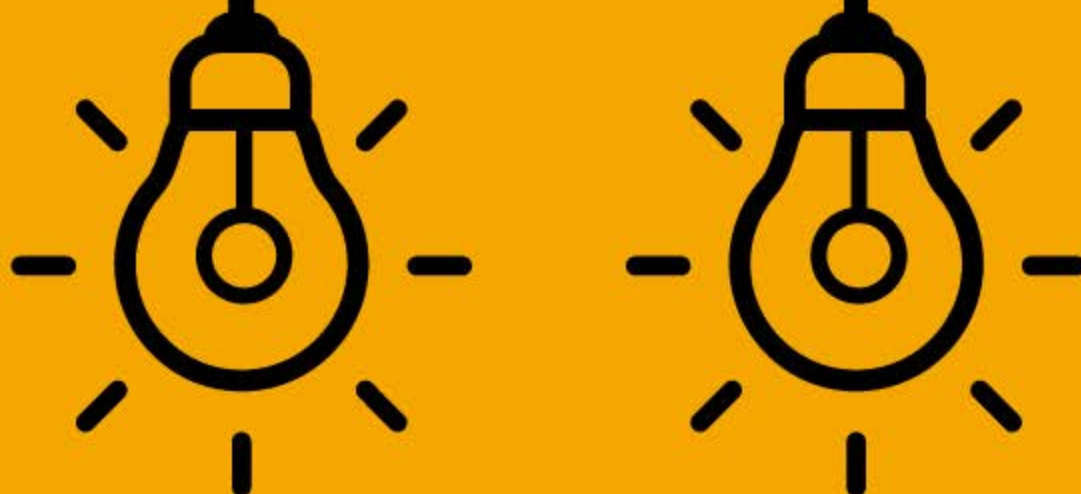
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Up to one million plant and animal species face extinction, many within decades, because of human activities (including climate change).

Without drastic action to conserve habitats, the rate of species extinction — already tens to hundreds of times higher than the average across the past ten million years — will only increase, says the analysis.

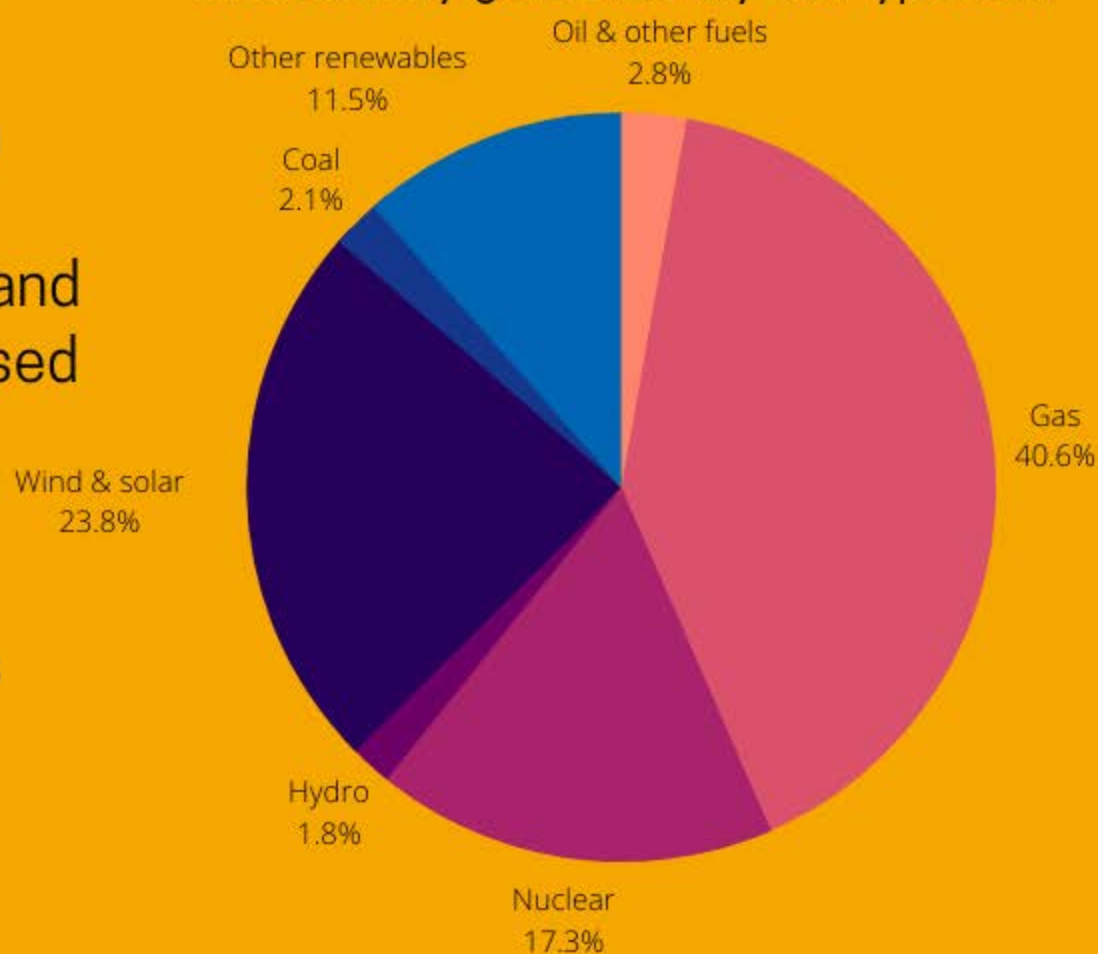
Source: Adapted IPBES report in www.nature.com Photo by Jack Hamilton on Unsplash



UK electricity

While there was a decline in electricity generation from fossil fuels between 2018 and 2019 resulting from increased use of renewables, (from 33.1% to a record 37.1%), fossil fuel use is still significant, as shown in this pie chart.

UK electricity generation by fuel type 2019



PLANTING TREES

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In May 2021, the UK government announced that tree planting would treble by 2024. This is important, particularly in the context of a recent report by the Woodland Trust which mentioned the threat to existing trees and concluded that UK native trees are increasingly threatened by insidious influences: pests and diseases, destruction by development, air pollutants and climate change

Source: www.gov.uk and www.woodlandtrust.org.uk/state-of-uk-woods-and-trees

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**There could not
be a more
important
moment that we
should have
international
agreement**”

Sir David Attenborough

WHAT IS THE ANTHROPOCENE?

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We are living in a time many people refer to as the Anthropocene. Humans have become the single most influential species on the planet.

It comes from Greek terms for human ('anthropo') and new ('cene'), recognising that we will have a lasting and potentially irreversible influence on Earth's systems, environment, processes and biodiversity

THE GREENLAND ICE SHEET

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From 2002 to 2016 0.8mm sea level rise per year was attributed to the Greenland ice sheet melting. The Greenland ice sheet is grounded on land therefore when it melts it adds to sea level rise

Source: NASA GRACE-FO Greenland Ice Loss

SOURCES OF N₂O EMISSIONS

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Overwhelmingly, the largest contributor to nitrous oxide (N₂O) emissions (from human activity) comes from agriculture with 59% of the global total.



Soil bacteria breaks down the nitrogen compounds in synthetic fertilizers, releasing N₂O into the atmosphere

MET OFFICE: ATMOSPHERIC CO₂ NOW HITTING 50% HIGHER THAN PRE- INDUSTRIAL LEVELS

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Carbon dioxide (CO₂) in the atmosphere is now reaching levels 50% higher than when humanity began large-scale burning of fossil fuels during the industrial revolution.

Recent measurements from the Mauna Loa observatory in Hawaii show that for several days in February and March 2021, atmospheric CO₂ levels exceeded 417 parts per million (ppm). Pre-industrial levels were about 278ppm. In the coming weeks, CO₂ levels will continue to increase further. As a result, 2021 is expected to be the first year on record that sees CO₂ levels of more than 50% above pre-industrial levels for longer than a few days.

This is an extract from an article by Prof Richard Betts MBE, head of climate impacts research at the Met Office Hadley Centre and University of Exeter, published by carbonbrief.org and available at bit.ly/carbonbriefmetoffice

Article Source: carbonbrief.org

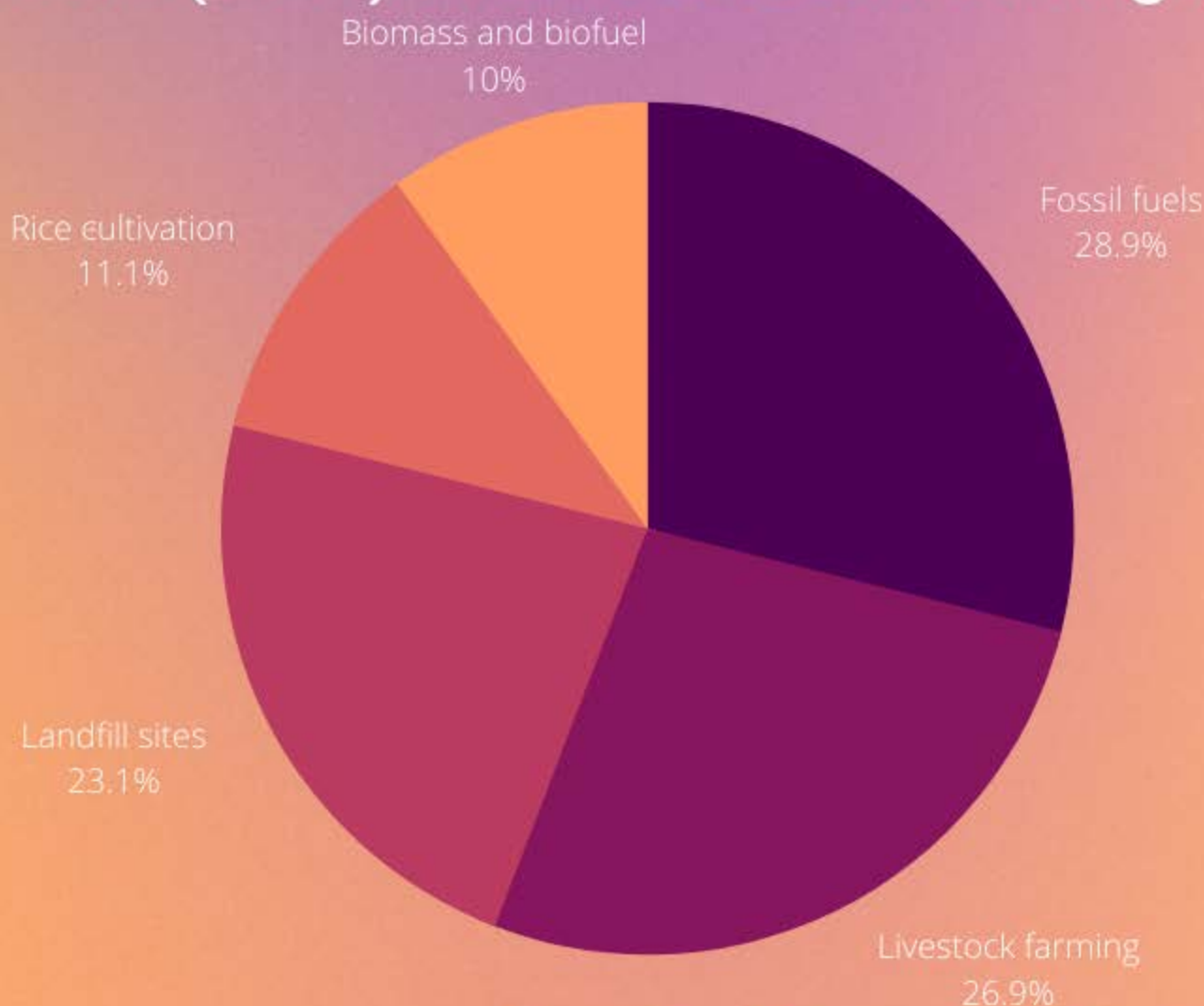
Source: Carbon Brief, photograph © Christopher Michel

SOURCES OF CH₄ EMISSIONS

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Globally, from 2000 to 2009, over 50% of methane (CH₄) emissions created by humans came from fossil fuels (29%) and livestock farming (27%)



Source: Small Gases, Big Effect © Nelles and Serrer

SOURCES OF CO₂ EMISSIONS

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The burning of fossil fuels (coal, petroleum and natural gas) to generate energy accounted for 85% of global carbon dioxide (CO₂) emissions in 2014.

The diagram below shows how energy derived from fossil fuels is used



**Within the transport category
road traffic is the largest
contributor of CO₂ at 17%**

DEFORESTATION

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Since humans started cutting down forests, 46% of trees have been felled globally, according to a 2015 study in the journal Nature.

Averaged over 2015-2017, global loss of tropical forests contributed about 4.8 billion tonnes of CO₂ per year (or about 8-10% of annual human emissions of carbon dioxide)

DID YOU KNOW

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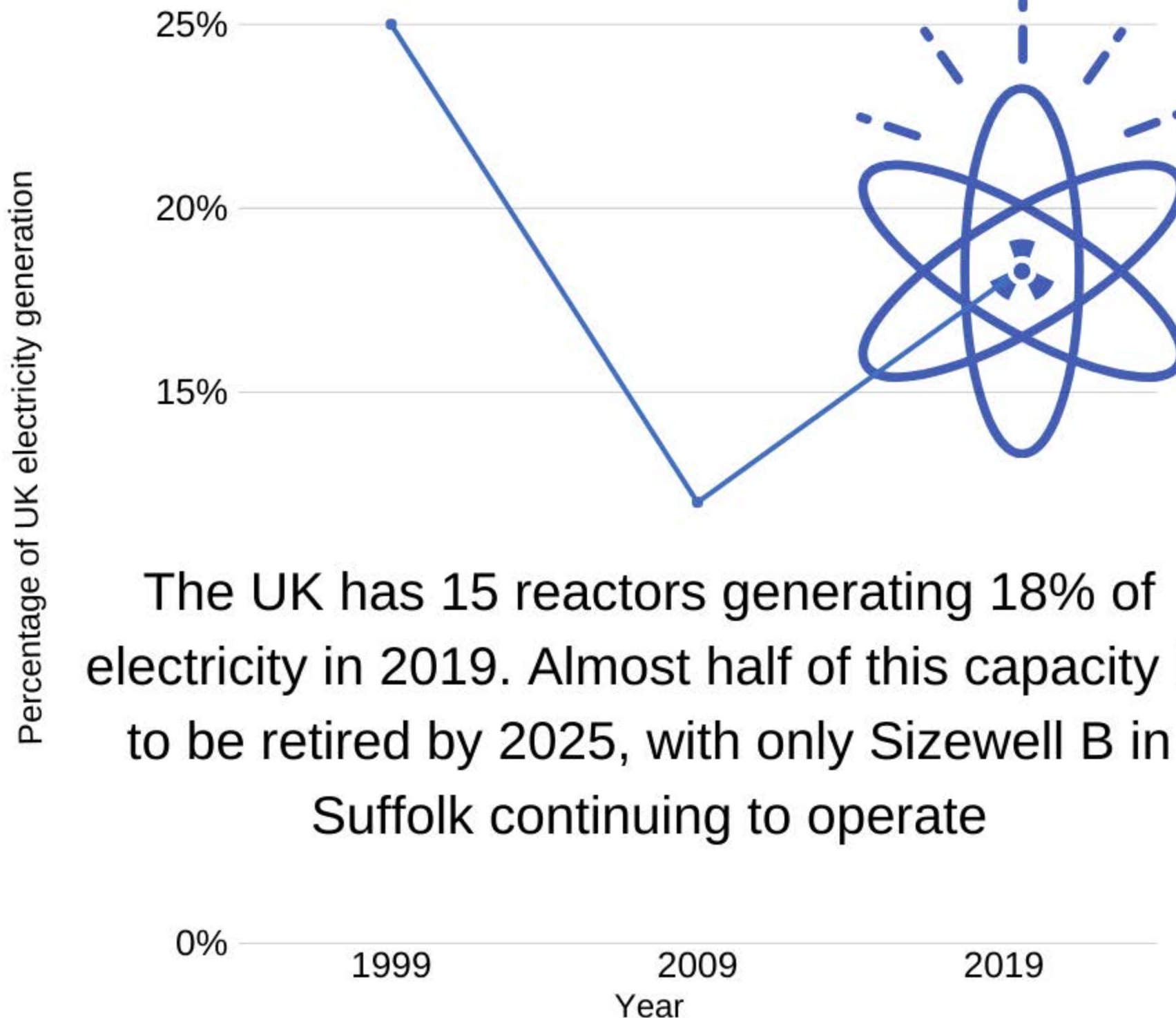
The Covid19 health crisis reduced CO_2 more than any government policy in history. Daily emissions of CO_2 fell by 17% in early April 2020 compared with 2019

NUCLEAR POWER

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The UK has 15 reactors generating 18% of electricity in 2019. Almost half of this capacity is to be retired by 2025, with only Sizewell B in Suffolk continuing to operate

WIND POWER

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The top ten wind power countries in
gigawatt (GW) of installed wind
capacity



Source: Power Technology

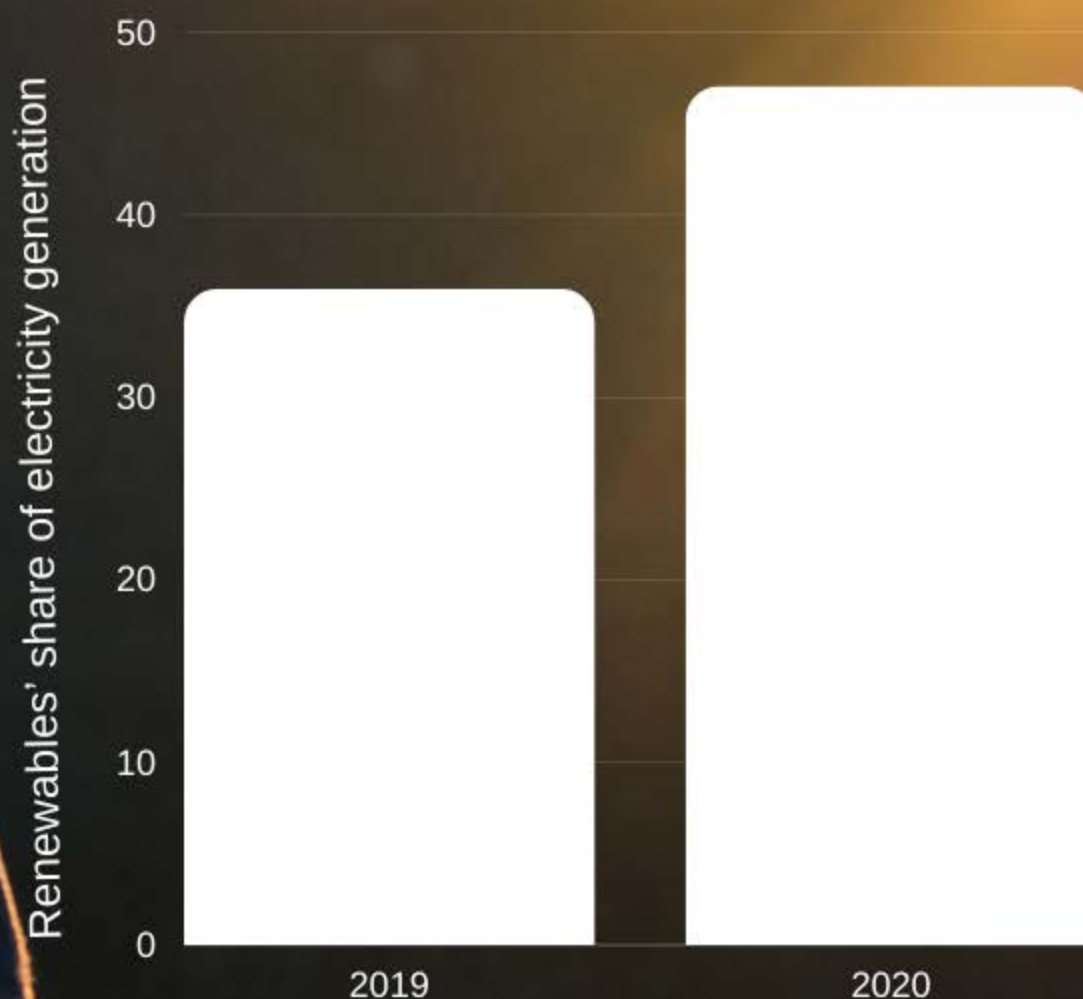
RENEWABLES AND SOLAR POWER

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Renewables accounted for a record 47% of UK electricity generation in the first 4 months of 2020, an 11% increase from 2019. 2.4% of this was from solar PV



Source: UK Energy Statistics, Q1 2020

WHAT IS RENEWABLE ENERGY?

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Renewable energy is generated from natural resources such as the sun, wind and water using technology which ensures that the energy stores are naturally replenished



Source: Energy Saving Trust

THE SOUTHERN HEMISPHERE

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The temperature has risen by 0.829°C over the past 170 years in the Southern hemisphere. There has been a continuous rise in temperature since

1950



Source: Climate research group UEA

THE NORTHERN HEMISPHERE

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The temperature has risen by 1.455°C over the past 170 years in the Northern hemisphere. 1.063°C of that increase has occurred since 1970



Source: Climate research group UEA

CLIMATE CHANGE

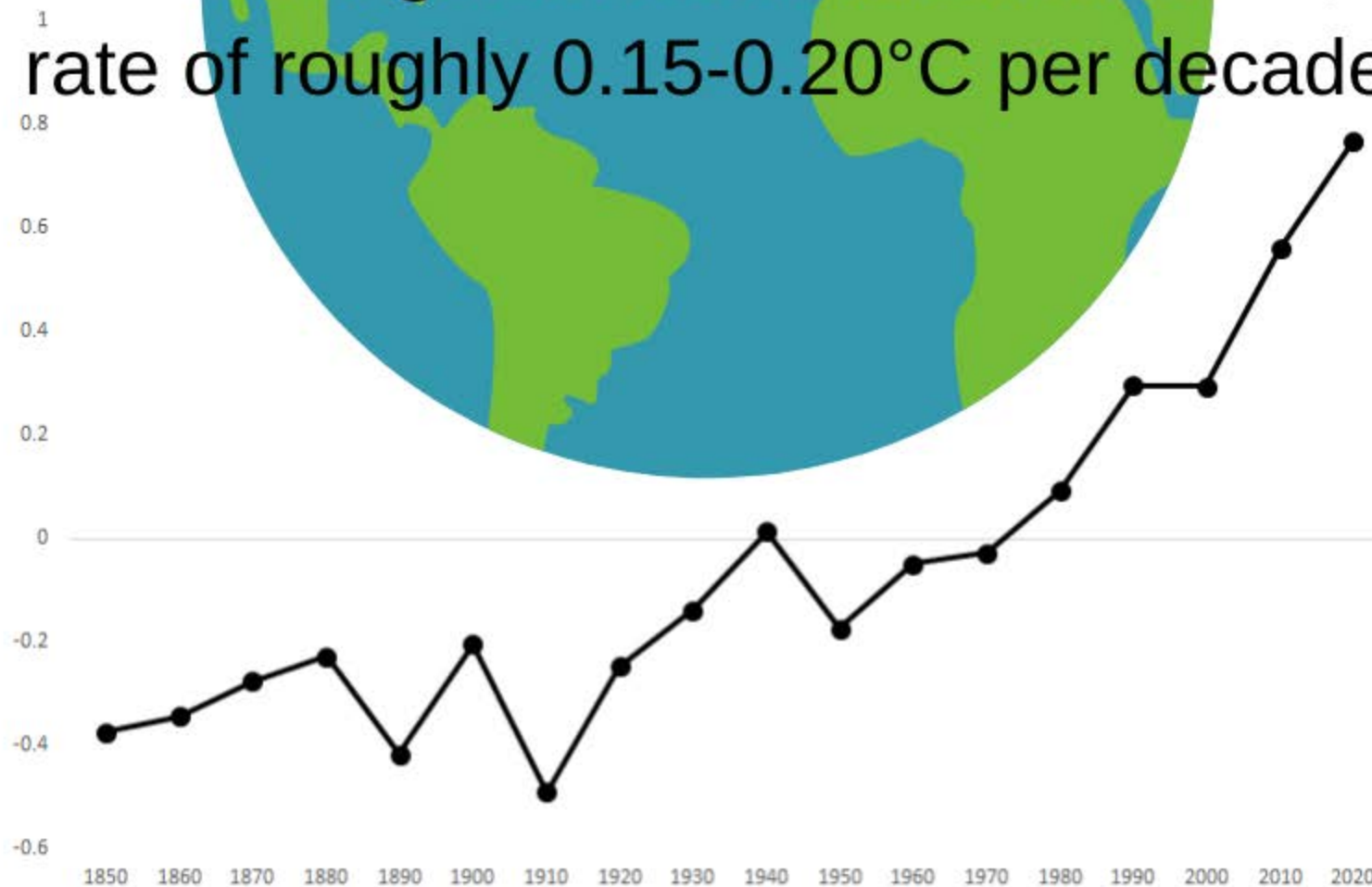
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Planet Earth's temperature has increased by a little more than 1°C since 1880. Two-thirds of the warming has occurred since 1975, at a rate of roughly $0.15\text{-}0.20^{\circ}\text{C}$ per decade

Difference from 1850-2020 average temperature $^{\circ}\text{C}$



Time 1850-2020

Source: Climate research group UEA

INNOVATION

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The collective battle we have today, in order to fight climate change, is to provide people with the ability to chose a life. To have a *better* life by behaving differently, by innovating, by creating new types of companies and startups

EMMANUEL MACRON

Source: The Independent 2017

BIODIVERSITY

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It is that range of biodiversity that we must care for, the whole thing, rather than just one or two stars

DAVID ATTENBOROUGH

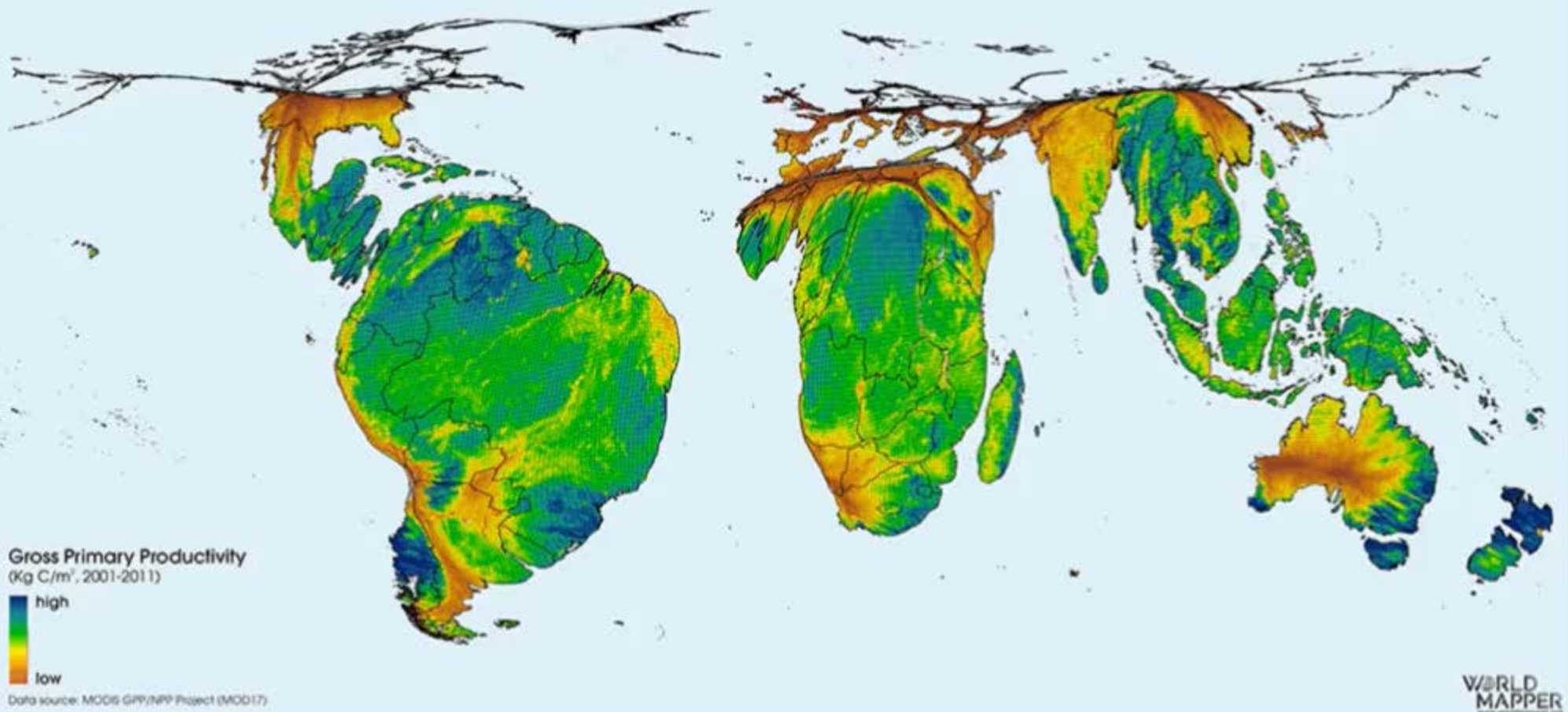
Source: Woodland Trust

NATURE'S HEARTBEAT

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January



This world map shows the metabolism of the terrestrial biosphere. When Gross Primary Production (GPP) is mapped through the lens of a gridded cartogram projection the result is this pulsating visualisation. It shows how the changing seasons determine the variability of energy production over the course of a year.

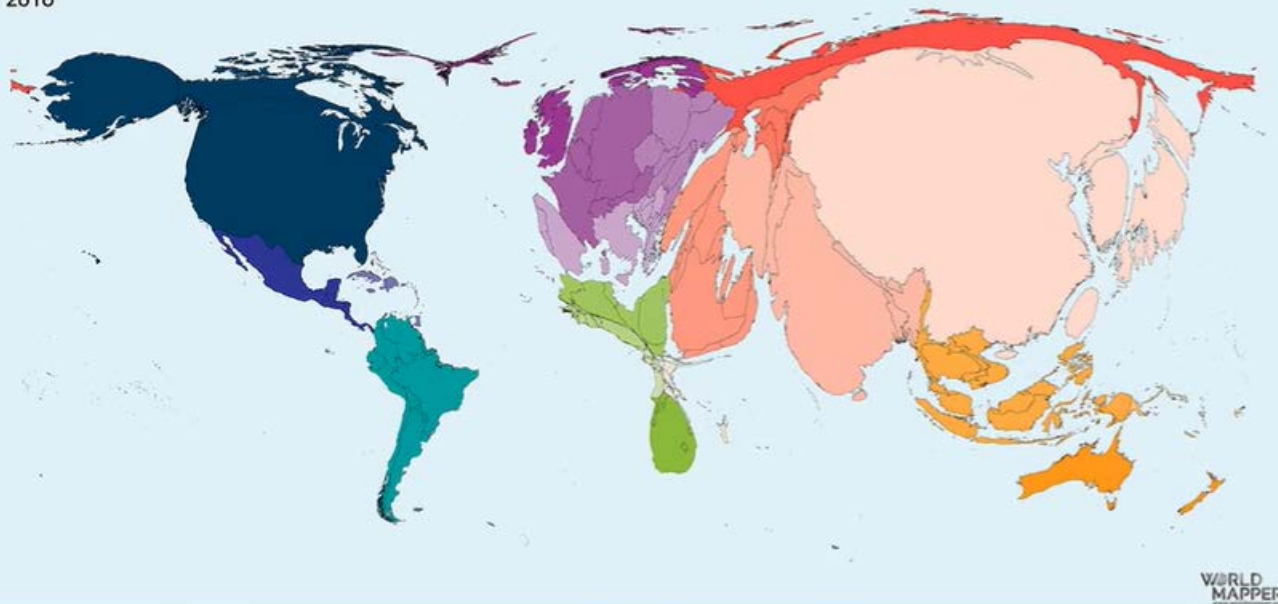
Source: <https://worldmapper.org/natures-heartbeat/>

CO₂ EMISSIONS SINCE 1970

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Carbon Dioxide Emissions
2016



This is an interactive world map of carbon dioxide (CO₂) emissions. In the second half of the twentieth century there was an exponential acceleration in annual emissions. In 2015 the atmospheric CO₂ concentration crossed the 400 parts per million (ppm) threshold, which is unprecedented in the history of modern humans on this planet

Source: www.worldmapper.org/map-animation-co2-emissions/