Net Zero Economy Index 2022

Collective action needed in an era of uncertainty

Economy-wide net zero ambitions continue to scale up, but progress on decarbonisation over the past 12 months has declined.

With further economic headwinds and energy price challenges ahead, countries – and businesses – have important decisions to make if they are to place decarbonisation efforts at the heart of their economic futures.

This year's results are an urgent reminder that we must act to meet ambitious net zero targets. By accelerating policy change and investment opportunities, nations can unlock resilient and affordable energy, clean and productive industry, and a healthy and just society. Businesses too seem poised to capture new opportunities, but how can we put climate action at the top of the transformation agenda?

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Foreword

A disrupted year reveals poor progress and further ratchets the rate of global decarbonisation required

Earlier this year, the IPCC issued another stark warning about the consequences of inaction on climate change. With the deadline to almost halve emissions by 2030 fast approaching, the need for urgent action by business and government has never been clearer.

However, seven years on from the groundbreaking Paris Agreement, our analysis shows that the globe is continuing to move further from the rate of decarbonisation required to limit warming to 1.5°C above pre-industrial levels. Although we see increasing levels of policy, business and investor commitments, progress on decarbonisation is slow, and does not yet create the confidence that promises made will be delivered.

The climate agenda has always had to compete with other priorities, especially those created by significant shocks to the system, and not least the impacts of the COVID-19 pandemic.

This year's data reflects a rebound in economic activity and economic stimulus measures that, in many countries, disproportionately supported a higher-carbon recovery. Geopolitical uncertainty, primarily as a result of the war in Ukraine, has introduced a new shock to the economic system. This context presents a real risk to how we reduce and respond to climate change, at a time when we can't afford to delay our efforts.

Concerns over energy security and price inflation strengthen the business case for action in the race to net zero

However, beyond the immediate horizon, there is an opportunity for these disruptors to strengthen the fundamentals of the business case for net zero investment.

The rise in energy prices and threats to supply have created a rush to fossil fuels in the short term; but the case has never been stronger for investment in renewable energy capacity as a route to increased energy security and greater price stability. Similarly, the financial case for energy efficiency has strengthened, especially in high energy-consuming and hard to abate sectors. Does this mean that the stage is set for business to step up to the plate?

Leading organisations are increasingly driving forward action on climate, motivated by shifts in the regulatory and consumer environment, and an increased recognition by investors of the importance of a low carbon transition.

This includes decarbonisation of their own organisations, improving the performance and resilience of their supply chains, and exerting their influence over others within their own ecosystems. More than 3,000 businesses and financial institutions are now committing to the Science Based Targets initiative (SBTi) to set meaningful targets to reduce their emissions, and global campaigns, such as the Glasgow Breakthroughs, are increasing business action and collaboration across sectors and systems.

Our analysis estimates the rate of global decarbonisation needed to deliver a 1.5°C aligned net zero world by 2050. It compares the current rates of decarbonisation of G20 members – representing 80% of global GDP and around 80% of global emissions – against what the science tells us is required. The spirit of collective action must be central to decarbonisation and achieving net zero. More than ever before, there is an urgent imperative for strategic collaboration – between nations, and by businesses and investors across nations.

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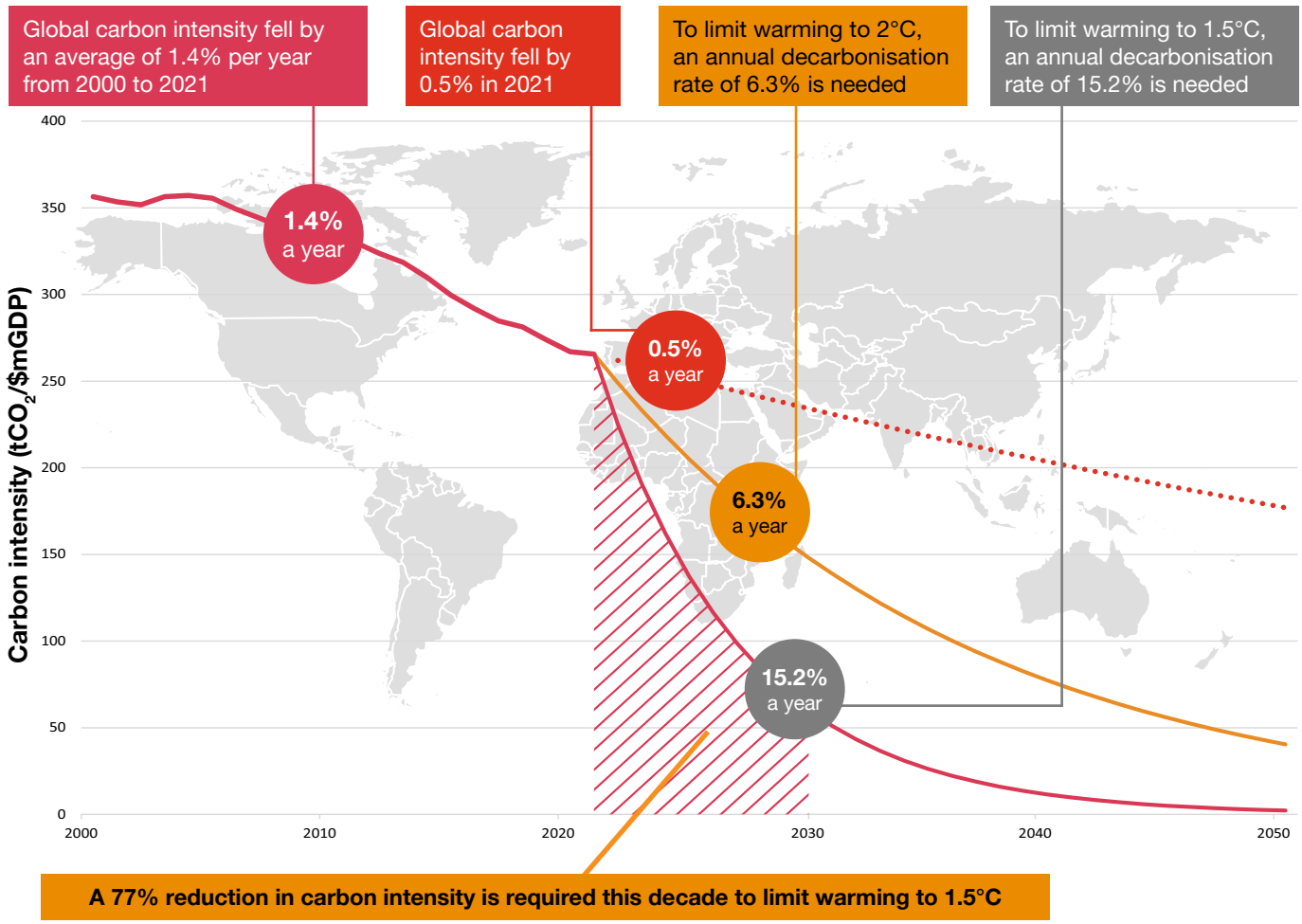
Action to decarbonise needs to catch up with net zero ambitions

At just 0.5%, the global rate of decarbonisation – the reduction in carbon intensity or energy-related CO_2 emissions per unit of GDP – in 2021 was at its lowest level in over a decade. Across the G20, the highest level of improvement was 4.6%, far below the 15.2% target decarbonisation rate now required to limit warming to 1.5°C.

Not one of the G20 member states – who collectively account for around 80% of global energy-related emissions – achieved more than a 5% reduction in carbon intensity in 2021.

Urgent action is needed to put us on course for a safer future, and with net zero ambitions and commitments on the rise, the real question is: will governments and businesses be able to work together to take the bold steps needed to deliver lasting progress?

Figure 1: Net Zero Economy Index 2022



To limit warming to 1.5°C, the annual global rate of decarbonisation required is 15.2%

To get back on track, decisive action is needed.

An average year-on-year global decarbonisation rate of 15.2% is required to achieve the 1.5°C target, up from 12.9% in last year's analysis, if we are to meet the climate goals adopted in the Paris Agreement and endorsed at COP26 last year. This equates to a 77% reduction in carbon intensity by the end of the decade.

This pace of change is 11 times faster than the global average achieved over the past two decades – of only 1.4% – and far out-strips what's been achieved by any country to date.

When compared to 2020 levels, global energy consumption and energy-related emissions increased by 5.5% in 2021. Absolute levels of carbon intensity vary across the G20, given that nations are at different stages of development and have very different socio-economic bases. In 2021, 266 tonnes of CO_2 was emitted for every million dollars of GDP generated worldwide, ranging from an average of 189 tonnes in the G7* to 351 tonnes in the E7*.

* G7: Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

* E7: China, India, Brazil, Mexico, Russia, Indonesia and Turkey.

G20: G7 countries, E7 countries, Argentina, Australia, Korea, Saudi Arabia, South Africa, and the EU.

Our metrics

The below sets out key metrics used in this analysis.
For further details, see the methodology and metrics section.

Carbon intensity

The primary purpose of the Net Zero Economy Index is to calculate national and global **carbon intensity (CO_2 / GDP)**, and track the rate of change needed to limit warming to 1.5°C above pre-industrial levels.

To do this, we use the IPCC carbon budget to calculate by how much emissions need to be reduced in the future, and divide this by the projected increase in GDP. This allows us to see the amount emissions must reduce to maintain projected GDP growth, providing insight to the scale of efforts required to decouple emissions from economic growth.

Fuel factor

The **fuel factor (CO_2 / energy)** measures how much CO_2 is emitted per unit of energy consumed. Put simply, how green the energy consumption is.

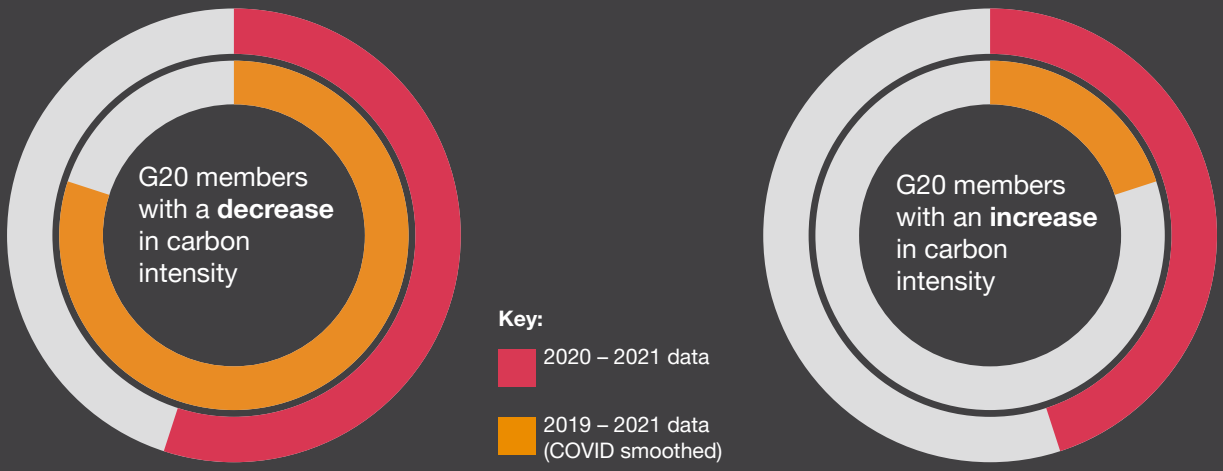
It indicates a country's shift in energy mix towards renewable energy sources, and can reflect movements away from the most highly emitting fossil fuels (such as coal). For each unit of energy consumed, different fossil fuels will release differing amounts of CO_2 emissions. For each unit of energy consumed from a renewable source, emissions will be reduced to negligible, or zero, therefore reducing the fuel factor towards zero.

Energy intensity

Energy intensity (energy / GDP) measures the amount of energy consumed per unit of GDP generated. It shows us how much energy is needed to generate a given amount of GDP.

Energy intensity is impacted by a range of factors, including: energy efficiency, in the form of policies, standards and technological advances; pricing and behavioural change; the sectoral composition of an economy; investment in more efficient technology and infrastructure; and climatic influences on energy usage.

The recovery from COVID-19 has not – in the short term – been a green one



Only 11 of the G20 managed to reduce their carbon intensity at all, when compared to 2020...

(vs. 16 out of 20, when compared with pre-pandemic levels in 2019)

...while nine of the G20 saw an increase in carbon intensity.

(vs. 4 out of 20, when compared with pre-pandemic levels in 2019)

The lifting of pandemic restrictions in 2021 has given way to a much needed resurgence in economic activity, but with this, we have seen a rebound in emissions.

The 2021 data has been skewed by the ramping up of economic activity, and appears to show the recovery from COVID-19 has not – at least in the short term – been a green one. This continues to take us further away from what we need to do in order to limit warming to 1.5°C above pre-industrial levels.

When the COVID-19 variance is removed from the data, by comparing 2021 levels with pre-pandemic levels in 2019, we see a global decarbonisation rate of 3%.

This suggests that, while decarbonisation has occurred over this period, there's still a long way to go.

Smoothing the data to account for the dramatic decrease in carbon intensity due to economic shutdowns in 2020, and the increase as economic activity resumed in 2021, allows for a more accurate reflection of decarbonisation progress.

While decarbonisation occurred over the COVID-19 period, there's still a long way to go

Carbon intensity change

G7 +0.1% ↑

(vs **-6.3%** when compared to COVID smoothed data)

E7 -0.9% ↓

(vs **-1.7%** when compared to COVID smoothed data)

When the COVID-19 variance is removed from the data, we see a higher rate of decarbonisation across both G7 and E7 countries. That said, it's worth noting that no G20 nation managed to achieve more than a 10% decarbonisation rate when comparing 2019 to 2021.

Fuel factor change

G7 +0.9% ↑

(vs **-2.8%** when compared to COVID smoothed data)

E7 -0.6% ↓

(vs **-1.8%** when compared to COVID smoothed data)

Energy intensity change

G7 -0.8% ↓

(vs **-3.6%** when compared to COVID smoothed data)

E7 -0.3% ↓

(vs **+0.2%** when compared to COVID smoothed data)

Our analysis last year looked at the significance of the pandemic on emissions and GDP, and this year it's clear the economic recovery has seen a rise in both metrics.

The contrast in G7 and E7 performance in 2021 reflects a greater reliance by G7 countries than their E7 counterparts on fossil fuels when extreme economic recovery efforts were required.

Geopolitical and economic fragility threatens progress

Looking ahead, the current geopolitical and economic context presents a real risk to future progress. The IPCC's 2030 deadline to reduce emissions by 43% is fast approaching, and our analysis shows that countries now need to work even harder to meet this figure. When looking at global carbon intensity, which accounts for the projected rise in GDP until 2030, we need to see a 77% reduction over this period.

With the COVID-19 recovery seeing an increased reliance on fossil fuels to power urgent economic growth, there's a risk that the same will happen in light of the war in Ukraine and ongoing energy crisis, as governments and economies respond to fiscal, security, affordability and inflationary challenges. Economic sanctions have also affected access to key resources necessary for net zero technologies such as copper, nickel and silicon.

This geopolitical and economic context will undoubtedly be a key factor in next year's analysis.

A possible turning point?

While policy makers are under pressure to ensure a secure and affordable energy supply, there is an opportunity to use disruptors to strengthen the business case for net zero investment.

The rise in energy prices and threats to supply have created a rush to fossil fuels in the short term; but strengthen the case for investment in renewable energy capacity for the long term.

Similarly, the financial case for energy efficiency has strengthened, especially in high energy-consuming and hard to abate sectors. Businesses will be looking at ways to consume less, while using energy more effectively, signalling a possible turning point in how we think about energy.

The drivers of carbon intensity

We have identified two drivers of carbon intensity

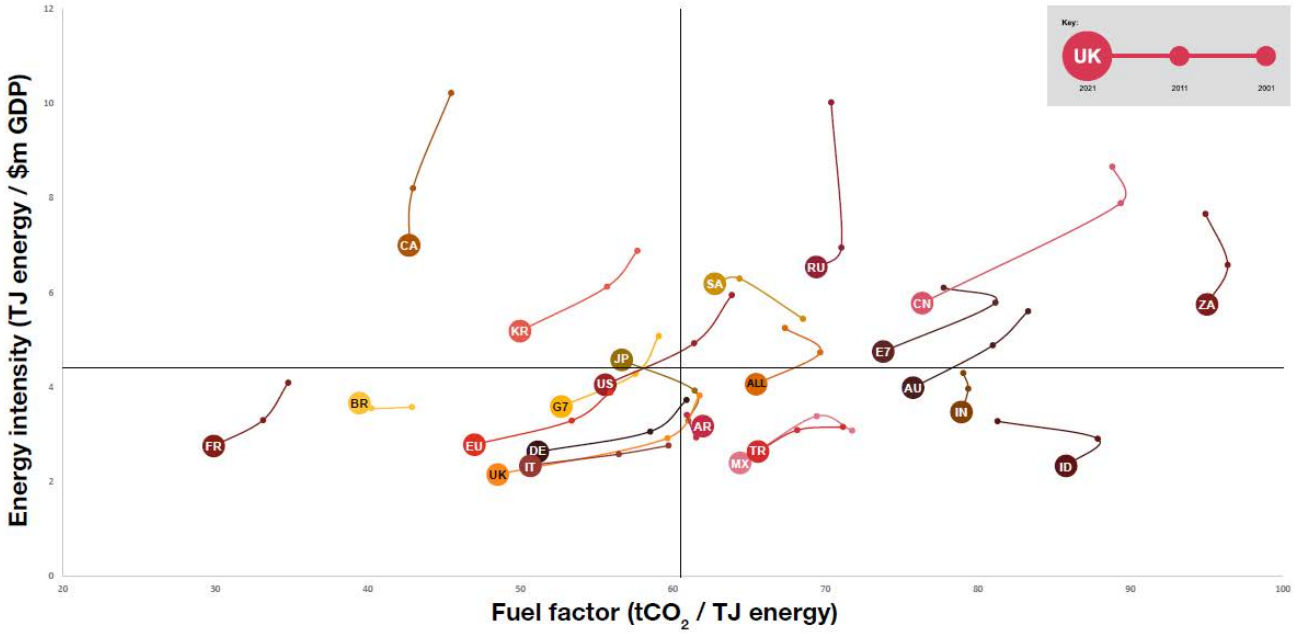
First, the carbon content of the national energy mix (**fuel factor**: CO_2 / energy) and second, the amount of energy consumed per unit of economic output (**energy intensity**: energy / GDP).

The graph below uses the relationship between these two drivers to show the decarbonisation positions of each of the G20 member states, and highlights the challenges that need to be overcome to deliver greater emissions reductions.

Over time, **countries need to shift towards the bottom-left quadrant** as they reduce the share of fossil fuels in their energy mix (moving left) and reduce the energy intensity of their economies (moving down).

Countries already in this quadrant are those with the lowest carbon intensities in our Index - but even they have a long way to go in reducing their fossil fuel dependence. Countries in the top right quadrant are those with the highest carbon intensities in our Index.

Figure 2: Movement of G20 fuel factor vs energy intensity (raw values) for 2001, 2011 and 2021



No ‘one size fits all’ approach can lead to success. All countries have the opportunity to improve their fuel factor and energy intensity, and will face different challenges along the way

Figure 2 illustrates the different starting points for each nation on their journey to net zero. These starting points are influenced by factors including a country’s natural resource base, dominant industries, level of development, and climatic influences on energy usage.

The movement of a country’s point on the graph reflects what has been achieved through targeted policy measures, good practice and tangible achievements.

Attempts to reduce high consumption prove to be priority number one

Over the last two decades, countries starting with the highest energy intensities have typically seen the biggest initial drop in energy intensity. This is coupled with minimal improvement in the decarbonisation of their fuel mix.

This is likely to be a result of a range of factors, such as shifts in economic activity, policies and standards to promote efficiency, capital equipment upgrades and modernisation. In more recent years, as a result of renewable energy sources becoming more affordable, the focus of these nations has included a shift in their fuel mix to renewable energy sources.

As renewable energy becomes more affordable, the fuel mix comes into focus

Other nations have seen more incremental reductions in their energy intensity, but have also delivered reductions to the proportion of fossil fuels in their energy mix.

Nations that tended to take this approach are the wealthiest in the G20, who have been able to increase their use of renewable energy before its improved affordability. This shift in fuel mix (movement towards the left on the graph) is now being replicated by most countries in the G20 as renewable energy sources become more affordable and coal is increasingly phased out.

Achieving net zero will look different for each country and sector

Each country and sector will have its own route to decarbonisation, focusing on changes to its own unique energy mix and efficiency gains, as well as other actions outside of our core energy analysis, for example, nature-based solutions and use of technology.

Businesses, governments and investors will need to focus on the quick wins with the highest impacts to put us on track to 2030, while at the same time investing in longer term interventions that will deliver on agreed goals for 2050. In parallel, they will need to adapt to the impacts of climate change that are already being experienced, and those that are increasingly inevitable in the shorter term.

International campaigns, such as the 2030 Breakthroughs and the Glasgow Breakthroughs, have rallied global leaders to set goals to accelerate the innovation and deployment of clean technologies across power, road transport, steel, hydrogen and agriculture, as well as individual sectors within the real economy.

Businesses and investors have the opportunity to take a leading role

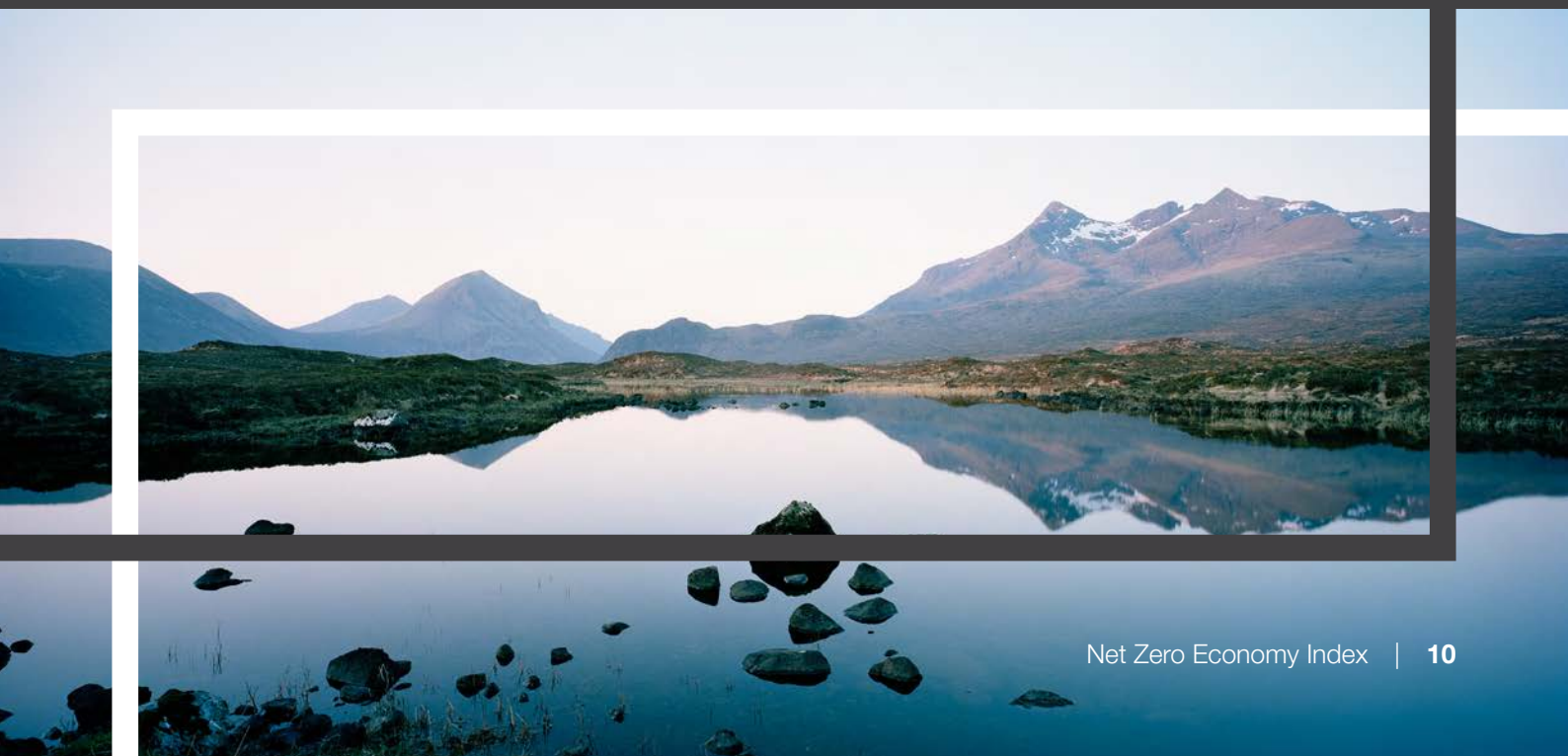
Businesses are continuing to drive forward the climate agenda, particularly at a sector level. Motivated by shifts in the regulatory and consumer environment, and an increased recognition by investors of the importance of a low carbon transition.

This includes decarbonisation of their own organisations, improving the performance and resilience of their supply chains, and exerting their influence over others within their own ecosystems.

Cross-sector initiatives continue to increase business and investment action, with more than 3,000 businesses and financial institutions working with the Science Based Targets initiative (SBTi) to reduce their emissions by setting science-based targets.

The Glasgow Financial Alliance for Net Zero (GFANZ), set up in conjunction with the UN-backed Race to Zero campaign, has more than 450 member firms from across the global financial sector, representing more than $130 trillion in assets under management and advice.

The spirit of collaborative action must be central to decarbonisation and achieving net zero. More than ever before, there is an urgent imperative for strategic collaboration – between countries, and between businesses and investors at a global and national level.



Our metrics and methodology

The Net Zero Economy Index tracks the decarbonisation of energy-related CO_2 emissions worldwide. The analysis is underpinned by bp's Statistical Review of World Energy, which reflects energy consumption per fuel type per country and CO_2 emissions based on the consumption of oil, gas and coal. Emissions are calculated by using consumption data and applying Default CO_2 Emission Factors for Combustion from the list of IPCC emission factors. Non-combustion activities, such as the use of oil products and natural gas in the petrochemicals industry, or oil used in the production of bitumen for road construction, are not included in the analysis. Estimates of the proportion of non-combusted fossil fuels are subtracted from the total consumption of fossil fuels before applying the relevant emission factors.

The analysis does not consider emissions from other sectors (e.g. Agriculture, Forestry and Other Land Use). Data for methane emissions associated with fossil fuel production, transportation and distribution from the IEA are included in bp's Statistical Review of World Energy and in our analysis. Carbon emissions are included from natural gas flaring and from industrial processes (which refer only to non-energy CO_2 emissions from cement production). No carbon sequestration is accounted for in the Net Zero Economy Index analysis. As a result, this data cannot be compared directly with national emissions inventories.

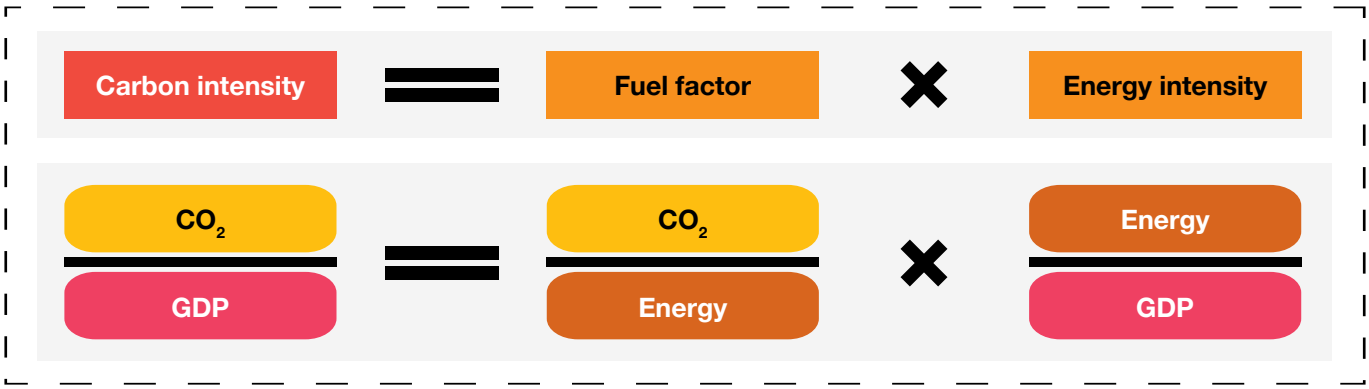
We use the IPCC global estimated carbon budget data on fossil fuel emissions taken from the IPCC Special Report on Global Warming of 1.5°C (SR15), to estimate the energy-related CO_2 emissions associated with limiting warming to 1.5°C and 2°C by 2100. We have elected to not use the updated global carbon budget from the IPCC's Sixth Assessment Report (AR6), as it is similar to the total budget attained from SR15 and AR6 does not provide interim emissions targets for specific years between the present-day and 2100, which are used in the model underpinning this analysis.

For GDP data, our analysis draws on the World Bank historical data. For long-term GDP projections, our analysis draws on two different banks of OECD forecast data. The first dataset assesses 2022 and 2023, accounting for the impacts of current world events such as COVID-19, which was updated in June 2022. The second dataset consists of 2024-2060 forecast data, updated in October 2021.

World GDP projections for 2061-2100 have been updated based on PwC analysis (decreasing by 0.1% from last year's forecast growth rate).

The countries our analysis focuses on are individual G20 economies, as well as focusing on world totals. The G20 is portioned into 3 blocks:
G7 economies (US, Japan, Germany, UK, France, Italy, Canada), E7 economies which covers the BRICs (Brazil, Russia, India and China), and Indonesia, Mexico and Turkey and other G20 (Australia, Korea, EU, South Africa, Saudi Arabia, Argentina).

The primary purpose of our model is to calculate national and global carbon intensity (CO_2 / GDP), and the rate of carbon intensity change needed to limit warming to 1.5°C above pre-industrial levels. We use the IPCC carbon budget to calculate the required quantity of emissions reductions in the future, and then divide this by the projected increase in global GDP, providing us a required rate of carbon intensity reduction to limit warming to 1.5°C. This allows us to see the amount emissions must reduce to maintain projected GDP growth, providing insight to the scale of efforts required to decouple emissions from economic growth. Carbon intensity is the product of two factors that we are exploring separately this year, allowing for greater insights in our analysis.



The **fuel factor** (CO_2 / energy) measures how much CO_2 is emitted per unit of energy consumed. It serves as a performance indicator for a country's shift in energy mix towards renewable energy sources, and can reflect movements away from the most highly emitting fossil fuels (such as coal). For a given unit of energy consumed, different fossil fuels will release differing amounts of CO_2 emissions. For a given unit of energy consumed from a renewable source, emissions will be reduced to negligible, or zero, thus reducing the fuel factor toward zero.

Energy intensity (energy / GDP) measures the amount of energy consumed per unit of GDP generated. It illustrates how much energy is required to generate a given amount of GDP. Energy intensity serves as a performance indicator for a country for factors including: energy efficiency, in the form of energy efficiency policies or technological advances enabling efficiency; energy pricing mechanisms; shifts in regional population and demographics; changes in the composition of an economic sector's output; maximising economic output per unit spend on energy usage; investment in new, more efficient technology and infrastructure; and climatic influences on energy usage.

To calculate the required percentage reduction in global fuel factor to maintain the world's course for a 1.5°C world, we use the IEA's values for percentage reduction of energy intensity presented in their Net Zero Emissions by 2050 Scenario (NZE) in the IEA's World Energy Outlook 2021. The scenario projects a 4.2% reduction in energy intensity year-on-year to 2030, followed by an annual reduction rate of 2.7% from 2030 to 2050. We divide the raw values of carbon intensity from our analysis by the raw values of global energy intensity we calculate using the IEA's NZE to calculate the necessary reduction in fuel factor.

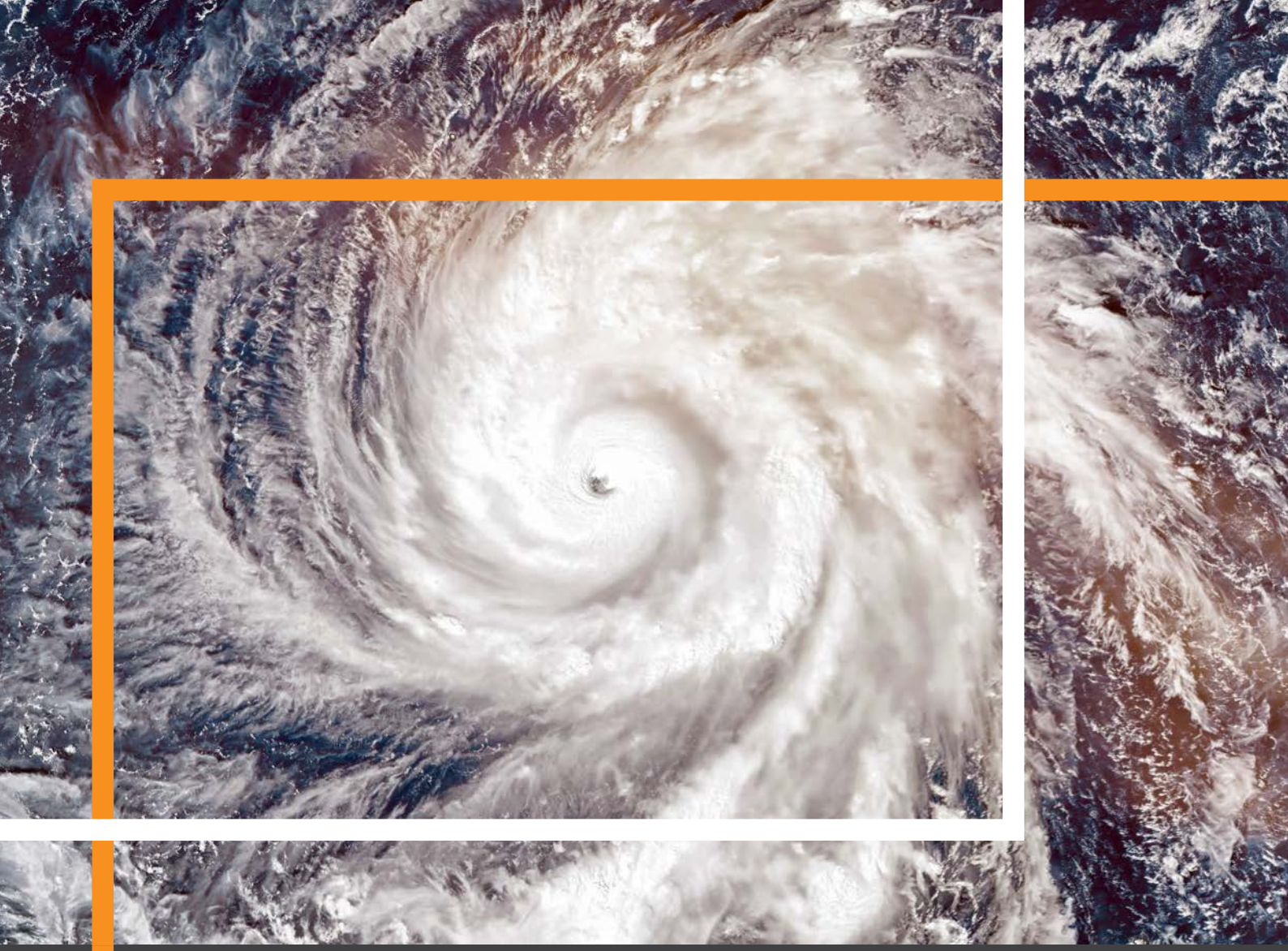
Using the energy consumption data provided in bp's Statistical Review of World Energy we have compared the proportions of different energy sources in the G20's fuel mix with that of the average fuel mix of the world, and observed how these have changed over time as the proportions of fossil fuels and renewables consumed has changed. Changes to the fuel mix affect the fuel factor, as a country increases the proportion of renewable energy in its fuel mix its fuel factor will decrease.

At any point in our analysis when we refer to the removal of variance in the data due to the effects of COVID-19 on energy consumption, emissions, GDP, or any of our calculations, we have used our methodology described as above, but comparing 2021 data with 2019 data. While it is important to assess the real change in our metrics between 2020 and 2021, there is also value in taking a macro-view of performance by assessing the reductions achieved when the anomalously large decrease in consumption and GDP (that occurred in 2020), and subsequent bounce back in these values in 2021, is smoothed in the data.

G20 performance across our key metrics

This table presents the data underpinning our analysis.

Country	Carbon intensity (tCO_2 / $m GDP) 2021	Change in carbon intensity 2020-2021	COVID-smoothed change in carbon intensity 2019-2021	Annual average change in carbon intensity 2000-2021	Change in fuel factor 2020-2021	Change in energy intensity 2020-2021
World	**266**	**-0.49%**	**-3.00%**	**-1.39%**	**-0.07%**	**-0.42%**
G7	**189**	**0.10%**	**-6.31%**	**-2.27%**	**0.90%**	**-0.80%**
E7	**351**	**-0.88%**	**-1.66%**	**-1.48%**	**-0.62%**	**-0.26%**
China	441	-2.83%	-3.70%	-2.74%	-1.66%	-1.19%
US	225	0.14%	-7.77%	-2.58%	0.77%	-0.63%
EU	131	0.82%	-6.01%	-2.43%	0.86%	-0.04%
India	274	2.93%	1.72%	-1.20%	1.90%	1.02%
Japan	200	0.58%	-3.19%	-1.26%	-1.30%	1.91%
Germany	134	1.67%	-5.59%	-2.46%	2.26%	-0.57%
Russia	454	3.07%	-0.07%	-2.25%	-0.30%	3.38%
Indonesia	200	-0.96%	-7.13%	-1.17%	0.09%	-1.05%
Brazil	144	5.64%	2.50%	-0.22%	5.56%	0.08%
France	82	1.41%	-7.28%	-2.65%	2.14%	-0.72%
UK	104	-1.47%	-8.49%	-3.85%	4.11%	-5.35%
Italy	119	2.28%	-2.65%	-1.69%	1.67%	0.60%
Mexico	170	-0.26%	-9.81%	-1.26%	-1.00%	0.75%
Turkey	173	-2.74%	-5.46%	-1.40%	1.85%	-4.51%
Korea	259	-1.59%	-8.01%	-2.09%	-2.43%	0.86%
Canada	299	-2.20%	-6.01%	-2.13%	1.43%	-3.58%
Saudi Arabia	388	-1.84%	0.21%	0.36%	-0.61%	-1.23%
Australia	302	-3.30%	-9.37%	-2.10%	-1.59%	-1.74%
Argentina	197	-0.42%	3.43%	-0.35%	1.44%	-1.84%
South Africa	546	-4.61%	-5.60%	-1.43%	-0.44%	-4.19%



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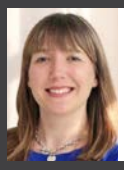

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