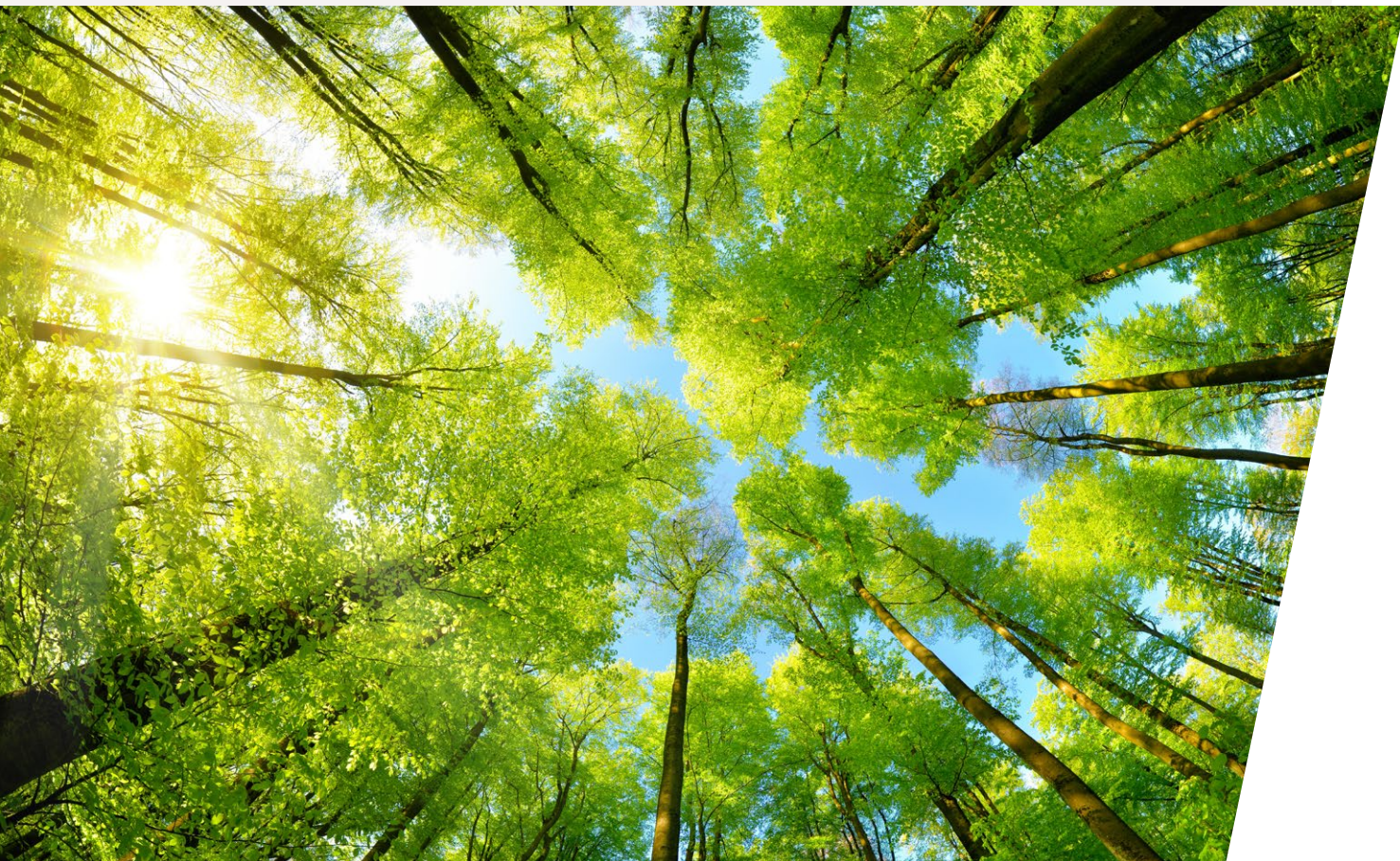


ESGnomics





Foreword

Climate change, reduced inequality and better governance are all challenges to making our world more just and sustainable in the future, and Rothschild & Co is committed to this goal.

The Group's economic research is part of this approach, providing analysis on the main risks and opportunities to which economic players are exposed. ESGnomics aims to convey in an educational manner the contributions of economics to the discussion of Environmental, Social and Governance issues.

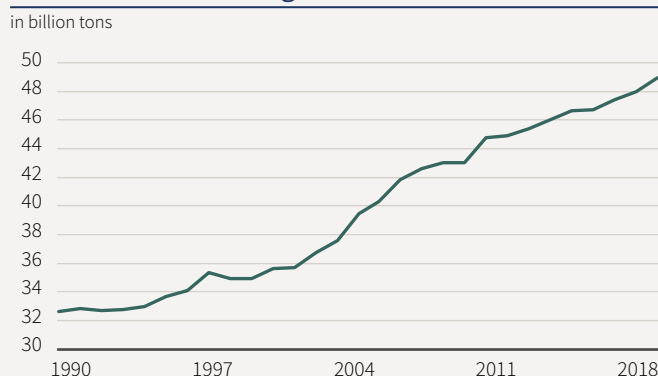
The challenge of decarbonization



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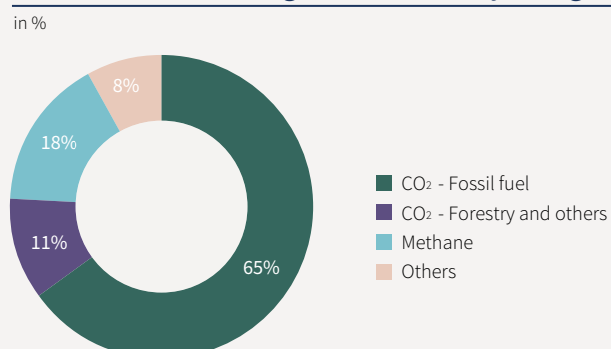
To prevent severe climate change, the world needs to rapidly reduce global greenhouse gas (GHG) emissions and we are approaching a decisive moment for international effort to tackle the crisis. There are still pathways to reach net zero⁽¹⁾ by 2050, yet they remain narrow and challenging.

World - Greenhouse gas emissions



Source: Macrobond, Rothschild & Co Asset Management Europe, April 2022.

World - Greenhouse gas emissions by category



Source: EPA, Rothschild & Co Asset Management Europe, April 2022.

Understanding the sources of emissions

The world emits around 50 billion tonnes of GHG each year and carbon dioxide (CO₂) accounts for three quarters of these emissions. Fossil fuel use is by far the primary source of CO₂, although it can also be emitted from direct human-induced impacts on forestry and other land use, such as through deforestation, land clearing for agriculture, and degradation of soils.

Reducing global CO₂ emissions to net zero by 2050 is consistent with efforts to limit the long-term increase in average global temperatures to 1.5°C⁽²⁾.

In order to envisage how we can most effectively reduce emissions, we first need to understand where they come from. The Kaya identity⁽³⁾ provide a useful framework for analyzing emission drivers by decomposing overall changes into four underlying factors: (1) population, (2) GDP per capita, (3) energy intensity of the GDP, (4) and carbon footprint of energy.

Territorial CO₂ emissions =

$$\text{Population} \times \frac{\text{GDP}}{\text{Population}} \times \frac{\text{Energy}}{\text{\$GDP}} \times \frac{\text{CO}_2 \text{ emissions}}{\text{Energy}}$$

Higher levels of economic activity are highly correlated with energy use and consumption of natural resources. In fact, population and GDP per capita growth – the first two components of the Kaya identity – were the main drivers of the increase in global CO₂ emissions since 1970⁽⁴⁾.

(1) Put simply, net zero means cutting GHG emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere by carbon sinks, oceans and forests for instance.

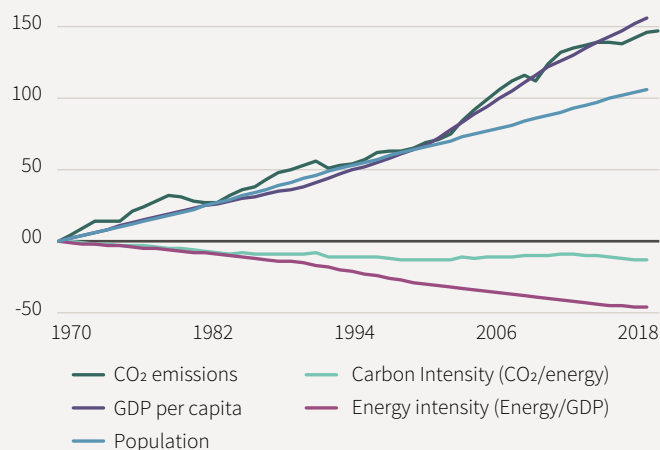
(2) IPCC, Global Warming of 1.5 °C, Special Report, 2018.

(3) Kaya Y., "Impact of Carbon Dioxide Emission Control on GNP Growth: Interpretation of Proposed Scenarios", 1990.

(4) IPCC, Climate Change 2014: Working Group III: Mitigation of Climate Change.

World - Kaya identity

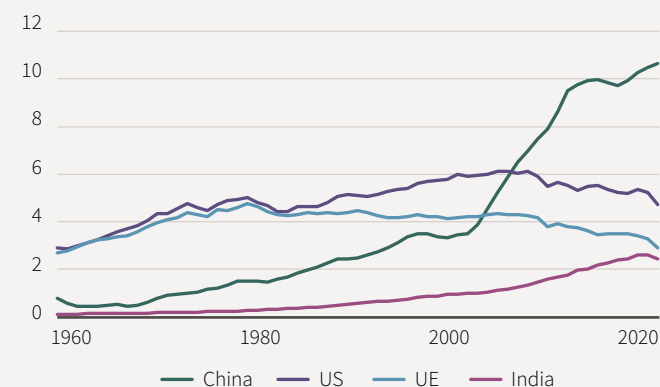
% change since 1970



Source: Our World In Data, Rothschild & Co Asset Management Europe, April 2022.

World - Annual CO2 emissions

in billion tons



Source: Macrobond, Rothschild & Co Asset Management Europe, April 2022.

In theory, limiting population growth is one way to limit GHG emissions, but projections show that the global population is expected to continue to expand in the foreseeable future. In addition, although each person added increases GHG emissions, the additional contribution varies widely depending on the socio-economic and geographic conditions. For instance, there is a 91-fold difference in per capita CO₂ emissions from fossil fuels between the highest and lowest emitters⁽⁵⁾.

Meanwhile, deep cuts to GDP per capita are politically unrealistic as economic growth is of central importance for welfare and issues such as debt sustainability, pensions and social security. Therefore, since emissions reductions in order to limit global warming cannot come from the first two factors, the world must rely on the decline of energy intensity and carbon footprint of energy.

“Territorial emissions can be somewhat misleading...”

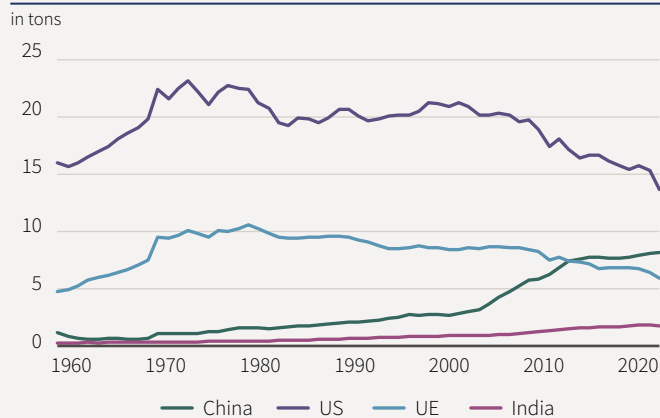
A major challenge

The reduction in carbon intensity of energy supply was the strongest in the 1980's and 1990's due to the delayed effect of the oil price shocks of the 1970's. However, since the beginning of the 21st century, the downtrend was slowed by different factors, namely the emergence of mass consumerism. For instance, declining energy intensities observed in China and India have been partially offset by increasing carbon intensities in these countries. Indeed, rising carbon intensities accompanied the early stages of the industrialization process, which is closely linked to accelerated electricity generation mainly based on fossil fuels (primarily coal). In addition, the rapidly growing transport sector was fuelled by oil, which further contributed to increasing carbon intensities⁽⁶⁾. That said, territorial emissions can be somewhat misleading. Developed economies such as the EU and the US import a lot of goods that are produced elsewhere – namely in India and China, and thus GHG emissions attributable to consumption is more revealing although difficult to estimate.

(5) Raupach M. R. and all, "Global and regional drivers of accelerating CO₂ emissions", Proceedings of the National Academy of Sciences, 2007.

(6) IPCC, Climate Change 2007: Working Group III: Mitigation of Climate Change.

World - Per capita CO₂ emissions



Source: Macrobond, Rothschild & Co Asset Management Europe, April 2022.

Overall, for the past few decades, declining carbon and energy intensities have been unable to offset income effects and population growth and, consequently, GHG emissions kept rising and show no sign of peaking. Even unprecedented circumstances such as the massive restrictions introduced to contain COVID-19 led only to a 6% drop in CO₂ emissions in 2020, from which a quick rebound to pre-pandemic levels promptly followed⁽⁷⁾.

In fact, given population and GDP growth projections, CO₂ emissions per unit of GDP (factors 3 and 4) have to decline by around -95%, or approximately -9% per year on average from 2019 until 2050 in order to limit global warming⁽⁸⁾. For comparison, between 1990 and 2016, the world achieved an average of -1.8% per year, implying the average speed CO₂ emissions reduction per unit of GDP during the next three decades will have to be almost five times greater.

“Decarbonization will require major transitions in the energy sector...”

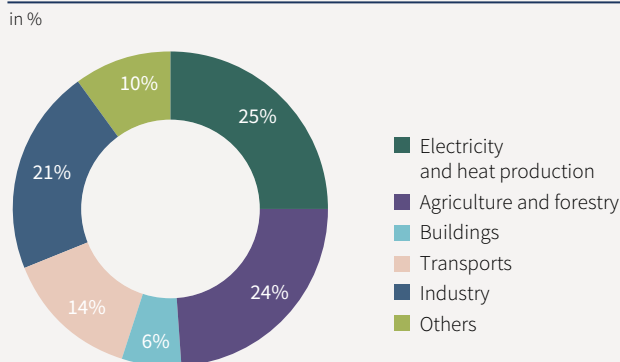
Innovation, but also behavioural changes, are key

That said, one should note that, in the past, climate efforts were not a high priority and, accordingly, most countries have put in place only modest policies. Today, the number of countries that have pledged to reach net zero emissions by mid-century or soon after continues to grow, now covering 135 countries, equivalent to almost 75% of global CO₂ emitters.

Still, decarbonization will require major transitions in the energy sector, involving a substantial shift from fossil fuels to renewable energy sources and improved energy efficiency. It is encouraging that since 2010, there have been sustained decreases of up to 85% in the costs of solar and wind energy, and batteries⁽⁹⁾. The lack of renewable energy storage capacity nevertheless represents a substantial challenge.

By economic emitters, the industrial sector accounts for about a fifth of global emissions and reducing them will involve using materials more efficiently, reusing and recycling products and minimising waste. Achieving net zero will also require low and zero emissions electricity, another significant emitter. Massive investment in existing green technologies and in the advancement of new breakthrough technologies are thus paramount. However, most emission reduction scenarios compatible with continued population and economic growth rely to varying degrees on the use of technologies that are not yet available, which can only illustrate the scale of the challenge.

World - Greenhouse gas emissions by economic sector



Source: EPA, Rothschild & Co Asset Management Europe, April 2022.

(7) IEA, “After steep drop in early 2020, global carbon dioxide emissions have rebounded strongly”, press release, 2 March 2021.

(8) Lenaerts, K., S. Tagliapietra and G.B. Wolff, “Can climate change be tackled without ditching economic growth?”, Working Paper 10/2021, Bruegel.

(9) IPCC, “The evidence is clear: the time for action is now. We can halve emissions by 2030”, press release, 4 April 2022.

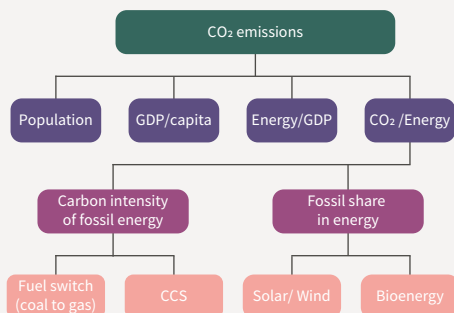
Structure of the analysis of global CO₂ emissions

Aggregated trends

Kaya identity

Kaya identity
(extension)

Technology



Source: Center for International Climate Research, 2017.

Dematerialization of the economy (e.g. through a shift from manufacturing to services) and altered consumption behaviour also seem essential aspects that have to be taken into consideration. In that regard, public policies covering fossil-fuel subsidy phase-outs, carbon pricing and other market reforms can ensure appropriate price signals, although governments will undoubtedly face stiff resistance.

Overall, a transition of the scale and speed needed to reach the net zero pathway cannot be achieved without sustained support and participation from every citizen as the changes will affect multiple aspects of people's lives – from transport, to heating, to labour market.

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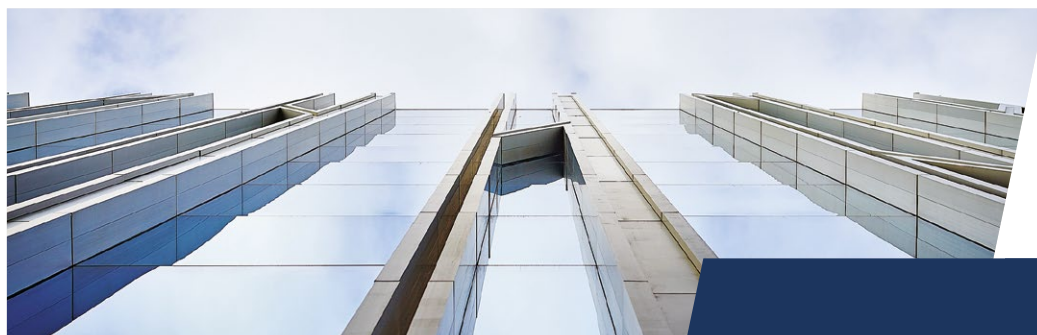
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