



GREENHOUSE GAS EMISSIONS
THE GLOBAL PICTURE

Martin Livermore

The Global Warming Policy Foundation

Briefing 49

Greenhouse Gas Emissions: The global picture

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Summary

The current round of international action on climate change mitigation is achieving little. Under pressure from a powerful environmental lobby, politicians pay lip service to the need for drastic decarbonisation of developed-world economies and commit to increasingly unrealistic targets. Meanwhile, global emissions continue to rise. Even with the major economic disruption caused by the Covid-19 pandemic, it is estimated that global emissions of carbon dioxide in 2020 will be only 5.5% lower than the previous year.

Leaving aside any consideration of the actual effectiveness of decarbonisation – if it could be achieved – it behoves the scientific and political establishment to revise their analysis of what can be done and how to achieve it, and focus efforts on developing realistic and affordable solutions. Fossil fuels will inevitably be replaced by other sources of energy, but only when credible, economic alternatives are available.

Whatever efforts European states make to reduce emissions, the outcome could simply be to cripple their economies, while China, India and the rest of the less-developed world continues to fuel growth with coal and oil. These countries will never follow the lead of the EU or others until the solutions provided are economic.

Despite this, politicians are reluctant to criticise activists such as Extinction Rebellion, despite their naïve demands for rapid and complete decarbonisation in single countries, which ignore the bigger picture.

In these circumstances, it is far better to focus resources on developing energy generation and storage technologies (plus, potentially, carbon capture technologies) that industry and domestic consumers would choose without compulsion or subsidies. The industrialised world would still be taking a lead, but in a much more rational way.

About the author

After graduating in chemistry, Martin Livermore worked for Unilever, Dalgety and DuPont for 27 years in a range of technical jobs in the food and agriculture sector, in the UK, South Africa and the Netherlands. He set up his own consultancy business in 2001, working with national and international trade associations and major companies on a range of science communications issues, while developing particular interests in the biotechnology and energy sectors. He was director of the Scientific Alliance from 2006 until 2018, working to encourage a rational, evidence-based approach to major policy issues.





1. Introduction

Concerns about the impact of climate change and, more specifically, the anthropogenic contribution to it, have been growing since the formation of the Intergovernmental Panel on Climate Change (IPCC) in 1988 and the coming into force of the UN Framework Convention on Climate Change in 1994. Although the extent of global warming over the rest of the 21st century is uncertain – headline figures are often worst-case scenarios from flawed climate models – there can be little disagreement about the facts: that we currently live in a gradually warming world and that human activities make some contribution to this.

Whatever readers may think about the advisability of taking specific actions to reduce net carbon dioxide emissions now, European governments are committed to doing so. What we can do is to help ensure the full implications of these actions are understood and propose ways to make mitigation actions as cost-effective as possible. If no cost-effective options are available, governments should acknowledge the situation and be prepared to refocus efforts towards development of technologies capable of delivering the change deemed necessary. In an ideal world, they should follow the path of least regret, with decisions being justifiable whatever the actual extent of changes in climate patterns turns out to be in several decades' time.

A generation of schoolchildren have grown up to see climate change as the great existential threat of modern times, just as older generations had theirs overshadowed by the Cold War. The emergence of Greta Thunberg into the public eye is an almost inevitable consequence. But it is not only young people who have been made anxious – in some cases apparently scared witless – by climate change; many older people have joined the demonstrations by Extinction Rebellion, which made plenty of headlines in 2019 and 2020. They are calling for radical action – necessary in their view – to secure the future of the human race. Not content with the commitment of the UK government to carbon neutrality by 2050, they demand that this goal is brought forward to 2025.

Most politicians dare not criticise this demand, even though it is patently unachievable. On an international scale, senior figures from around the world applauded Miss Thunberg for berating them about 'stealing her childhood'. However, reality has to intervene at some point, and the protestors and activists must accept two facts if any action taken on climate change is to be rational and effective. The first is that, while politicians may make rash promises, they are only representatives of the citizenry. If voters are unconvinced that real sacrifices and reductions in their standard of living are worth it, elected politicians ultimately have to accept this. The second is that European citizens could decide to revert to pre-industrial norms, but it would make precious little difference to the trajectory of climate change without serious action; by China in particular, but also, in coming decades, by India and Africa.

Rapid decarbonisation is never going to be easy, but radical change can happen surprisingly quickly if the right technology is available at an affordable price. At present, the focus is largely on the electricity generation sector, which is the least difficult by some margin. Even so, the technology to provide a secure zero-carbon supply simply does not exist (unless governments are willing to encourage investment in a significant number of new nuclear power stations). Currently, there is no way of storing sufficient energy from intermittent sources to maintain the power supply over extended periods when neither solar nor wind energy is generated. Affordable energy-storage solutions on a vast scale could change the situation dramatically, but that is currently just a pipe-dream.

And the rest of the economy is more difficult still. It is technically possible to convert houses heated by gas or oil to electricity (or, potentially, hydrogen), although at a vast cost in both domestic and energy generation infrastructure. Transport and, in particular, aviation present rather more difficulties. Moving away from steel and concrete for construction would be extremely difficult.

In other words, the low-hanging fruit has already been picked; things can only get more challenging and expensive in future. The icing on the cake is that, even if we make the whole of Europe a zone with zero emissions, we will still consume food and use products and raw materials imported from countries where carbon dioxide emissions are currently much higher than our own, and which show no sign of peaking in the near future. The EU is considering a levy on imports based on the carbon dioxide emissions embedded in their production. On the face of it, this is a rational move, but would almost certainly have a severely negative impact on the economies of major exporting countries in Asia. Conceivably, manufacturing jobs lost from Europe could be repatriated, which might well raise nominal emissions.

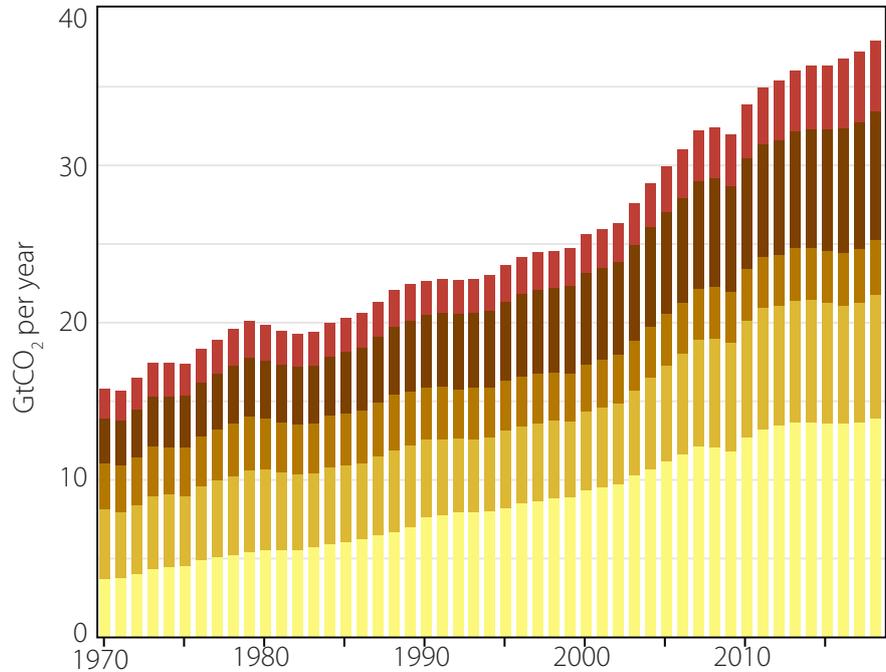
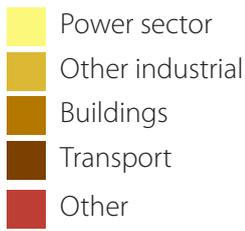
It is futile to make drastic changes to our lifestyles in the name of emissions reduction unless other countries are doing the same. Ultimately, global emissions will not decline steeply until better technologies are available to enable cuts to be made efficiently and affordably.

2. The current situation

The trend of global carbon dioxide emissions has been upward for many years. Figure 1 shows the latest available global figures for CO₂ emitted from fossil fuels (to 2018).¹ All sectors show an rising trend, with the exception of buildings. These figures take no account of emissions of carbon dioxide and other greenhouse gases from other sources; for example, the agriculture and forestry sector contributes CO₂, methane and nitrous oxides that must be considered as part of the wider picture. However, for the purposes of this study, we will consider only use of fossil fuels.

The baseline against which emissions are measured is 1990, when total CO₂ emissions ran at approximately 23 gigatonnes (Gt)

Figure 1: Global emissions 1970–2018.¹



annually. By 2018, this had risen to about 38 Gt per annum, an increase of about 65%. In a world seemingly committed to drastic cutbacks and a goal of achieving ‘carbon neutrality’ by mid-century, this is an obvious policy failure.

A small drop in emissions associated with the financial crisis of 2008 can be seen, but this had no effect on the longer-term trend. A similar drop will occur in 2020 because of the economic disruption caused by the Covid-19 pandemic, but the economic recovery will inevitably see things return to normal once more. One recent study estimated that CO₂ emissions will fall this year by about 2 billion tonnes, a drop of 5.5% from 2019.² This may well have a longer-lasting impact on global trade but, unless consumption patterns in major economies change significantly, the impact on emissions by 2025 are likely to be very modest. Viewed from another perspective, the paltry emissions reduction brought about by the major economic disruption occurring across the world brings the sheer scale of the ‘net zero’ challenge into sharp focus.

Despite the clear problem with keeping to the path mapped out for the steep reduction in use – and ultimate phase-out – of fossil fuels, many developed countries continue to impose tighter national targets, at an increasing cost to their own economies. Their naïve implicit assumption appears to be that where they go, others will follow. Unfortunately for policymakers, emerging economies can continue to boost their own growth via further expansion of their use of fossil fuels, while paying lip service to a cleaner, greener future.

The West faces a stark choice if it is serious about meeting global targets: it must either fund the transition away from coal, oil and gas in Asia, Africa and South America, or it must help develop the new technologies that would permit cost-effective global decarbonisation. In democracies, voters will ultimately determine the approach society will accept.

3. The European situation

Focussing on Europe rather than the world, we could be forgiven for thinking that policy targets are much more achievable. To quote from a recent Eurostat article:³

In 2017, greenhouse gas emissions in the EU-28 were down by 22% compared with 1990 levels, representing an absolute reduction of 1240 million tonnes of CO₂-equivalents, putting the EU on track to surpass its 2020 target, which is to reduce [greenhouse gas] emissions by 20% by 2020 and by 40% by 2030 compared with 1990.

While this may be true, Figure 2 shows the trend in greenhouse gas emissions and future pathways, revealing the scale of the task. The target of a 20% reduction by 2020 (relative to 1990) looks certain to be met, but the path to this relatively modest goal has not been smooth. Note the biggest drop in emissions followed the 2008 world financial crisis, a factor clearly evident in Figure 1 as well. On the other hand, the goal of a 40% reduction by 2030 will clearly be missed in the absence of further measures, and the goal of an 80% cut by 2050 looks well-nigh impossible. Nevertheless, this target is now considered too *conservative*, and in 2019 the then UK government made a commitment that the country's economy would be carbon-neutral by this date. How this might be achieved has not been made clear.

This rather unfavourable situation gets considerably worse if emissions are counted for all consumption rather than simply those produced domestically. Figure 3 shows total UK greenhouse gas emissions, including those embodied in imported goods.⁴ Evidently, the UK cannot claim to be a net-zero economy (as it currently hopes to be in just 30 years' time) if we are in effect simply exporting our emissions to China and others.

As Figure 3 clearly shows, UK government policy is bringing the domestic emissions for goods and services down, while embedded emissions from imports show no clear trend. Overall,

Figure 2: EU28 greenhouse gas emissions and projections

- Historic
- Projected:
 - - - with existing measures
 - - - with additional measures
- Targets

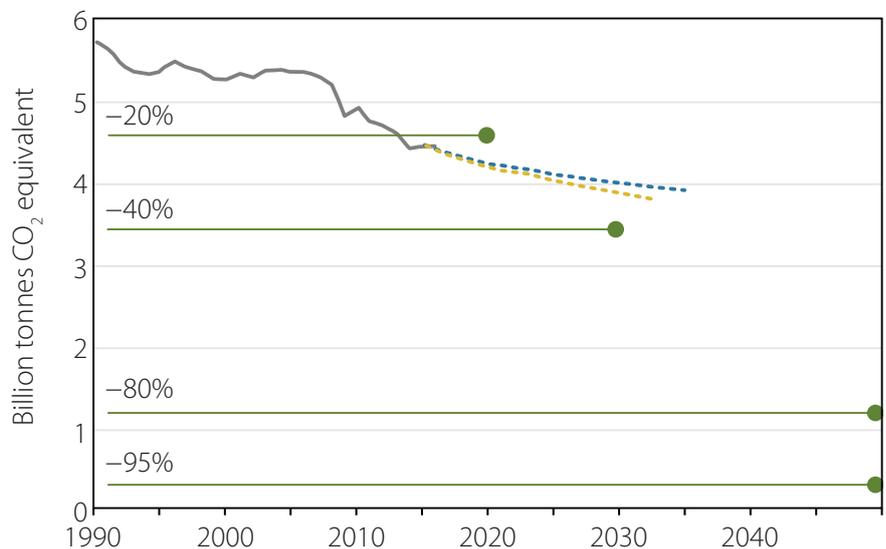
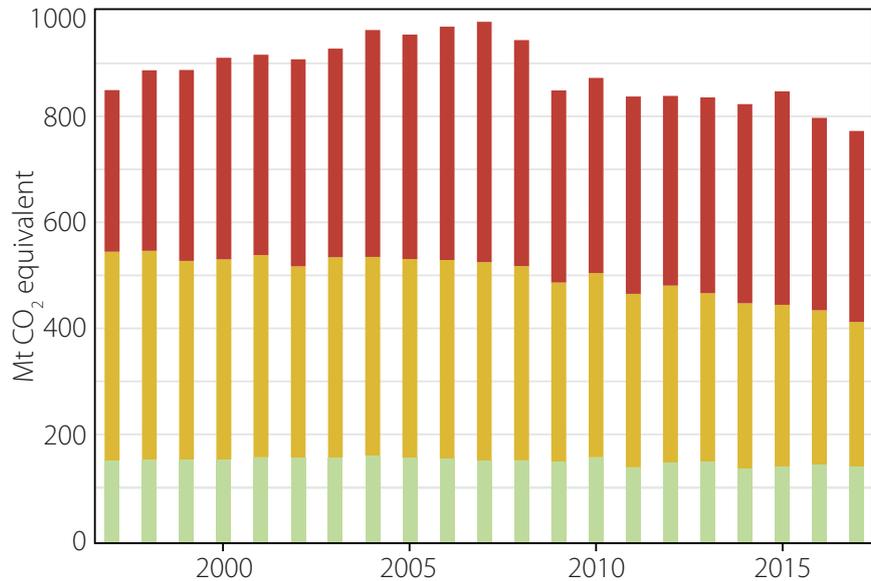


Figure 3: Total greenhouse gas emissions associated with UK consumption (DEFRA).



though, embedded emissions are accounting for a greater percentage of UK emissions on a consumption basis. As an aside, the greenhouse gases directly generated by UK households is a relatively minor and fairly static contributor to the total. However, reducing these emissions – primarily from heating homes – is a massive and expensive task for the future.

As for the UK, so for the rest of Europe. The breakdown may vary from country to country, but all rely to a large degree on imports of consumer goods, food and essential building materials such as steel. In the post-Brexit era, there may be different degrees of inter-connectedness, but the fundamentals remain the same.

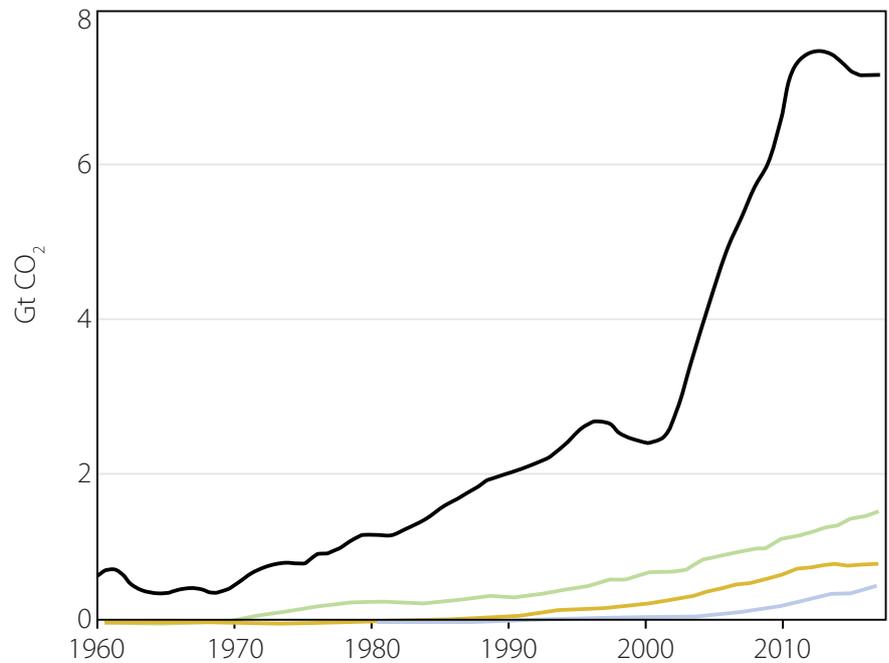
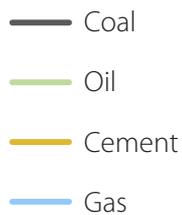
Despite these hard facts, politicians are seemingly powerless to resist the increasingly stringent demands of activists. In 2019, under the Extinction Rebellion banner, a mixture of young and old idealists and semi-professional demonstrators brought parts of London (and Cambridge and other cities) to a halt, apparently with the complicity of the police. Taking worst-case scenarios and predicting not just big impacts on society but the effective demise of civilisation, they demand changes so drastic as to transform society, in effect bringing about a 'Great Leap Backwards'. It is doubtful that this would be tolerated in a democracy but, even if it happened, the impact on global emissions would not come close to achieving the global targets deemed necessary by the IPCC.

4. The Chinese situation

China is by some way the world's leading emitter of greenhouse gases. Not only does it have the largest population, but its economy has grown rapidly and fairly steadily for several decades. In addition, relatively low labour costs make it a major source of both consumer goods and construction materials for the global market.

Figure 4 shows the rapid increase in Chinese emissions from the mid-1990s, and illustrates how a massive upsurge in use of coal has been the primary cause.⁵ A vast increase in electricity generation from coal-fired power stations has both fuelled the dynamic

Figure 4: Chinese fossil CO₂ emissions by source



economy and provided the basis for a steadily increasing standard of living for much of the population. The downside has been a very high level of air pollution, especially in big cities. Despite this, the government is continuing to build yet more coal-fired generating capacity, albeit hopefully with improved treatment of exhaust gases.

Researchers based at the Norwegian CICERO institute have analysed the situation and reported on the Carbon Brief website.⁶ They estimate that CO₂ emissions in China grew by 2.3% in 2018, compared to 1.7% the previous year. This, however, is against economic growth of 6.6% for the year, meaning that emissions per unit of GDP fell by 4%.

China, currently still the world's most populous country, also has a slightly higher than average level of emissions per capita. The latest World Bank figures give this as 7.5 tonnes per capita, which compares to 4.6 for France, 9.3 for Norway, 8.9 for Germany, 6.5 for the UK and 16.5 for the USA. The global average was 5.0 and the EU overall was 6.4. Given that China is still undergoing steady economic growth, it seems unlikely that the emissions per capita will decline steeply enough to avoid a continued increase in total emissions over the next decade or two.

5. The wider world

For comparison with the situation in China (7.5 tonnes per capita), CO₂ emissions were 1.7 t/capita for India, and just 0.8 t/capita for sub-Saharan Africa.

Although India has a large and relatively prosperous middle class, its rate of growth has been modest compared to China's (it is ironic that the world's largest Communist state has a thriving free-market economy, while the world's largest democracy has an economy constrained by government regulation and bureaucracy). Ac-

According to the UN, India's population is expected to overtake that of China (currently 1.4 billion) by 2024, just a few years away. If economic development gathers pace even modestly, the impact on global emissions could be very significant, especially as India too relies heavily on coal.

If India is to begin to fulfil its economic potential and if future governments enact policies that allow a rapid rise in prosperity such as seen in China, then per-capita energy use and CO₂ emissions are certain to grow very significantly. The impact on *global* emissions could be very dramatic and, unlike China, India has not made any commitments to increase its use of renewable energy or to cut emissions. In fact, even China has no obligation to begin making cuts until 2030, and even then the commitment is not binding.

India already has many of the requirements for economic growth to accelerate in the near future. Sub-Saharan Africa, by contrast, has a very high incidence of poverty and deprivation and many countries continue to suffer from poor governance, corruption and conflict. Despite the transfer of many billions of dollars in international aid over the last half century, few countries in the region have seen any significant improvement in the standard of living of the majority of their citizens. At 1.2 billion, the continent's population is comparable to those of China and India. If the current high fertility rates are maintained, the population is likely to double by 2050. If all these new mouths are to be fed (as well as the existing ones) without a reliance on international aid, economies will have to grow and energy use will inevitably rise from its existing low baseline.

6. The likely situation in 2050

To date, the much-vaunted Paris climate agreement has singularly failed to have the intended impact, with global emissions having risen for the past three years. Even in Europe, the economic bloc most committed to the goals, progress has been relatively limited. The European Environment Agency compiled its latest set of figures in November 2019 and, to quote from their key messages, 'EU greenhouse gas emissions decreased by 2% in 2018, following a 0.6% increase in 2017'.⁷

The USA, seen as a pariah by climate change activists because of its departure from the Paris climate agreement, continues to see a reduction in its own per-capita emissions as more local initiatives make their impact. China, meanwhile, has effectively been given a free pass and is still praised in some quarters for its 'leadership' in emissions reduction via its policies on such things as renewable energy and electric cars, despite its enormous continued investment in coal-fired power stations. Nevertheless, the reality of China's continued reliance on coal for many years to come has been acknowledged by those monitoring the situation; The Climate Action Tracker give China's Nationally Determined Contribution towards the Paris climate agreement a rating of 'Highly

Insufficient'.⁸ This same source comments that domestic policy is heading in a slightly better direction, but this was before the disruptive effective of the Covid-19 pandemic, which means that economic recovery has become the top priority.

While making predictions is a dangerous game, some trends are more likely than others over the coming three decades. All of this assumes, of course, that climate change remains a high-priority issue and that notional political commitment to action is kept up.

First, we can assume that the EU will remain at the forefront of action, whether or not it turns out to be effective. In the last few years, the bloc's share of global CO₂ emissions has remained at 9.6%.¹ The target for 2030 is a reduction of 40% from 1990 levels, building on a goal of 20% by 2020. The earlier objective has surely already been achieved (although we will have to wait for the final tally), at least in part because of the loss of swathes of heavy industry and improvements in energy efficiency. From here on, however, goals will become harder to realise: increasing reliance on renewable energy makes it more difficult to maintain a secure, stable electricity supply, tackling domestic heating is a massively expensive and disruptive undertaking, and there is a long way to go before electric vehicles take over from conventionally-powered cars. Despite the practical difficulties, even more stretching targets for 2030 are currently under discussion, with a reduction of up to 65% in emissions being proposed.

The aspiration is to move to carbon neutrality by 2050, a goal to which the UK has now committed, but on which EU member states have yet to agree. Without major technological progress, it seems inconceivable that the target will be met. If I were a betting man, I would wager that the maximum reduction that will be achieved will be no more than 50–60%. Even if the target were to be met, there would still be significant emissions embedded in imported food and manufactured goods.

To be generous, let us assume that the goal is actually achieved, cutting emissions equivalent to 10% of the current global total. The USA contributes about 14% of global emissions and that share is continuing to fall, despite President Trump taking the country out of the Paris climate agreement. Individual cities and states have some quite radical targets. Nevertheless, it is unrealistic to think of America being anywhere close to carbon neutrality by mid-century. Let's be generous once again and say that the US cuts its emissions by a similar absolute amount as the EU, giving a combined 20% reduction in the current baseline level of global emissions for these two leading economic blocs.

But what about the other 80% we are told need to be cut? There are two obvious elephants in the room: China and India. China already accounts for 29% of global emissions, more than double that of the USA, having taken first place from that country in only 2006. What happens in China really matters, and the situation does not look promising: the country's emissions continue to rise at around 1% annually. The country is already the world's

largest user of coal, and is adding more coal-fired power stations to its fleet.

In fact, the situation in 2018 moved even further from the hoped-for downward trend. According to the latest analysis from the International Energy Agency:

In China, CO₂ emissions grew by 2.5%, or 230 Mt, to 9.5 Gt. A jump of over 5% in electricity generation from coal-fired power stations drove up emissions by 250 Mt, which more than offset the impact of a decline in coal use outside of the power sector. An 80-Mt growth in emissions from gas combustion came predominantly from outside of the power sector, as gas was increasingly chosen as a substitute for coal-based heating.⁹

It defies logic to believe that the current Chinese regime would close these power stations while they are still economic to run, or that it would compromise the economic growth that helps it keep a secure hold on political power. The growth in use of gas for heating is a further reminder of the fact that other major challenges lie ahead, outside the power sector.

The government has pledged that emissions will peak by 2030, although there has been considerable speculation that this goal could be reached as early as 2022. Time will tell. In the meantime, China's large-scale programme of overseas investment via the Belt and Road Initiative is putting far greater resources into building coal-fired capacity than into renewable energy projects.

If making predictions is difficult in general, where China is concerned it is virtually impossible. In some respects, it is easier to see the trend in India. The economy is continuing to grow far faster than the industrialised world, as we might expect, although it is now at a rate below 5% per annum, which is not in the same league as the 10% year-on-year growth that brought China to its present position. But it is much greater than the current rate of population growth, now down to a little over 1%. On average, Indians are becoming more prosperous. Already, the number of under-15s has peaked, and total numbers are also expected to peak and begin to decline in the 2060s (but not before rising to 1.68 billion from the 1.35 billion estimated in 2018). That's another 25% growth in GDP needed just to stand still.

Continued growth in living standards also means maintaining economic growth at levels that are high by European standards; 5% seems to be the bottom end of the expected range. Sustained growth of this sort can only come from more energy-intensive sectors. India currently has a high percentage of rural dwellers engaged in small-scale farming, but continued urbanisation can be expected, which will certainly push up the carbon intensity of the Indian economy from its relatively low current score of 0.29 kgCO₂ per GDP unit. For comparison, the carbon intensity of the Chinese economy is at present 0.45 kgCO₂/GDP unit. Whatever happens in China, it is surely inevitable that India will make a significantly greater contribution to emissions in the 2030s and 2040s.

There is also another elephant in the room; an African one.

Unlike most other undeveloped regions, sub-Saharan Africa has made little economic progress since the Second World War. A combination of poor governance, conflict and widespread corruption has caused misery for millions, and billions in overseas aid have achieved very little. But it is surely not going to be that way for ever. Despite very significant problems, both South Africa and Nigeria are countries that have great potential and have leaders who are genuinely trying to move away from the kleptocracy of recent years. There are also signs of hope in countries that have suffered from relatively recent conflicts, such as Rwanda and Ethiopia. From a very low baseline, growth is happening.

This is a region with a population of over a billion. By mid-century, this is likely to have at least doubled. We have to assume that poverty levels will have decreased to some degree over this period, and that more people will have access to grid electricity. If educational standards can be raised for the large numbers of young people, there is the basis for a highly productive workforce to become the new Asia and produce goods for the global market. Even modest growth will lead to a significant rise in emissions, at least in part from power stations built with money from China's Belt and Road Initiative.

If we take all this into account, the actions of the developed world, however successful in reducing emissions, will be at least partially offset by rises in a range of emerging and developing economies, particularly China, India and Africa. Simply carrying on down the current UN-mediated path of multilateral action therefore has little chance of achieving its highly ambitious aims. In the short term, the major economic contraction caused by the Covid-19 pandemic will cause a noticeable downward blip in the emissions curb, but all countries will want to get back to a fully operating and productive economy as soon as possible. If that does not happen, climate change mitigation may not be the most important problem to address.

7. Building a credible plan

At present, achieving the stringent emissions targets envisaged face two major barriers:

- replacing fossil fuels is, by and large, not yet economic and can only be achieved by a mixture of subsidy and compulsion;
- even for the power sector, full replacement of fossil fuels by renewables is not feasible, and the heating/cooling and transport sectors are even more difficult.

The first obstacle is being addressed by carbon taxes, obligations on companies to use a certain amount of renewable energy, and subsidies in one guise or another. This is a drain on the economy of any country and the burden looks set to increase as the low-hanging fruit have been picked and harder tasks face policymakers. The second obstacle is a more basic one; without some means

of providing electricity for the times when the wind is not blowing and the sun is not shining, a secure, fully renewable energy supply is unachievable. As nominal wind and solar capacity is ramped up in an attempt to compensate, it becomes increasingly difficult to protect the grid from the inevitable overload when the wind blows strongly and the sun is fully out. But no matter how much nominal capacity is in place, there will be unavoidable periods of grid failure, surely unacceptable in a modern society. For example, the recent rolling blackouts in California have resulted from an inability to import electricity from neighbouring states when solar or wind generation fails to deliver. It does not matter how low the marginal cost of wind energy becomes, it is the cost of the total electricity supply network – and its stability – that is crucial.

For carbon neutrality to be a credible goal, there have to be economic alternatives to fossil fuels that are affordable and scalable. Only then will economies at all stages of development adopt them. The only plausible alternative involves development of effective, broadly applicable, and economic carbon capture and storage systems, something that remains highly unlikely.

Alternatives to fossil fuels also have to be deployable so as to provide a secure energy supply that can be used for heating, cooling, cooking, lighting and transport. They might include wind and solar, and also nuclear energy, with the proviso that its cost has to be brought down, something that may be in prospect according to a recent newspaper report.¹⁰ The average voter cares little about the difficulties of balancing the grid or the technologies used to generate and store energy. What is important to them is the cost and reliability of the domestic energy supply. Wind and solar alone could suffice to provide a secure energy supply if only an economic way could be found to store energy on a vast scale, sufficient to provide continuity of supply across large areas for extended periods, potentially several days. Nothing on this scale appears to be even on the horizon at present.

A further option to reduce net emissions is carbon capture and storage, much discussed but to date with singularly little effect. Scrubbing exhaust gases of power stations to remove carbon dioxide is feasible, but this is the easy part; storage is the big issue. Most initiatives to date have involved piping CO₂ to underground reservoirs or, somewhat ironically, to improve extraction rates from depleted oil fields. The problem with this approach is that there are no economies of scale. Each project is unique and costs are likely to remain prohibitively high, even if appropriate reservoirs can be found within reasonable distance of the source (a big if). Even government-supported pilot schemes have largely failed to reach fruition. Even if successful, there is a good deal of opposition to this approach from parts of the environmental lobby, which would prefer to see the end of fossil fuel use.

The purpose of this paper is to put the attempts to achieve a 'carbon neutral' economy in one country (or even one region) in the context of the global situation. Separately, the GWPF has published studies this year that put the cost of achieving this goal

as at least £3 trillion for the UK alone.¹¹ That comes to a bill of over £100,000 for every household in the country. Some would argue that this is money well spent, as the cost of avoiding a future catastrophe. However, the net benefit of this exorbitant expenditure would be precisely zero, given that it would be unilateral. If all EU member states were to go down the same path, the exact cost would be difficult to estimate, but it would not be unreasonable to pro-rate the UK figure. With a population of 512 million (including the UK) compared to 66 million for the UK alone, the total cost for the entire bloc would probably be in excess of €20 trillion.

In round terms, Europe and the USA each emit about the same quantity of CO₂ – approximately 5 billion tonnes annually – while China's emissions are about the same as both of these regions together. Eliminating all European use of fossil fuels by mid-century would reduce global emissions by maybe 10% from current levels. But, in the meantime, it is likely that China and other growing economies will have increased their output by a similar amount. Without developing economic and effective ways in which the proposed net-zero economy can be developed, the UK and EU member states would be crippling their economies and making their citizens' lives poorer for exactly nothing.

This discussion has deliberately ignored the contribution of agriculture and land-use change to net emissions. Consideration of these factors would not change the essential argument, although matters would become more complicated as we begin to consider the ramifications of how we feed and clothe ourselves.

The big problems to be solved can be identified, but there are no obvious paths to solutions at this stage. For 'net zero' to be a credible goal, solutions have to be developed that are both economic and scalable. Energy generation and storage systems would need to be deployed in the world's poorest countries as well as the richest, and in rural areas with low population density as well as in major metropolises. There would have to be no raw material or manufacturing capacity constraints, and any changes to current lifestyles would have to be acceptable to citizens of the world's democracies.

All this is a tall order indeed, and will need intensive work in competing centres of excellence to stand a chance of success. In the meantime, it is wasteful and foolhardy to continue blindly to expand the use of existing technologies, subsidised by ever-increasing amounts from consumers and taxpayers. This does not mean that all attempts to reduce use of fossil fuels have to stop; there is certainly a place for building more nuclear power plants, continuing to develop nuclear fusion and, in some cases, adding solar and wind energy generation capacity. But to continue to assume that this alone has a chance of eliminating CO₂ emissions in thirty years' time – at any cost – is a fantasy that should be recognised sooner rather than later.





8. Revised objectives for EU and UK climate change policy

While developed countries may in principle be able to afford to fund at least a partial transition to a decarbonised economy, the money for this project will ultimately come from the pockets of taxpayers and consumers; in other words, voters. Whatever the rhetoric, there comes a point where expensive, radical change is simply not politically feasible in a democracy. All of which leaves politicians on the horns of a dilemma: while continuing to at least pay lip service to the climate change mitigation agenda is the path of least resistance at present, voters will be unforgiving when, as will inevitably happen, the cost of living rises and public services are compromised.

A more rational approach would be to accept that progress at present is severely limited by available technology, and refocus policy accordingly. This could perhaps be based on three key principles:

- Implement energy-saving programmes wherever feasible (for example, replacing filament lighting by LEDs, or retro-fitting insulation to homes where it is cost-effective to do so).
- Invest in a robust, secure electricity supply that minimises CO₂ emissions. This may well include some further wind and solar installations, but only if they are cost-effective. Otherwise, a continuing role for gas and nuclear seems appropriate. Indeed, there is good evidence that nuclear and gas alone could be as effective as renewables plus gas in reducing emissions, but at a significantly lower cost
- Fund a large programme of research and development to address the problems highlighted earlier: reliable renewable energy, large-scale energy storage, and even systems for removal of atmospheric carbon dioxide.

Moving in this direction would require a degree of political courage that has been absent for some time, but has a far better chance of ultimate success than the current attempts to make drastic emissions reductions with inadequate technology. This also offers the best chance that emerging and developing economies will follow suit. The main difficulty would be getting support from the network of groups engaged in the present multilateral round of climate change negotiations, but the argument is there to be made. Not only are there real problems in getting agreement to take the action currently being proposed, but the chances of achieving the objectives are essentially zero until economies at all stages of development have a viable alternative to their current paths.

9. Summary and conclusions

Current unilateral efforts to reduce greenhouse gas emissions are failing to stop global emissions from rising, despite the increasingly extreme rhetoric coming from influential environmental groups. While politicians continue to argue that the developed world has an obligation to lead the way in decarbonisation and that the rest of the world will inevitably follow, there is no realistic chance of this happening within the increasingly tight timescale being proposed.

The primary reason is that economic solutions to achieve the targets are not even in sight. In the medium to long term, the chances of success would be immeasurably greater if current efforts were to be focussed on R&D to provide the new technologies that would make decarbonisation feasible. If the industrialised world led with this, China, India and the rest of the world would follow because it made economic sense.



Notes

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Our main focus is to analyse global warming policies and their economic and other implications. Our aim is to provide the most robust and reliable economic analysis and advice. Above all we seek to inform the media, politicians and the public, in a newsworthy way, on the subject in general and on the misinformation to which they are all too frequently being subjected at the present time.

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