

Challenge of global net zero emissions by 2050

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Nottingham

Challenge of global net zero by 2050

“How did you go bankrupt? Two ways.

Gradually, then suddenly.” Ernest Hemmingway

Challenge of global net zero by 2050

1. Growth, energy and climate
2. Emerging economies and emissions
3. Prospects for growth and emissions
4. Solutions - possible and impossible?
5. Conclusion

1. Growth, energy and climate

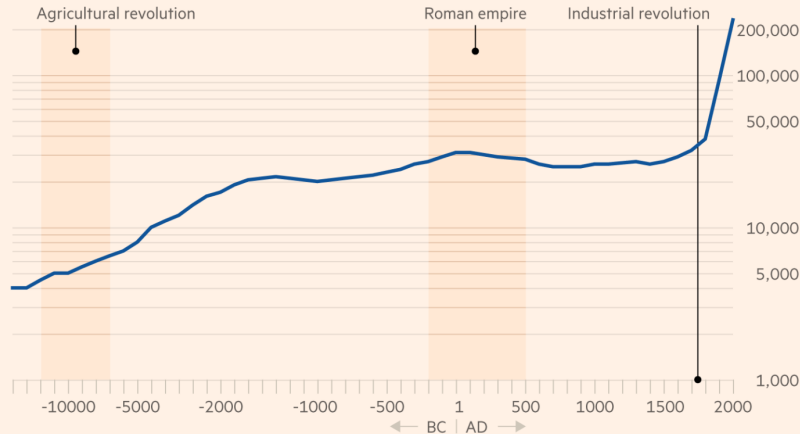
- The harnessing of the market to fossil fuels was the human breakthrough
- This started two centuries of liberation from pervasive destitution and transformative growth
- The growth revolution is now spreading across the entire world
- The result has been ever-greater consumption of fossil fuels
- And, of course, higher temperatures

2. Growth, energy and climate

The shift to fossilised sunlight changed everything

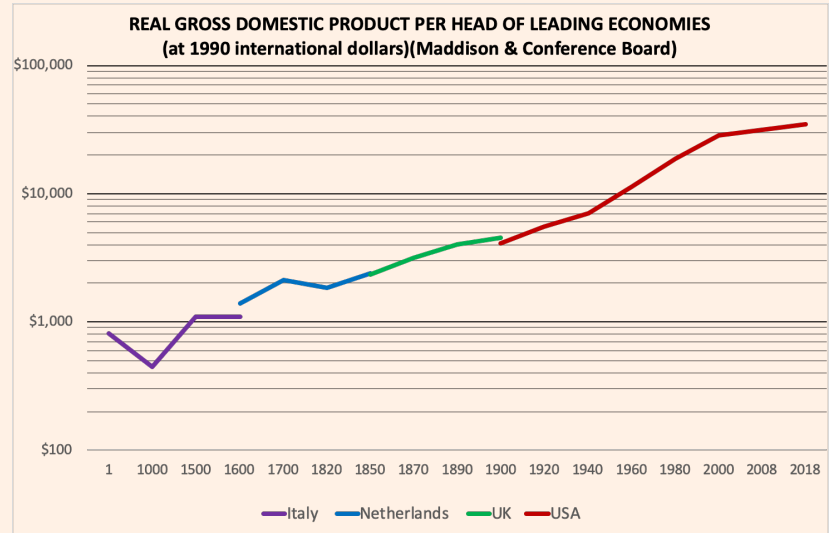
The rise of human energy capture

Energy capture per head per day of leading western economies (kilocalories, log scale)



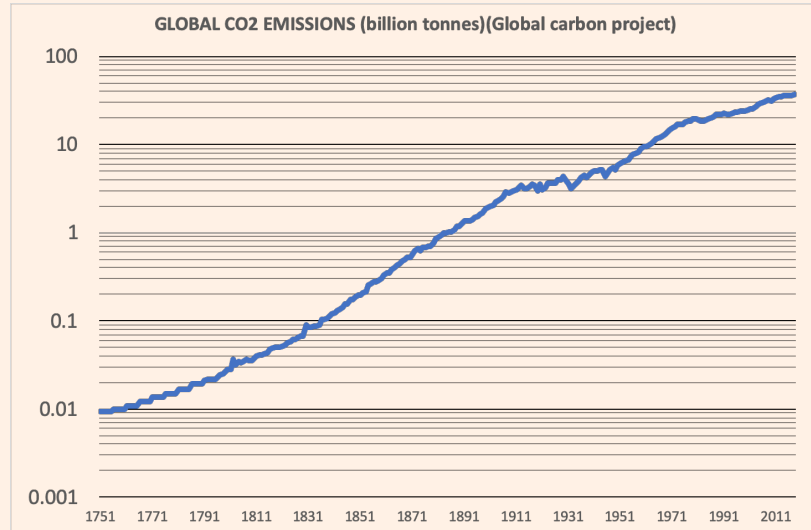
Source: Ian Morris, Social Development, October 2010
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It allowed enormous rises in real output per head

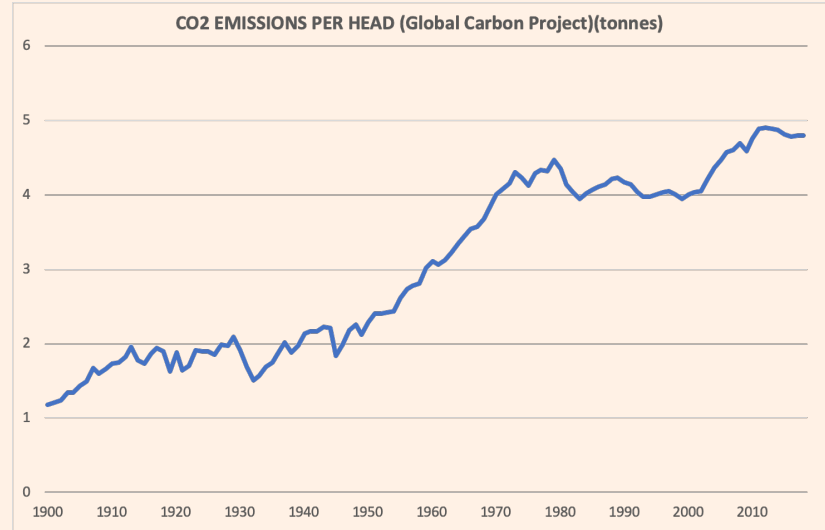


2. Growth, energy and climate

Fossil fuels drove huge growth in emissions of carbon dioxide

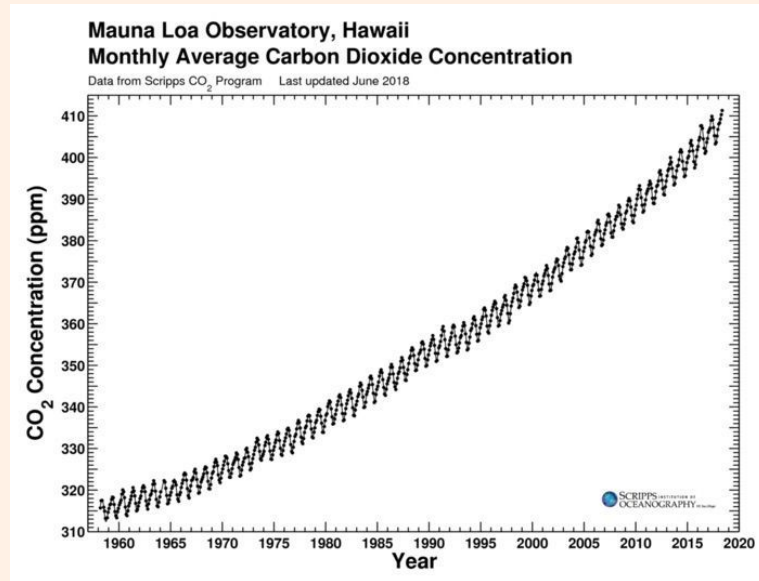


Growth in emissions has slowed but emissions per head remain high



2. Growth, energy and climate

CO₂ concentrations have risen steadily



And the planet is already 1° C hotter than in pre-industrial times

Global average temperature difference (degrees C)

Compared to 1850-1900 'pre industrial' average



Source: Met Office

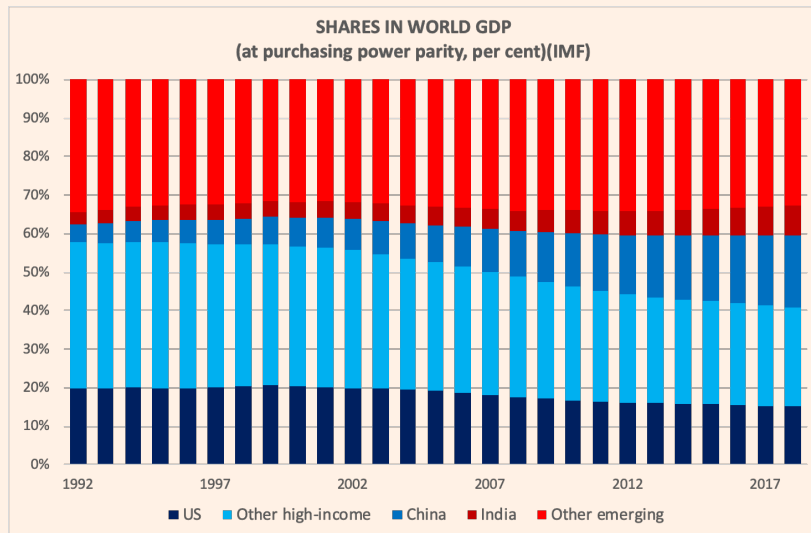
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2. Emerging economies and emissions

- The big economic transformation is the economic rise of emerging economies, especially China
- Emerging countries now generate almost two-thirds of CO2 emissions
- Yet emerging countries are still relatively poor
- And their emissions per head are also relatively low
- So the potential for increasing global emissions remains enormous, unless there are some huge changes

2. Growth, energy and climate

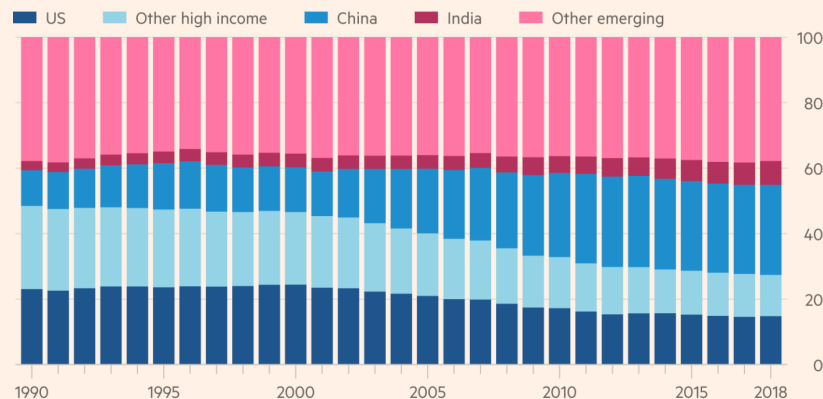
Emerging countries now generate 60 per cent of global output (at PPP)



And a higher proportion of global emissions

Emerging and developing countries now generate close to two thirds of emissions

Share of global annual CO₂ emissions (%)

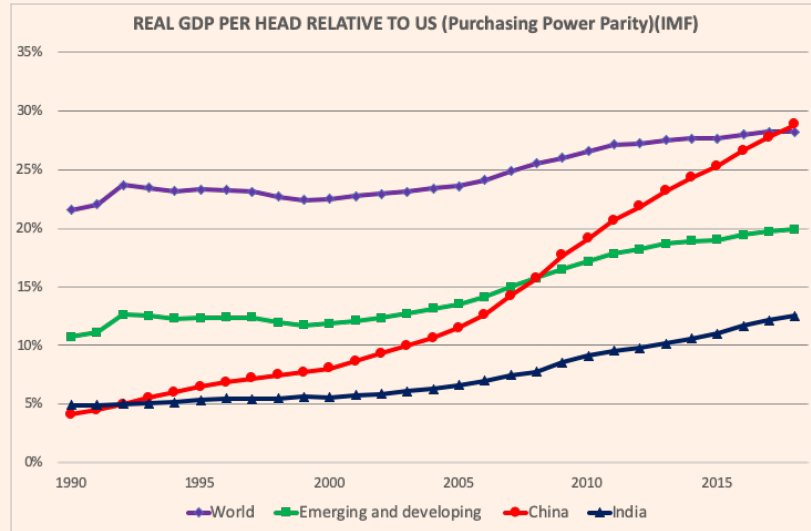


Sources: Global Carbon Project, Our World in Data

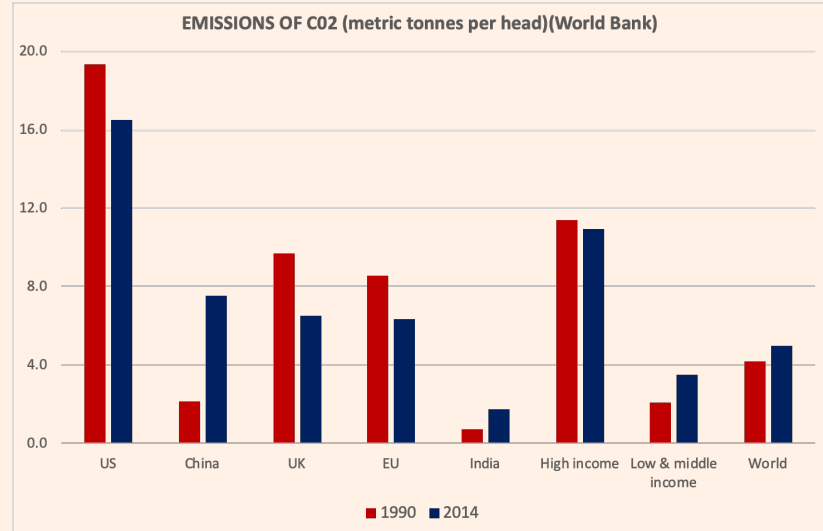
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2. Growth, energy and climate

Yet emerging economies - even China - are still relatively poor

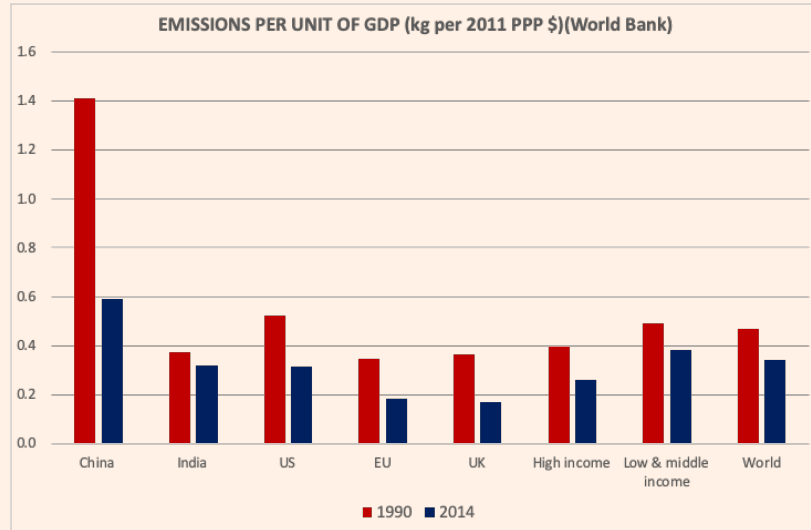


And they mostly emit far less CO2 per head than high-income countries

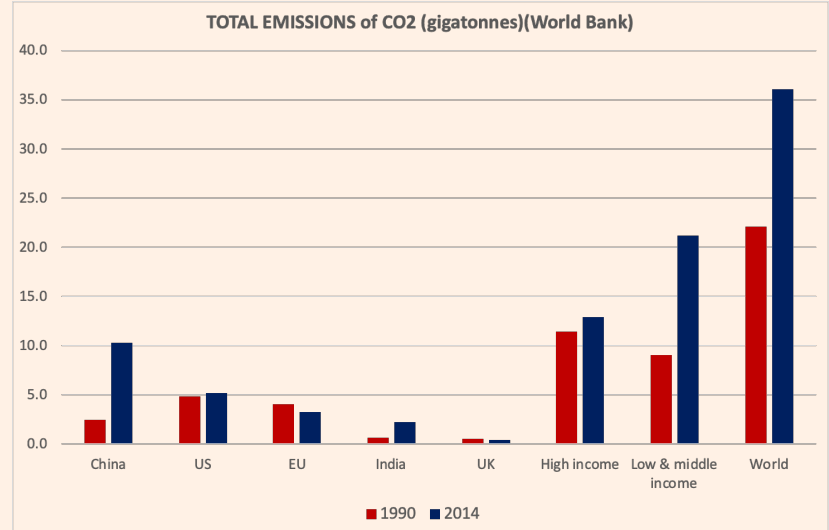


2. Growth, energy and climate

Carbon efficiency of GDP has improved, but not by nearly enough



To stop the huge increase in annual emissions of CO2



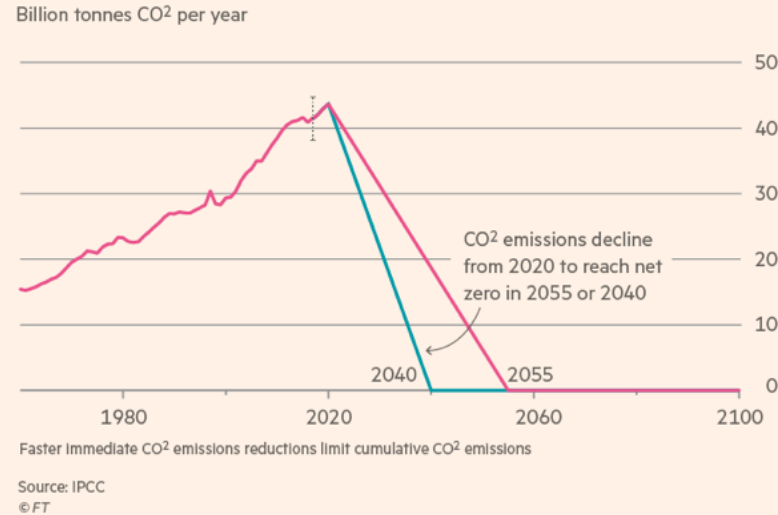
3. Prospects for growth and emissions

- Somehow, the world must reverse the long rise in emissions
- This is a huge challenge
- Between 1990 and 2018, the world economy grew at an annual rate of 4.1 per cent, while carbon emissions grew at a rate of 2.2 per cent. Between 2010 and 2018, they grew at 3.8 and 1 per cent, respectively
- The emissions-efficiency of output rose, but not by nearly enough
- What should we assume about growth and target emissions and so the required reductions in emissions per unit of output?

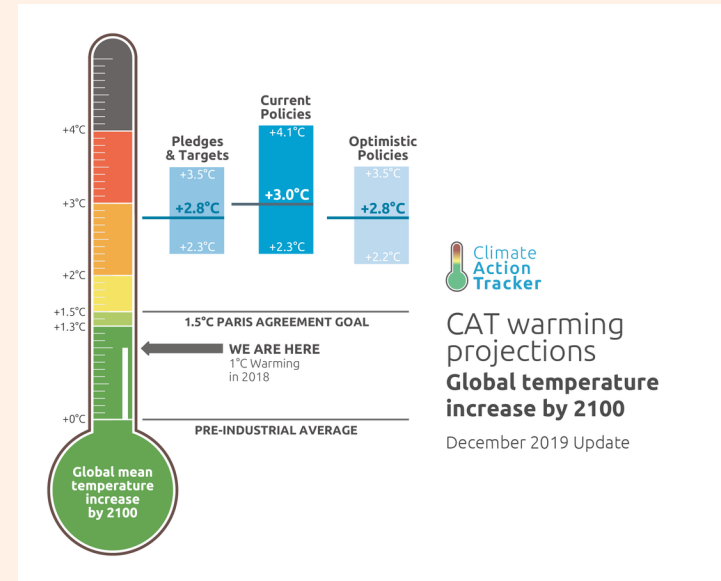
3. Prospects for growth and emissions

Hitting a 1.5° C increase would be very demanding

Hitting 1.5C needs immediate cuts in emissions



We are currently in line with a median probability of plus 3°C



3. Prospects for growth and emissions

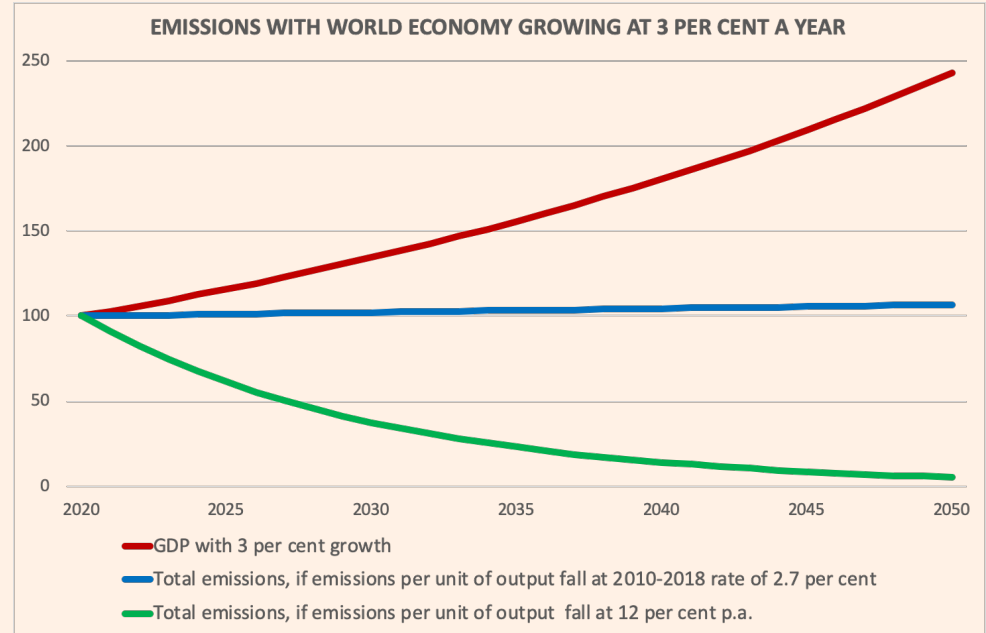
- Between 1990 and 2018 global emissions per dollar of global real GDP (at PPP) fell 36 per cent, an annual rate of close to 2 per cent. Between 2010 and 2018, global emissions per dollar of global real GDP (at PPP) fell a bit faster, at a rate of 2.7 per cent. But this is nowhere near fast enough
- So how fast do emissions per unit of global output have to fall, to reduce emissions by, say, 95 per cent over 30 years?
- The answer is extraordinarily fast, though the scale of the task depends on rates of economic growth

3. Prospects for growth and emissions

- If the world economy expanded at 3 per cent a year, it would take a reductions in CO2 emissions per unit of output at 12 per cent a year to reduce emissions by 95 per cent, by 2050
- Even if the economy stagnated, emissions per unit of output must fall at 7 per cent a year, if total emissions are to shrink by 95 per cent, by 2050
- *If CO2 emissions per unit of output continued to fall at 2010-2018 rates, the world economy would have to shrink by almost 90 per cent, by 2050, if emissions are to fall by 95 per cent*
- Economic stagnation is not the answer, because emissions would still be too high. De-carbonising growth is the sole answer

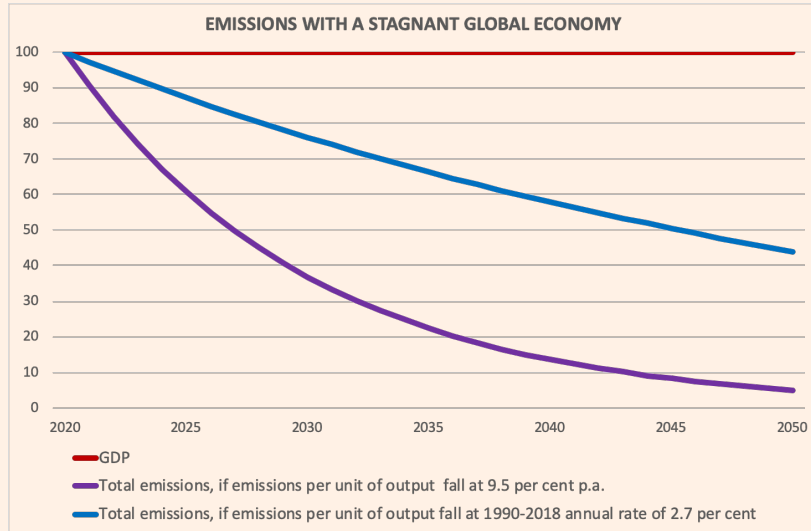
3. Prospects for growth and emissions

The challenge of combining continued economic growth with a 95 per cent reduction in gross CO₂ emissions by 2050 requires a 12 per cent annual fall in emissions per unit of output. At the 1990-2018 rate of fall of emissions per unit of output, total emissions will rise.

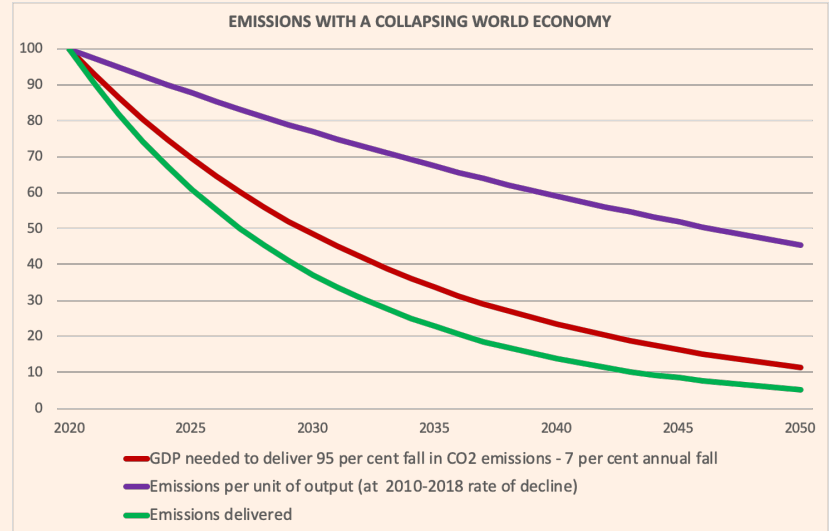


3. Prospects for growth and emissions

Economic stagnation would not solve the climate challenge



At 2010-2018 rates of emissions decline, it would take an economic catastrophe



4. Solutions – possible or impossible

- Politics:
 - No policy solution will work that is not actively implemented by *all* significant countries
 - Countries will *not* agree to be locked into relative poverty
 - They will also *not* agree to be locked into unequal emissions per head at the cost of permanent relative poverty
 - Rich countries are unlikely to accept permanent real income stagnation and certainly will not accept huge real income declines
 - So no solution will be implemented that does not offer economic growth

4. Solutions – possible or impossible

- Economics:

- The relevant solution has to deliver economic growth and de-carbonisation at a historically unprecedented rate
- This require *credible* technical, financial and business solutions
- While such solutions do exist in theory. They will not be implemented, at scale and in time, given the inertia in the energy system, in terms of supply and demand, without dramatic policy intervention
- Massive, globally-agreed-and-implemented government support will be needed, in terms of resources, incentives, finance and planning
- It would be like mobilisation for a global war
- The market will respond to incentives
- But *no* political system anywhere is geared up for this at present

4. Solutions – possible or impossible

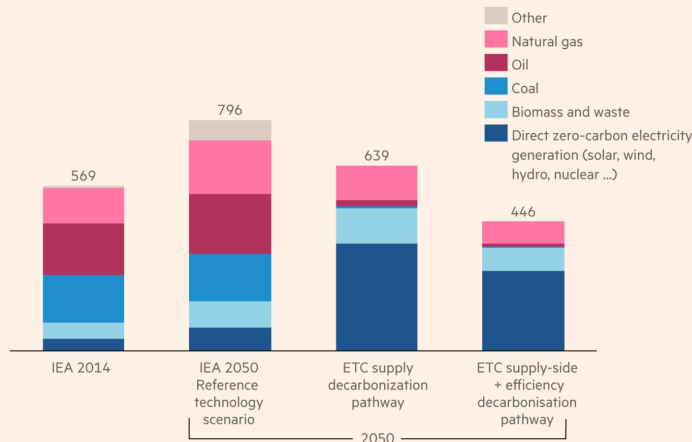
- Policy:
 - There will have to be far more ambitious plans for cuts in emissions across the world
 - There will have to be a huge shift in energy investments, especially in emerging and developing countries
 - There will have to be strong price incentives to shift private behaviour
 - There will have to be a global agreement to punish the free-riders
 - There will have to be aggressive moves to spread technology across the world
 - There will have to be changes in accounting and in recognition of risks across economies

4. Solutions – possible or impossible

What the new economy could look like

The needed shift to the electricity economy

Primary energy demand in a zero-carbon economy (exajoules per year)

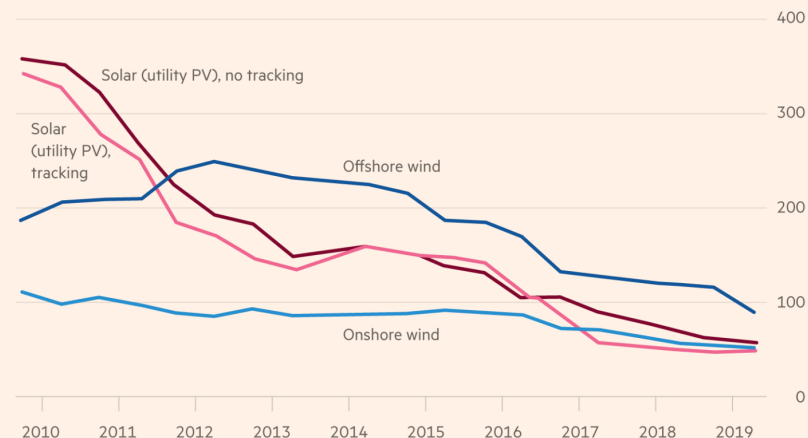


Sources: International Energy Agency; Energy Transitions Commission
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Falling prices of renewables is a help and a hope

The falling costs of renewable electricity

Global average levelised costs (Real 2018 \$ per MW hour)



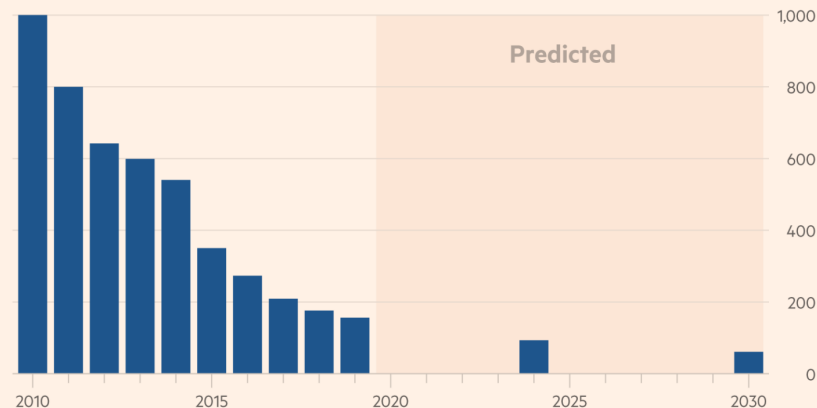
Source: BloombergNEF
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4. Solutions – possible or impossible

Storage is also getting much cheaper

The cost of batteries has collapsed

Battery pack prices (\$ per kw hour of storage)

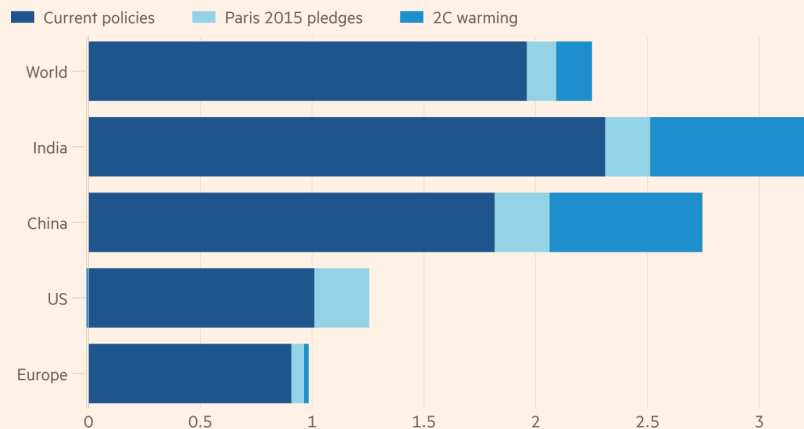


Source: BloombergNEF
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Energy investment must increase, to achieve the emission objectives

Energy investment has to occur mainly in emerging economies

Energy investment needs, 2030 (% of GDP)



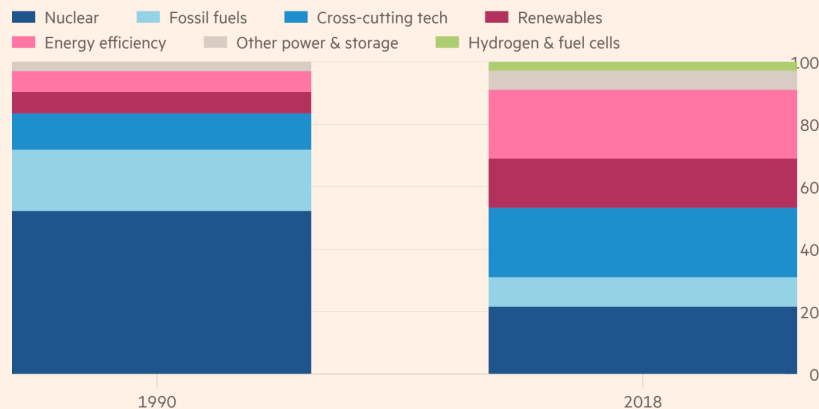
Source: IMF
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4. Solutions – possible and impossible

The shift to research on renewables must go further

The shift in R&D spending towards renewables

Global public energy R&D expenditure (%)



Total energy R&D at 2018 prices and PPPs = 1990 \$13.1bn; 2018 \$18.9bn

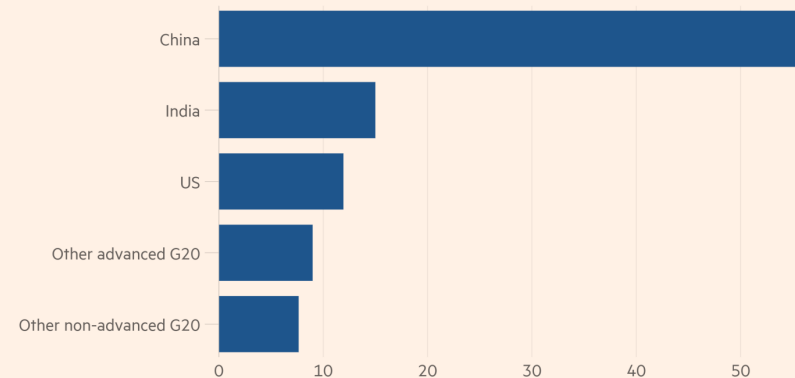
Source: IMF

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And carbon pricing must be introduced, to cut emissions

Where emissions would be cut most with carbon pricing

Country shares of G20 CO₂ reductions below baseline with a \$50/tonne carbon price in 2030 (%)



Source: IMF

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5. Conclusion

- Modern prosperity is based on fossil fuels
- People will *not* give up the reality (or hope) of prosperity
- If things are to change, three things need to happen:
 - Our populations need to be persuaded there is an existential crisis
 - They need to be persuaded there is a workable and tolerably low-cost solution
 - To achieve that, policy-makers need to agree an effective, just, global, long-term plan of action
- None of this has happened, despite three decades of global discussion. Today's populist tribalism makes success far more difficult
- I fear that it will now not happen
- You should prepare for heroic adaptation and big crises