# Key indicators to track current progress and future ambition of the Paris Agreement

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We have had three years with virtually no growth in carbon dioxide emissions from fossil fuels and industry.
What has caused the slowdown and does this put us on a path "well below 2°C"?

*We have developed a framework to help answer this question, to track progress towards the 'Paris goal', to inform the five-yearly 'global stocktake' (GST), and to help increase the ambition of the Nationally Determined Contributions (NDCs).*

## Key indicators

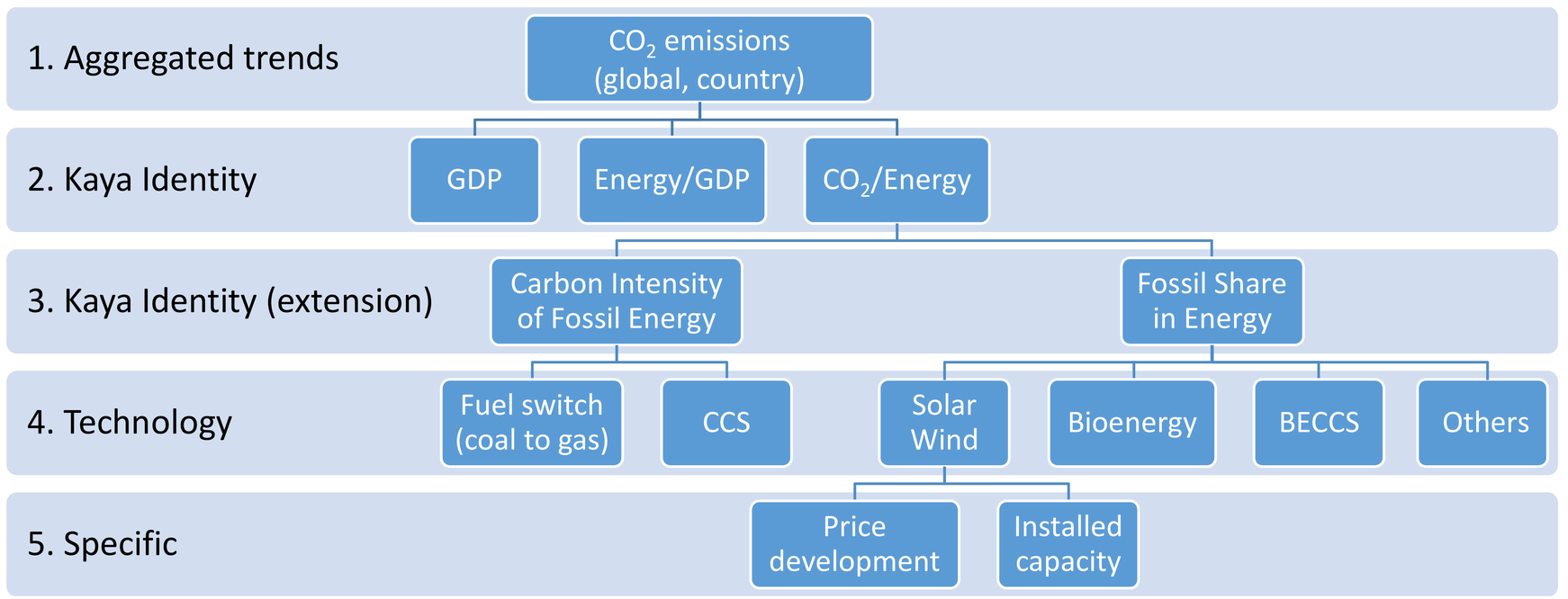
At right is the nested structure we used to analyse the slowdown in global emissions growth. The structure is not unique, and can be adapted for each country or different applications.

We first analysed global and country-level emissions, and then performed a decomposition using variations of the well-known Kaya Identity.

At each step, we "zoomed in" to get more detail. Each new layer of analysis is driven by the data and results.

As one penetrates deeper into the framework, the analysis can branch out into different areas for deeper and more relevant analysis.

The indicators can be selected to map directly to key components of the NDCs and 1.5 °C and 2°C emission scenarios.




## Simplified Kaya Identity

In the poster, we use a form of the Kaya Identity to decompose changes in $CO_2$ emissions:

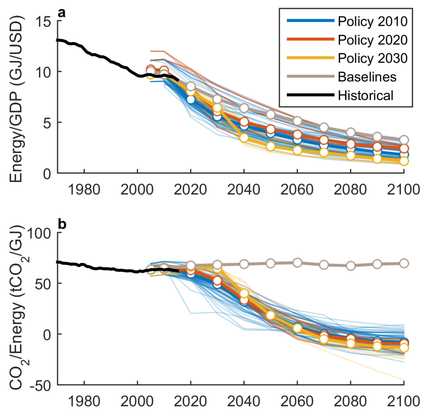
$$CO_2 = GDP \times \frac{Energy}{GDP} \times \frac{CO_2}{Energy}$$

We look at how each term changes over time, to attribute changes to Gross Domestic Product, Energy Intensity (Energy per unit GDP) or Carbon Intensity ($CO_2$ per unit Energy).

***Each of these terms is used in the Nationally Determined Contributions (NDCs).***

To help focus on trends, we smooth the data over time. This removes interannual variability (e.g., a warm winter), but requires careful interpretation of single years.
In the figures on the right, we apply a smoothing window of 11 years. The vertical shading indicates when the smoothing window gets smaller as the end year is approached.

## Energy and carbon intensity

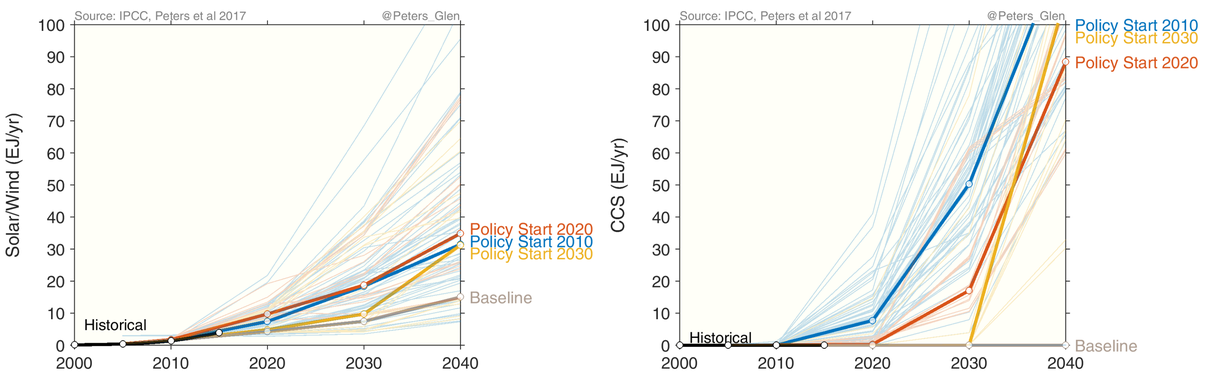



The IPCC assessed 116 scenarios with a likely chance of keeping global warming below 2°C. The scenarios had globally uniform climate policies starting in 2010, 2020, or 2030. The scenarios without climate policy are also shown.

The scenarios clearly show that climate policy, relative to a baseline without climate policy (brown), leads to only small improvements in Energy Intensity (top), but significant improvements in Carbon Intensity (bottom).

In the paper, we therefore decompose the Carbon Intensity into more detail as this may indicate early progress in mitigation, such as growth in solar and wind power.

## Development of solar/wind and carbon capture & storage



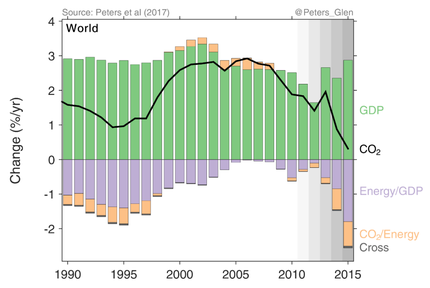

There has been strong growth in solar and wind electricity generation in the last decade. The recent growth is consistent with the 2°C scenarios assessed by the IPCC.

In contrast, there has been limited growth in carbon capture and storage.

According to the 2°C scenarios assessed by the IPCC, carbon capture and storage is a critical technology to keep below 2°C. Many integrated assessment models cannot keep below 2°C without carbon capture and storage, while they can with limited solar and wind.

To keep options open to stay below 2°C, it is necessary to have a globally-coordinated effort on the development and deployment of large-scale carbon capture and storage.

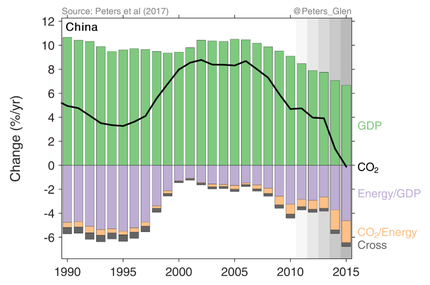
## World




Globally, there have been improvements in the energy intensity (purple) and carbon intensity (orange) in recent years, returning to levels not seen since the 1990's. GDP growth (green) has been weaker since the global financial crisis, but is beginning to strengthen again.

**These three effects combined – slightly lower economic growth, improved energy intensity, improved carbon intensity – have all led to the slower growth in global $CO_2$ emissions.**

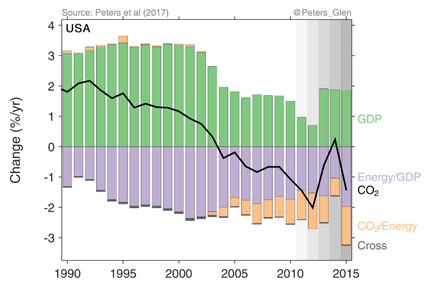
## China




The recent slowdown in emissions growth is due to weaker economic growth and improvements in both energy and carbon intensity. Improvements in carbon intensity are largely due to an increase in non-fossil energy sources, like wind, solar, and hydropower.

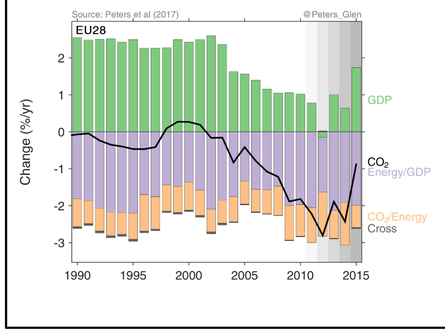
Since economic growth is lower than expected, and emission intensity (energy plus carbon intensity) exceeds the 3-4% per year declines consistent with China's NDC, *it is quite possible that China will meet its emissions pledge much earlier than expected*.

## USA




The decrease in emissions (negative growth) is driven by lower economic growth since the global financial crisis, continual improvements in energy intensity, and the emergence of improvements in carbon intensity.
The improvements in carbon intensity have been driven by a shift from coal to gas, with increasingly contributions from the rapid growth in wind and solar.
*It is unclear if the US is on track to meet its NDC, particularly if stronger economic growth returns.*

## European Union

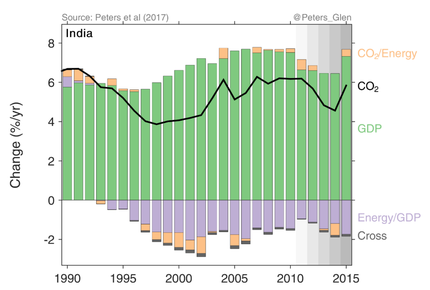



The EU has been consistently reducing emissions over the last decades. Lower emissions growth in the last decade is driven by lower economic growth since the global financial crisis, and continual but stable improvements in energy and carbon intensity.

Carbon intensity has improved due to an increased share of renewables, but a slight shift back to less efficient use of fossil fuels has tempered those gains.

*$CO_2$ emissions from fossil fuels are now 20% below 1990 levels, well on the way to 40% in 2030.*

## India




India has had robust emissions growth of around 5% per year in the last decade, driven by strong economic growth and only tempered slightly by improvements in energy intensity.

India has pledged to reduce its emission intensity by 33-35% in 2030 relative to 2005 levels, about 1.5% per year, and roughly consistent with current trends.

*Because of the strong and needed growth in economic activity, India's emissions may grow strongly in the next decade.*

**Additional Material** (see QR code on the top right)
*Nature Climate Change* paper dx.doi.org/10.1038/nclimate3202
Blog www.cicero.uio.no/no/posts/klima/emissions-growth-slowdown
Presentation https://www.slideshare.net/GlenPeters_CICERO/emissions-slowdown-are-we-on-the-way-to-2c
Video https://www.youtube.com/watch?v=zXhpRt14ccA
Global Carbon Project http://www.globalcarbonproject.org/

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Center for International Climate Research


Peters, G.P., Andrew, R.M., Canadell, J.G., Fuss, S., Jackson, R.B., Korsbakken, J.I., Le Quéré, C., Nakicenovic, N., 2017. *Key indicators to track current progress and future ambition of the Paris Agreement*. Nature Climate Change 7, 118-122.



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