Carbon dioxide emissions continue to grow despite emerging climate policies

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A failure to recognise the factors behind continued emissions growth could limit the world's ability to shift to a pathway consistent with 1.5°C or 2°C of global warming. Continued support for low-carbon technologies need to be combined with policies directed at phasing out the use of fossil fuels.

Global fossil CO_2 emissions grew at 1% per year in the 1990's, accelerated to 2.9% per year in the 2000's, but have returned to a slower growth rate of 0.9% per year since 2010 with a more pronounced slowdown from 2014 to 2016. Despite modest declines in emissions in the United States and the European Union over the last decade, the growth in emissions in China, India, and most developing countries have dominated global emission trends over the last 20 years. The Global Carbon Budget projection[1] suggests global fossil CO_2 emissions will grow 0.5% (range –0.4% to 1.4%) in 2019, with emissions projected to decline in the US and the EU28, but projected to increase in China, India, and the Rest of the World (Figure 1a).

While a focus on countries and regions is important, a focus on type of fossil fuels and key emitting sectors is particularly relevant for monitoring changes and implementing adequate mitigation policies. Globally, and over the last decade (2009-2018), 42% of fossil CO_2 emissions were from coal, 34% from oil, 19% from natural gas, and the remaining 5% from cement and other smaller sources (Figure 1b). In 2019, CO_2 emissions from coal are projected to decline 1.1% with substantial drops in emissions from coal use in the US (–13%) and the EU28 (–10%) and weak growth in China and India due to economic and weather anomalies. Oil is projected to grow 0.9% in 2019 and natural gas 2.5%, both in line with growth over the last decade.

At the most aggregated level, over the last decade, 45% of fossil CO_2 emissions come from the energy sector, dominated by electricity and heat production. Industry sectors, such as metals production, chemicals, and manufacturing, cover 22% of global emissions. Land transport combined with national shipping and aviation contribute 20% of global emissions, while international shipping and aviation add another 3.7%. The remaining 10% is from buildings, agriculture, fishing, and other sectors not elsewhere covered (e.g., military). In the following, we detail key changes in fossil CO_2 emissions across these sectors for the different fossil fuels: coal, oil, and gas.

Coal is still king, but losing power

The changes in global emissions have primarily been driven by changes in coal use, while growth in the use of oil and gas continued unabated since 1980 following the oil crises in the 1970s (Figure 2a). Many analysts have speculated that coal use may have peaked. The decline in coal use in Organisation for Economic Co-operation and Development (OECD) countries is clear, with a 25% decline in the last decade. Growth in coal use in non-OECD countries has remained strong but is heavily influenced China. A global peak in coal use is highly dependent on the pathway in China, which now accounts for 50% of global coal use. While changes in the structure of China's economy may have contributed to a recent decline in coal use[2], Chinese emissions are rising again and it is too early to proclaim a coal peak in China or globally[1].

The dramatic shifts in coal use have occurred in different sectors (Figure 2). The largest share of global coal use is for electricity & heat (around 67%), followed by industry such as metals, chemicals, and manufacturing (27%). The levelling off global coal use in the 1990s resulted largely from the collapse of the Soviet Union[3] but was partially offset by strong growth in electricity and industry in China and India. The recent modest decline in global coal use has primarily occurred due to continued declines in coal power in the US and European Union and a slowdown in coal power growth in China, combined with a slowdown in the growth in industrial production in China. The declines in electricity generation likely represent a more systematic structural change with electricity generation from coal being replaced by non-fossil energy sources or with natural gas. The recent decline in coal use by industry may represent the effects of economic headwinds in China, as there are very few technologies to guarantee declines in the hard-to-mitigate industrial sectors[4].

Oil shows resilient growth

Global oil use has grown almost unimpeded for several decades (Figure 2b), with the main disruptions occurring during the oil crises[3] in 1973 and 1979. The oil crises primarily hit oil use in OECD countries, but more so in sectors where oil was used inefficiently (electricity and industry) with limited effects in transport (Figure 2b). Global oil use is dominated by land transport, representing 50% of emissions from oil use and growing at 1.9% per year (104MtCO_2 per year) in the last decade. Oil use in OECD countries declined after the global financial crisis in 2009 but has since begun to rise again, making current oil use similar to the levels in 2009. Oil use in non-OECD countries continues to grow strongly, despite a slowdown in the growth rate in the last few years. National and international aviation represent around 8% of the emissions from oil use and is growing at around 3% per year (25MtCO_2 per year) in the last decade. Other sectors (industry, power, other) are flat at the global level, with declines in OECD countries offset by increases in non-OECD countries.

While aviation is receiving increased public attention, the continued growth in emissions from land transport are far more significant in aggregate terms and is the main driver of CO_2 emissions from oil globally. The deployment of electric vehicles is promising, but demand for transport services is growing more rapidly. In many markets, electric vehicles are adding to demand and not replacing existing vehicles, therefore having minimal effect on oil use. If electrical grids are not decarbonised fast enough, then the addition of electric vehicles may partly shift emissions from transport to the energy sector. Oil is generally an inefficient energy source outside of transport, suggesting there are many opportunities to reduce oil use in the power sector and industry.

Natural gas is only a temporary fix

CO_2 emissions from natural gas use have been growing steadily and almost uninterrupted for over half a century, and they are currently the fastest growing fossil fuel (Figure 2b). Natural gas has contributed to the largest increase in global fossil CO_2 emissions in recent times, accounting for around 35% of the growth in the last decade and 50% in the last few years. Natural gas use is

growing strongly in most countries, with the 44% of gas use in electricity and heat growing the most rapidly globally. OECD countries generally have more diverse usage of gas, with significant gas use in industry, energy, and buildings. Non-OECD gas use is more concentrated in the electricity sector.

Natural gas has been portrayed as a bridge fuel from coal power to non-fossil power generation because it emits about 40% less CO_2 than coal per unit of energy and can therefore reduce emissions if gas substitutes coal in electricity generation. While natural gas can help begin decarbonisation in electricity generation, it still emits CO_2 and natural gas use without Carbon Capture and Storage (CCS) needs to be phased out not long after it displaces coal use. In some instances, natural gas could lead to worse outcomes for the climate than coal depending on methane leakage rates[5]. Natural gas is also an attractive alternative in industrial, commercial, and residential applications, but without CCS, the emissions still contribute significantly to global warming.

While natural gas may be necessary to aid a transition from coal to non-fossil energy in some national circumstances, expanded natural gas use without CCS could limit the ability to meet ambitious climate targets. The rapidly growing global Liquified Natural Gas (LNG) market will support the expansion and reach of natural gas in the coming decades, while plans to develop CCS that could limit the climate impacts of natural gas still lagging at the small-scale demonstration stage.

Shift focus to fossil fuels

The continued growth in global fossil CO_2 emissions is taking place despite growing public and policy attention, five cycles of the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports, and almost 30 years of international climate negotiations. While some climate policies have fallen into place, leading to rapid progress in the deployment of clean energy technologies in the last decade, few policies are in place to phase out fossil fuel technologies in parallel, and CO_2 emissions continue to grow globally. Even following the apparent policy breakthrough leading to the Paris Agreement in 2015, it is likely that global fossil CO_2 emissions will have grown over 4% through to the end of 2019. Current national policies still put the world on a pathway of increasing greenhouse gas emissions through to 2030[6].

The continued growth in fossil fuel use and associated CO_2 emissions is happening despite significant progress in low carbon technologies[7] and progress in some countries in reducing energy use[8]. Growth in energy use and emissions is dominated by developing countries, as they strive to close the large disparity between per capita energy use compared to developed countries[9]. This suggests current policies are either not enough to effect global emissions, are slow to have a detectable effect, or simply fail to directly address the root cause of the problem: phase out CO_2 emissions from the use of fossil fuels[10]. The rapid growth in solar and wind will help reduce the use of coal in power generation, but current policies to phase out coal use are focussed in countries with old coal fleets[11,12]. Natural gas may displace some coal in power generation, but it at best only offers a short-term solution, as once coal is displaced CO_2 emissions continue at an albeit lower rate. The rapid growth in electric vehicles has been insufficient to alter global oil use, as the growth in transport demand far outpaces the deployment of electric vehicles. Very little attention has been placed on the difficult-to-mitigate sectors[4], such as industry, aviation and shipping, and a complete decarbonisation of electricity generation.

The failure to mitigate global emissions, despite positive progress on so many aspects of climate policy, suggests the full bag of policy options are not being effectively deployed. Most policies tend to focus on supporting low-carbon alternatives, such as solar, wind, or electric vehicles, but these technologies often add to existing demand and therefore do not significantly displace fossil fuel use[13]. Public policies need to place far more attention on directly cutting back the use of fossil fuels

or remove their emissions through CCS, particularly the phasing out of coal power plants[14] and conventional vehicles, well before they reach their productive end-of-life.

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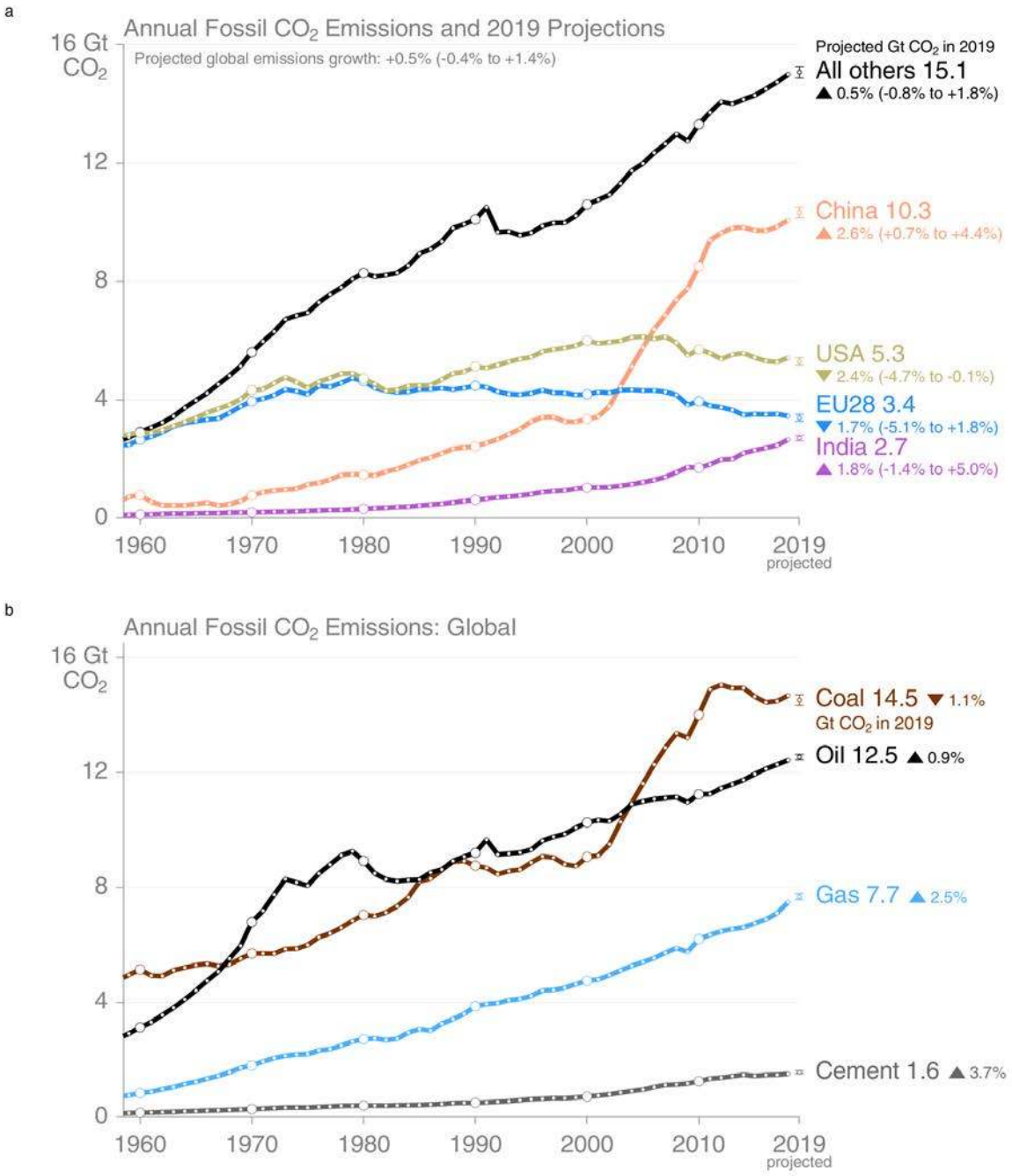

Figure 1: Global fossil CO_2 emissions showing projections[1] for 2019 for a) regions and b) fossil fuels and cement. The projections for China, USA, EU28, and India in 2019 are based on monthly data available at the time of submission, while all others are projected based on economic data. The projections are done separately for coal, oil, gas, and cement in each region. The Indian projection is based on the Indian financial year, April 2019 to March 2020. Both China and India exhibit higher uncertainty than usual because of unusual economic (China and India) and monsoon (India) events.

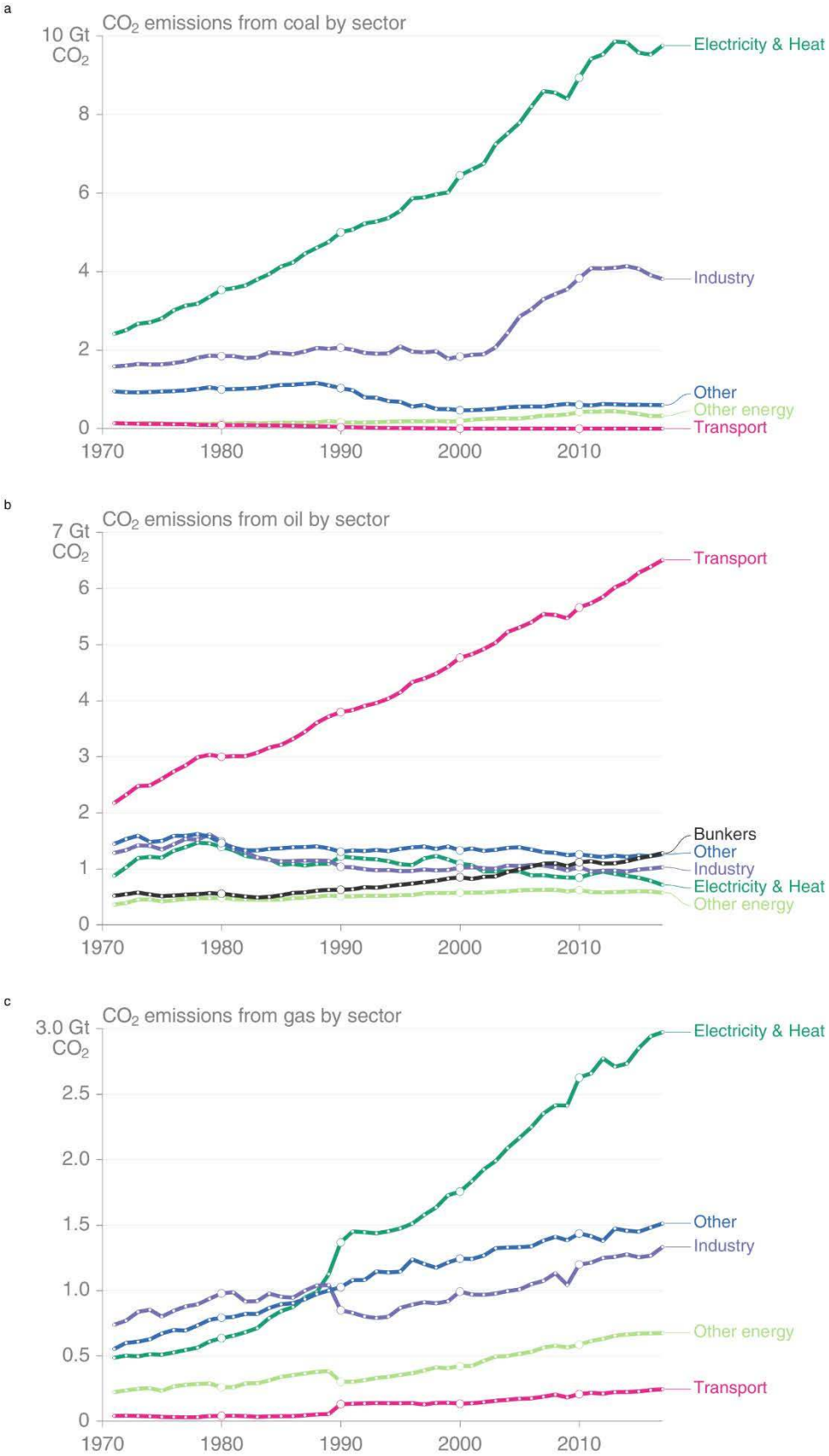

Figure 2: CO_2 emissions from different fossil fuels by sector. Bunkers are emissions from international aviation and shipping. Source: IEA[15] based on detailed data on energy demand and IPCC Guidelines.

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