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China's Carbon Emissions After the Pandemic

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Abstract

Is China on a path to peak its greenhouse gas emissions in the near future? We compare trends in carbon emissions and energy production in the first five months of 2019 to the first five months of 2023. Emissions grew substantially, especially from the energy sector. Though renewable energy production has increased substantially, coal production is growing more strongly than before the pandemic. The changing geopolitical environment may further impede the peaking of emissions in China.

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China's Carbon Emissions After the Pandemic

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Introduction

Is China on a path to peak its greenhouse gas emissions in the near future as it has pledged under the Paris Treaty? We compare trends in carbon emissions and energy production in the first five months of 2019 to the first five months of 2023. The former period represents typical conditions before the COVID-19 pandemic, while the latter is the first period after China removed most COVID-19 related restrictions in December 2022. Carbon emissions have increased substantially over this period, especially from the power sector of the economy, where decarbonization efforts would be expected to be first focused. Though renewable energy production has increased substantially, production of fossil fuels is growing more strongly than just before the pandemic. There is little sign of "growing back greener" (Taherzadeh, 2021). Going forward, the changing geopolitical environment may further impede the peaking of emissions in China (Ahmed, 2023).

Our new findings contrast with the research of Le Quere *et al*. (2021), who argued that "the pervasive disruptions from the COVID-19 pandemic have radically altered the trajectory of global CO_2 emissions" (197). Emissions fell sharply globally because of the curtailment of passenger transport during the pandemic (Jiang and Stern, 2021) but Le Quere *et al*. (2021) believed there was a window of opportunity to continue the slowing of emissions growth that they had seen since 2015. Similarly, Chen *et al*. (2022) predicted that Chinese emissions would peak between 2021 and 2026 at a level between 11.7–13.1 Gt with more than 80% probability and Lui (2022) wrote that China is "set to significantly overachieve the targets it promised internationally for 2030, with emissions peaking by 2025."

Analysis

Figure 1 presents estimates of daily carbon emissions from Carbon Monitor (Liu *et al*., 2020). The box plots show the variation in daily emissions over the first five months of each of the two years. There was no significant change in emissions from the residential and transportation sectors. However, these are the two smallest sectors. There were statistically significant increases in emissions from the industrial ($p = 0.0017$) and power sectors ($p = 0.0000$). Mean daily emissions rose between 2019 and 2023 by 0.84 million tonnes or 8% and 1.89 million tonnes or 16%, respectively, from these two sectors. Total emissions rose by 2.69 million tonnes or 10%.

The shares of solar and wind in total power generation increased from 1.9% and 6.2%, respectively, in 2019 to 3.5% and 11.2% in 2023. Figure 2 shows that though electricity production from wind and solar grew very substantially over the four years, so did electricity generation from fossil fuels. Note that data for January and February are presented as a single period in the data and so we omitted them from the figure and the following analysis. From March to May, average monthly thermal power generation increased 83 TWh or 21% between 2019 and 2023, while generation from new renewables increased 56 TWh or 124%. Nuclear generation increased by 29%, while hydropower fell by 18%. So, it is not surprising that with the majority of increased electricity output coming from fossil fuels, emissions of the sector increased substantially.

Production of energy in general has also continued to increase. Figure 3 shows the growth in coal production from 2019 to 2023. The growth rate of coal production seems to have accelerated. Comparing March-May 2018 to the same period in 2017 coal production fell 1.3%. In the year to March-May 2019 coal production rose by 2.8% and increased by 5.2%, respectively. In the following year to March-May 2020. coal production increased 8.1% despite the onset of the pandemic. In the years to March-May 2021 and 2022 it increased by 1.1% and 13.9%, respectively, while in the year to March-May2023 it increased by 6.4%. So, despite growing during the pandemic, the growth rate in 2023 is higher than in the two years preceding the pandemic. The fall in coal's share of total energy consumption appears to have slowed or halted, falling from 72.5% in 2007 to 57.7% in 2019 but then to 56% in 2021 and 56.2% in 2022.

Discussion

This growth in emissions happened despite the restrictions of China's Zero-COVID policy. Now, there may be catch up growth as well as economic stimulus as the economy comes out of this period of slow growth (Wood-Mackenzie, 2023), though so far news reports suggest a slow recovery. Previous research has found mixed results regarding the behaviour of carbon emissions following recessions. Burke *et al*. (2015) found that globally over the five decades from 1961 to 2010 emissions tended to grow more slowly relative to GDP following recessions than after economic expansions became established. However, emissions grew strongly in 2010 following the global financial crisis partly because energy intensity rose. This may have been due to stimulus spending on energy intensive activities such as construction (Jotzo *et al*., 2012).

Besides coal, China suffers from energy insecurity (Webster and Tobin, 2022) as it consumes much more oil than it produces. China also has the most to gain from reducing carbon emissions. Tol (2019, 188-189) estimates that around half the global benefits from mitigation accrue to China and as the largest emitter, a given percentage reduction in emissions in China translates to more avoided carbon than anywhere else. For these reasons, we might expect China to be a leader on climate action among developing countries. In the past, China has set seemingly ambitious climate mitigation goals, though these were not necessarily very strict compared to business as usual (Jotzo and Stern, 2010). Under the Paris Treaty China has pledged to peak carbon emissions by 2030 and reach net zero emissions by 2060. However, increasing political tensions between the US and China are reducing the potential for co-operation on climate policy (Webster and Tobin, 2022). At COP 27 in Sharm As-Sheikh in November 2022, China did not join a pledge to curb methane emissions and refused to provide financial support as part of the Loss and Damage Fund (Smith and Hackbarth, 2022). This stance and the data we have presented in this article cast some doubt on China following through on its previous pledges and certainly on peaking emissions in the next two years.

Methods

We downloaded data on daily Chinese carbon emissions from the Carbon Monitor website (Liu *et al*., 2020). We estimate the difference in emissions between the two periods by estimating a separate regression equation with just a constant for each period using seemingly unrelated regressions and then computing the difference in regression coefficients between the two equations and its standard error. We use Newey-West autocorrelation robust standard

errors with 14 lags. Total emissions rose 2.69 million tonnes (standard error = 0.52 million tonnes, p = 0.0000). Mean daily emissions from the power sector increased by 1.89 million tonnes (0.28, 0.0000) between the two periods and emissions from industry increased by 0.84 million tonnes (0.27, 0.0017). On the other hand, there was no statistically significant change in emissions from the transport (-0.05, 0.03, 0.0988) or residential (-0.07, 0.07, 0.3352) sectors. Monthly and annual Chinese data are from the National Bureau of Statistics of China: https://data.stats.gov.cn/english/easyquery.htm?cn=A01 and https://data.stats.gov.cn/english/easyquery.htm?cn=C01

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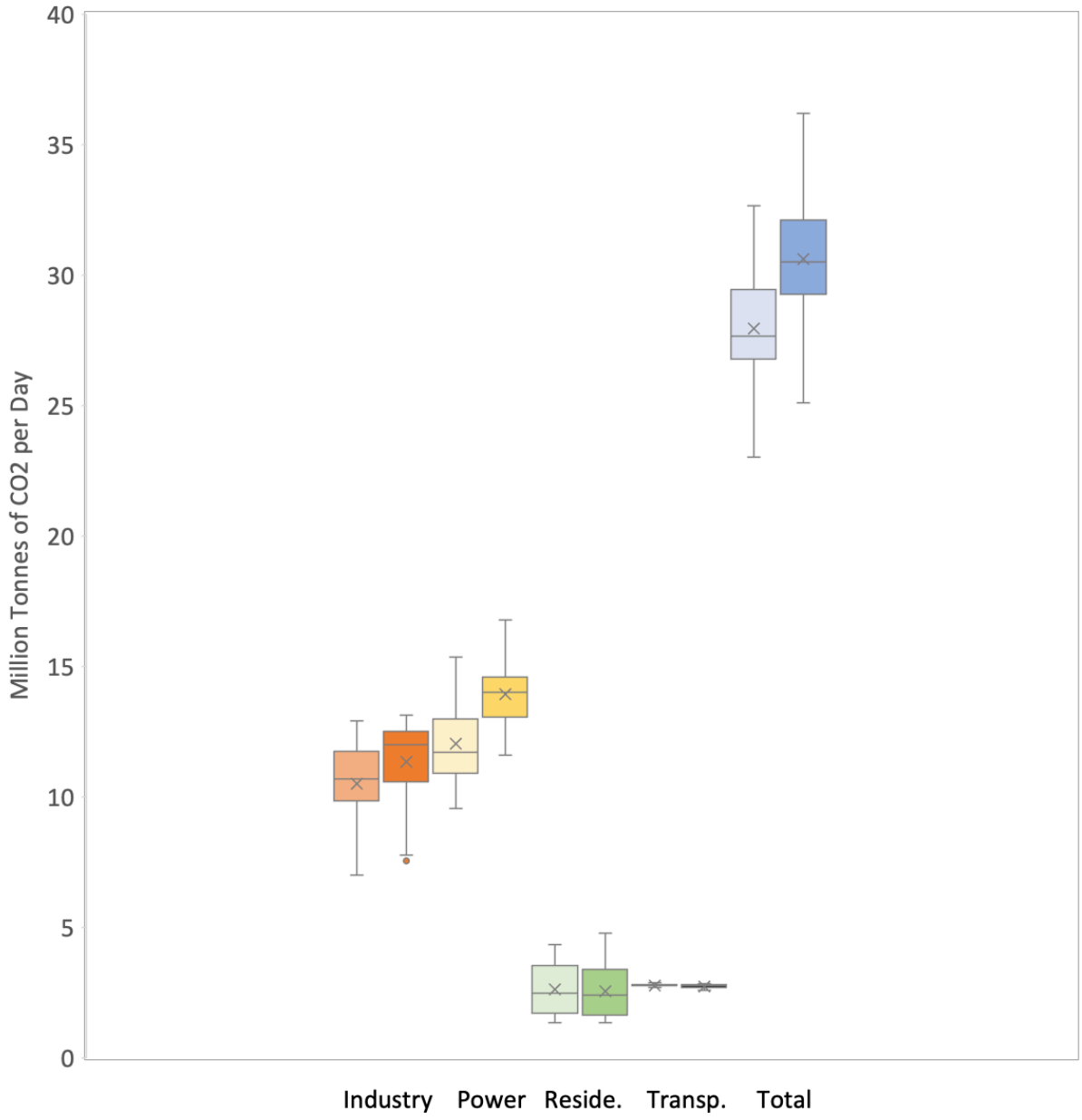

Figure 1: Chinese Carbon Emissions in 2019 and 2023. Carbon dioxide emissions from fossil fuel and cement production. Each pair of box plots shows daily data for 2019 emissions on the left and 2023 on the right. Reside = residential sector. Transp. = transportation sector. Source: Carbon Monitor.

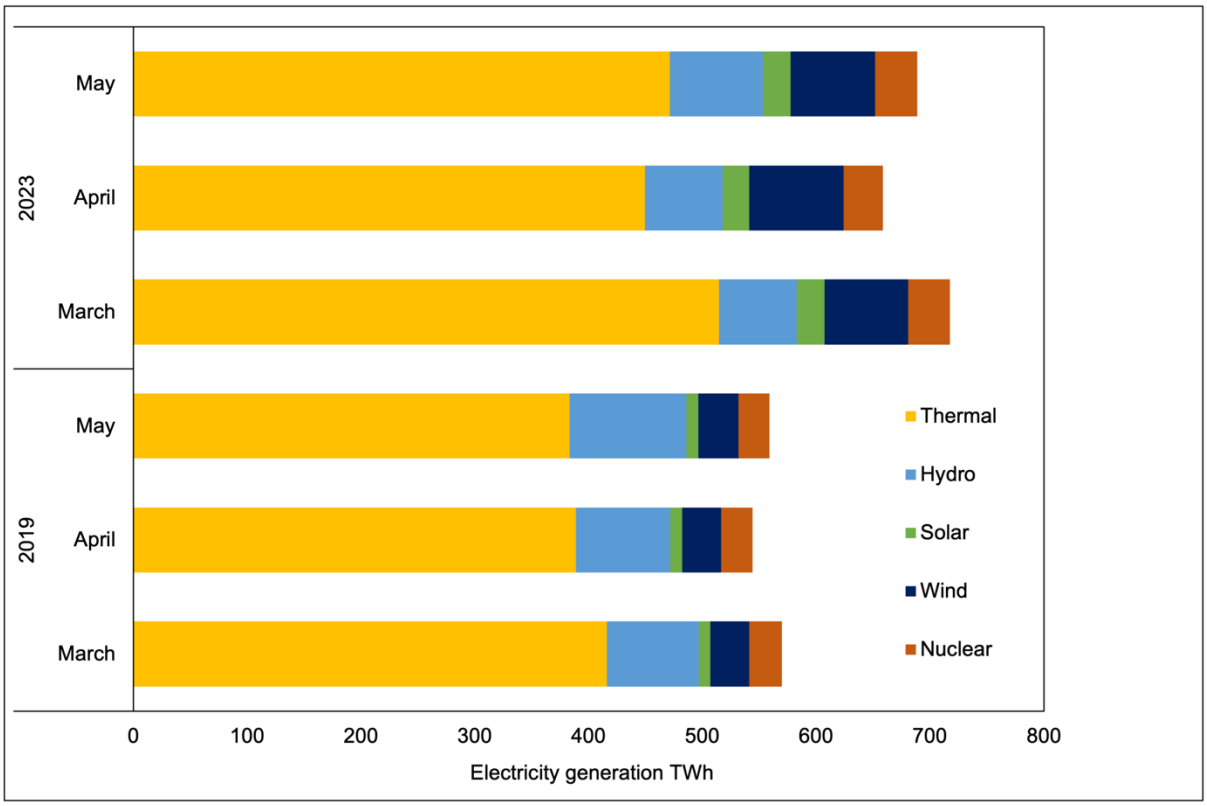

Figure 2: Energy Sources of Chinese Electricity Production in 2019 and 2023. Source: National Bureau of Statistics of China.

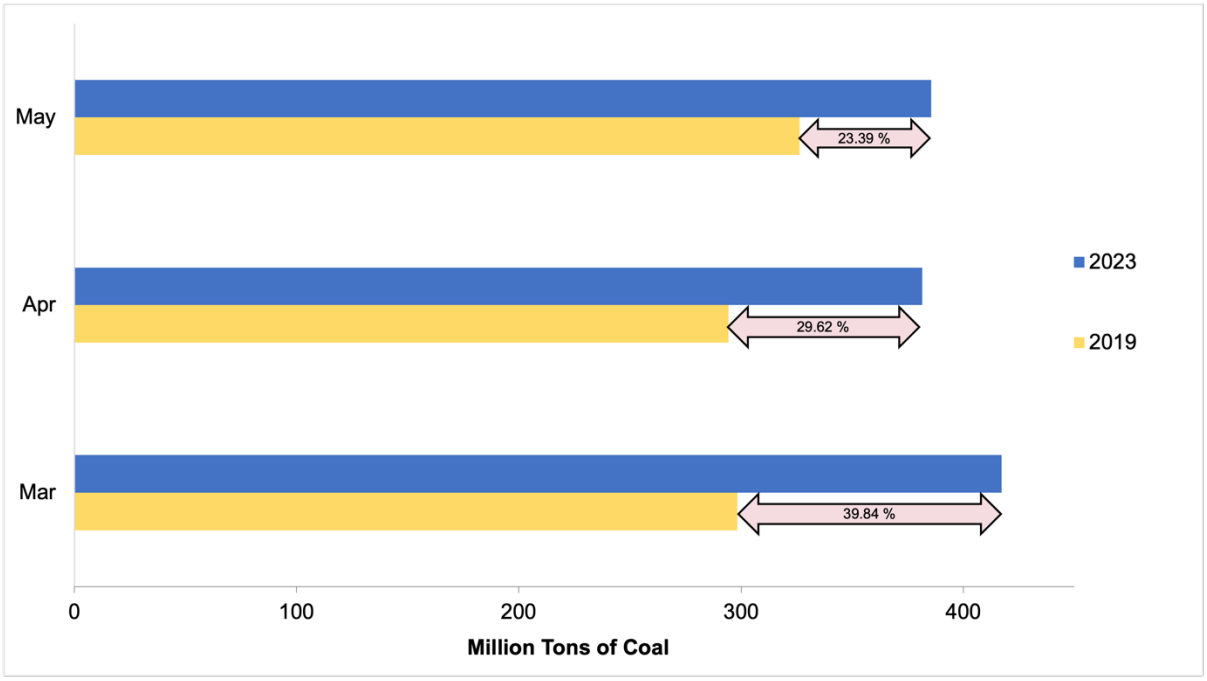

Figure 3: Chinese Coal Production in 2019 and 2023. Source: National Bureau of Statistics of China.