

China, India and world coal production & CO2 emissions up to 2022

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Coal production comes from mines with different heat content and the range is huge. The best coal data comes from the German BGR which reports separately hard coal and lignite

Others distinguish anthracite, bituminous, sub-bituminous and lignite with a range for heat content from 4 to 15 kBtu/lb or 1 to 3.75 and for carbon percentage from 25% to 98 % or 1 to 4 = huge range, as the range of heat content per country for crude oil is 5.04 (Sudan) to 6.4 MBtu/b (Cuba) or 1 to 1.3, when the range for natural gas is 900 to 1100 Btu/cf or 1 to 1.2!

<https://www.purdue.edu/discoverypark/energy/assets/pdfs/cctr/outreach/Basics8-CoalCharacteristics-Oct08.pdf>

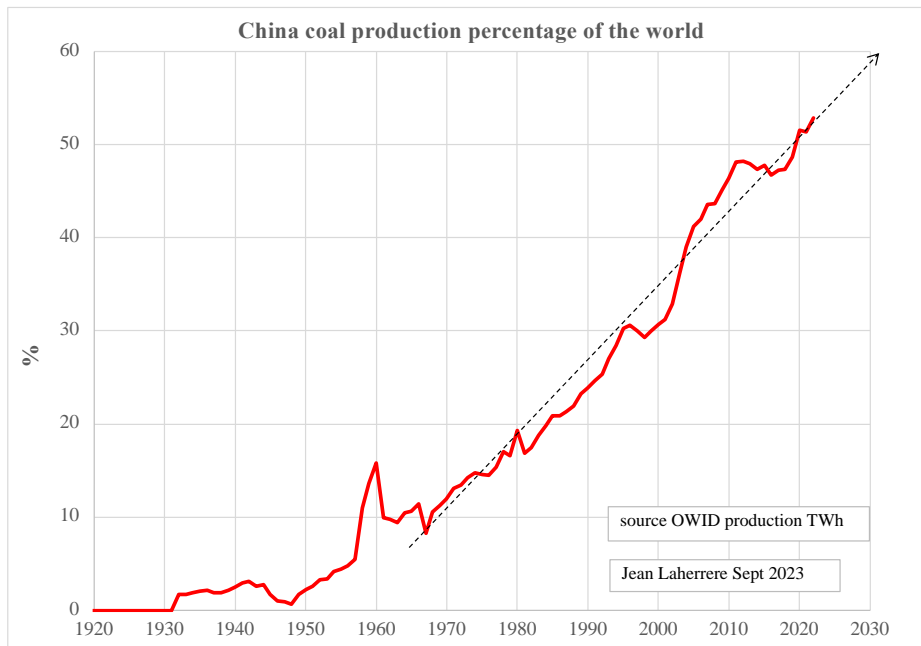
| % weight | Anthracite | Bituminous | Sub-Bituminous | Lignite |
|-----------------------|---------------|---------------|----------------|-------------|
| Heat Content (Btu/lb) | 13,000-15,000 | 11,000-15,000 | 8,500-13,000 | 4,000-8,300 |
| Moisture | < 15% | 2 - 15% | 10 - 45% | 30 - 60% |
| Fixed Carbon | 85 - 98% | 45 - 85% | 35 - 45% | 25 - 35% |
| Ash | 10 - 20% | 3 - 12% | ≤ 10% | 10 - 50% |
| Sulfur | 0.6 - 0.8% | 0.7 – 4.0% | < 2% | 0.4 – 1.0% |
| Chlorine (ppm) | 340 ± 40ppm | 340 ± ppm | 120 ± 20ppm | 120 ± 20ppm |

Coal data is reported in weight (Mt) or energy = Gtoe (1 toe = 42 GJ), EJ or TWh (1 TWh = 3.6 PJ)

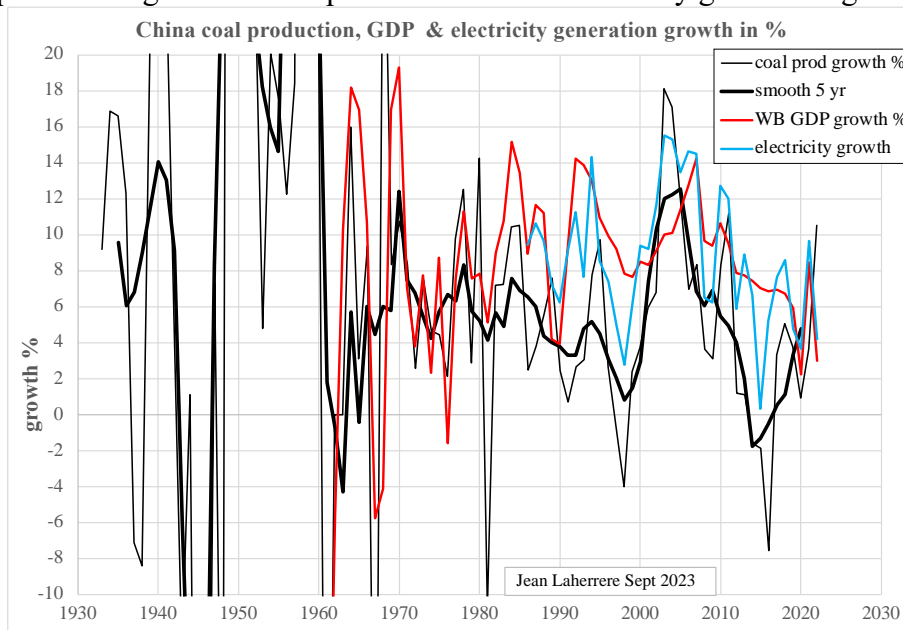
My 2009 paper http://aspo.france.viabloga.com/files/JL_charbonWellmer09.pdf «Anthracite et lignite d’après le BGR et autres: commentaires sur le rapport BRGM: «10 enjeux des geosciences»» mentions the lack of consensus on coal classification.

-China coal production

China coal production percentage of the world coal production has raised from almost 0% in 1950 to over 50 % of the world coal production in 2020: from 1965 the increase looks linear, and the percentage could reach 60% in 2030!



In the next graph, China coal production annual growth displays a big percentage of 20% from 1950 to 1960, about 6% from 1965 to 2012, negative 2014 to 2016 and back to 10 % in 2022: coal production growth is compared to GDP and electricity generation growth



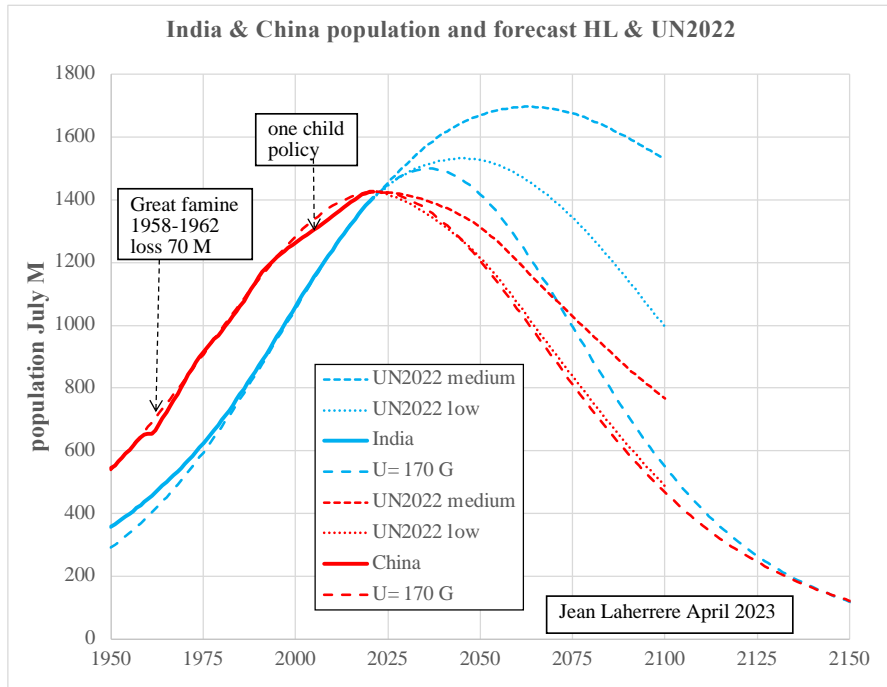
China significant present growth value could decline sharply in the future!
But it is very hard to extrapolate the past recent years!

China is not anymore, the most populated country, it is India.

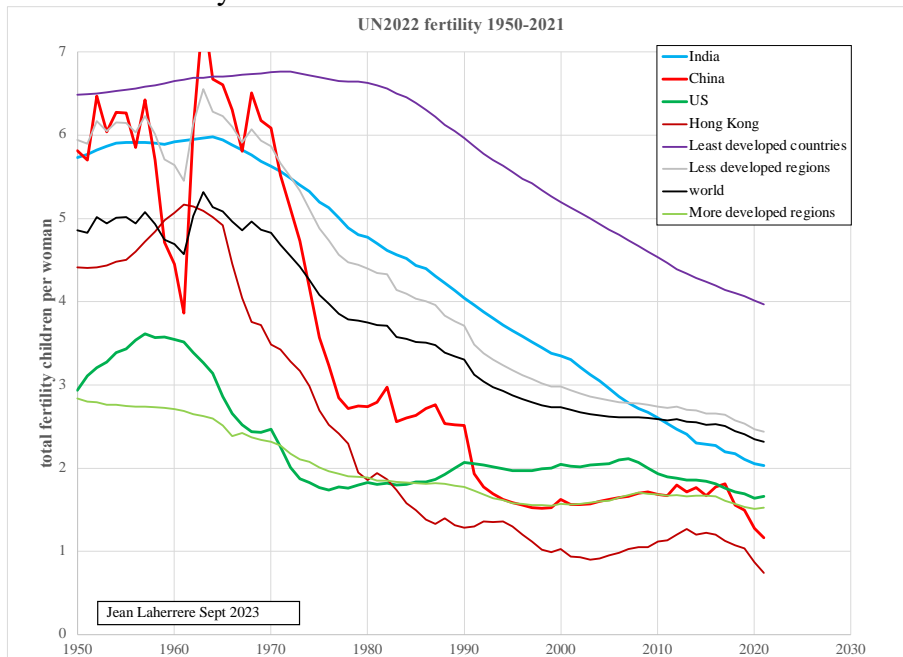
My forecast for China population using HL is lower than UN2022 medium, about UN2022 low

China population is peaking and will decline when India population will peak around 2035 or later

These forecasts are not reliable on long term, as it is likely that in front of the strong decline the countries will react or will see migration from countries with higher fertility



Total fertility of China has dropped sharply with 1960 famine, during the 1970s, again for the last 4 years, when India fertility has declined smoothly. Hong Kong is less chaotic. US fertility is over China fertility since 1990!



President Xi Jinping handling of the covid with a bad zero covid and putting the Communist party control of the country over country freedom has stopped China dynamism (with the collapse of Evergrande = 300 G\$ debt, followed by Country Garden) and the public control of dynamic private enterprises as Alibaba (Jack Ma is gone) and Tencent. Furthermore, he did not respect the 1984 agreement between China and UK on Hong Kong to have until 2047 “one country, two systems” https://en.wikipedia.org/wiki/Handover_of_Hong_Kong
The 1984 Sino-British Joint Declaration had set the conditions under which Hong Kong was to be transferred, with China agreeing to maintain existing structures of government and economy under a principle of "one country, two systems" for a period of 50 years

I doubt that his dream for China to be ahead of the US in 2049 will be reached because China declining fertility, when US population is forecasted to be on increase in 2060 by the US census.gov

Another problem is that Chinese data is manipulated and unreliable.

China needs energy, has large coal resources, and has reduced the pollution problem, as the mine deaths.

BGR2021 reports the seven largest hard coal productions

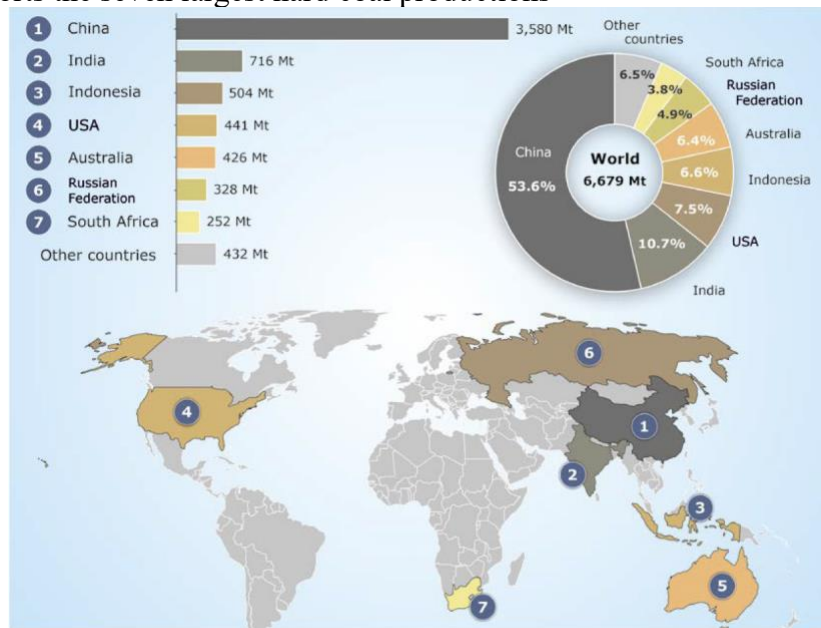


Figure 3-12: The seven largest hard coal producing countries 2020.

and importing countries

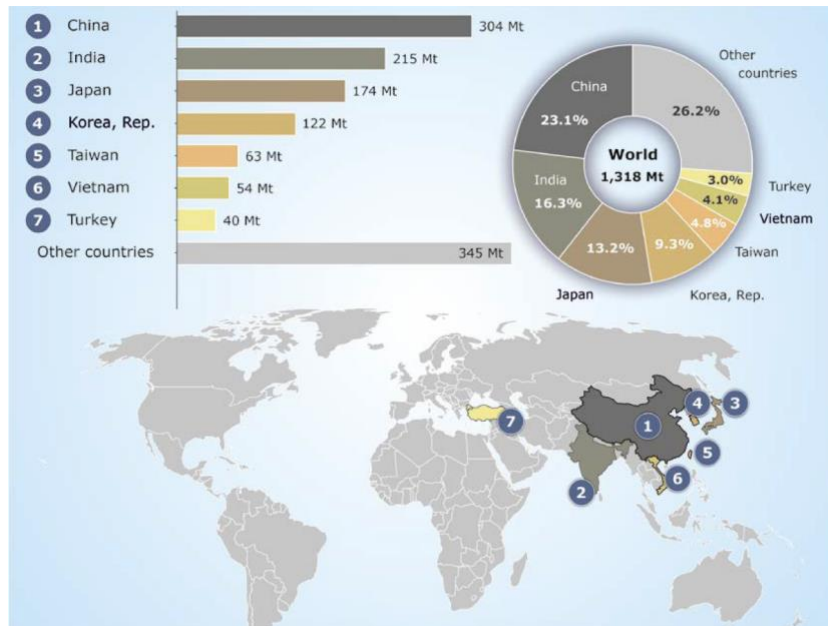


Figure 3-14: The seven largest hard coal importing countries 2020.

As for hard coal reserves and resources, the BGR 2020 data displays a complex comparison, US is added because of its large resources:

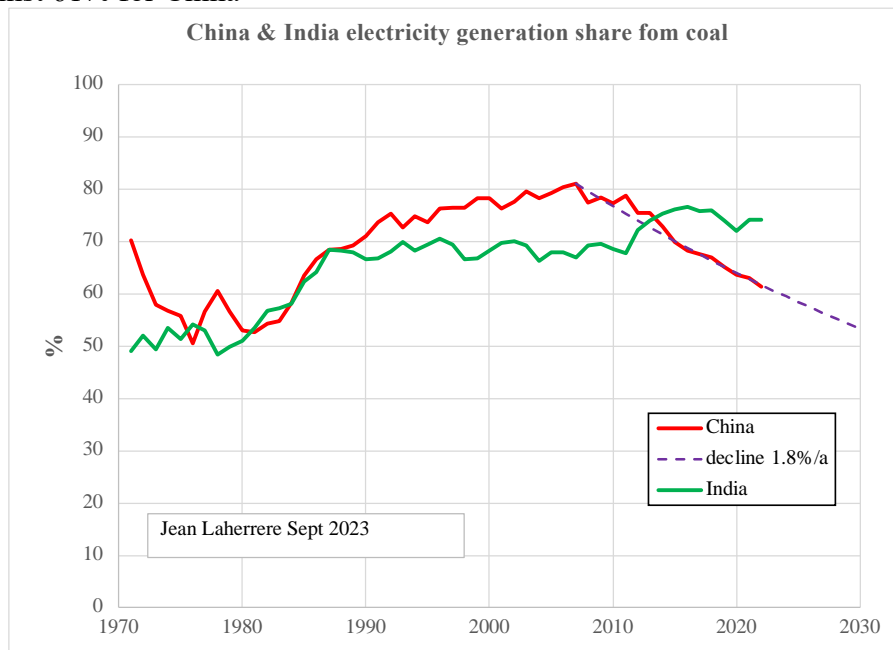
| Gt | production | reserves | resources | remaining potential |
|-------|------------|----------|-----------|---------------------|
| World | 6.7 | 756 | 16189 | 16945 |
| China | 3.6 | 135 | 5318 | 5454 |
| India | 0.7 | 106 | 181 | 287 |
| US | 0.4 | 218 | 6460 | 6678 |

Same for lignite

| Gt | production | reserves | resources | remaining potential |
|-------|------------|----------|-----------|---------------------|
| World | 1 | 320 | 3681 | 4002 |
| China | 0.3 | 8 | 324 | 332 |
| India | 0.04 | 5 | 39 | 44 |
| US | 0.05 | 30 | 1368 | 1398 |

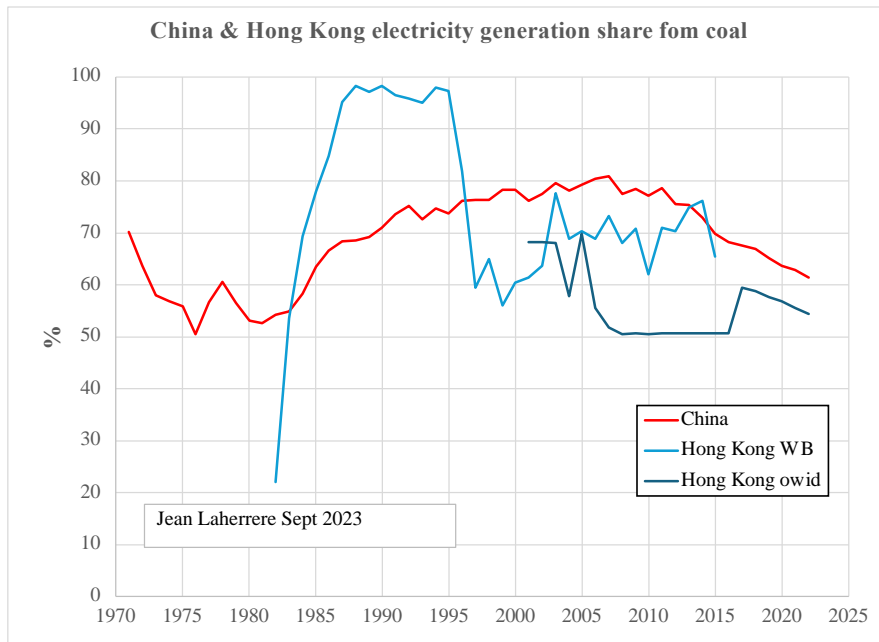
China electric generation share from coal was 80% at peak in 2007 (from a low of 50% in 1976) and declined but still 61% in 2022 with a rate of 1.8% per year for the last 10 years and likely still over 50% in 2030

India electric share from coal was below or equal China from 1971 to 2014 but being in 2022 at 74% against 61% for China

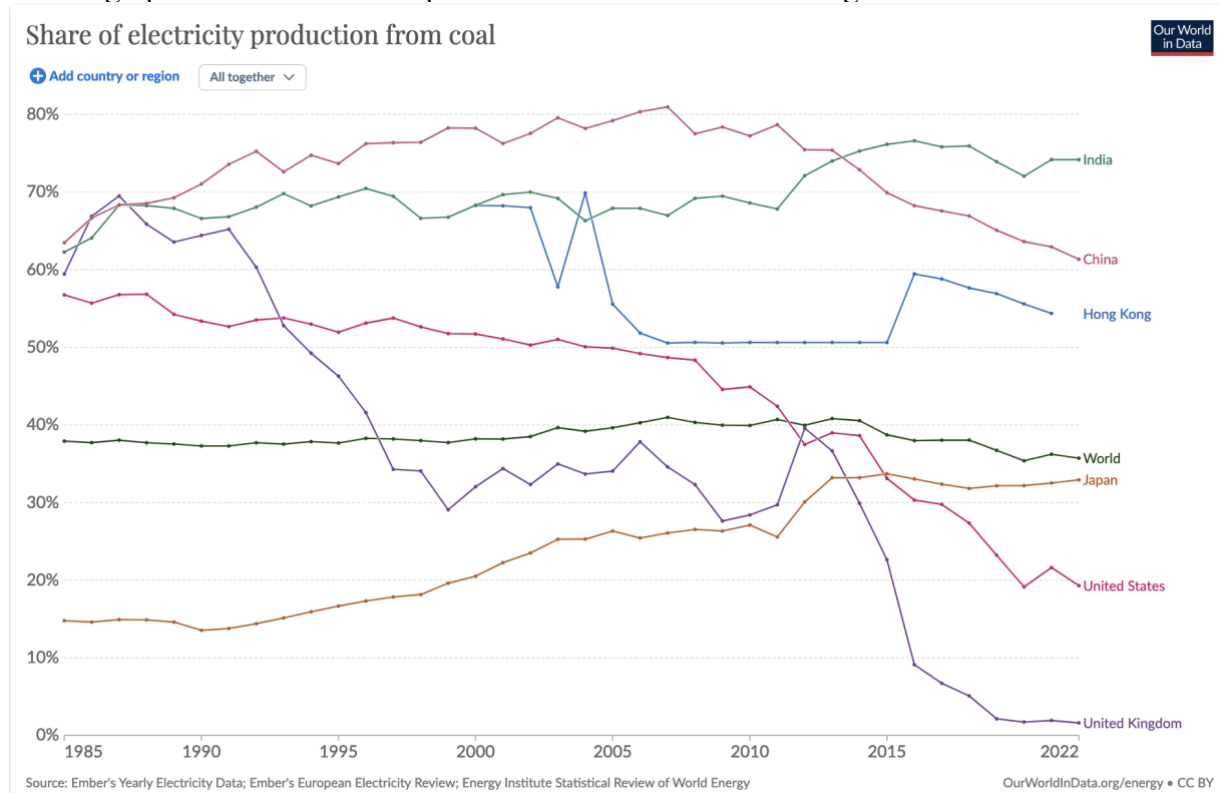


It is queer to see the change in Hong Kong electricity share from coal in 1997 where the two systems disappear in one year to be similar in 2013!

But the data from OWID is different, also from hk.gov with 25% in 2020

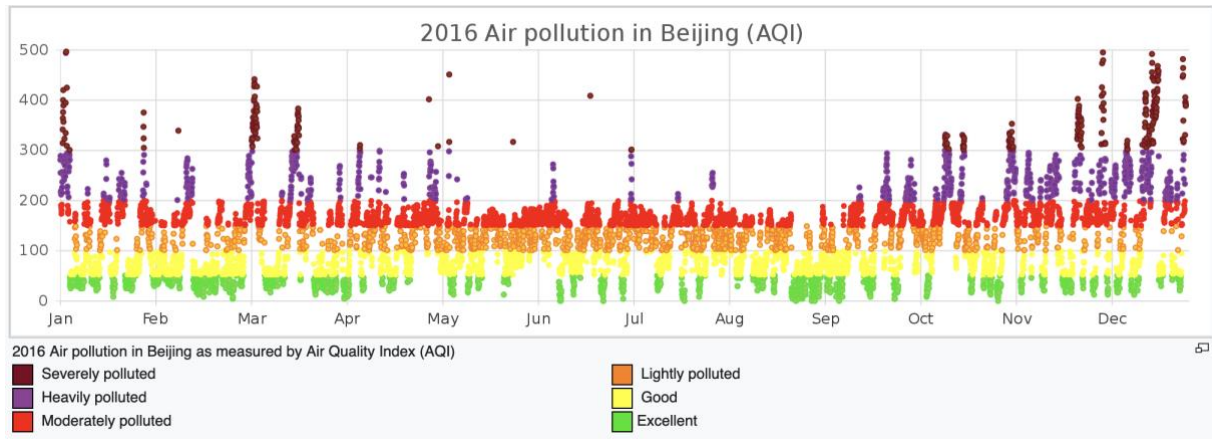


OWID graph where India and Japan are the countries with a rising share from 1985 to 2022

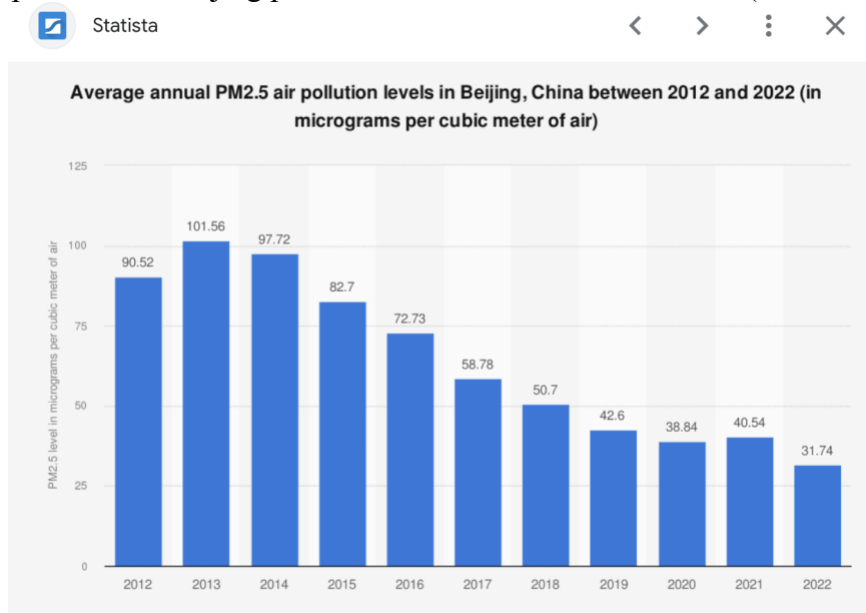


-China pollution

China (as India) is more concerned by particles pollution than by CO2 emissions:
 Beijing 2016 daily air pollution displays numerous severely polluted days: pollution comes from coal mines but also coal fires and Gobi Desert.
https://en.wikipedia.org/wiki/Pollution_in_China#Water_pollution



The PM2.5 air pollution in Beijing peaked in 2013 and declines to 2022 (not in 2021)



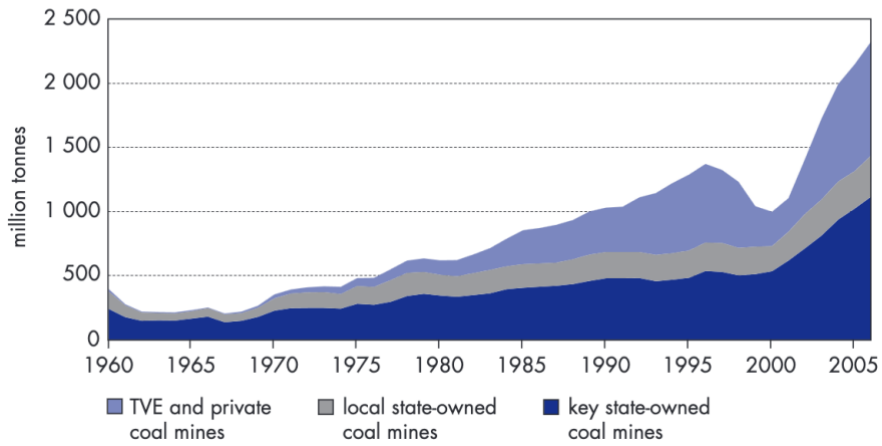
In 2017 <https://www.thelancet.com/article/S2542-5196%2820%2930161-3/fulltext> more than one million of deaths were attributed to air pollution in China, but air pollution has been largely reduced as shown by the above graph

But coal mine deaths are as serious as air pollution

Deaths in coal mines occur mainly in small mines and TVE = township and village enterprise
2008 IEA paper= "Cleaner coal in China"

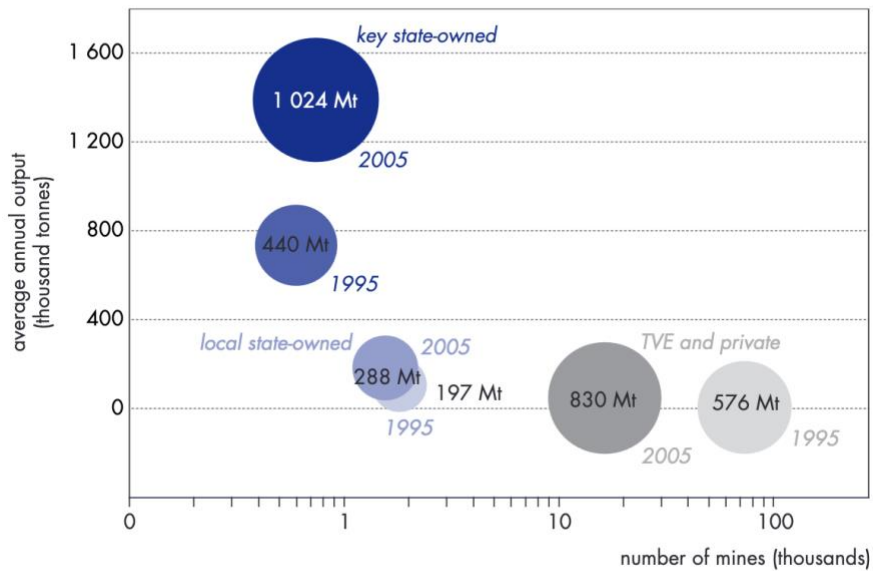
Around 16 000 township and village enterprise (TVE) mines and private mines account for a large proportion of China's coal resources, with varied potential for exploitation.

. Coal production by mine ownership, 1960-2006



The township and village enterprise production in 1995 and 2005

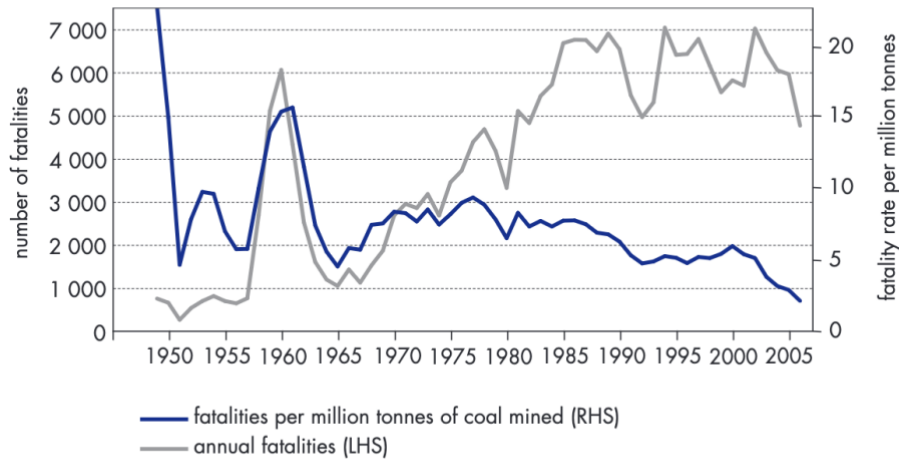
.. Coal mine categories: number of mines and average annual production per mine, 1995 and 2005 (total annual production from each category shown by area of circles)



Sources: 1995 data: Ye and Zhang (1998); 2005 data: CNCA (2007).

The coal mining fatalities peaked with a plateau at 7000 deaths from 1985 to 2003

. Coal mining fatalities: annual total and rate per million tonnes of coal mined, 1949-2006



Source: SACMS [2007].

Coal deaths peak is in 2003 at almost 5000 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3056041/>

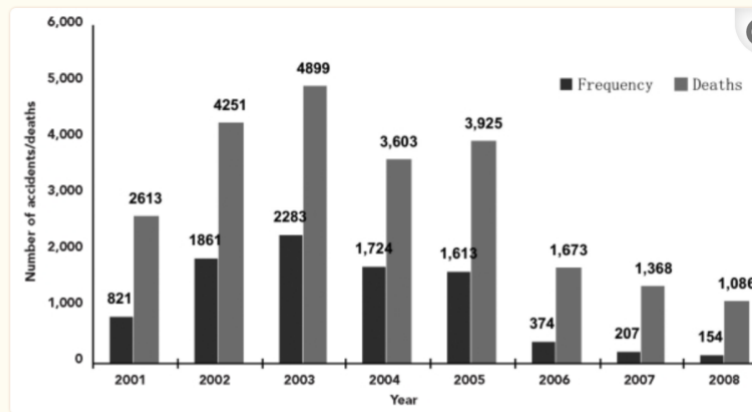
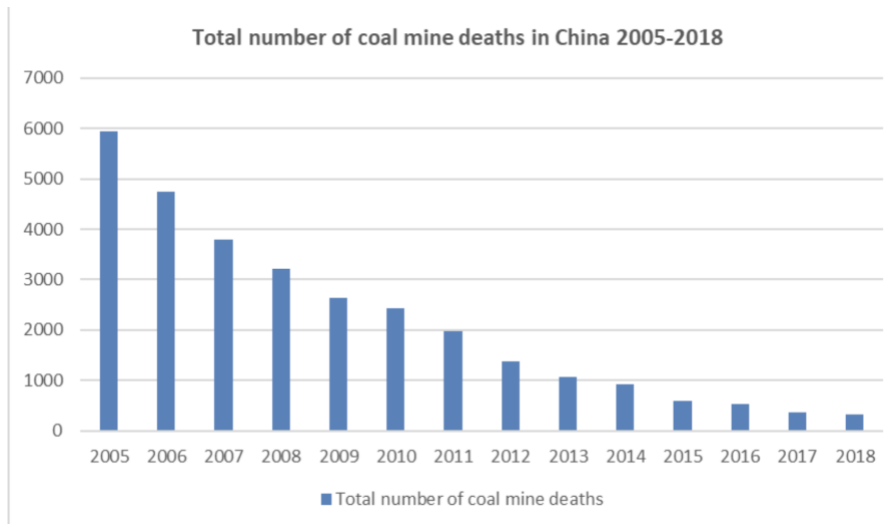


Figure 1.

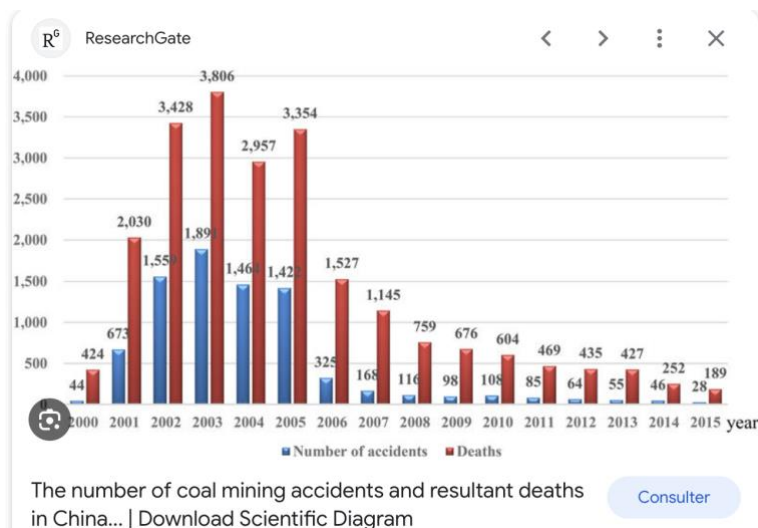
Number of coal-mining accidents and deaths in China, by year: 2001–2008

But coal mine deaths are below 1000 since 2014 from this source

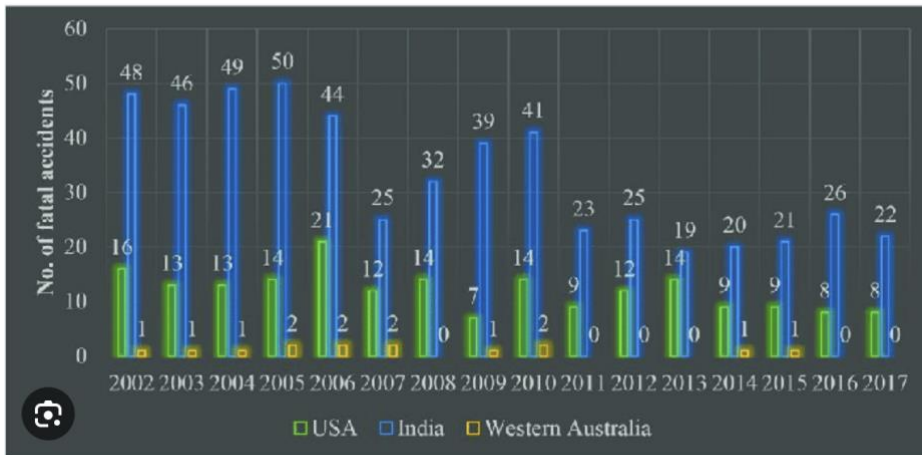
<https://clb.org.hk/en/content/deaths-coal-mine-accidents-china-fall-new-low-333-2018>



This source reports different data with coal mine deaths below 1000 since 2008
https://www.researchgate.net/figure/The-number-of-coal-mining-accidents-and-resultant-deaths-in-China-between-2000-and-2015_fig9_329948932



In India from 2002 to 2017 underground coal mine deaths peaked at 50 in 2008 and 22 in 2017 and zero in US as coal mining is on surface

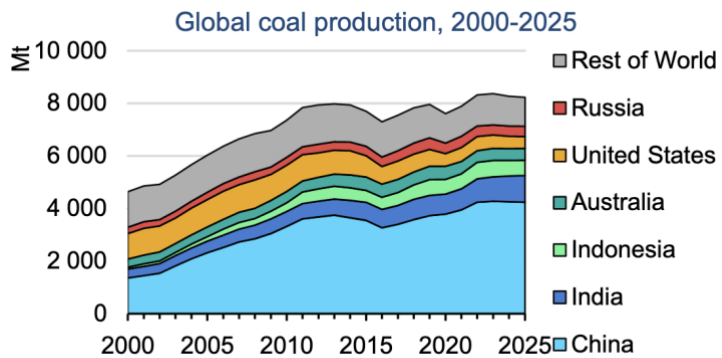
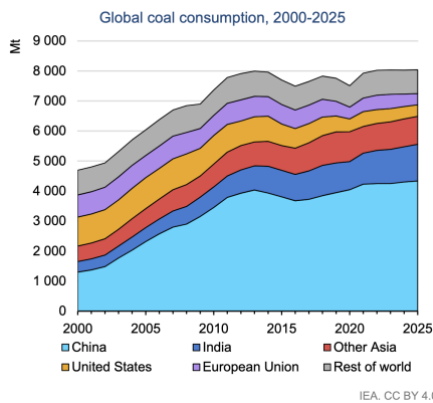


Comparison of the number of fatal accidents in Indian underground coal... | Download Scientific Diagram

Consulter

-Coal production and consumption

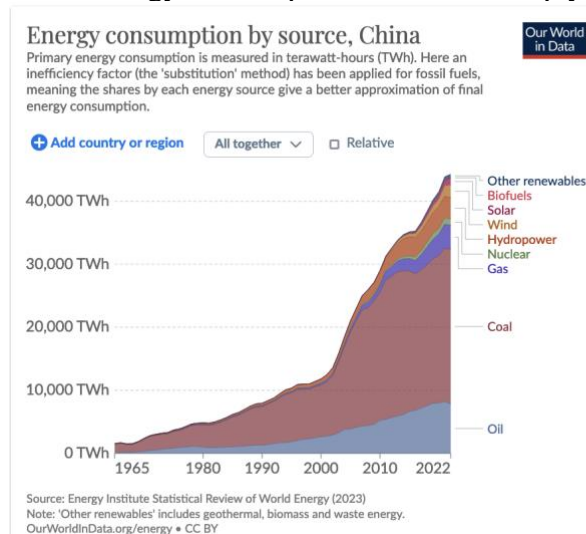
World coal consumption and production is forecasted by IEA up to 2025, with China over 50% and peak beyond 2025 and India second.



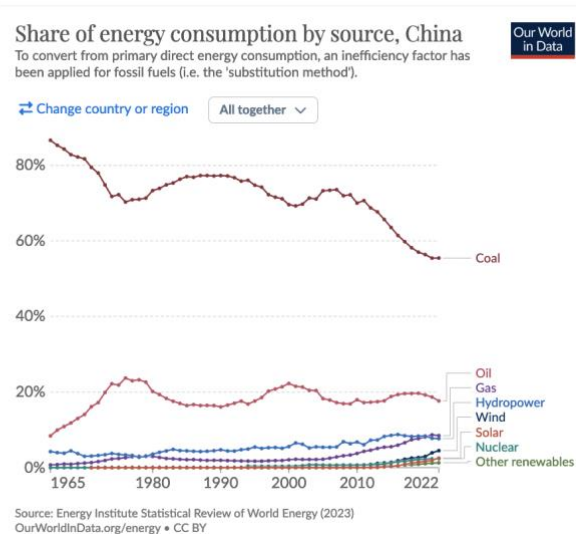
IEA. CC BY 4.0.

IEA. CC BY 4.0.

In China coal consumption went from 85% of energy consumption in 1965 to 55% in 2022
China energy consumption increased sharply since 2003:



Source: Energy Institute Statistical Review of World Energy (2023)
Note: 'Other renewables' includes geothermal, biomass and waste energy.
OurWorldInData.org/energy • CC BY



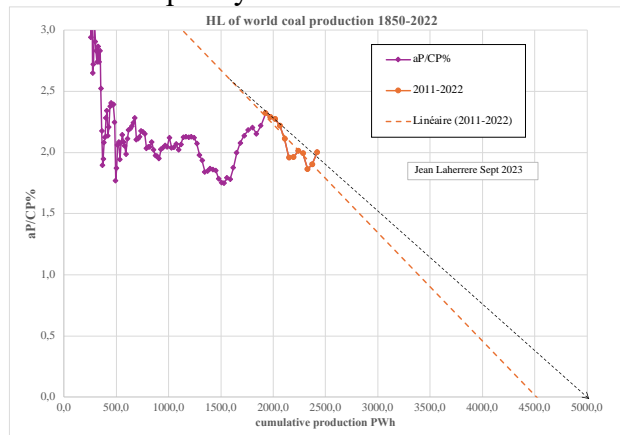
Source: Energy Institute Statistical Review of World Energy (2023)
OurWorldInData.org/energy • CC BY

-HL of coal production

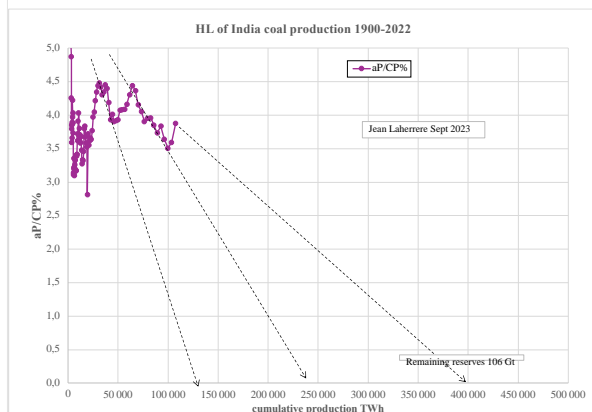
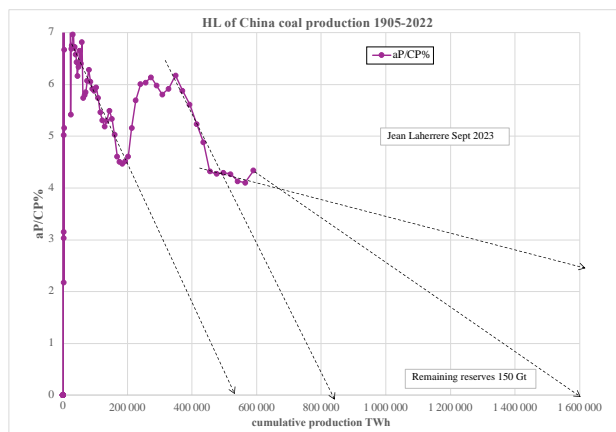
World coal production from OWID = ourworldindata.org

The unit is TWh, but I remind that energy unit is the joule J with power unit = Watt where $W=J/s$ and $Wh = 3600 J$

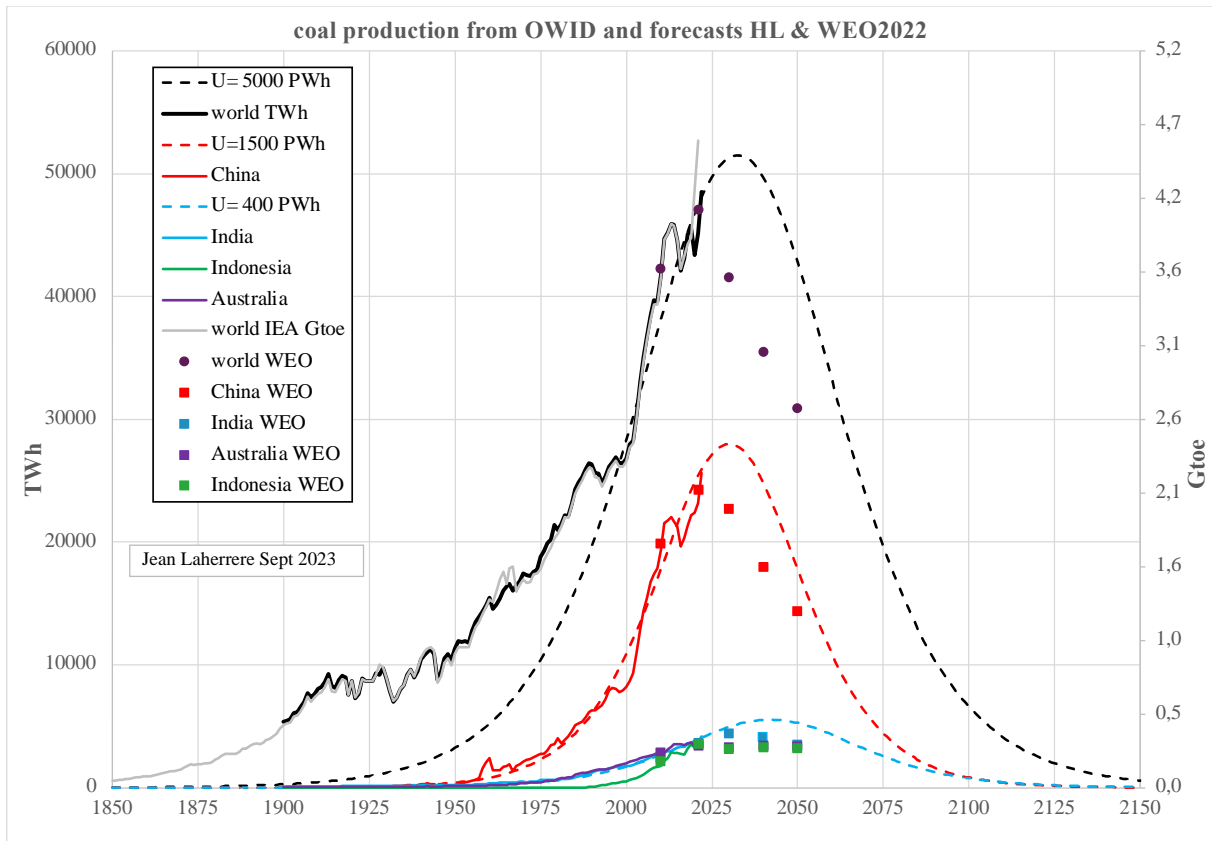
HL of world coal production trends poorly towards 5000 PWh



But HL of China and India coal production are useless: coal ultimates are taken as 1500 PWh for China and 400 PWh for India with the help of remaining reserves.

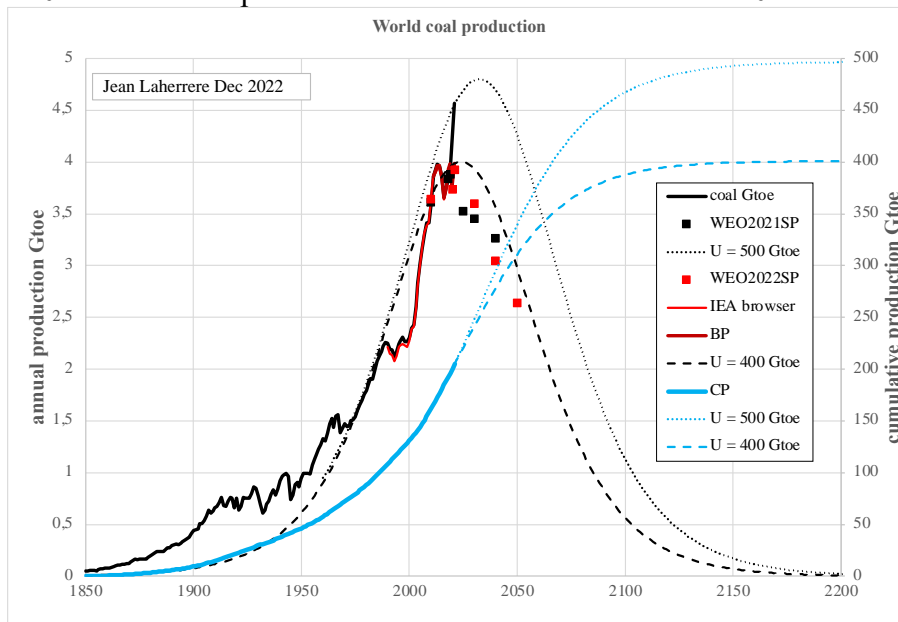


China coal production from OWID in TWh displays a sharp rise from 2000 to 2014 and since 2018. G Forecasts from IEA/WE0 2022 SP are plotted.

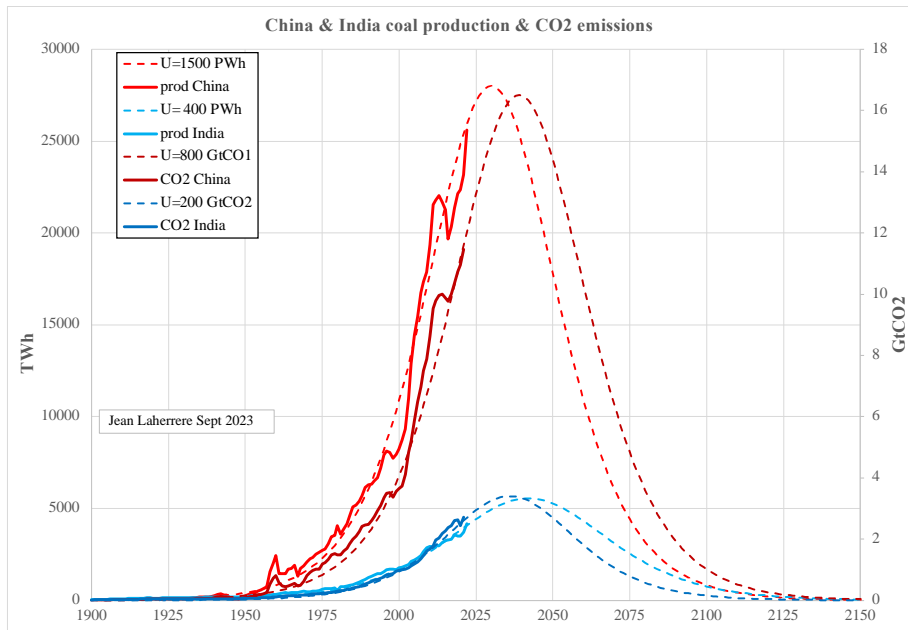


Coal production peak could be for the world 2040 (2011 for IEA, for China 2030 (2011 for IEA) and for India 2040 (40 for IEA).

My previous 2022 world coal production forecast in Gtoe with WEO2021 SP



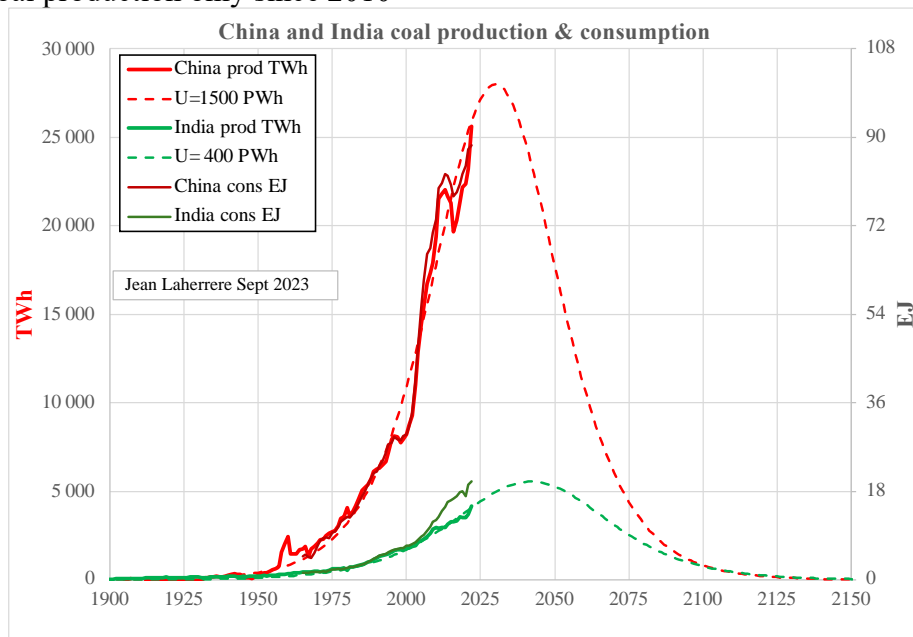
China & India coal production and CO2 emissions



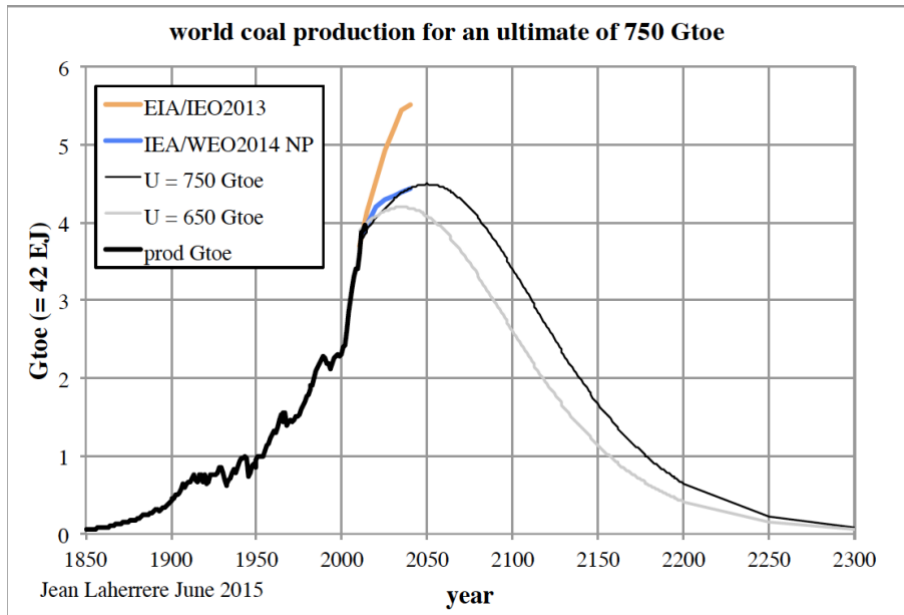
China coal production peak will occur around 2030 when China CO2 emissions will occur around 2040.

India coal production will occur around 2040 as CO2 emissions.

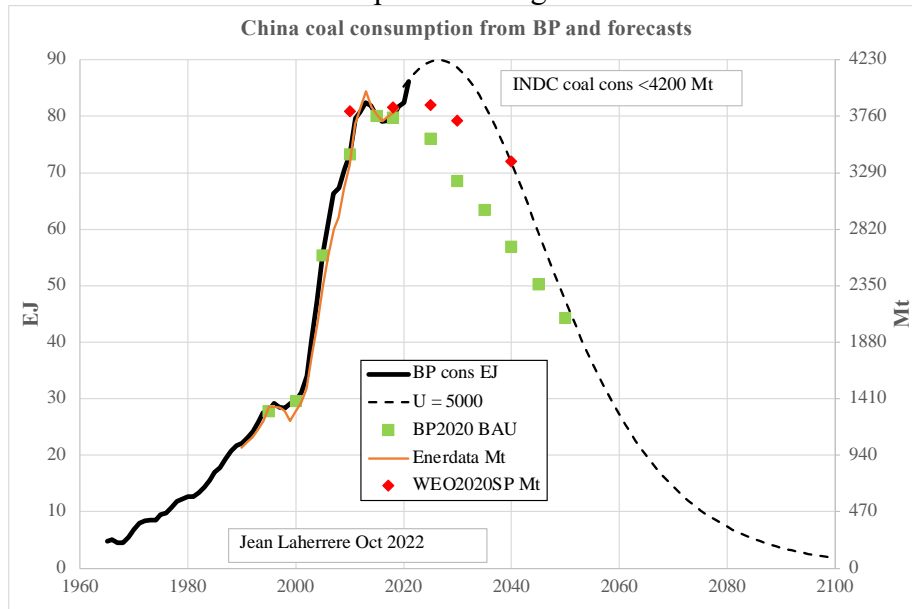
China coal consumption is close to China coal production when India coal consumption is larger than coal production only since 2010



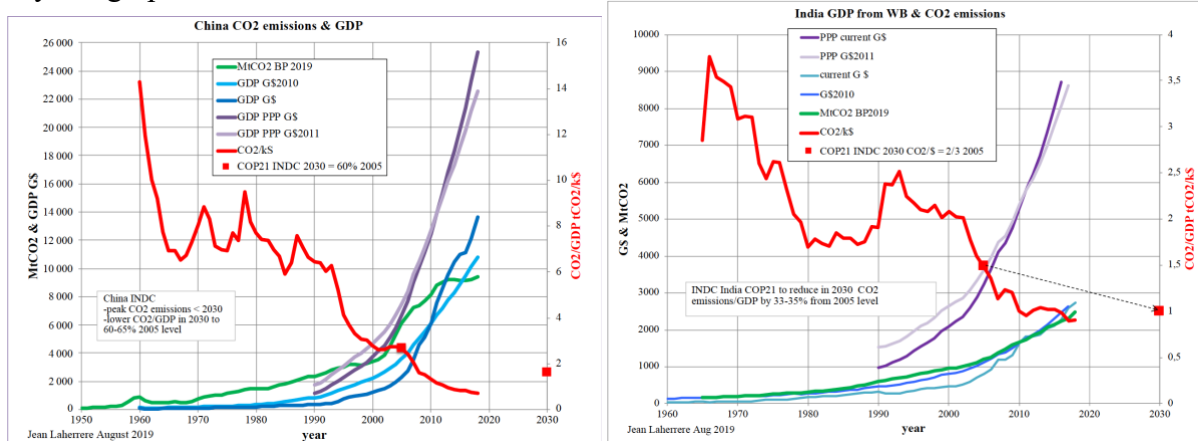
My coal production forecast in 2015 which was in line with IEA/WEO, but not EIA



My 2022 forecast on China coal consumption was higher than EIA or IEA forecasts for 2030

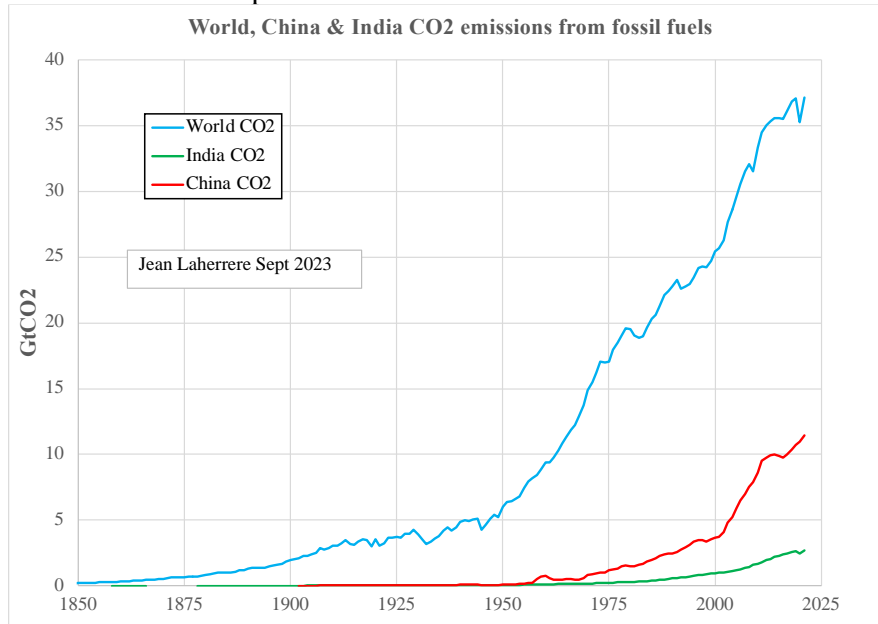


My old graphs for China & India CO2 emissions in 2019

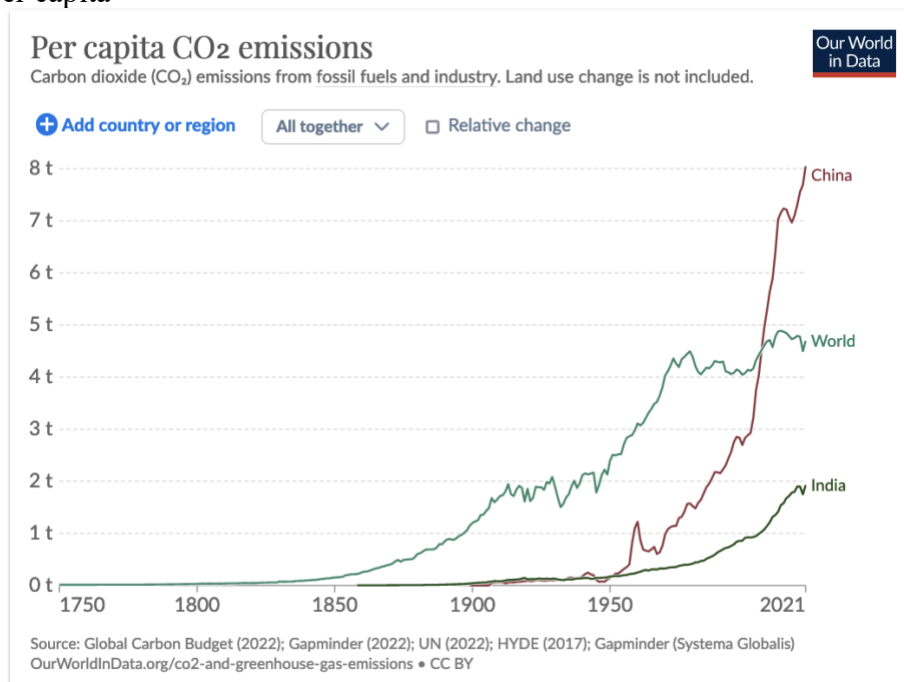


-CO2 emissions

CO2 FF emissions started a sharp increase since 1947:

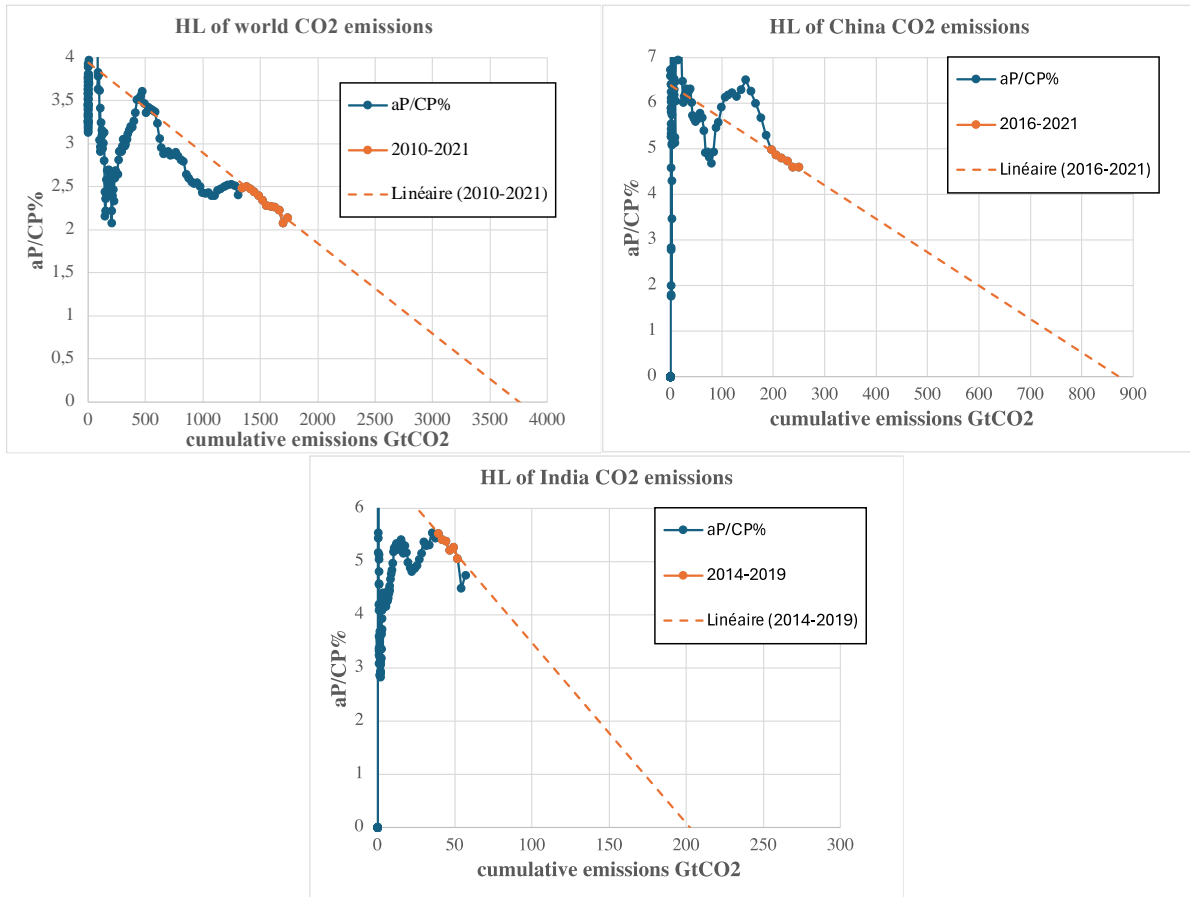


China CO2 emissions after a plateau is rising again since 2017 and it is worse on CO2 emissions per capita



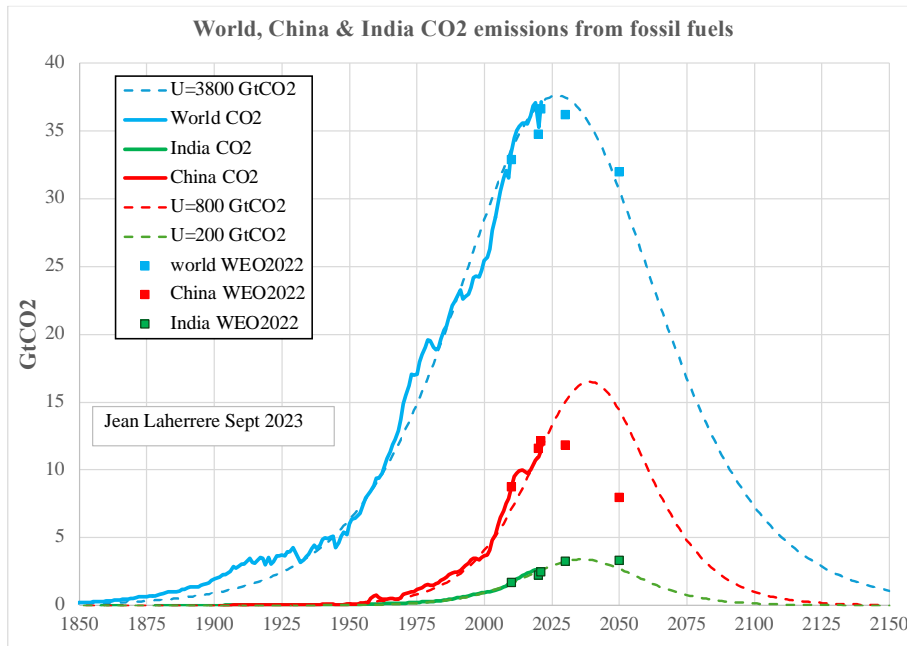
CO2 emissions are forecasted using HL

CO2 FF emissions will peak around 2025 for the world and 2040 for India and China



CO2 FF emissions ultimates are taken in GtCO2: 3800 for world, 800 as China and 200 for India

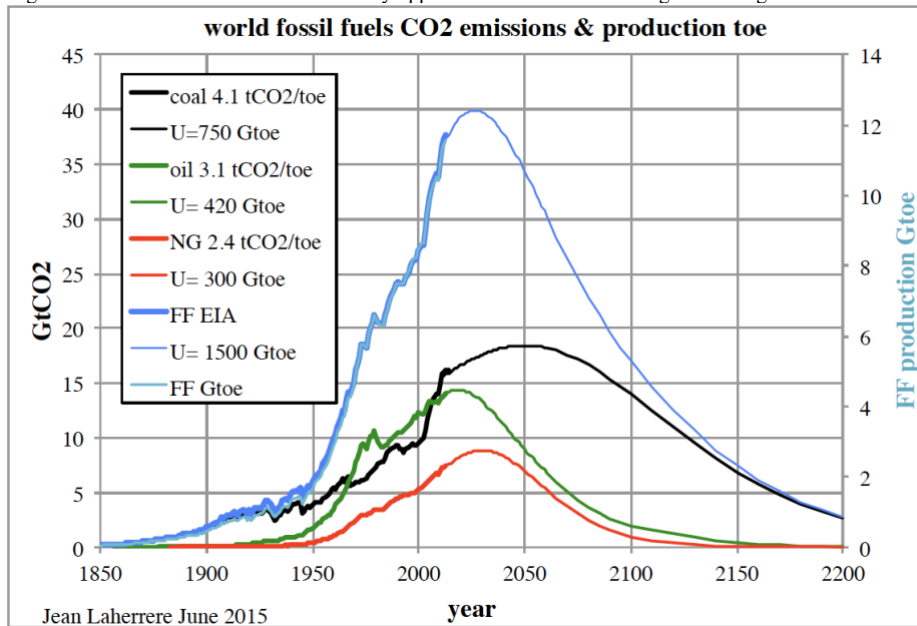
IEA/WEO 2022 SP CO2 forecasts are plotted: they agree with my HL forecasts for the world and India, but China WEO forecast for 2050 is much lower



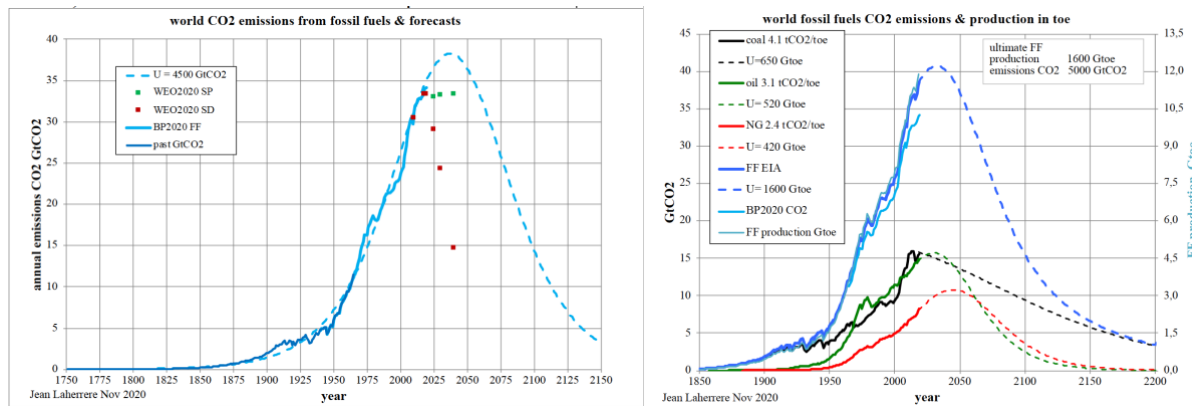
Present forecasts are compared to our previous forecasts

My 2015 forecasts with Bernard Durand where coal peak was forecasted beyond 2050

-Durand B. & Laherrere J.H. 2015 « Fossil Fuels Ultimate Recovery Appraisal, Clue to Climate Change Modelling » International Scientific Conference 7-10 juin Paris
<https://aspofrance.org/2015/12/11/fossil-fuel-ultimate-recovery-appraisal-clue-to-climate-change-modeling-december-2015-bernard-durand>



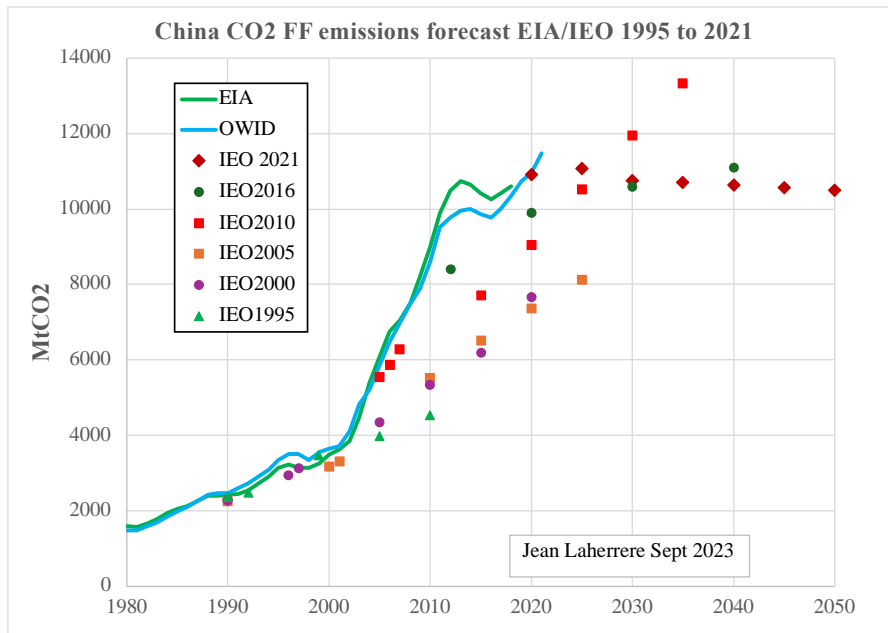
My 2020 forecast where coal production was forecasted in decline because the coal problems in China



China CO2 FF emissions are plotted since 1980 with the evolution of EIA/IEO reference forecasts from 1995 to 2021: the evolution is just chaotic, meaning that CO2 forecasts are unreliable.

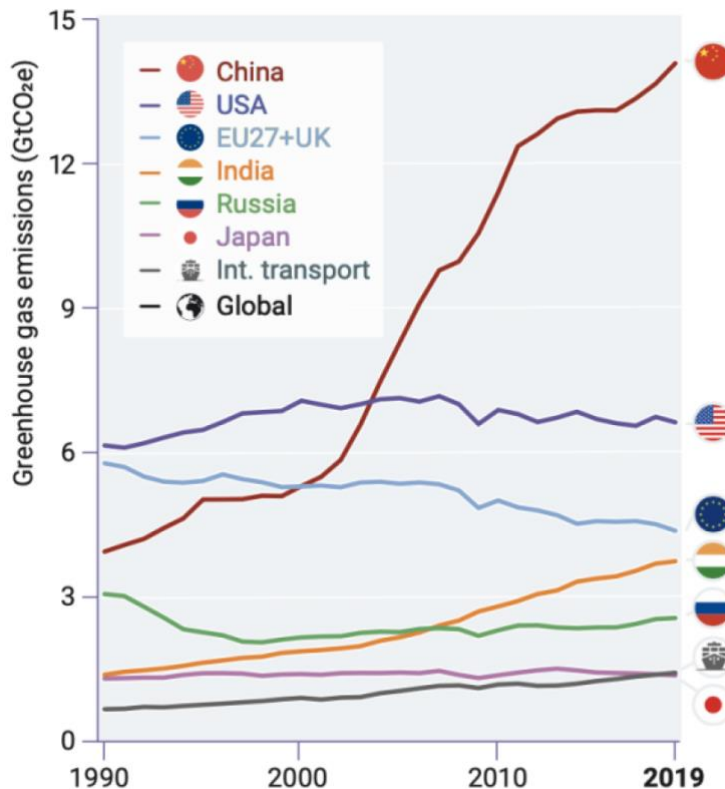
China CO2 emissions went down in 2022 but return to record levels in Q2 2023

<https://www.carbonbrief.org/analysis-chinas-co2-emissions-in-q2-2023-rebound-to-2021s-record-levels/>



-CO2 emissions/GDP

My February 2021 paper “COP21 commitments for CO2 emissions from 2019 data for world and main countries” <https://aspofrance.org/2021/02/27/cop21-commitments-for-co2-emissions-from-2019-data-for-world-and-main-countries/> reports that China and India were the countries with the strongest increase in greenhouse gases from 1990 to 2019



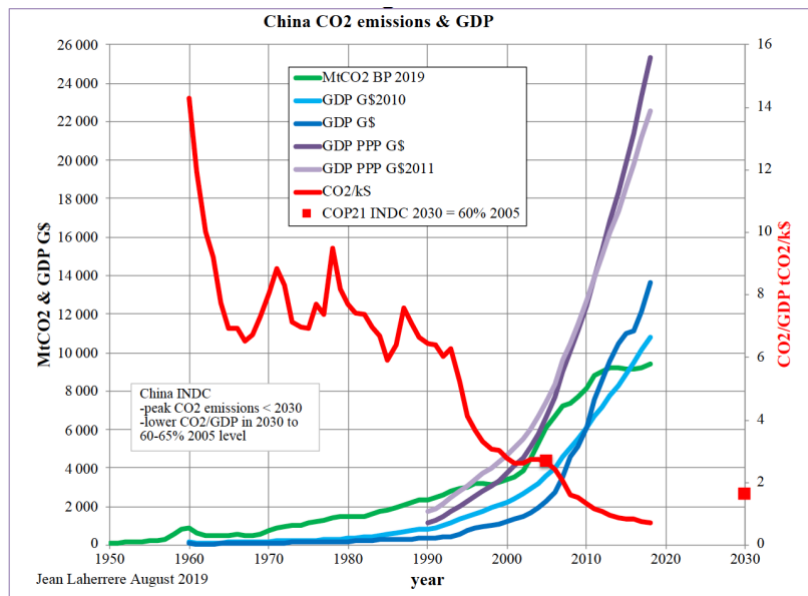
This 2021 paper mentions the Paris COP21 agreement with the INDC =intended nationally determined contribution

Most INDC are indicated as CO2 emission, except for 2 countries committed only for CO2 emission per GDP: China and India

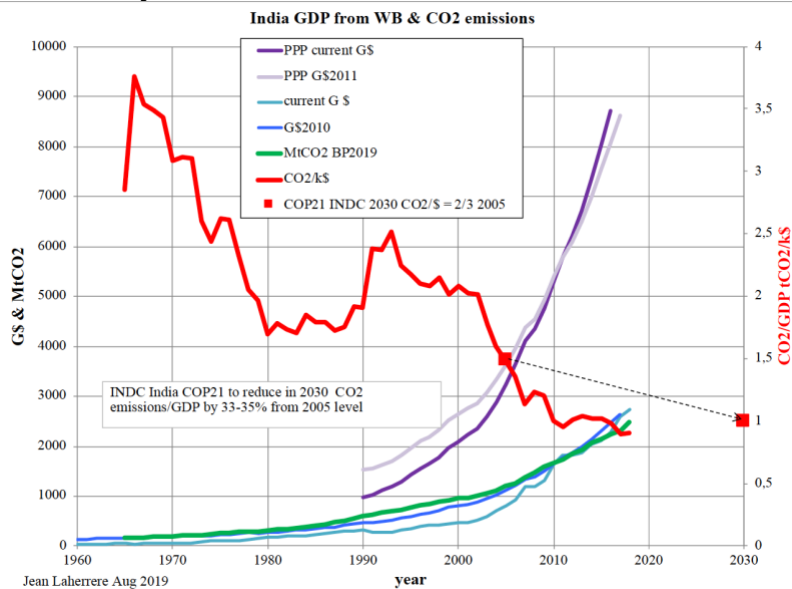
China has agreed that their INDC is in 2030 to lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level and to increase the share of non-fossil fuels in primary energy consumption to around 20%.

China in COP21 is committed in 2030 to be for (CO2/\$) at 60% of 2005: already reached in 2018 which is well over. CO2/k\$ is declining since 1987!

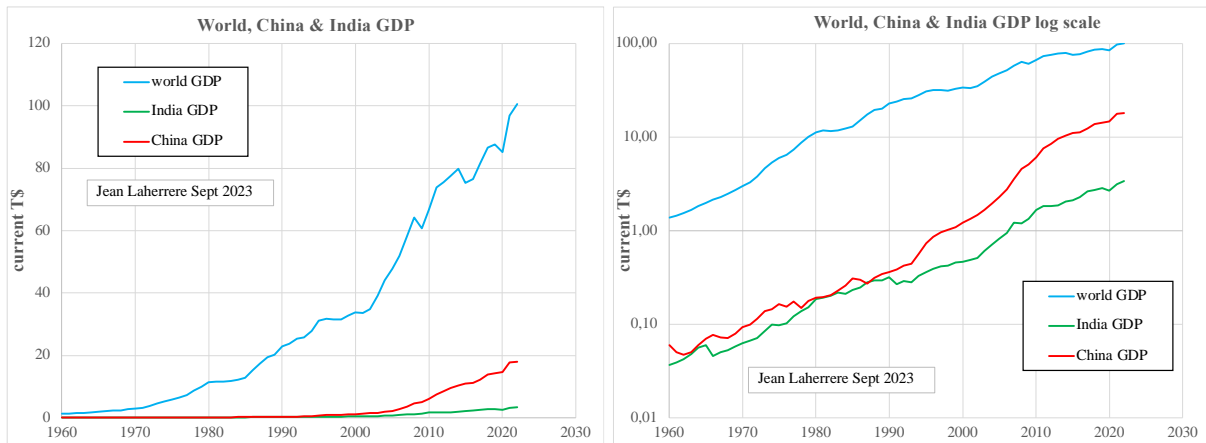
The graph shows that in 2019 China CO2/GPD is below the limit and can increase their CO2 emissions



India CO2/GPD was already in 2019 below the INDC limit

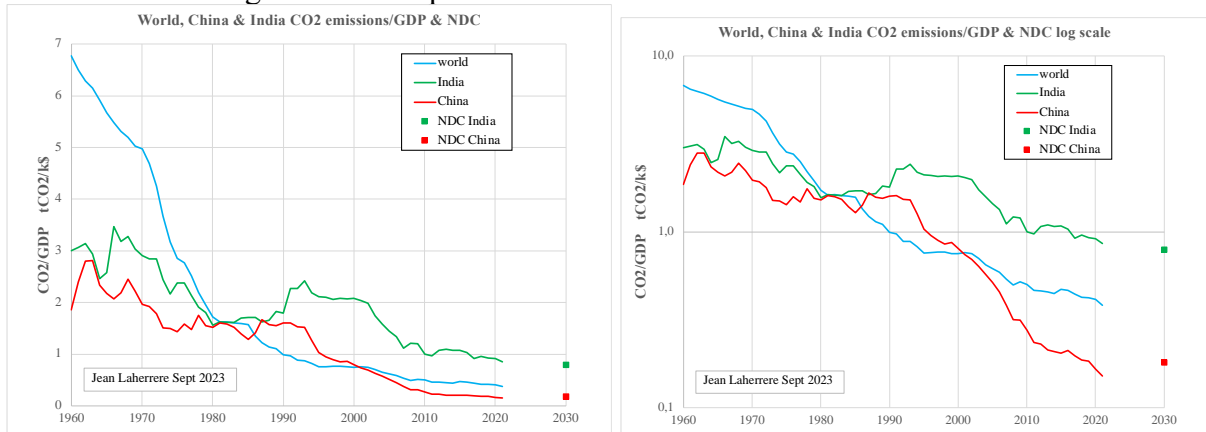


GDP are taken from WB and plotted in T\$ and in log scale to compare growth



China and India had similar GDP growth from 1960 to 1990 but since 1990 China has a larger growth

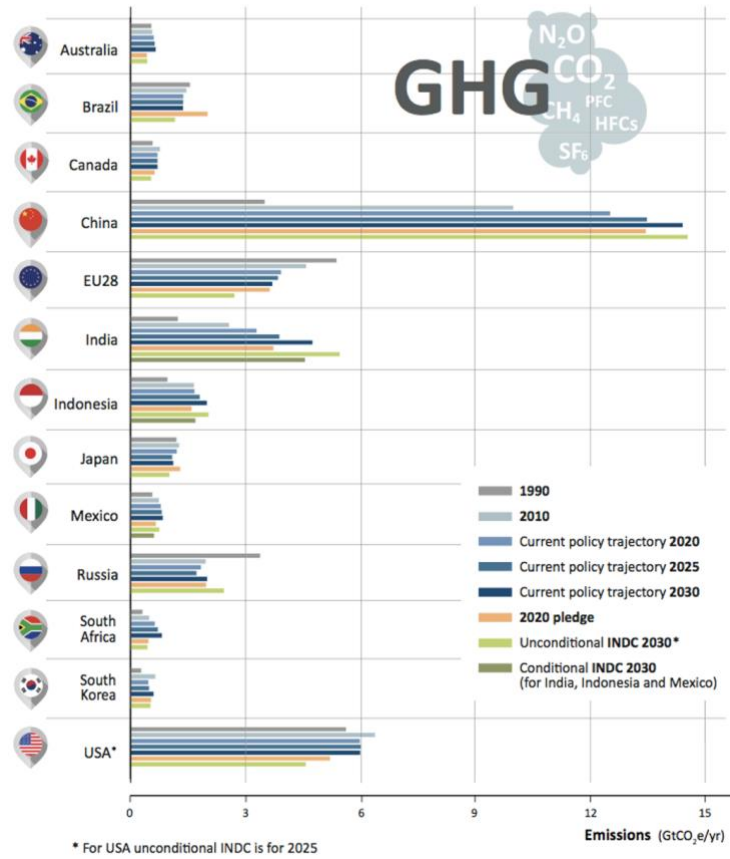
The ratio of CO₂ emissions versus GDP in tCO₂/k\$ is plotted since 1960 for the world, China and India and in log scale to compare the diminution



China has the largest decrease since 1992 and India since 2010 has a decrease similar with the world

The next figure from researchgate.net https://www.researchgate.net/figure/Greenhouse-gas-emissions-for-G20-countries-with-INDCs-submitt-ed-by-1-October-for_fig5_307477016 forgets to mention that the INDC = Intended Nationally Determined Contributions for China and India are different from the other countries being greenhouse emissions per unit of GDP instead of greenhouse emissions.

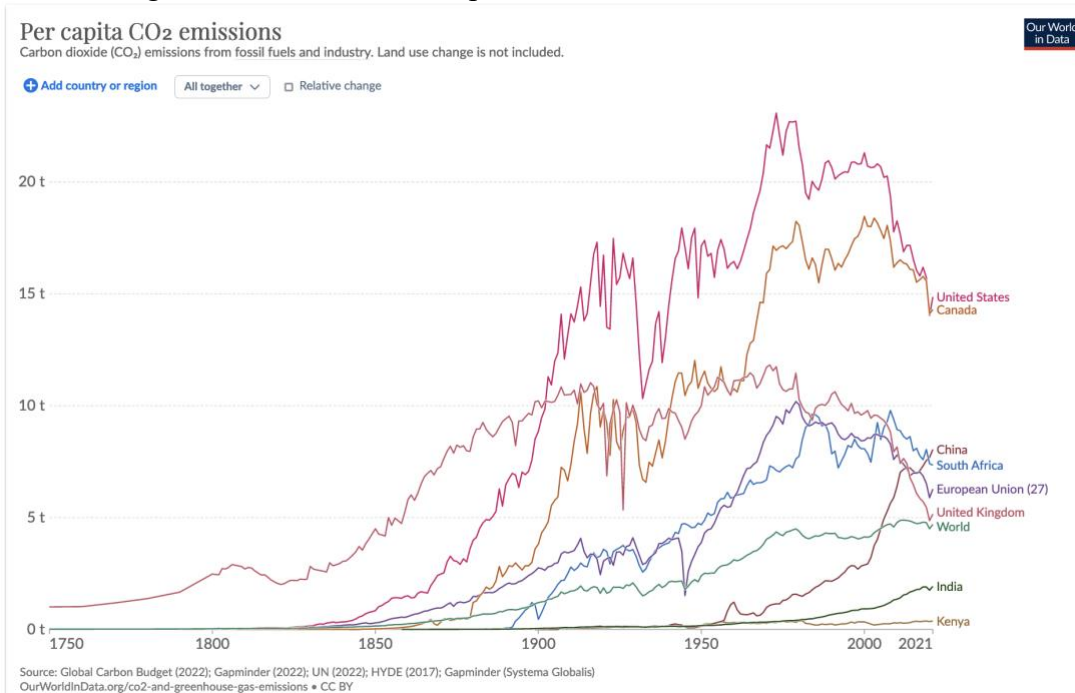
Figure 3.5: Greenhouse gas emissions for G20 countries with INDCs submitted by 1 October for historic emissions (1990, 2010), current policy trajectory emissions (2020, 2025, 2030), and INDC emissions (2025, 2030)



China and India have submitted a stronger INDC target despite they are the few countries increasing their greenhouse emissions per capita as shown by this OWID graph

-CO₂ emissions per capita

They are declining for most countries except China and India



Income per capita from OWID versus population

Only 1.8 Gpeople have a mean income over 15 \$/d which is the income of China.

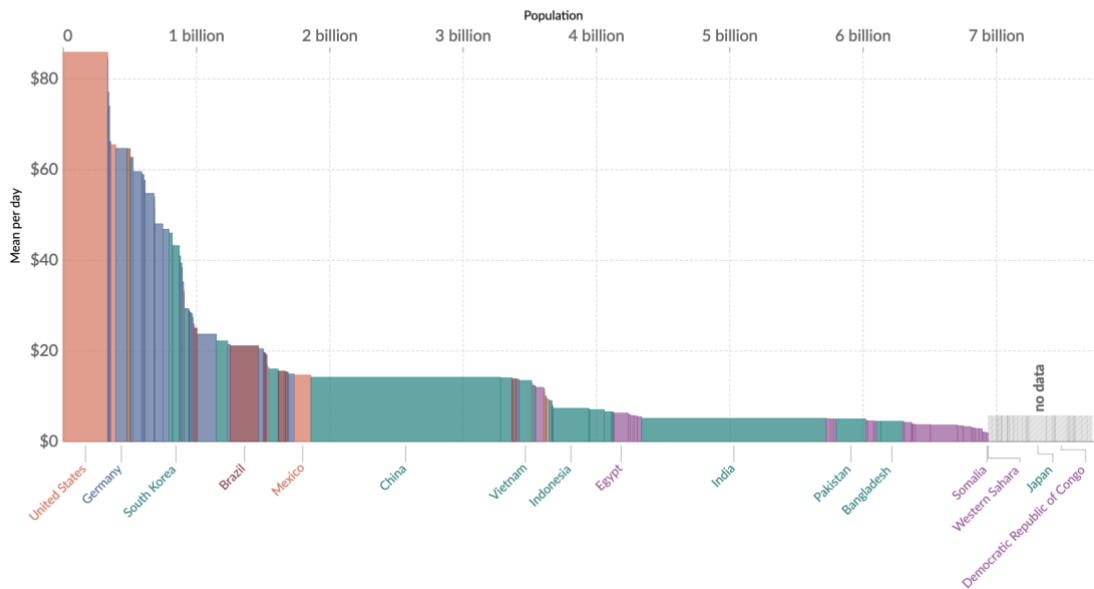
Mean income or consumption per day, 2019

This data is adjusted for inflation and for differences in the cost of living between countries.

Our World
in Data

Select countries or regions Show 'no data' area

Africa Antarctica Asia Europe North America Oceania South America



Source: World Bank Poverty and Inequality Platform (2022)

OurWorldInData.org/economic-inequality • CC BY

Note: This data is expressed in international-\$ at 2017 prices. Depending on the country and year, it relates to income measured after taxes and benefits, or to consumption, per capita.

-Conclusion

China coal production is today more than half of world coal production

China coal production growth was around 6%/a since 1947 but was low in 2016 because air pollution and mine deaths, the present growth is still high.

China coal production was constrained by air pollution (peak 2013) and mine deaths (peak 2003), but less today.

China coal production is not constrained by the COP21 Paris Agreement because the limit in CO2 emissions is related to GDP (as India), when for other countries the limit is for CO2 emissions.

China electricity generation share from coal is 61% in 2022 and likely over 50% in 2030.

China coal production will peak around 2030 (2021 for IEA) when India coal production will peak around 2040 (same for IEA)

China and India need coal to increase their low income per capita.