



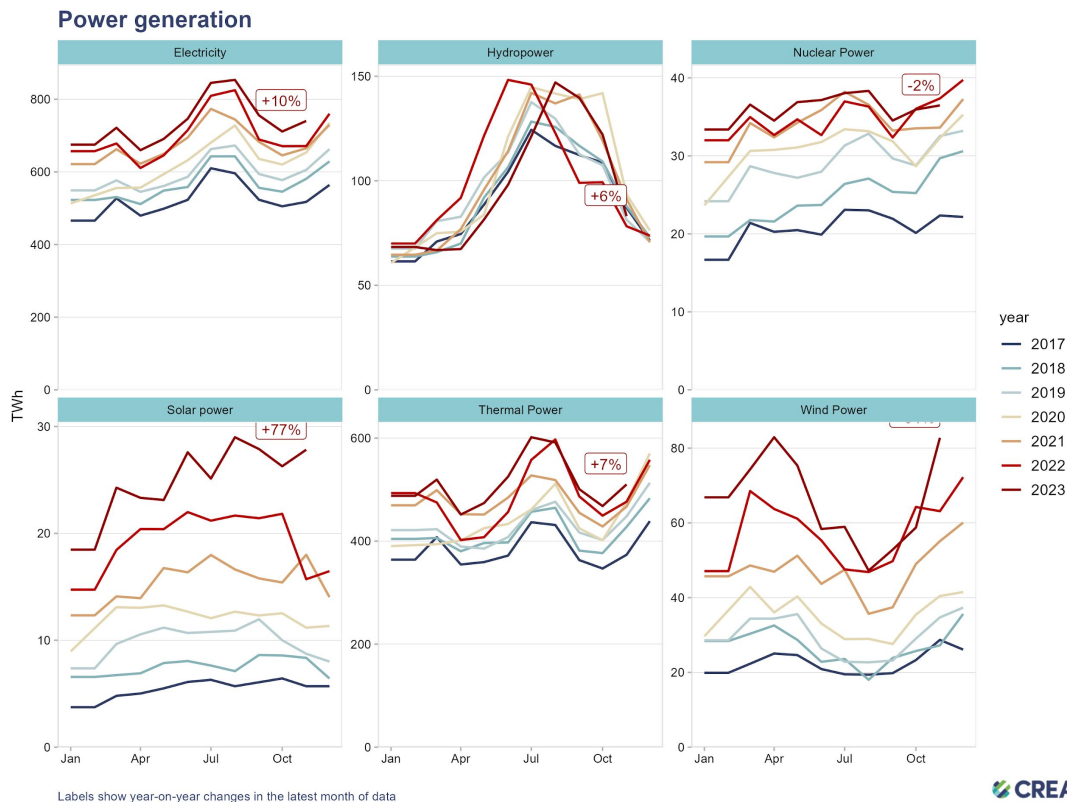
Centre for Research on Energy and Clean Air

China energy and emissions trends

December 2023 snapshot

Power production speeding up, solar surge

- November witnessed a 10% increase in total power generation, against a lower baseline from last year's covid lock-down.
- Solar power generation maintained a robust growth rate of 77%, with wind generation also exhibiting a consistent upward trend.
- Hydropower growth slowed this month, as November usually marks the start of the dry season in China's southwestern region.
- Thermal power generation experienced a year-on-year increase of 7%.
- Nuclear power generation, on the other hand, saw a 2% decrease, mainly due to a higher number of scheduled maintenance operations.

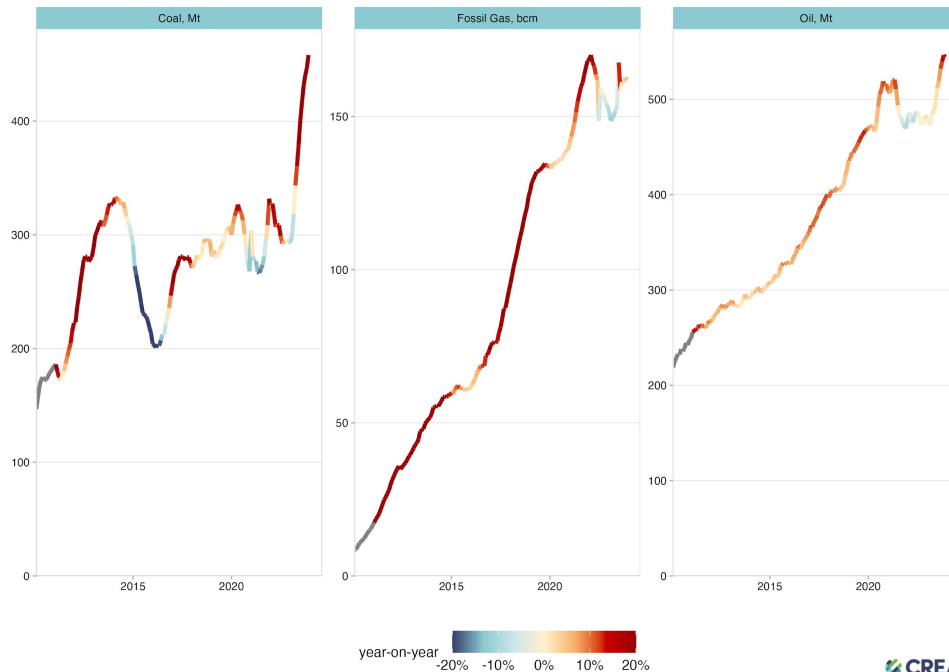


Oil and coal imports balloon, but for different reasons, while gas stumbles

- Crude oil imports increased 12% while net oil product exports fell 35% on year, showing the resurgence of domestic demand.
- Fossil gas imports increased by 5% in November but year-to-date imports are still down from the 2021 peak, showing the effects of high prices and change in policy towards gas.
- Coal imports climbed 35% year-on-year in November.

Fossil fuel imports

12-month moving sum

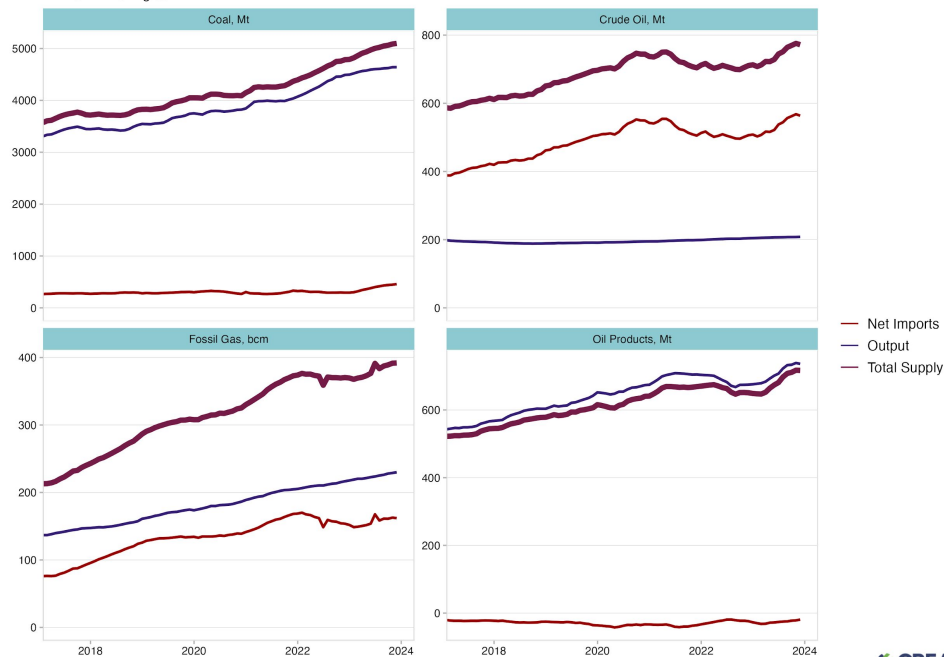


Strong fossil fuel imports due to gap between demand and domestic supply

- Total supply (production plus net imports) continued to increase and hit a new record for all fossil fuels, indicating continued increase in demand.
- Growth is currently supplied mainly by imports for all fuels, with oil output flat and coal output increasing much slower than implied demand.
- In the case of gas, imports are still down from their peak due to an increase in domestic output since 2021, but current rebound in demand is resulting in increases in imports.
- Coal supply growth slowed down, reflecting the slowdown in thermal power and steel.

The government engaged in a major push to increase domestic coal production and suppress high prices in 2021–22. The result was a massive increase in the tonnage of coal produced, but at the cost of deteriorating coal quality, which means that the energy content of the coal produced didn't increase correspondingly. Coastal users shifted to imported coal en masse, which led to a surge in imports in 2023. The failure of the domestic coal mining push has major implications for China's approach to energy security. Read more: [What is causing the record rise in both China's coal production and imports?](#)

Fossil fuel supply
12-month moving sum

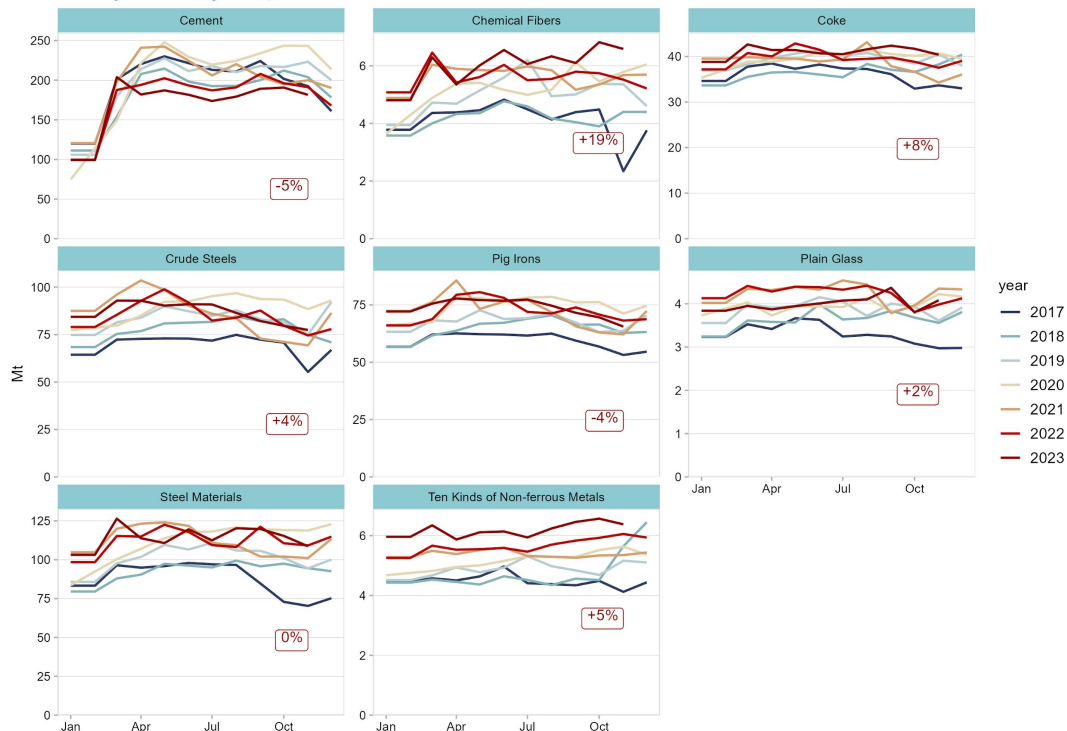


Real estate investment continues to contract

- Pig iron fell 4% and cement by 5% in November, showing the real estate investment contracted further.
- In November, crude steel production increased by 4%, potentially driven by the end-of-year domestic construction rush and stimulation from rebounding steel prices
- The government reportedly aims to limit full-year crude steel output below 2022 level, but this would require a 8% reduction in Nov-Dec, which is unlikely to be realized.
- Chemical and non-ferrous metals output growth continued strong.
- Steel output maintained on the same level as last year. Export support continued, which increased 43.2% from last year. Growth in investment in railways and industrial machinery offset much of the drop in domestic steel demand for construction.
- Batteries, solar and other cleantech manufacturing is driving demand for related commodities.
- Cement output has been declining since 2020, leaving the industry with overcapacity and testifying to declining construction volumes.

The steel and cement industries are the largest CO2 emitters in China, when emissions from their electricity use are included. They are also bellwethers of real estate, infrastructure and other fixed asset investment which play an outside role in China's emissions and economy.

Heavy industry output

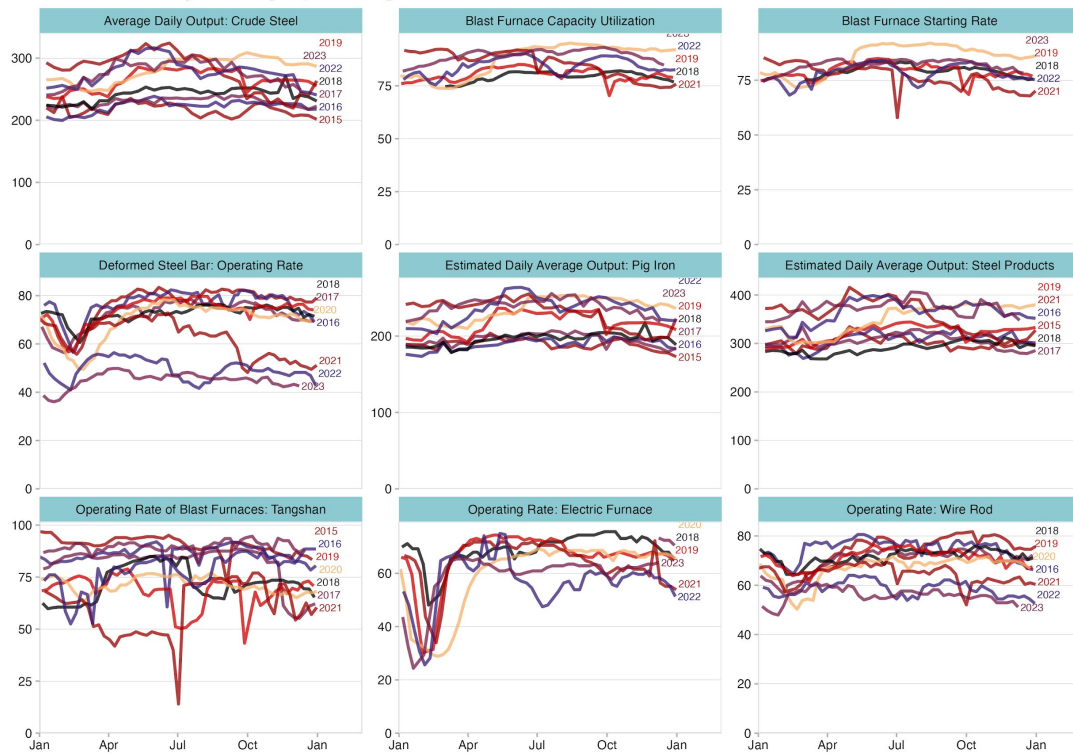


Labels show year-on-year changes in the latest month of data

Crude steel output continues to decline

- Pig iron and crude steel output have continued to slide further in November.
- Production of steel products used in construction (rebar, wire rod) continues to plumb new lows.
- Steel products output began to fall in November after a jump in late October.
- The operating rate of blast furnaces in Tangshan, China's "steel capital" and an important source of air pollution in Beijing, reached the highest rate for October–November since at least 2014.
 - Hebei industrial output is a bellwether of national priorities: when air quality and emissions are the priority, it is the most tightly regulated area due to its impact on Beijing's pollution levels.

Steel industry weekly operating indicators

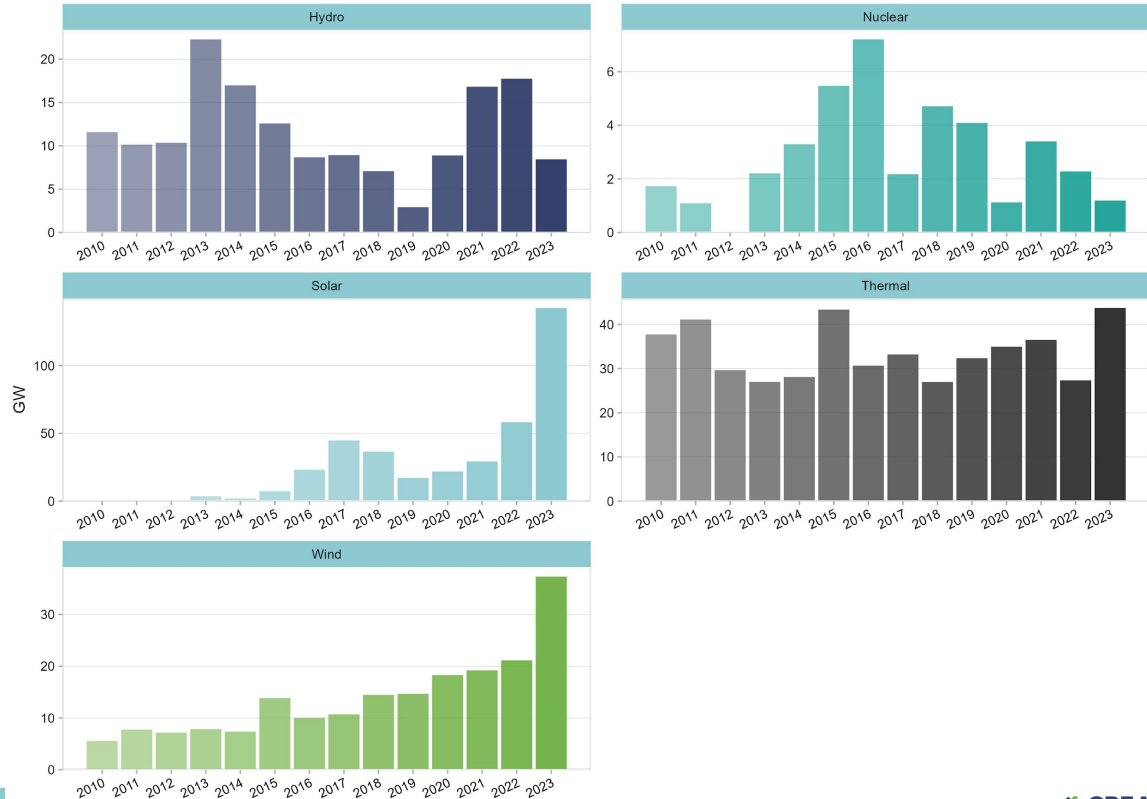


Source: Wind Information

Record solar&wind – and coal – additions

- Strong wind and solar installations continue, with a whopping 143GW of solar and 37GW of wind installed in January–October.
- Commissioning of thermal (coal and gas) power plants made a new record for the first ten months of the year, since at least 2009. This is due to coal power projects being started or restarted in 2020 entering operation, showing the urgent pace of construction.
- China introduced coal power capacity payment mechanism, with implementation scheduled for 1 January, 2024.

Newly added power capacity, January to October



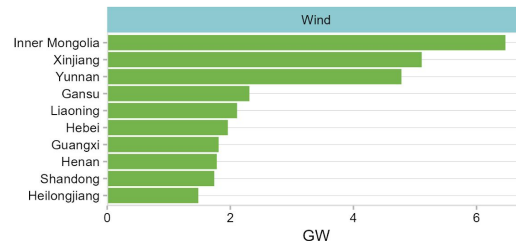
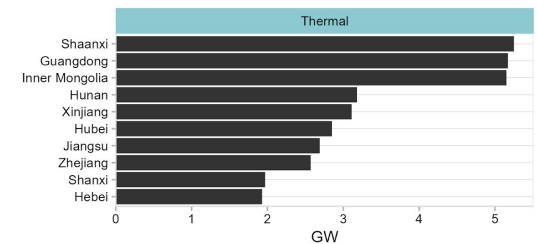
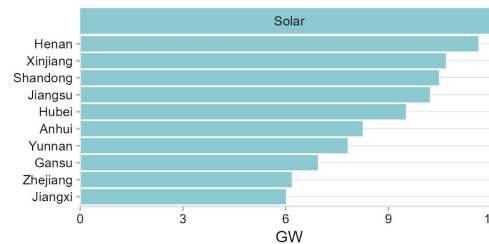
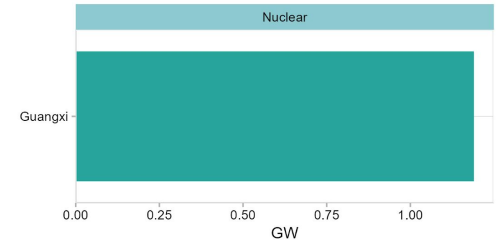
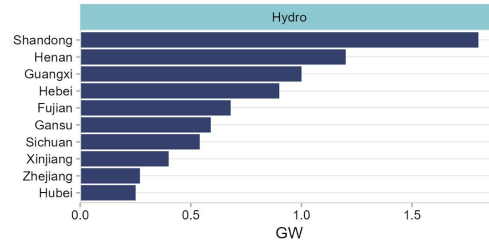
Distributed solar and centralized wind boom

- Solar power installations are led by Henan, and Shandong, which have ambitious rooftop solar policies (known as “whole-county distributed solar”), striving to meet rooftop solar installation targets by the end of 2023.
- Inner Mongolia and Xinjiang lead in wind development, aiming for full operation of its large-scale clean energy bases by year-end.
- Thermal (coal) power additions accelerated in Shaanxi, Inner Mongolia and Xinjiang, which are aiming to export power to eastern demand centres. However, Guangdong, Inner Mongolia and Xinjiang, which are aiming to export power to eastern demand centres. However, Guangdong, Zhejiang and other eastern provinces have started a large wave of new coal power projects, leading to redundancy once plants are completed in a few years.

Read more: [China's new coal power spree continues as more provinces jump on the bandwagon](#)

Newly installed power capacity by province

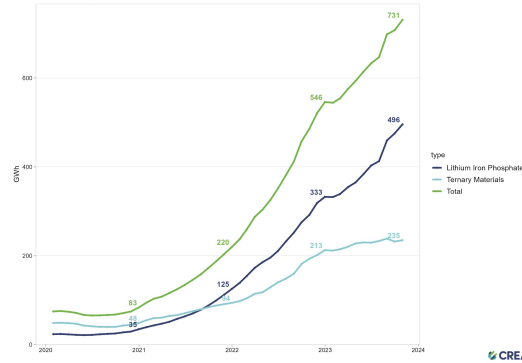
January - October 2023



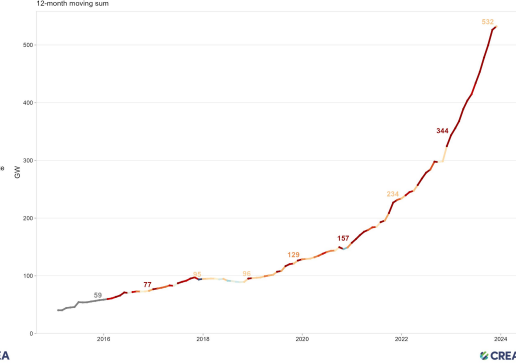
Record solar cell and electric vehicle output

- Solar cell production in the past 12 months reached 532 gigawatts, doubling in the past two years and predicting rapid growth in global solar power installations. One more doubling will take solar cell output to the level needed to cut global emissions in line with Paris agreement.
- EV production continued to gain share, with a 39% increase year-on-year in November in new energy vehicles, while total vehicle output grew by 24%.
- The strong growth in EVs is making a dent in gasoline demand for the first time. The share of EVs of all vehicles on the road increased from 5.5% a year ago to 8.7% now, shaving approximately 3%-points off gasoline demand growth.

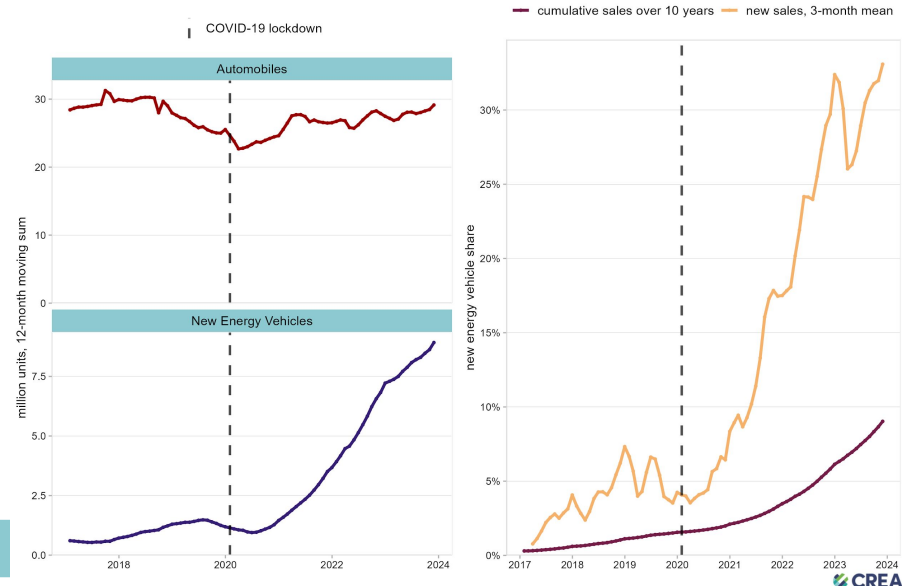
Battery output
12-month moving sum



Solar cell output
12-month moving sum



Vehicle production

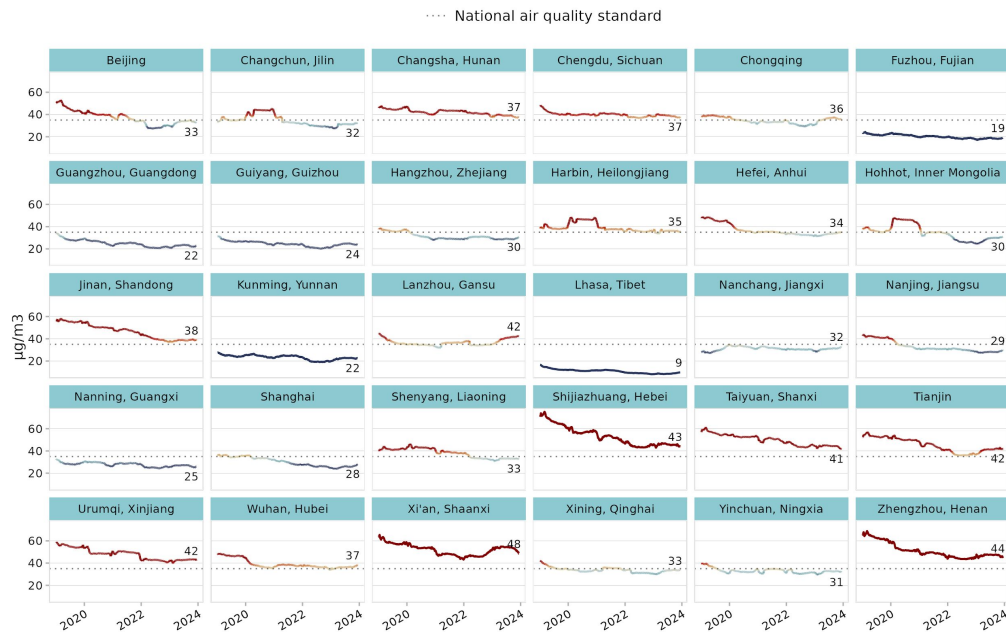


13 provincial capital cities have not met national standard for PM2.5 yet by November

- By November, 13 out of the 30 provincial capitals exceeded the national PM2.5 air quality standard (35 $\mu\text{g}/\text{m}^3$) for their 12-month moving average of PM2.5. Xi'an, Zhengzhou and Shijiazhuang had the worst average PM2.5 levels at 49.8, 46.1 and 44.1 $\mu\text{g}/\text{m}^3$, respectively.
- Hefei and Xining were at the top of nearly breaking the national standard, with their 12-monthly moving average values at 34.9 and 33.8 $\mu\text{g}/\text{m}^3$, respectively.
- In November, the 12-month moving average of PM2.5 in 17 provincial capitals increased since October, accounting for 57% of the total.

PM2.5 concentrations in province capitals

12-month moving average

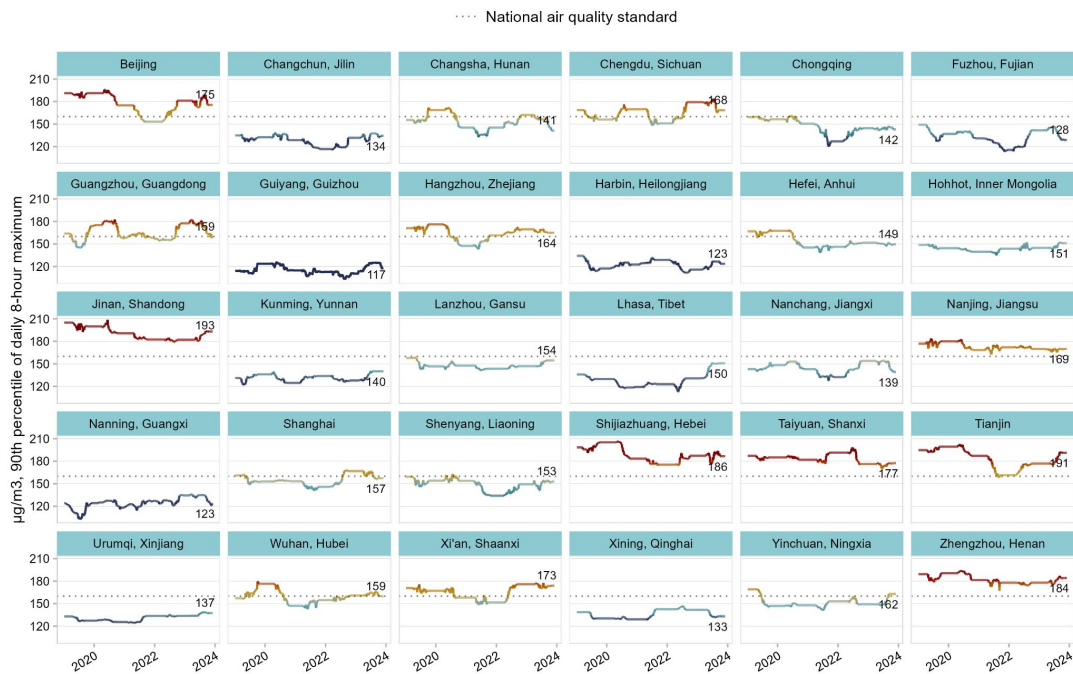


High ozone pollution occupies key regions

- 11 provincial capital cities in mainland China have not reached national standard (160 ug/m³) yet for this year. This number dropped by one since October.
- The heaviest ozone pollution was concentrated in key regions of Jing-jin-ji and surrounding areas, Fenwei plain, and Yangtze delta area, while ozone pollution was relatively lighter in the capital cities of Guizhou and Guangxi in the southwest, and Heilongjiang in the northeast.
- Shanghai, Guangzhou and Wuhan have the risk of not meeting national standard for ozone this year, with concentrations at 157, 159 and 159 ug/m³ respectively.

Ozone concentrations in province capitals

90th percentile over 12 months

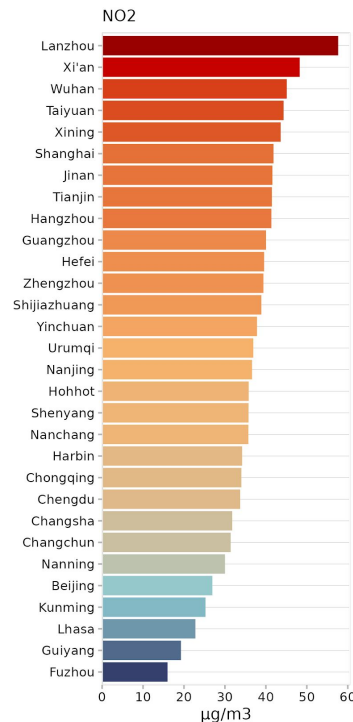
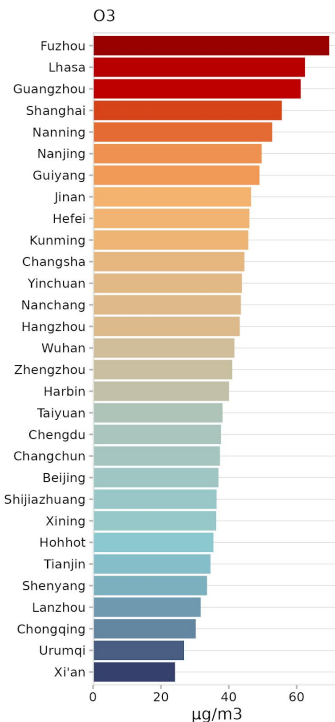
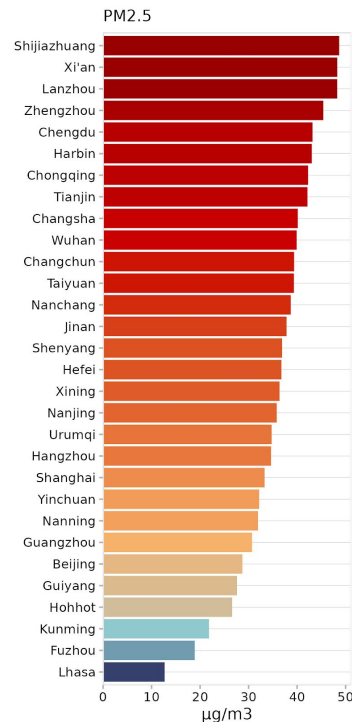


Northern and southeastern region face worst air pollution in November

- North and Northwest China had the worst PM2.5 levels in November. Shijiazhuang, capital of Hebei province, Xi'an and Lanzhou rose to the top. Followed by Zhengzhou, Chengdu and Harbin.
- The worst ozone levels were measured in the capitals of Fujian, Tibet, Guangdong, Shanghai and Nanning, focusing in southeastern region.
- Lanzhou, capital of Gansu, ranked worst for NO2 levels, and is followed by Xi'an. NO2 contributes to PM2.5 and ozone levels, besides being a dangerous pollutant in its own right.

Monthly average pollutant concentrations in province capitals

Nov 2023



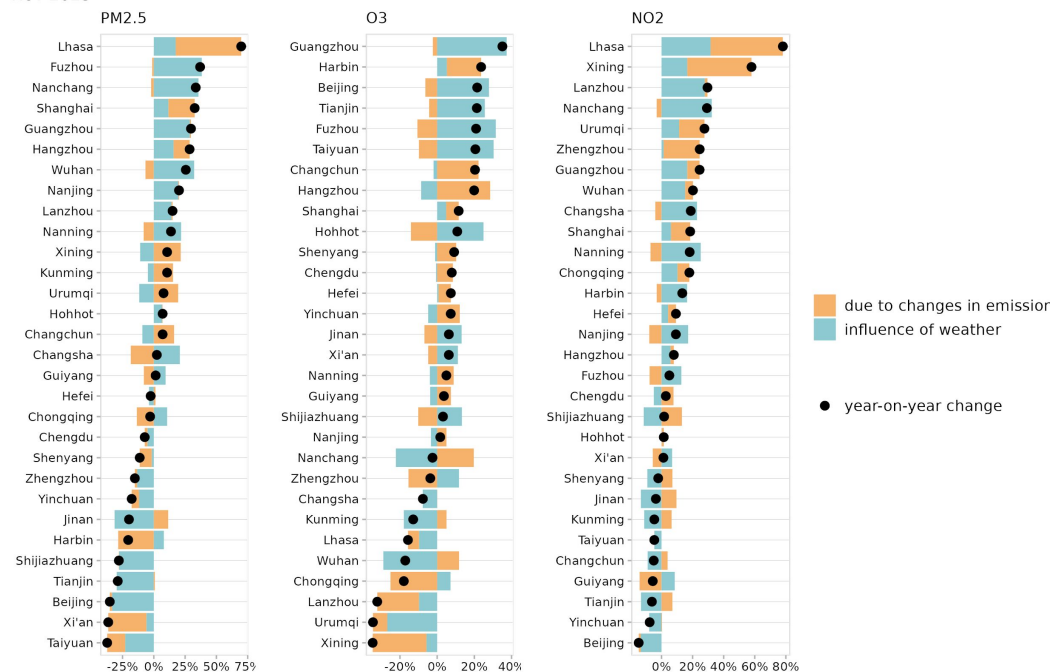
PM2.5 pollution is prominent in the southeastern region, while ozone is on the rise in the east coast

- Emissions of PM2.5-forming pollutants increased the most in Fuzhou (Fujian) and Nanchang (Jiangxi) in the southeastern China mainly due to influence of weather. The year-on-year increase in PM2.5 attributed to emissions increases was the most significant in Lhasa (Tibet), Xining (Qinghai), Shanghai, as well as in Urumqi (Xinjiang).
- Guangzhou, Beijing and Tianjin, saw increases in ozone levels due to unfavorable weather conditions, even as our analysis indicates a decrease in ozone-forming emissions.
- Harbin, Changchun and Hangzhou saw increase in ozone level mainly due to increase in emissions.
- NO2 increase was highest in Lhasa, Xining and Lanzhou.

Our analysis projects the influence of weather conditions on air pollution levels using a machine-learning model trained on actual data for each city. The variation that cannot be explained by weather conditions is attributed to changes in emissions.

Year-on-year changes in pollutant concentrations in province capitals

Nov 2023



Worst 7-day air pollution episodes by pollutant

PM2.5 (excluding sandstorms)

city	province	dates	average concentration	highest daily concentration
Xingtai	Hebei	Oct 28 – Nov 03	150	234
Handan	Hebei	Oct 28 – Nov 03	146	243
Baoding	Hebei	Oct 27 – Nov 02	141	224
Hengshui	Hebei	Oct 28 – Nov 03	137	185
Cangzhou	Hebei	Oct 28 – Nov 03	135	192

Ozone

city	province	dates	average concentration	highest daily concentration
Zhanjiang	Guangdong	Nov 20 – Nov 26	121	131
Fuyang	Anhui	Oct 28 – Nov 03	113	131
Maoming	Guangdong	Nov 21 – Nov 27	112	129
Bozhou	Anhui	Oct 27 – Nov 02	111	127
Jinan	Shandong	Oct 27 – Nov 02	111	147

Sandstorms ($PM_{2.5}$)

city	province	dates	average concentration	highest daily concentration
Qingyang	Gansu	Nov 30 – Dec 06	15	75
Bayan Nur	Nei Mongol	Nov 30 – Dec 06	14	63
Wuhai	Nei Mongol	Nov 30 – Dec 06	14	67
Shuozhou	Shanxi	Nov 30 – Dec 06	14	99
Wuzhong	Ningxia Hui	Nov 30 – Dec 06	14	48

NO_2

city	province	dates	average concentration	highest daily concentration
Lanzhou	Gansu	Nov 16 – Nov 22	72	91
Taiyuan	Shanxi	Oct 26 – Nov 01	69	77
Baoding	Hebei	Nov 29 – Dec 05	63	87
Wuhan	Hubei	Oct 27 – Nov 02	63	72
Foshan	Guangdong	Nov 19 – Nov 25	62	77

Unit: $\mu\text{g}/\text{m}^3$

Data sources

- Industrial output, power generation and power capacity additions, as well as fuel imports and exports are based on Chinese government data, through Wind Financial Terminal. Some of the data is not included in public releases.
- Measured air quality data is compiled from Chinese government air quality monitoring stations. Weather-controlled air quality is derived from CREA's [deweathering algorithm](#).