China’s energy transition and climate status report

July 2025 edition

Agora Energy China

Agora Energy 博众智合

Agora Energiewende

Foreword

Dear readers,

China plays a pivotal role in shaping the global response to the twin challenges of energy transition and climate change. As the world's largest emitter of greenhouse gases and the leading clean energy market, China's actions are central to achieving global climate goals. Any credible global climate solutions must include strong, sustained progress from China. Understanding the country's evolving energy system and climate policies is therefore essential for policymakers, researchers and stakeholders around the world.

Yet China is a country of vast complexity, with a rapidly transforming energy landscape, diverse regional dynamics, and a policymaking process that is often opaque to outside observers. This complexity makes it challenging to interpret developments in a timely, accurate and context-aware manner. There is a growing need for regular, data-informed updates on China's energy transition and emissions trends that are accessible to the international community.

To help fill this critical information gap, Agora Energy China, together with Agora Energiewende, is launching this *China's energy transition and climate status report* as an annual publication. Our aim is to provide a clear, evidence-based overview of recent developments in China's energy and climate landscape, grounded in the latest data and policy analysis.

As the inaugural edition, this report represents a starting point. While this report aims to offer a comprehensive and relevant overview of China's energy transition and climate status, we recognise the value of diverse perspectives. We warmly welcome your feedback, insights and suggestions to help shape future editions and enhance the report's relevance for a global audience.

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About the data

Data for this analysis was compiled from publicly available sources, including the National Bureau of Statistics of China, National Energy Administration, National Development and Reform Commission, China Electricity Council, China National Petroleum Corporation Economic & Technology Research Institute, Sinopec, China National Coal Association, China Customs, International Energy Agency, International Renewable Energy Agency, Energy Institute, Global Energy Monitor, World Bank, International Monetary Fund and various media outlets. Figures are subject to periodic revisions by the above sources.

The data sourced from the National Bureau of Statistics for this slide deck is current as of 31 May 2025.

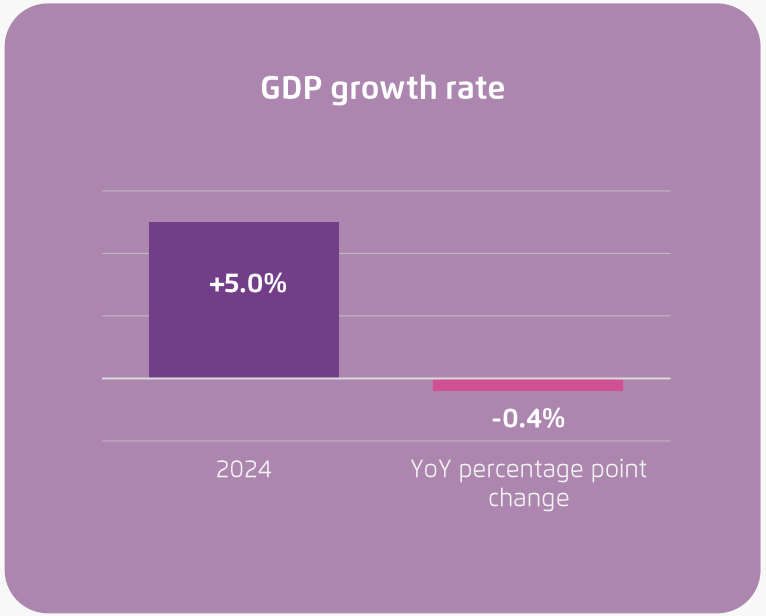
Carbon dioxide emissions estimates are based on default emission factors published by the National Development and Reform Commission. Industrial process emissions are based on a comprehensive update of a peer-reviewed 1990–2000 China industrial process emissions inventory available at *Nature*.

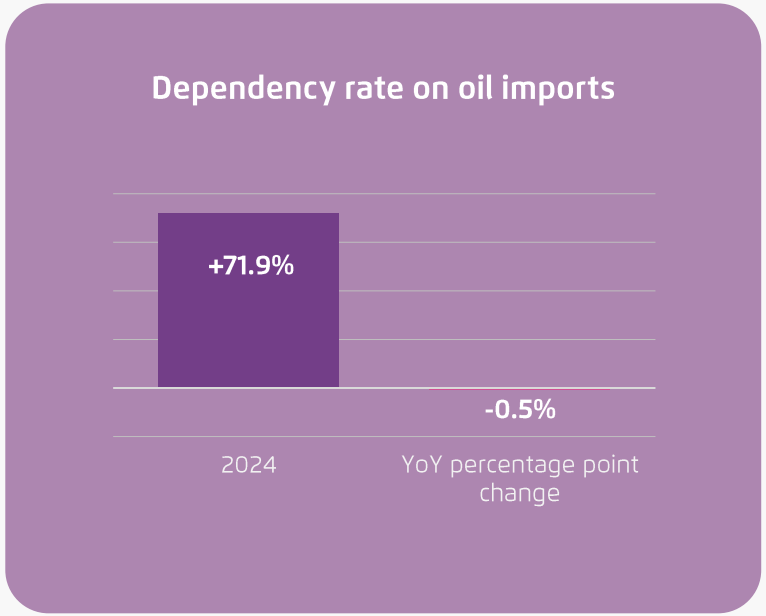
Executive summary: key findings

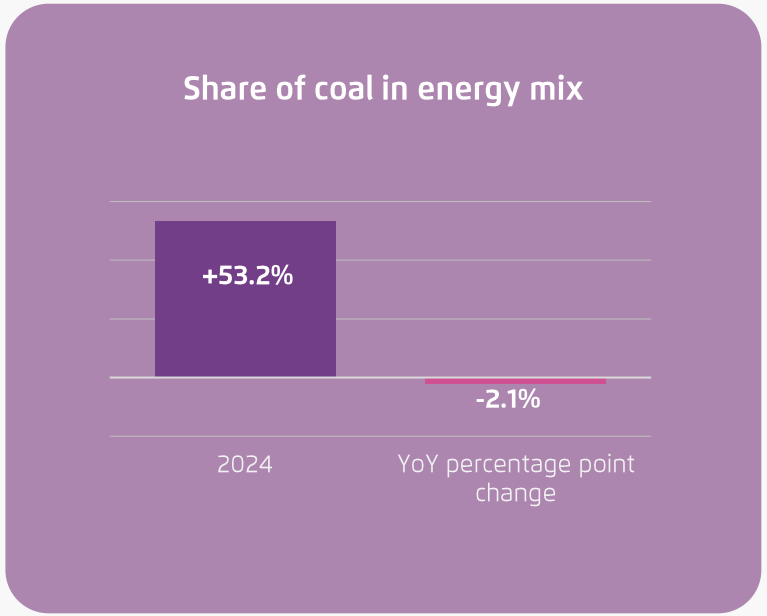
1. **China's emissions have shown early signs of plateauing, marking a major climate milestone.** CO_2 emissions from fuel combustion fell 1.2 percent year-on-year (YoY) in Q1 2025, the first drop tied directly to rapid clean energy deployment. This shift is bolstered by President Xi Jinping's new 2035 climate pledge, covering all sectors and greenhouse gases. A stronger Nationally Determined Contribution could drive an earlier, deeper emissions peak before 2030 and faster decline toward the 2060 neutrality goal.
2. **Renewables are reshaping China's power system at record speed.** China added 277 gigawatts (GW) of solar and 79 GW of wind in 2024, reaching its 2030 target six years early. Renewables now make up over half of installed capacity. However, transformation requires more than capacity expansion: market reforms and grid flexibility are urgently needed to ensure power grid reliability and system efficiency.
3. **Industrial decarbonisation is accelerating, led by electrification.** Energy intensity fell 3.5 percent in 2024, avoiding 130 million tonnes CO_2, as firms are scaling up clean technologies like electrification and green hydrogen. Yet coal chemicals expansion and weak carbon pricing undermine progress. Sustained momentum depends on scaling electrification, boosting circularity and stimulating green product demand, supported by stronger carbon pricing.
4. **A just coal transition is imperative amid continued new coal expansion.** Despite record renewable growth, China began construction on 94.5 GW of new coal power in 2024 – the highest since 2015. To avoid long-term carbon lock-in, it must stop issuing new permits and optimise the utilisation of existing assets. Ensuring a just transition in coal-dependent provinces is essential to align energy security with climate commitments.

 Note: The data sourced from the National Bureau of Statistics for this slide deck is current as of 31 May 2025.

Recap: The year 2024 saw fragile economic recovery and energy security concerns, with coal expansion underlining the need for a just transition







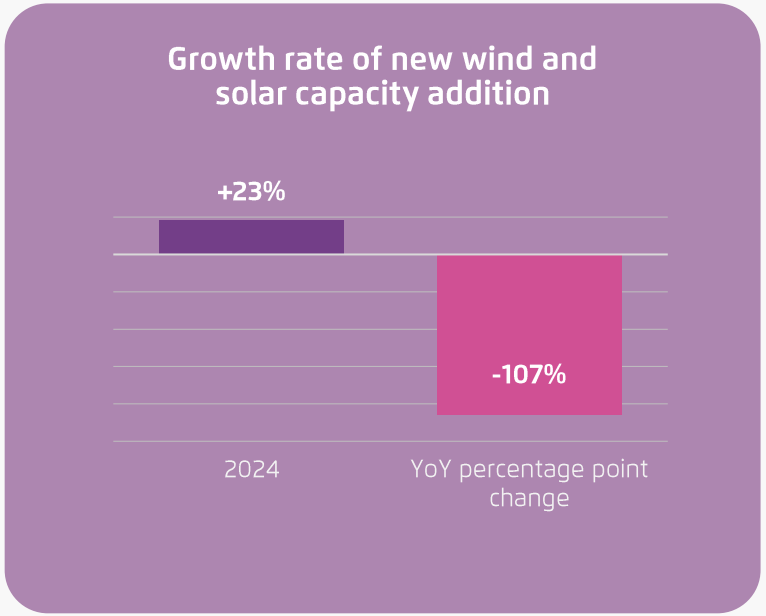
→ China's 2024 slowdown exposed recovery fragilities – from trade tensions to energy security risks – underscoring the need for reform and diversification.

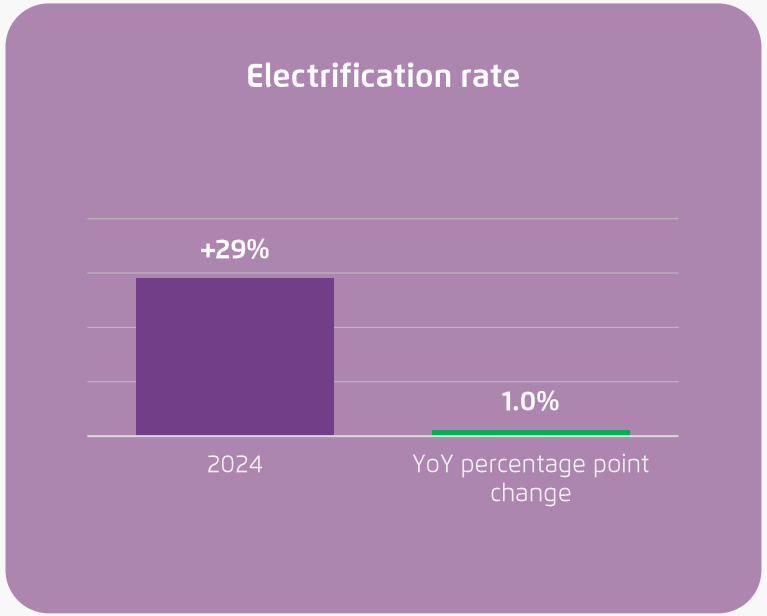
→ China's heavy oil import reliance fuels energy security concerns amid rising geopolitical tensions, complicating its shift from abundant domestic coal resources.

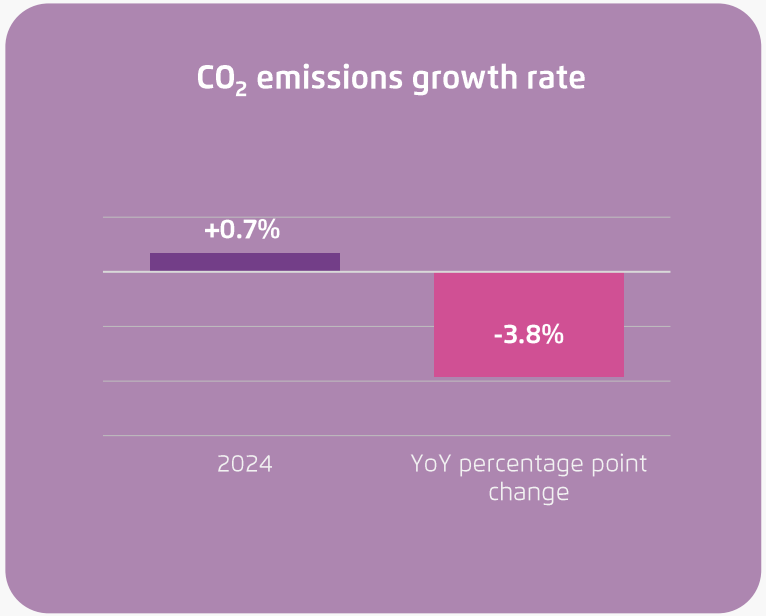
→ Despite energy structure improvements, coal remains dominant – highlighting the urgent need for implementing a just transition in key provinces.

 Source: NBS and CNPC ETRI

Recap: At the same time, the emissions plateau linked to clean energy growth signals a significant climate milestone, while electrification booms





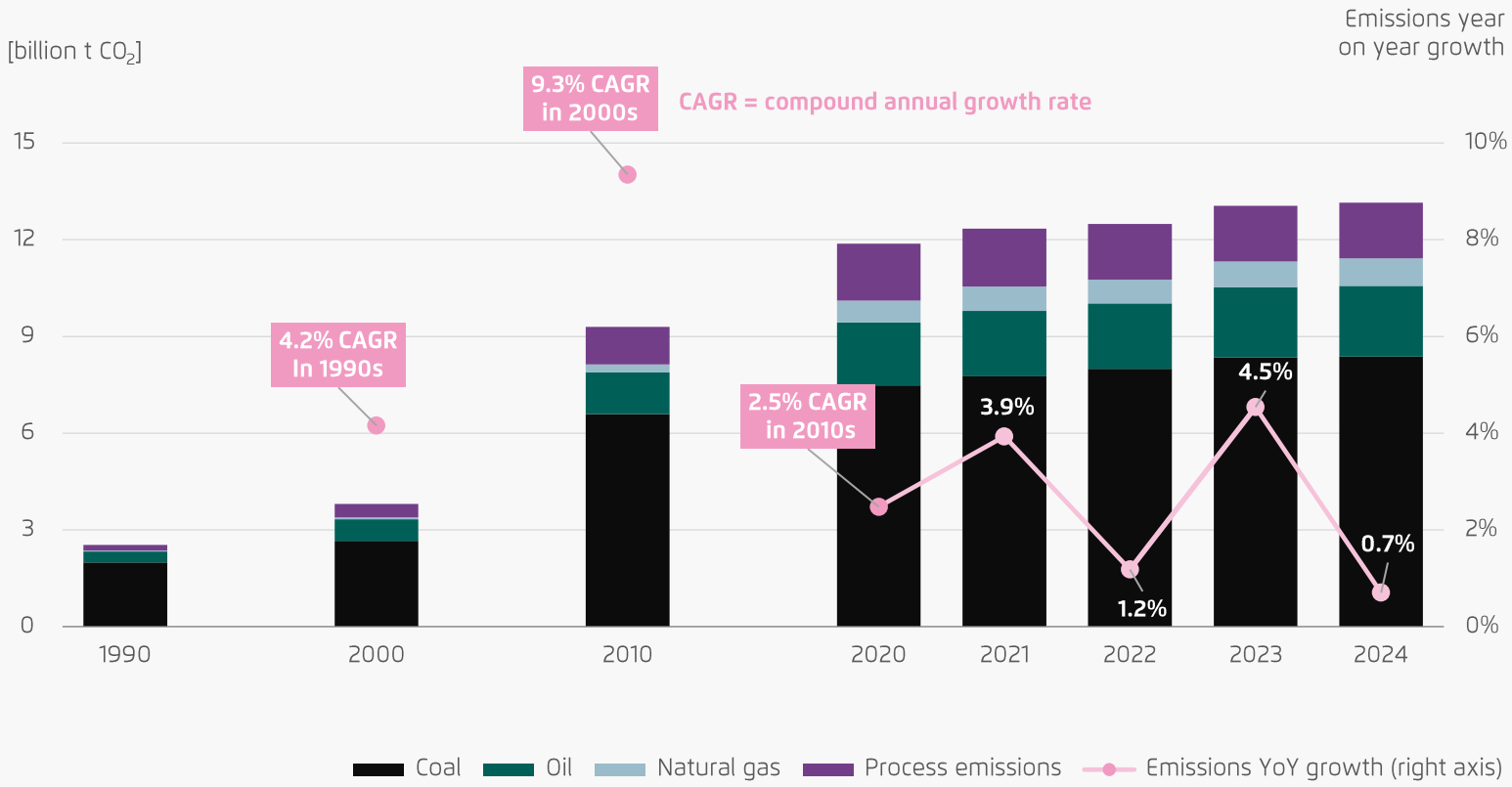


- China added a record 358 GW of new wind and solar capacity in 2024, but the 23% YoY growth lagged far behind 2023's pace due to an increasingly high baseline.
- China's electrification rate (share of power in final energy consumption) is about 8 points above the global average, and it also leads in indirect electrification through widespread water electrolyser deployment.
- China's emissions show early signs of plateauing, marking a significant climate milestone and reflecting record deployment of renewables and other clean technologies.

 Source: NEA, CEC and Agora's own estimation. Note: CO_2 emissions include industrial process emissions.

Climate mitigation (1/2): China remains the world's largest CO_2 emitter, but its emission growth slowed significantly in 2024

China's CO_2 emissions by source vs emission growth, 1990–2024

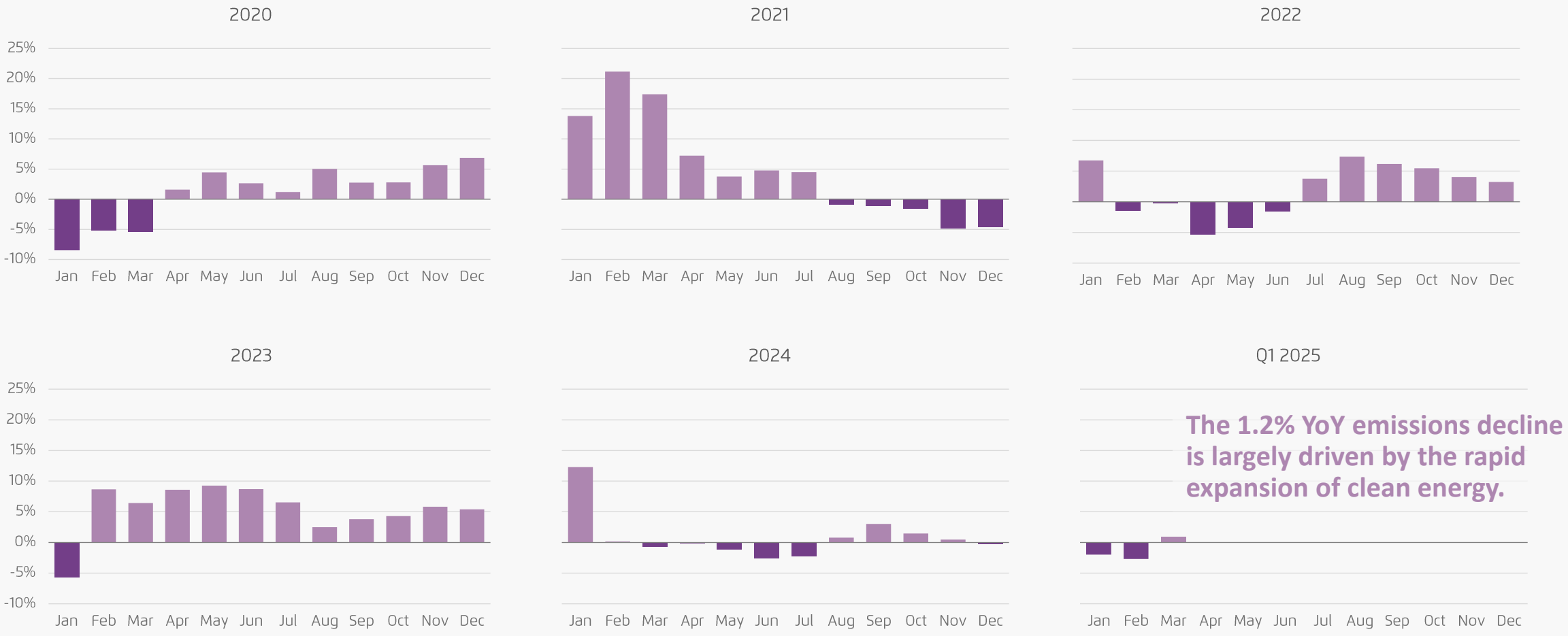


Have China's emissions peaked?

- **Sign of a sustained slowdown:** Emission growth has sharply decelerated – from 9.3% annually in the 2000s to 2.5% in the 2010s. In 2024, YoY growth fell to 0.7%, followed by a 1.2% decline in fuel combustion emissions in Q1 2025.
- **A structural shift:** Record deployment of renewables, electric vehicles and clean tech – but also fragile recovery and trade tensions – are all dampening fossil fuel demand.
- **Uncertainty persists:** Mounting energy security concerns could trigger a shift back to fossil fuels, while data quality issues may lead to revisions that cloud the outlook.

 Source: NBS, NEA, NDRC, various industrial sources and Agora's own estimation

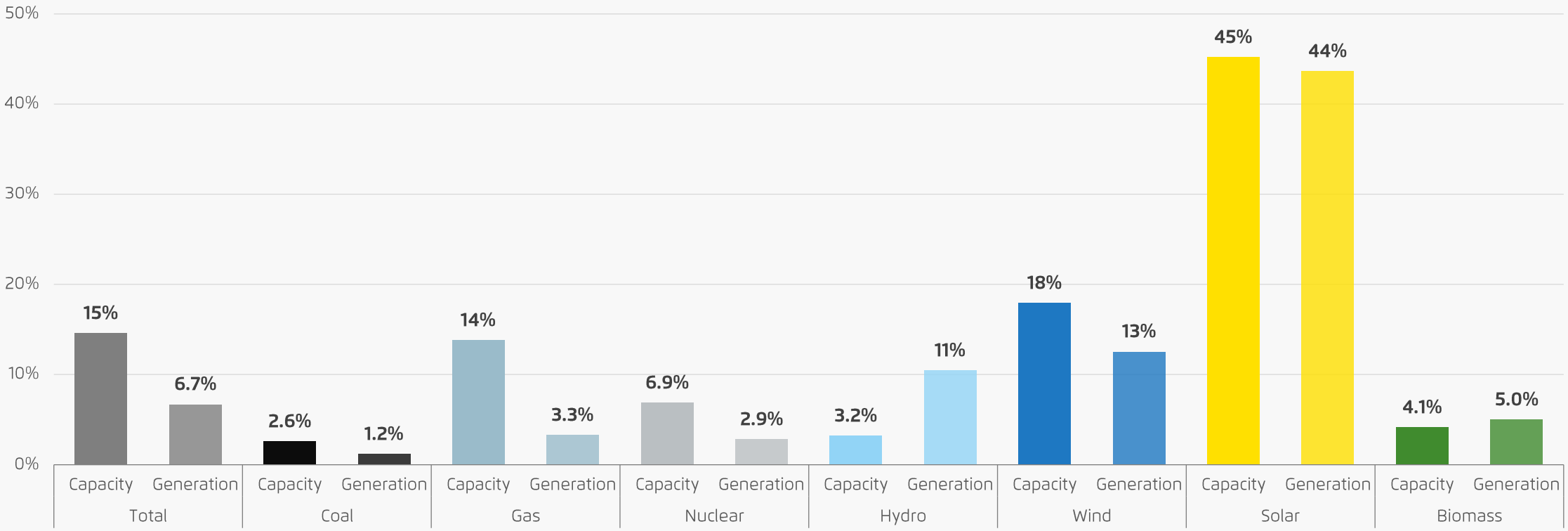
Climate mitigation (2/2): YoY monthly change of fuel combustion CO_2 emissions in 2020–Q1 2025 shows early signs of plateauing



 | Source: NBS, CEC, NEA, NDRC, IEA and Agora's own estimation

Record renewables (1/2): Driven by double-digit growth in wind and solar, China achieved its 2030 renewable target in 2024 – six years early

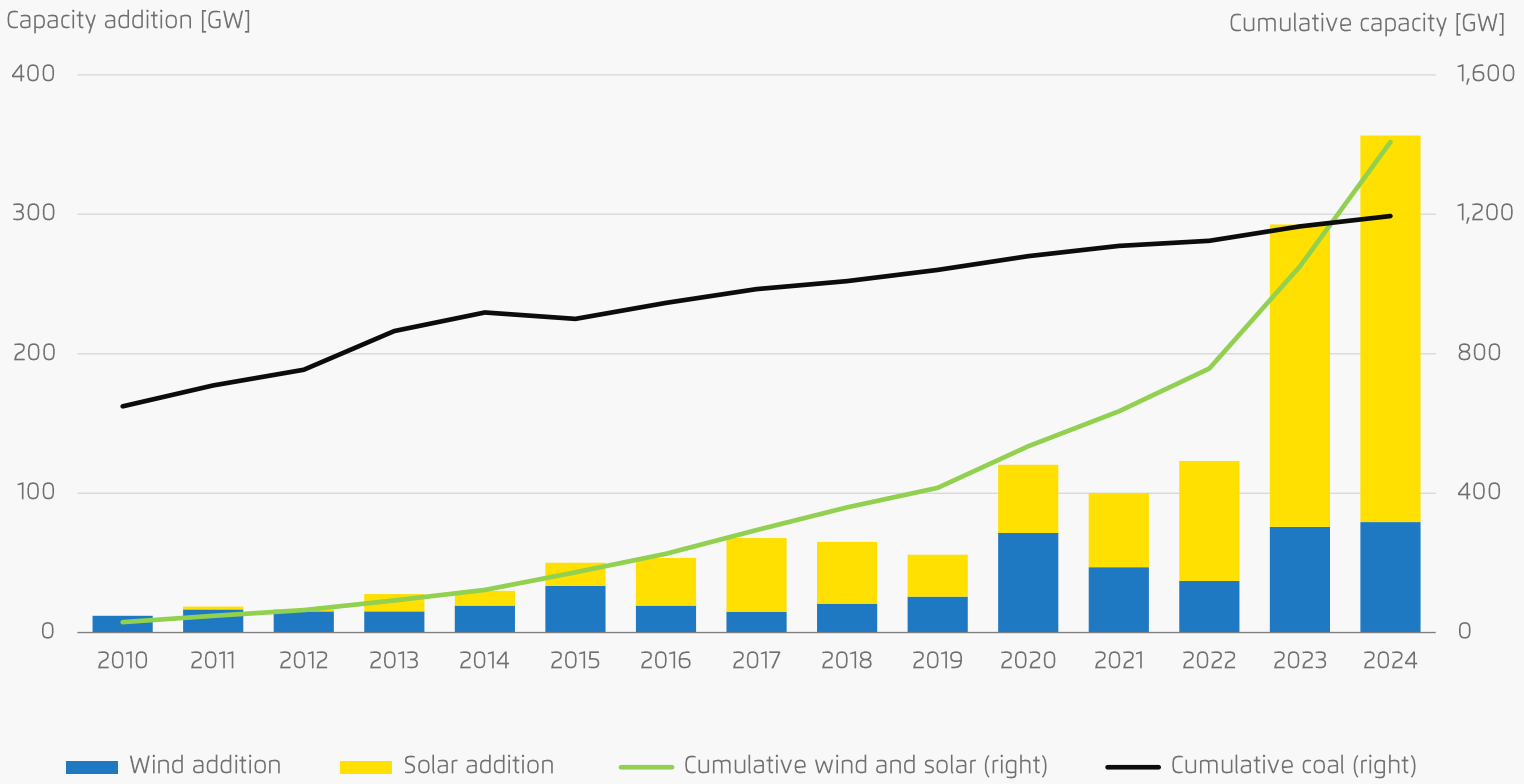
YoY change of cumulative installed capacity versus power generation by type, 2024



 Source: NEA, CEC, IEA and various media sources

Record renewables (2/2): Wind and solar outpaced coal in installed capacity, shifting the power system towards being increasingly renewables-based

China's capacity race between variable renewables and coal power, 2010–2024



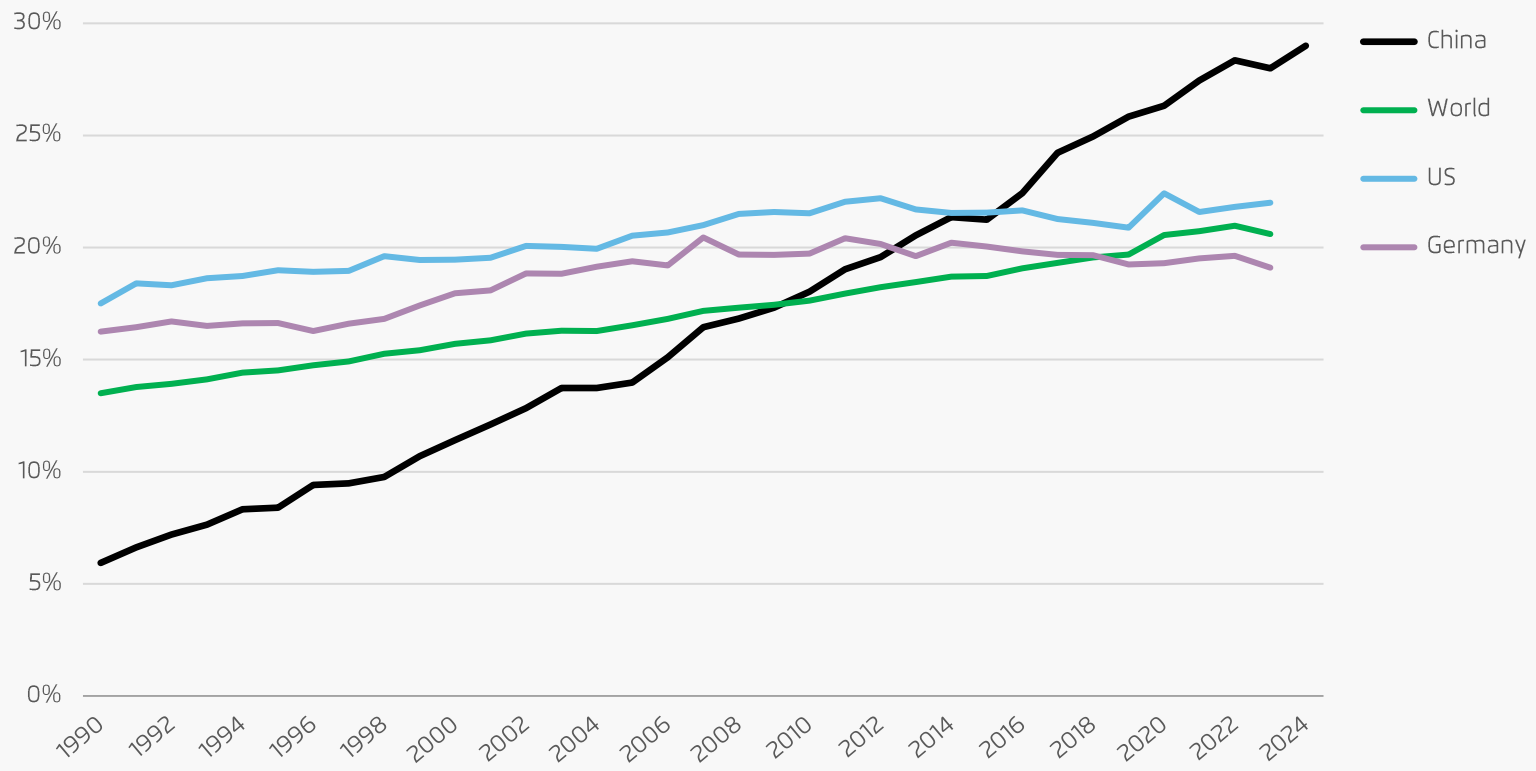
Shift towards a renewables-based power system:

- **Shift from coal to renewables:** In 2024, China's wind and solar capacity surpassed coal, hitting the 2030 target six years early. By contrast, the EU's total installed power capacity stood at 1,131 GW in 2024.
- **Massive investment-driven growth:** China invested USD 625 billion in clean energy in 2024 – over a third more than the EU.
- **Accelerated wind and solar rollout:** Driven by record-breaking installations in 2023 (293 GW) and 2024 (358 GW), China is rapidly advancing its transition towards a renewables-based system.

 Source: NEA, CEC, IEA, Eurelectric and various media sources

Electrification is accelerating in China, now outpacing global peers and laying a strong foundation for decarbonising key sectors

China’s electrification rate in the international context, 1990–2024



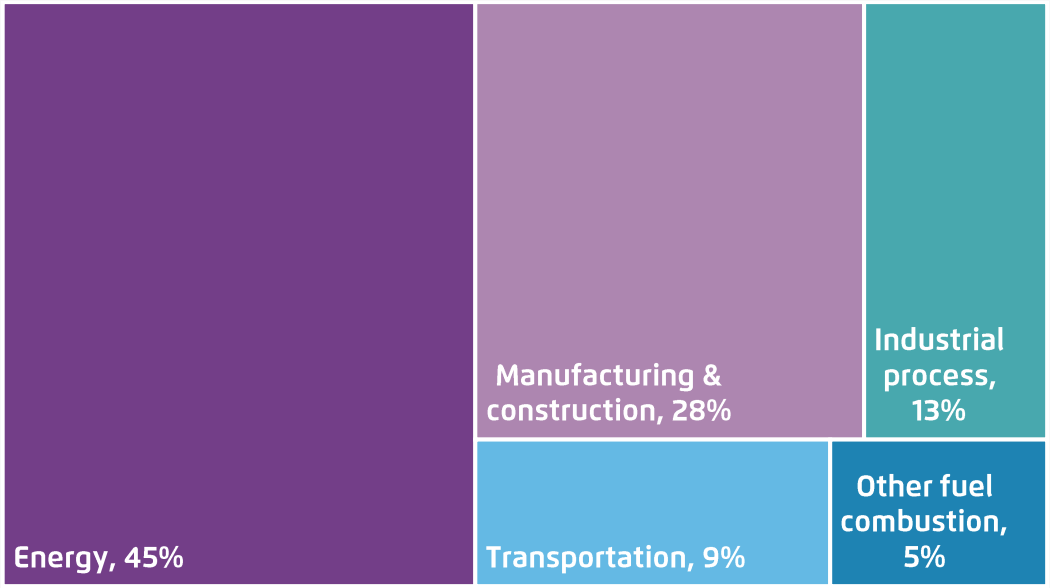
China’s electrification success benefits deep decarbonisation:

- **Rapid electrification gains**: Despite a late start, China’s electrification rate hit 29% in 2024, outpacing many peers. Growth was driven by industrial use, electric vehicles, HVAC and digital services.
- **Next phase of deep green electrification**: The key challenge is aligning clean power supply with demand in high-emission sectors like heavy industry and transport to unlock electrification’s full decarbonisation potential.
- **Electrification is a means, not the goal:** True progress lies in decarbonised electrification.

 Source: IEA, EnerData, SCIO, CNPC ETRI, China Energy News, EFC and CEC. Note: HVAC = heating, ventilation and air conditioning

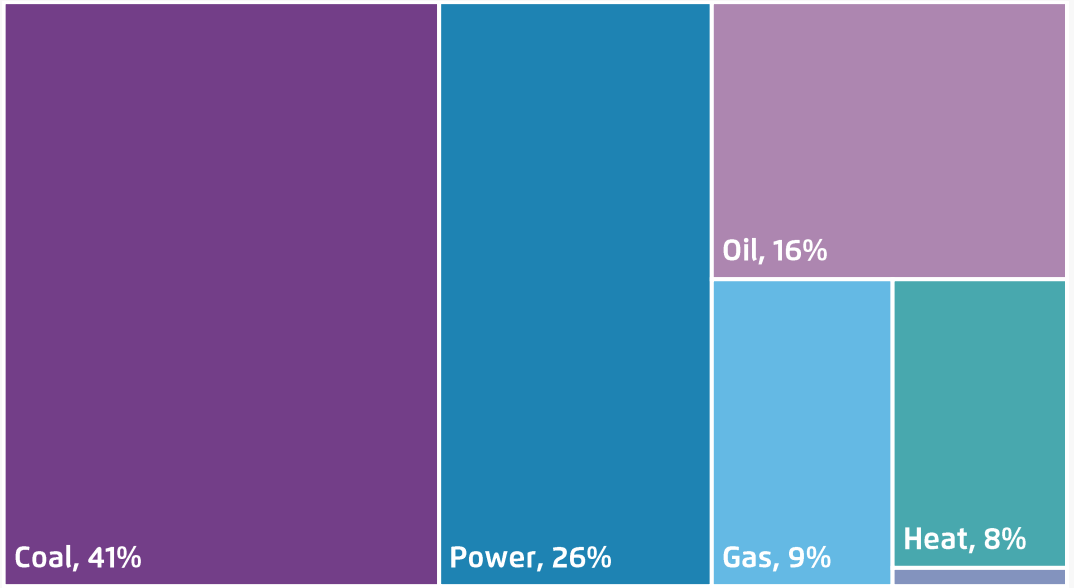
Industry holds significant potential for emission reduction through deep direct/indirect electrification and clean technology deployment

Composition of China's national CO_2 emissions by sector, 2021



Industrial process emissions make up 13% of China's total emissions, driven largely by cement, steel, lime and chemical production. In addition, industry also accounts for more than one quarter of China's fuel combustion CO_2 emissions.

Industry's energy consumption structure by fuel type, 2022



China's industrial electrification rate is around 29%, matching its national average. With non-energy uses like feedstock production making up nearly 20% of industrial energy, there is major potential for indirect electrification via green hydrogen and its derivatives.

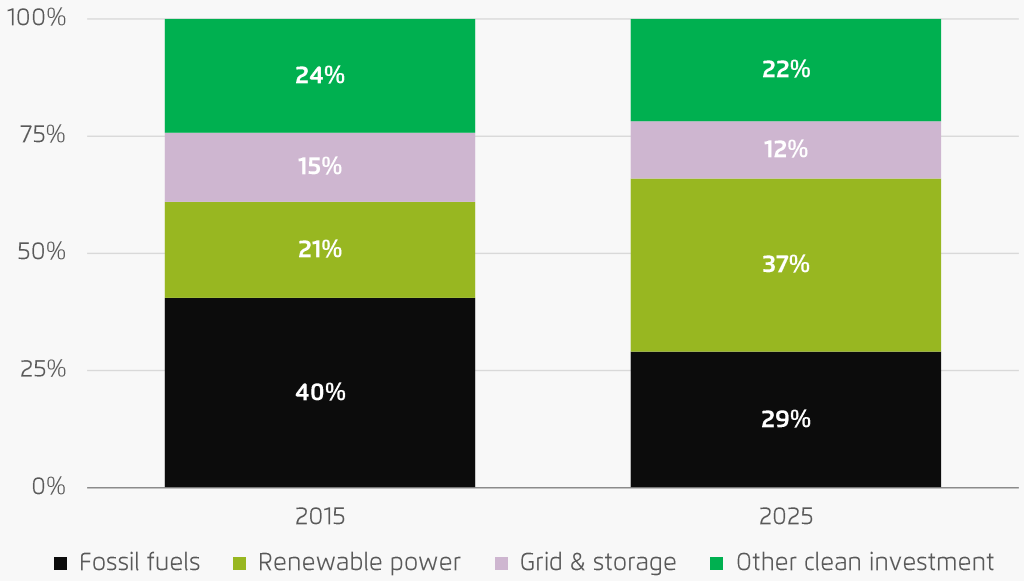
 Source: MEE, China 2024 Biennial Transparency Report, McKinsey & Company, State Grid Energy Research Institute, Rocky Mountain Institute, CEC and NBS

Coal transition (1/2): China remains the dominant force in global coal, but its investment mix is increasingly shifting to renewables and cleantech

China in global coal landscape

China is the world's leading coal economy, operating over half of global coal mines and coal-fired power plants. This highlights its dominant role in the sector.

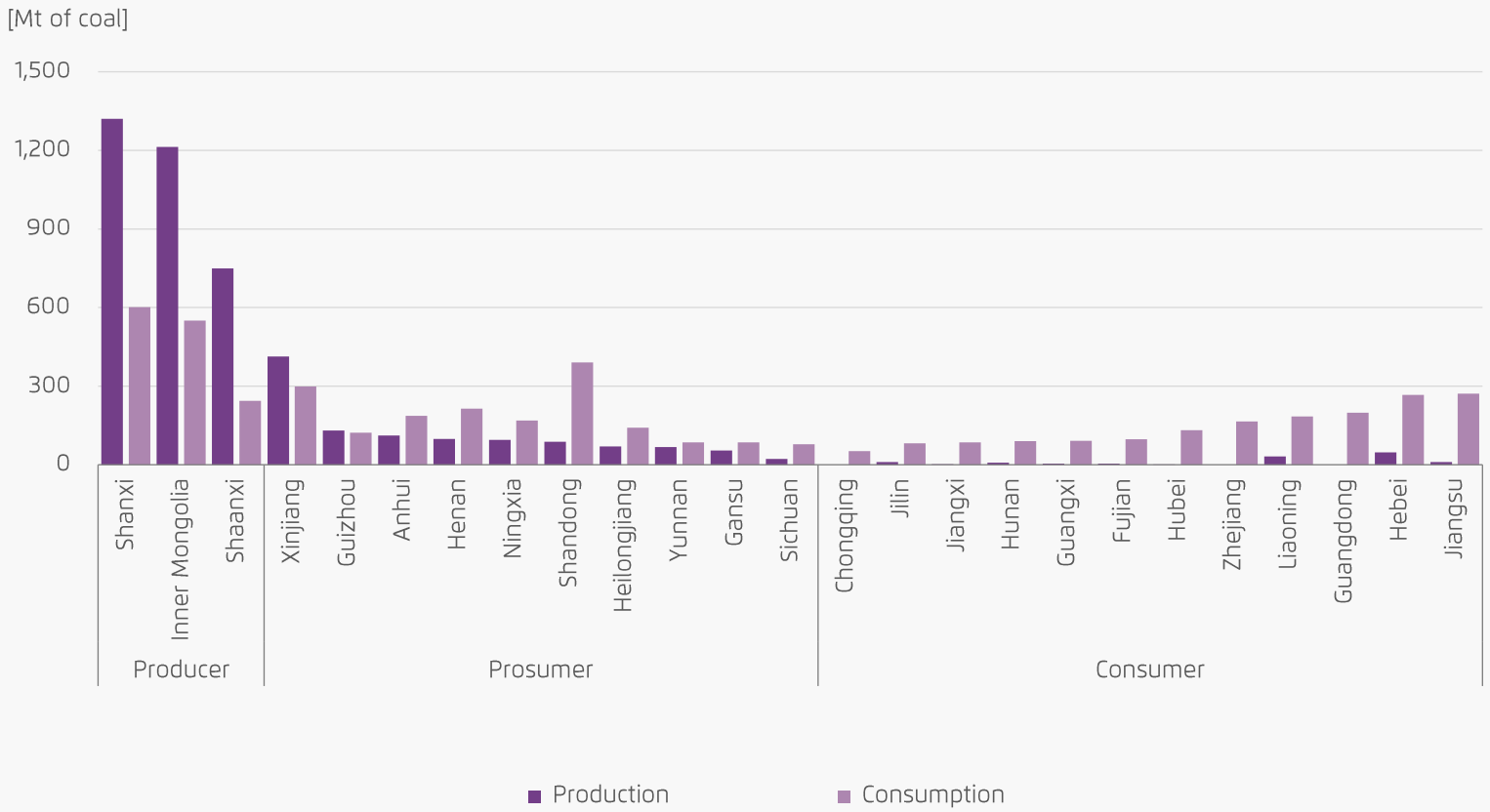
China's energy investment across sectors, 2015 versus 2025



China's energy investment is shifting increasingly towards renewables, as fossil fuels – especially coal – gradually lose prominence in the investment mix.

Coal transition (2/2): Three producers account for over 70% of national output, concentrating both risks and opportunities for a just transition

Coal production versus consumption in major coal provinces, 2022

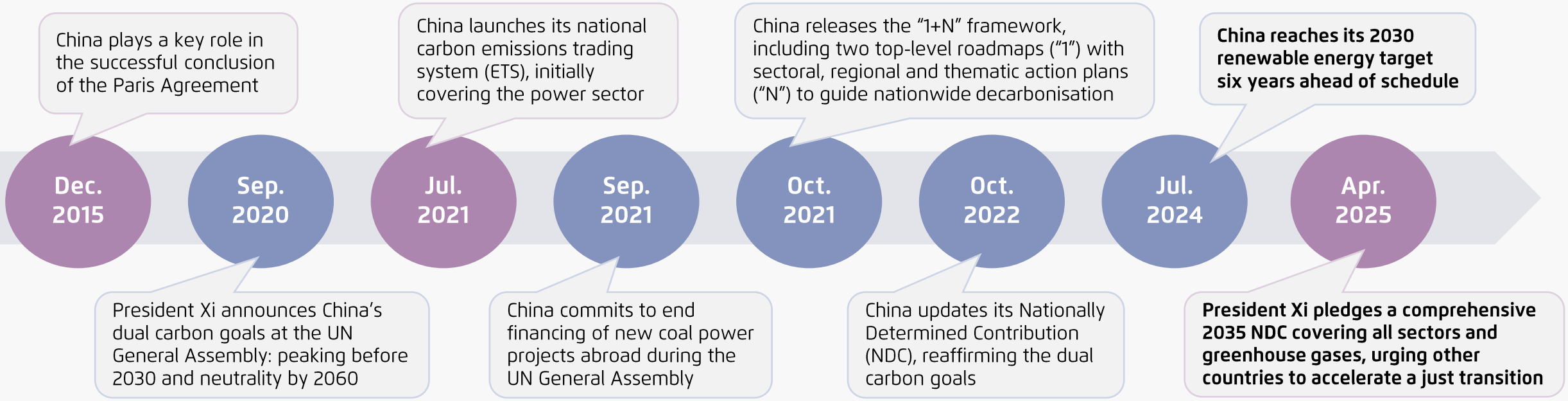


Major coal provinces (those contributing > 1% to national coal production or consumption) include:

- → **3 producers** (production > 2× local consumption): Heavy coal reliance heightens exposure to transition risks.
- → **5 prosumers** (production between 20–200% of local consumption): Xinjiang is particularly poised for further production growth, driven by local demand, external markets and easing transport bottlenecks.
- → **12 consumers** (production ≤ 20% of local consumption): Low local output encourages coal-to-clean transition.

Source: Adapted from Kevin Tu (2023). Green hydrogen economy: Opportunities and challenges in decarbonising the coal chemical manufacturing industry.
Note: “Prosumers” are coal regions that consume a significant share of their own coal production.

China delivered key climate milestones in 2024/2025 despite rising geopolitical tensions and economic slowdown



- China achieved its 2030 renewables target six years ahead of schedule, underscoring the country's accelerating clean energy expansion and sustained policy momentum.
- CO_2 emissions show early sign of plateauing, with a Q1 2025 fuel combustion emissions decline driven by record renewables – a potential turning point in China's emissions path.
- China signals it will set a new 2035 climate target that covers all sectors and greenhouse gases, towards a broader, more integrated approach to climate action.

Chapter 1:
Key developments and outlook

Key data and facts in 2024

+5.0% (↓-0.4%)

China's **economy** expanded by 5.0% in 2024, aligning with official targets. This growth was bolstered by a surge in exports and a notable uptick in clean energy investments, which contributed a record 10% to the nation's GDP.

71.9% (↓-0.5%)

China's **oil import dependence** stood at 71.9%, highlighting ongoing energy security risks. This heavy reliance increases exposure to global market volatility and underscores the need to diversify energy sources and boost domestic alternatives.

+0.7% (↓-3.8%)

China's **emissions** rose modestly by about 0.7% in 2024, followed by a 1.2% YoY drop in fuel combustion CO_2 emissions in early 2025, driven primarily by declining industrial emissions and rapid growth in renewables and electric vehicles.

53.2% (↓-2.1%)

Coal's share in China's energy mix declined to 53.2%, down from 55.3% in 2023. Yet coal consumption still grew 1.7% YoY, underscoring the difficulty of cutting absolute coal use despite a growing clean energy share.

18.5% (↑2.7%)

Wind and solar supplied 18.5% of China's electricity, up from 15.8% in 2023. Driven by a record 358 GW new capacity addition, China met its 2030 renewable target six years ahead of schedule, a major milestone in its energy transition.

8.8% (↑0.3%)

Natural gas use rose 7.3% in 2024, making up 8.8% of China's energy mix. Though often viewed as a bridge fuel, its small share of power generation and persistent infrastructure gaps cast doubts on its role in the energy transition.

→ China's economic growth slowed in 2024, exposing weaknesses in its post-pandemic recovery. Structural issues and soft global demand highlighted underlying fragilities.

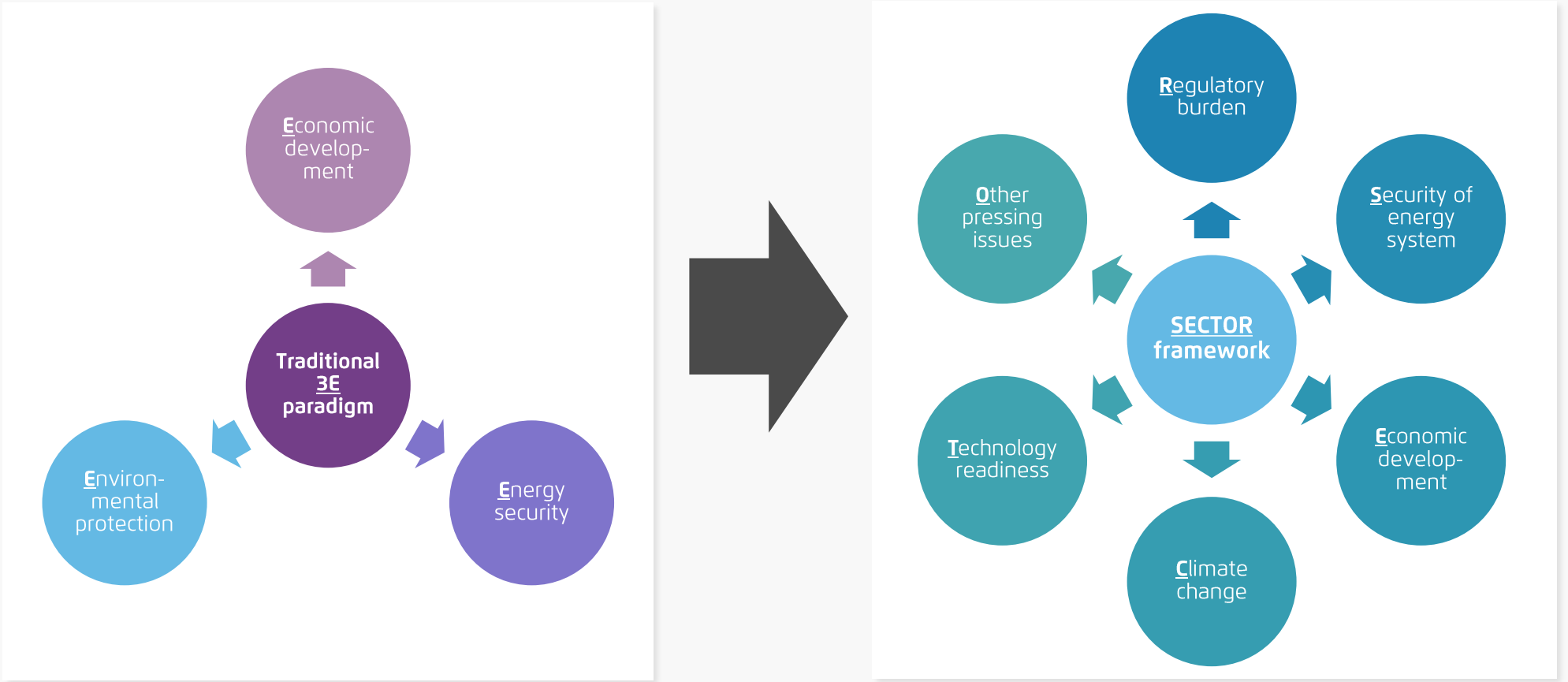
→ Energy security concerns persisted due to continued reliance on imported fossil fuels, stressing the need for domestic production and greater energy diversification.

→ Emissions plateaued, signalling early gains from clean energy efforts. While promising, deeper decarbonisation will require sustained policy support.

Source: NBS, CNPC ETRI, CEC and Agora's own estimation. Note: emissions include industrial process emissions. Numbers in brackets show YoY percentage point changes – green indicates an increase, red a decrease. Note: As of 2 July 2025, the NBS revised the share of coal in China's 2023 energy mix from the originally reported 55.3% to 54.8%, this revision is not reflected in the analysis presented in this slide deck.

Energy and climate policy-making

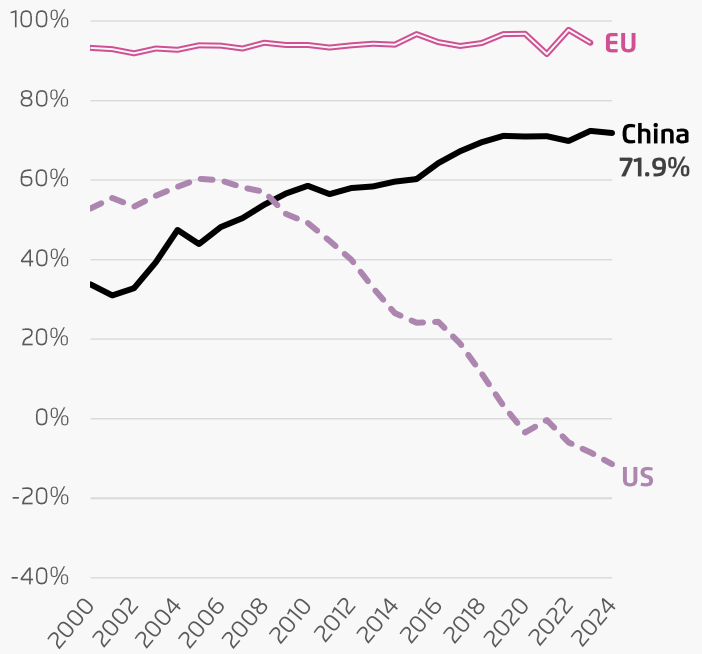
China should shift from the traditional **3E paradigm** to a more adaptive **SECTOR** framework, better suited to navigating an increasingly complex and disruptive global landscape.



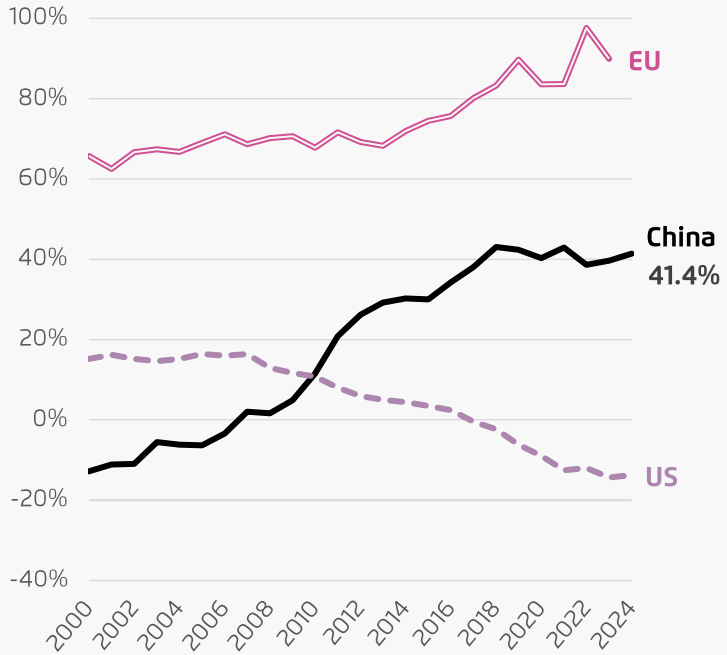
 Source: Kevin Tu (2024). Prospects of the Chinese coal chemical industry in an increasingly carbon-constrained world.

Security of energy system is expanding beyond oil to include gas and power, highlighting the need to redefine what a secure energy system means

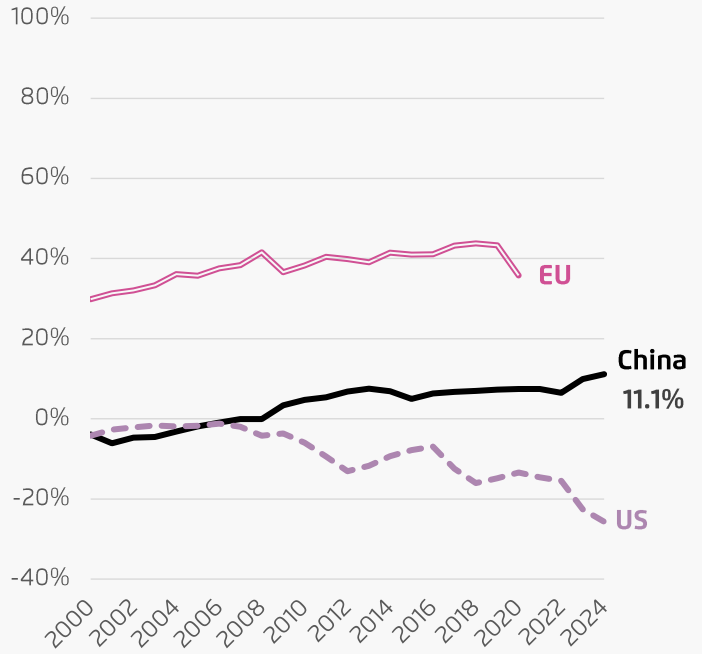
Dependency rate in **oil imports**, 2000–2024



Dependency rate in **gas imports**, 2000–2024



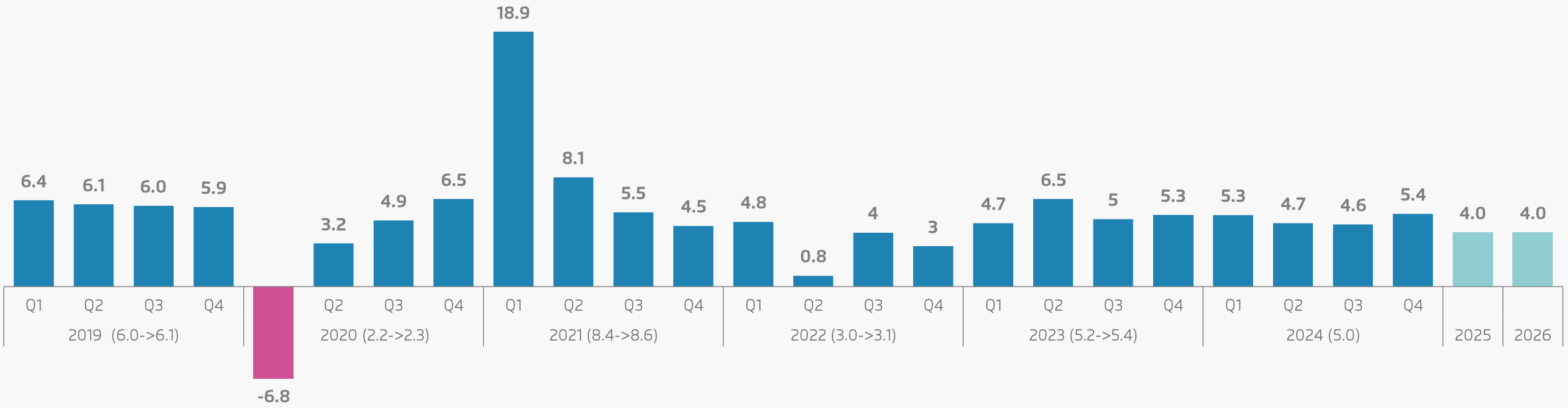
Dependency rate in **coal imports**, 2000–2024



 Source: CNPC ETRI, US EIA, Eurostat, NBS, China Energy Weekly and Agora's own estimation. Note: All dependency rates in this slide deck are based on net imports, unless stated otherwise.

Economic development

China’s quarterly and annual GDP growth rates (%) in 2019–2024, and short-term economic outlook in 2025 and 2026

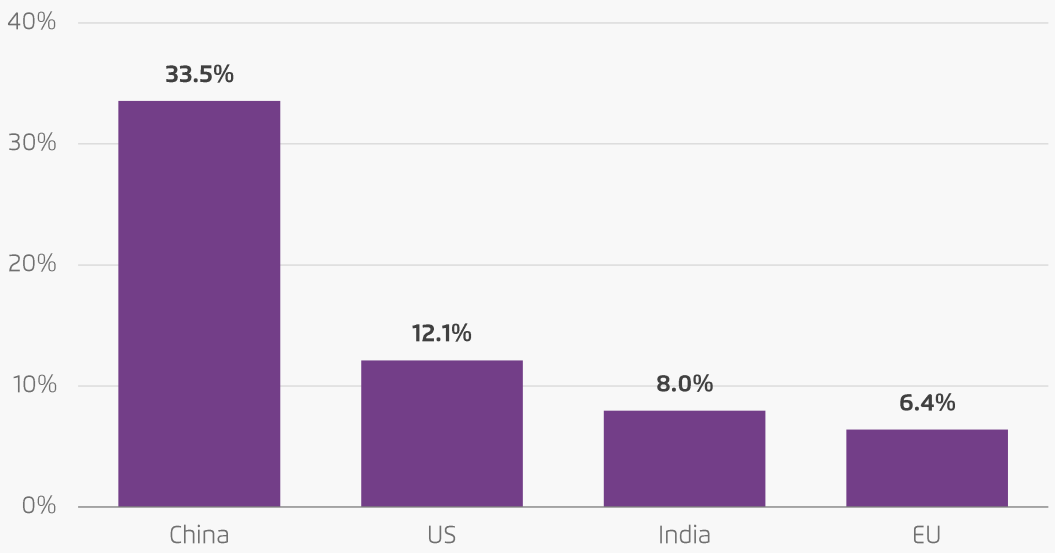


- China’s economy grew by 5.0% YoY in 2024, reflecting a steady but restrained recovery, with further deceleration likely in the near term.
- Weak consumer demand and the ongoing property crisis continue to weigh heavily on domestic activity, limiting the strength of the rebound.
- Rising trade tensions and global uncertainties are dampening external prospects, contributing to a cautious economic outlook and policy stance.

 Source: NBS, and IMF April 2025.

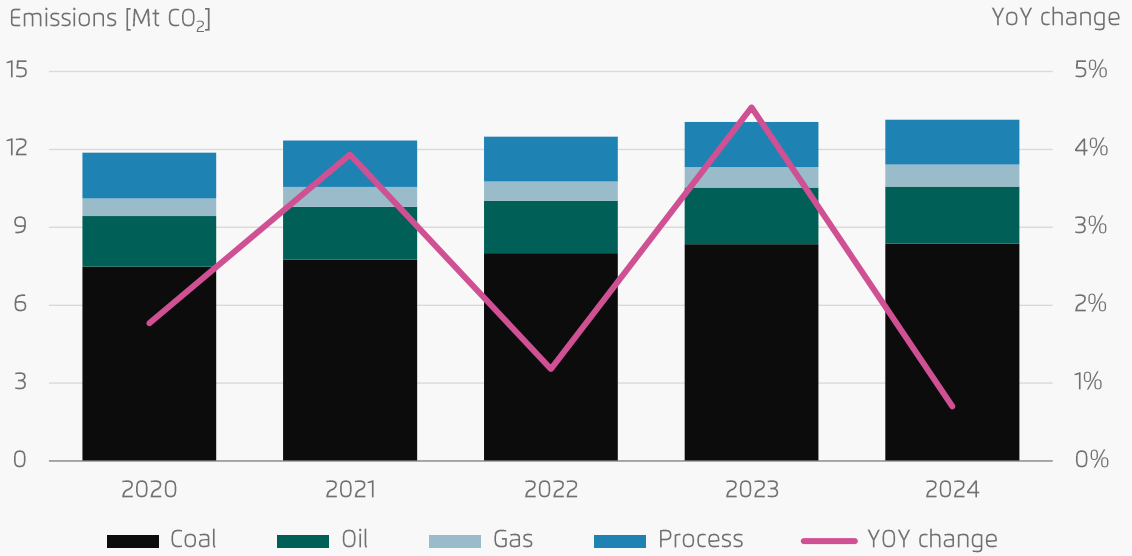
Climate change

Share of global CO_2 emissions by economy in 2024



- China, the world's largest emitter, contributes to around one third of global CO_2 emissions – exceeding the total emissions of many developed countries combined.
- Given the scale of its emission footprint, China plays a pivotal role in determining the success of any global climate strategy or agreement.

China CO_2 emissions by source versus emissions YoY change

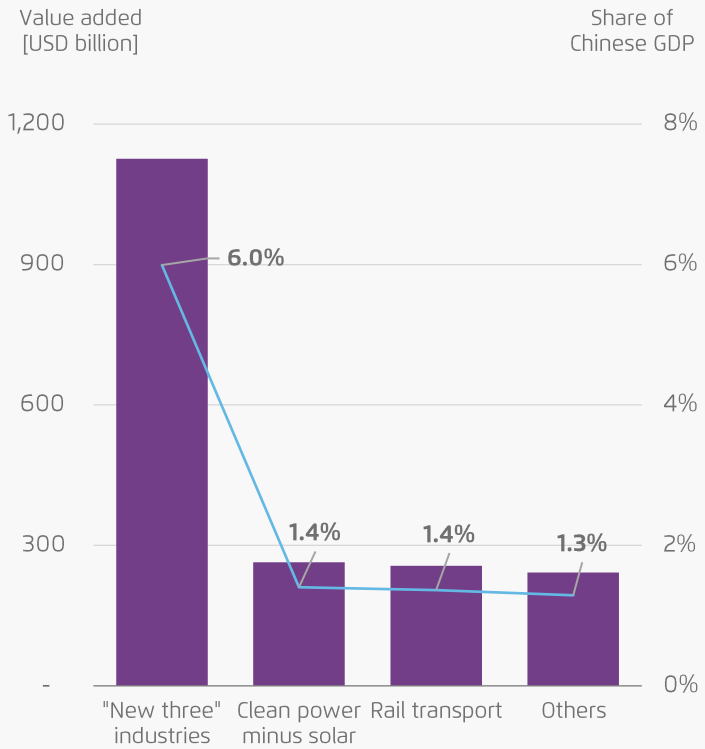


- Emissions plateaued, driven by record renewables deployment, rising transport electrification and declining industrial process emissions.
- Coal remains the dominant energy source in China, underscoring the urgent need to accelerate its phase-down to meet climate and air quality goals.

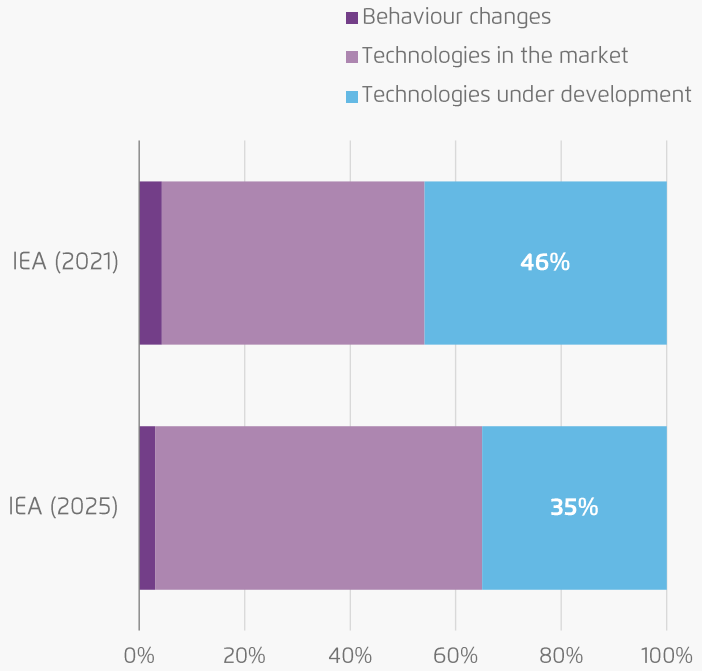
 Source: IEA, NBS and Agora's own estimation. Note: process emissions are included.

Technology readiness

Clean energy tech contributed a record 10% to China's GDP in 2024



Contribution to global net-zero emission reductions by mid-century by technology readiness



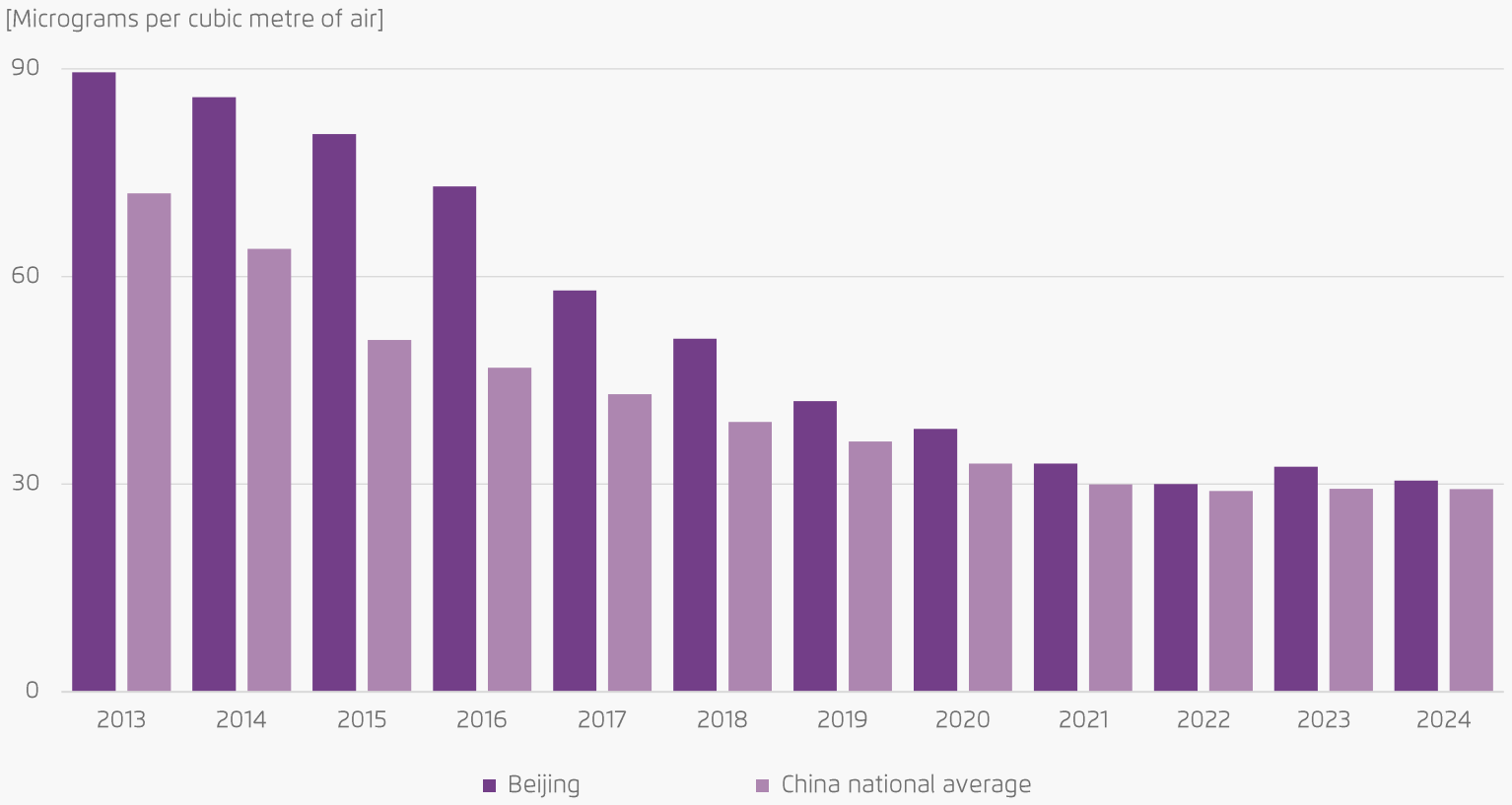
Technology readiness matters:

- **Cleantech a major economic driver:** In 2024, clean energy technologies made up over 10% of China's economy, with solar, electric vehicles and batteries alone contributing 6% to GDP.
- **Rapid maturation of key technologies:** The share of emission reductions reliant on immature technologies dropped from 46% to 35% in just three years.
- **Net zero increasingly within reach:** As cleantech matures, net-zero goals are expected to rely more on commercially available solutions.

 Source: China Brief/CREA, IEA, and Agora's own calculation

Other: air pollution control has been a key driver of China's energy transition and climate mitigation agenda, especially prior to 2020

Average annual PM2.5 concentration in Beijing versus China average, 2013–2024



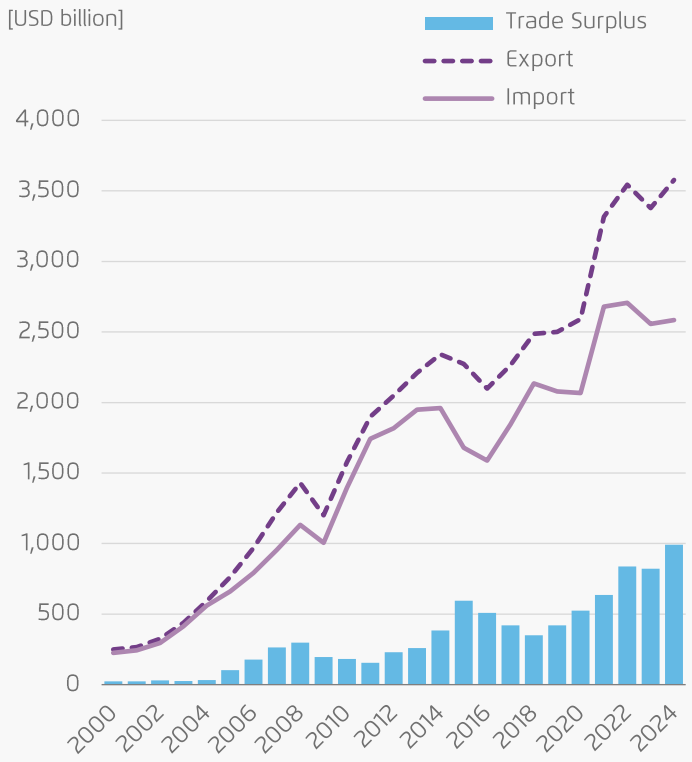
Air pollution control often complements climate action:

- **Major progress since 2013:** China has significantly reduced air pollution, cutting average PM2.5 levels to 29.3 micrograms per cubic metre by 2024.
- **Air quality and climate goals align:** China aims to essentially eliminate severe air pollution by 2025, creating strong synergies with its broader climate mitigation efforts.
- **Coordination needed across regions:** Regional pollutant transfer remains a key PM2.5 source in cities, underscoring the need for stronger inter-regional coordination.

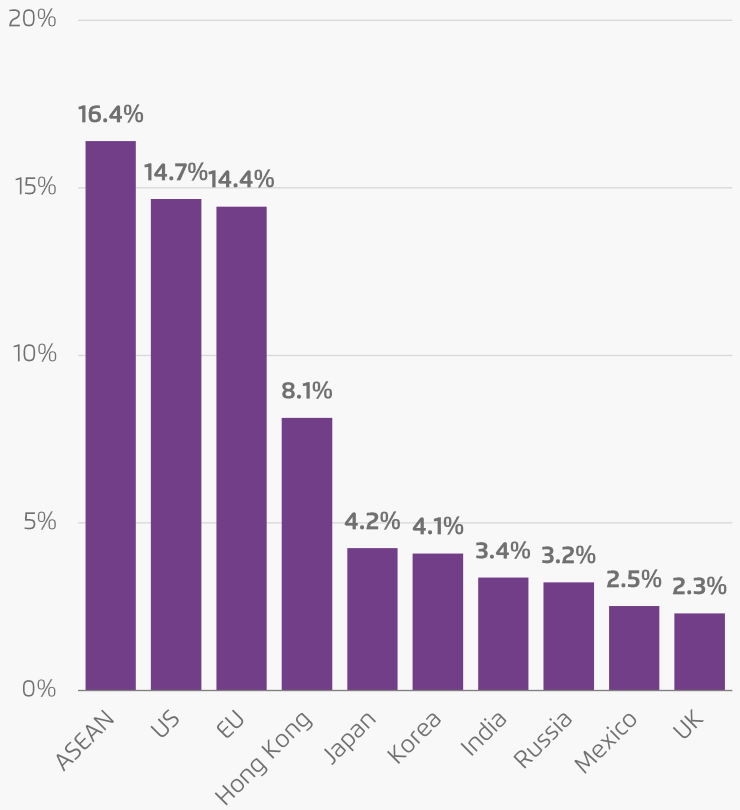
Source: Ministry of Environmental Protection, Ministry of Ecology and Environment and Beijing Environmental Monitoring. Note: PM2.5 refers to particulate matter with a diameter of 2.5 micrometers or less (fine particulate matter).

Other: international trade

China's imports, exports and trade surplus, 2000–2024



Share of China's top 10 export destinations in 2024



China's evolving trade landscape amid shifting global dynamics:

→ **Record trade surplus despite headwinds:** China's trade surplus hit a record USD 992 billion in 2024, despite rising global tensions.

→ **Exports to Global South drive growth:** Net exports drove nearly one-third of GDP growth, with 7.1% export growth led by high-tech and green products. Export destinations are shifting towards the Global South, as the US share fell from 18.2% in 2018 to 14.7% in 2024.

→ **Weak import growth signals soft demand:** Imports rose just 1.1% YoY, reflecting weak domestic consumption.

Regulatory landscape: the level of burden is critical

Comparison of regulatory burden: coal versus renewables

Category	Coal	Renewables (e.g., wind and solar)
Environmental compliance	Strict emission standards in dust control, desulfurisation and denitrification	Much lower burden with focus on ecological protection and land use
Carbon pricing exposure	Covered by China's national carbon market (ETS)	Minimal exposure due to zero direct emissions
Safety	High occupational risk: > 250,000 coal mining fatalities since 1949	Much lower risks than in coal industry
Public opposition	Increasing, some NIMBY* resistance	Generally low, but land use and biodiversity conflicts emerging in some regions
Decommissioning costs	High: includes site remediation, mine rehabilitation and waste handling	Relatively low; concerns growing around solar photovoltaic panel and wind turbine blade recycling

→ Despite strong central authority, China struggles with uneven local policy enforcement, creating gaps between national targets and local actions.

→ Renewables face fewer regulatory and compliance barriers than fossil fuels, allowing for quicker, more streamlined deployment with lower financial and operational risks.

→ Clean energy aligns better with China's priorities – energy security, economic growth and global competitiveness – supporting its long-term strategy.

- Not In My Back Yard: Opposition by residents to proposed developments in their local area, even if they may support such projects elsewhere
- Source: Compilation of China's Coal Industry Statistics 1949-2009, CNCA and Ministry of Emergency Management

Chapter 2:
Carbon emissions

Key data and facts in 2024

+0.7% China's **CO_2 emissions** rose just 0.7% in 2024 – the slowest growth since the post-2016 rebound – reflecting a slowdown in stimulus-driven heavy industry and infrastructure. Emissions from fossil fuel combustion increased slightly more, by 0.9%.

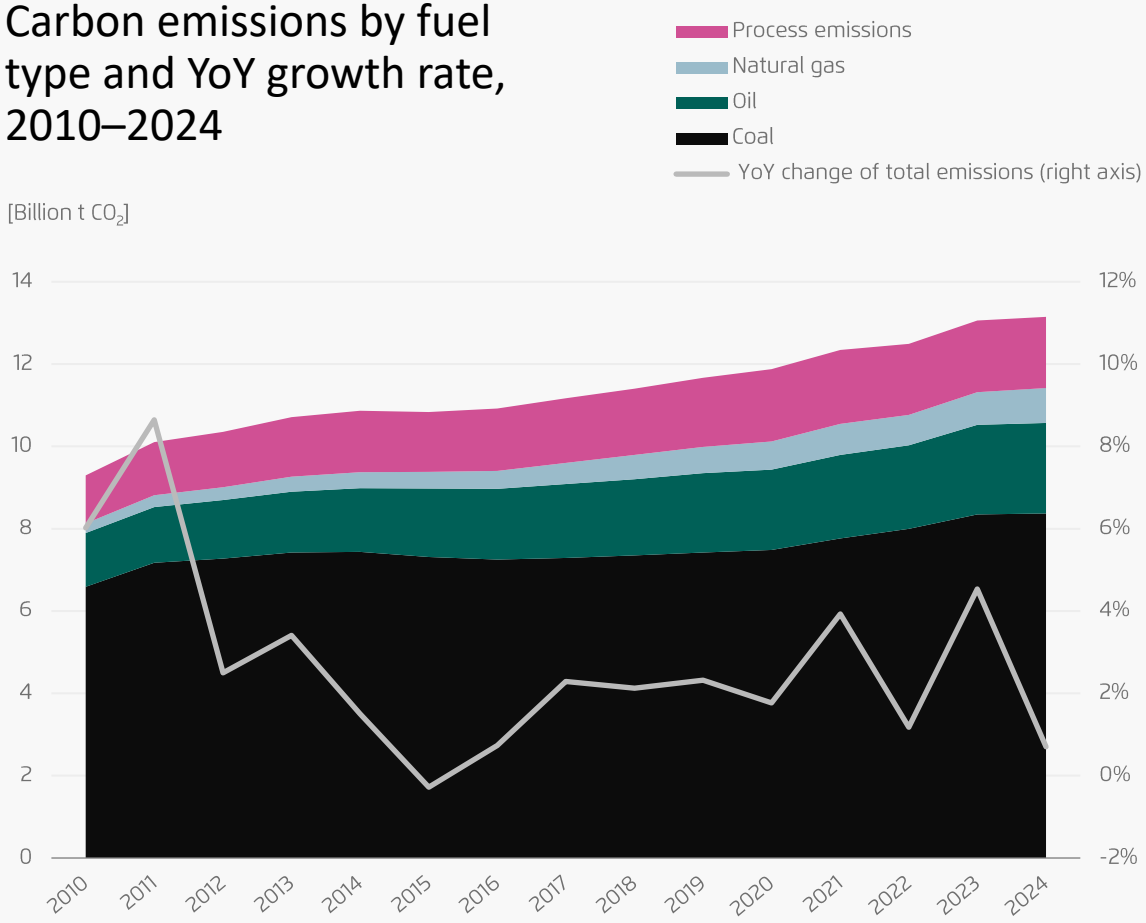
-1.2% By Q1 2025, **fuel combustion CO_2** emissions declined 1.2% YoY, driven by the expansion of clean energy. This marked the first emission reduction primarily attributed to structural shifts in the energy mix.

73% In 2024, **coal** accounted for 73% of China's fuel combustion CO_2 emissions – 8 percentage points lower than in 2010. Meanwhile, the shares of oil and gas increased by 3 and 5 percentage points, respectively.

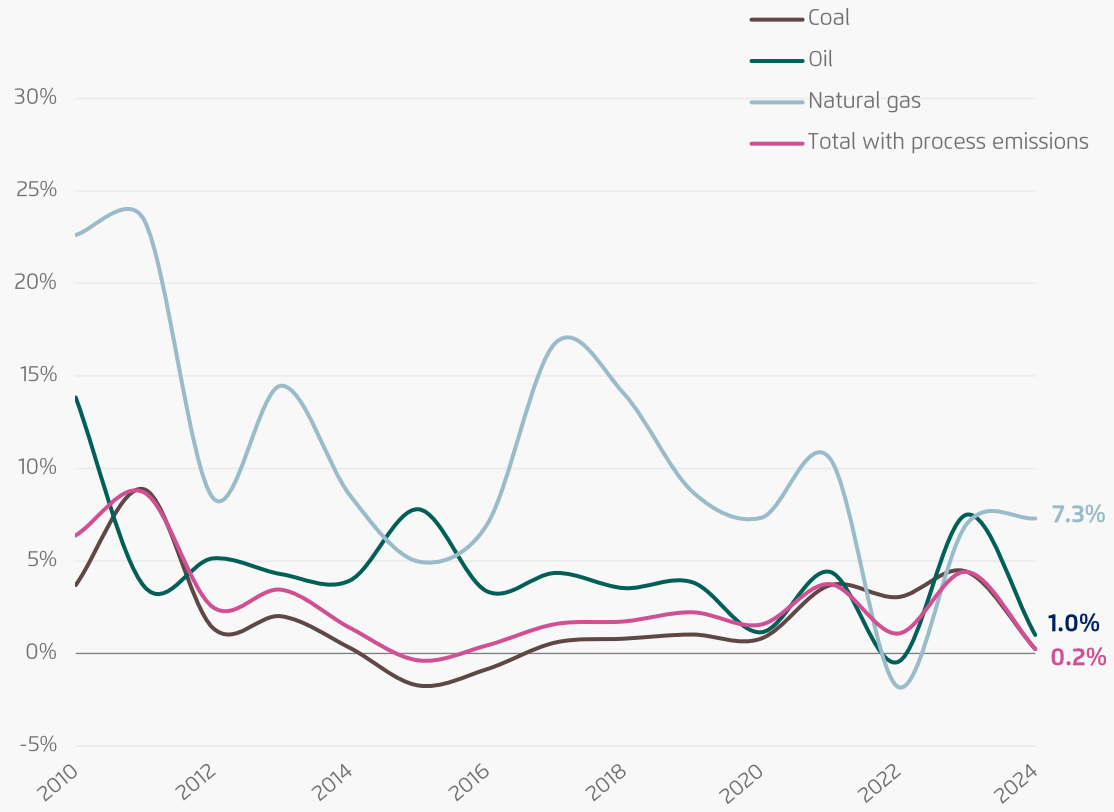
13% **Industrial process emissions** accounted for 13% of China's total emissions in 2024, down from a peak of 15% in 2020. The decline reflects both reduced output in key industries like cement and steel, and targeted efforts to cut process emissions.

Growth of annual CO_2 emissions slowed significantly in 2024

Carbon emissions by fuel type and YoY growth rate, 2010–2024



YoY growth rate of carbon emissions by fuel type, 2010–2024



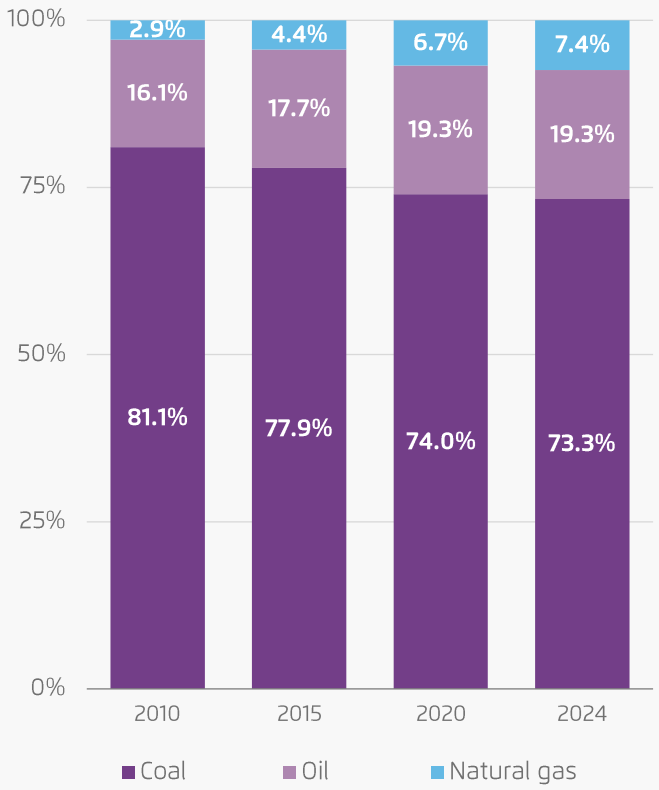
 | Source: NBS, NDRC, various industrial sources and Agora's own estimation

Agora Energy 博众智合

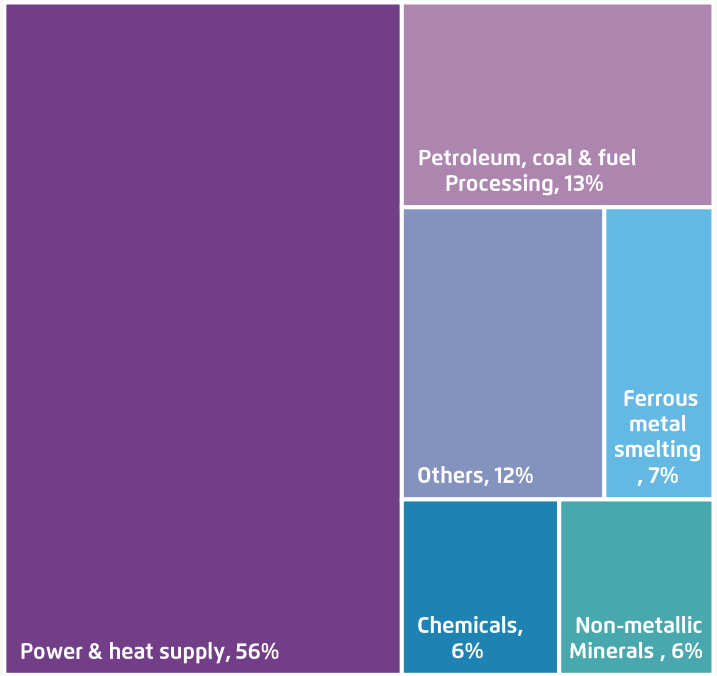
Agora Energiewende

CO_2 emissions from fuel combustion remain dominated by coal power, which continues to be the largest single source

Energy-related CO_2 emissions by source



Coal consumption by sector, 2022

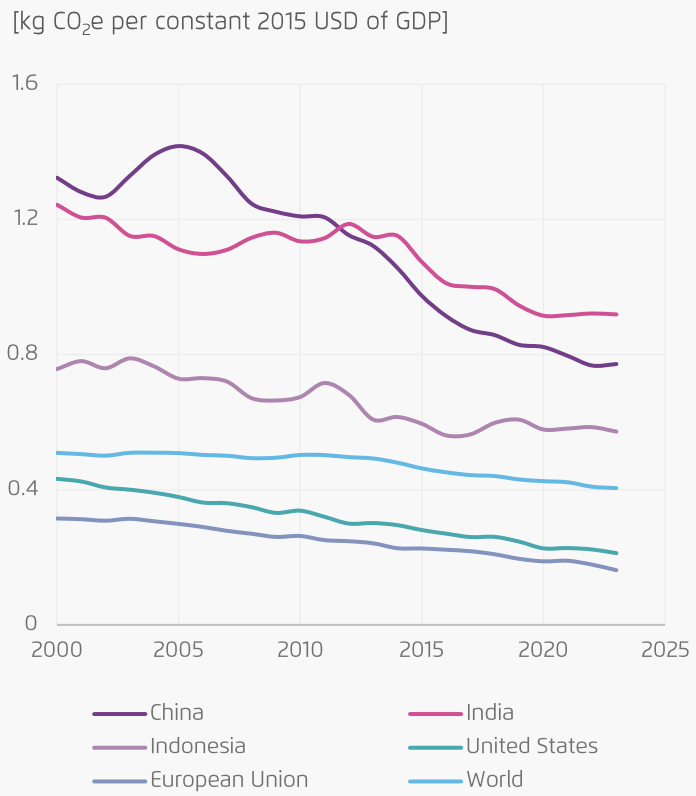


Emission mix by fuel type and sector:

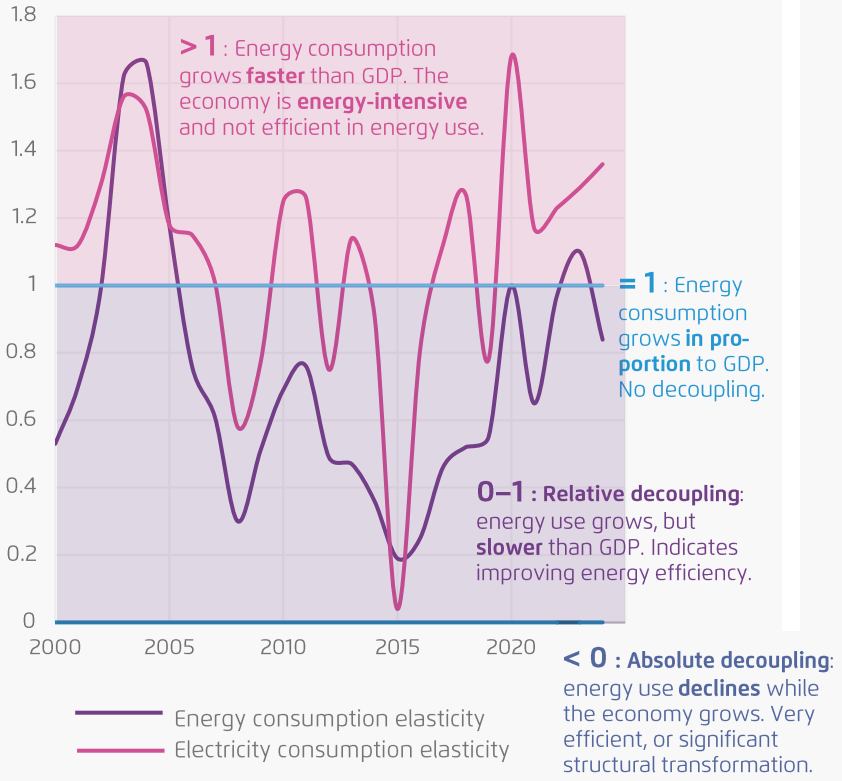
- **Coal still dominates emission mix:** In 2024, coal accounted for 73% of China's fuel combustion CO_2 emissions – down 8 points from 2010 – oil and gas shares rose by 3 and 5 points.
- **Power sector drives coal use:** The power sector used over half of total coal consumption and was the only major sector with steady growth through and after the pandemic.
- **Industry coal demand remains strong:** Strong output in thermal power, chemicals, metals and paper in 2024 reinforced coal's core role in the energy system.

Carbon intensity continues to decline, but a successful transition still requires decoupling energy use from economic growth

Carbon intensity by country, 2000–2023



Energy and electricity consumption elasticity, 2000–2024

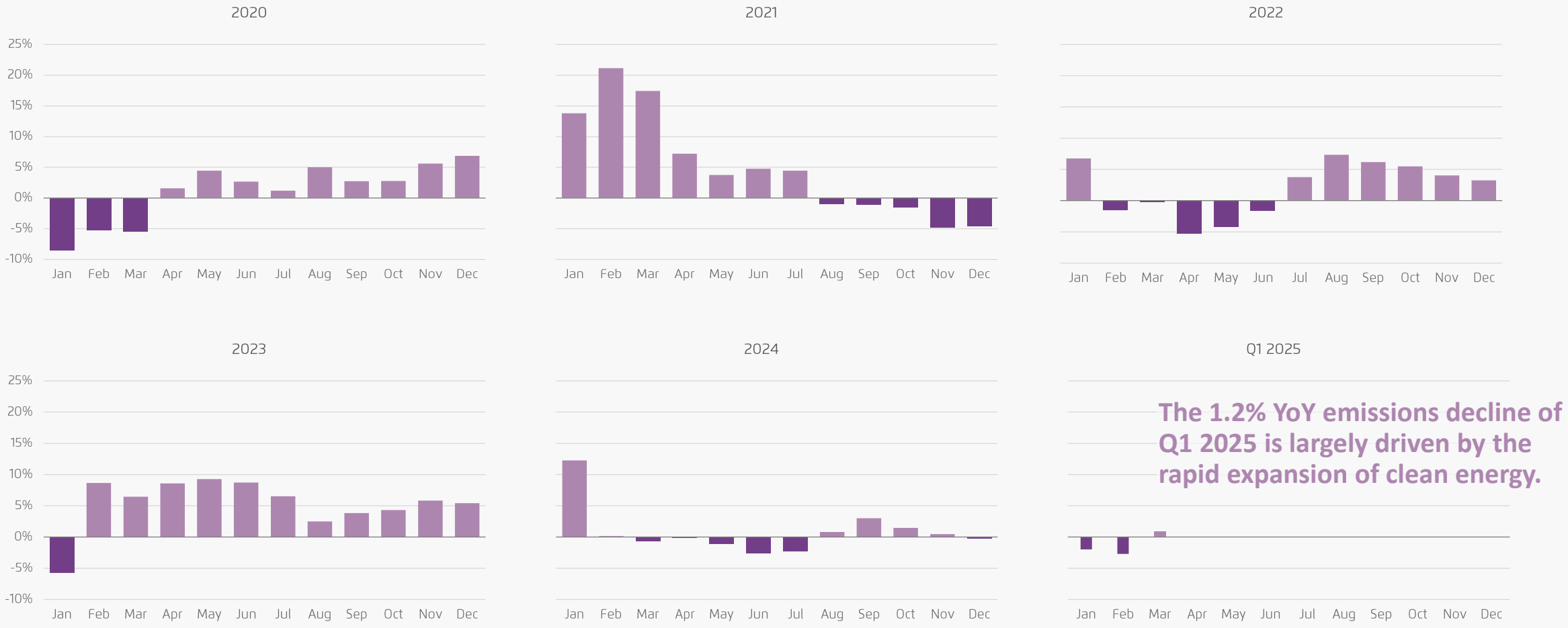


Trends in carbon intensity and energy use:

- → **Carbon intensity falls, but still high:** China's carbon intensity is declining rapidly due to energy efficiency gains – but remains nearly double the global average.
- → **Energy use still tied to growth:** Energy consumption continues to rise in step with GDP, showing limited decoupling from economic activity.
- → **Power demand outpaces all:** Electricity use is growing faster than both total energy consumption and GDP – highlighting the accelerating shift toward electrification.

 Source: The World Bank, NBS

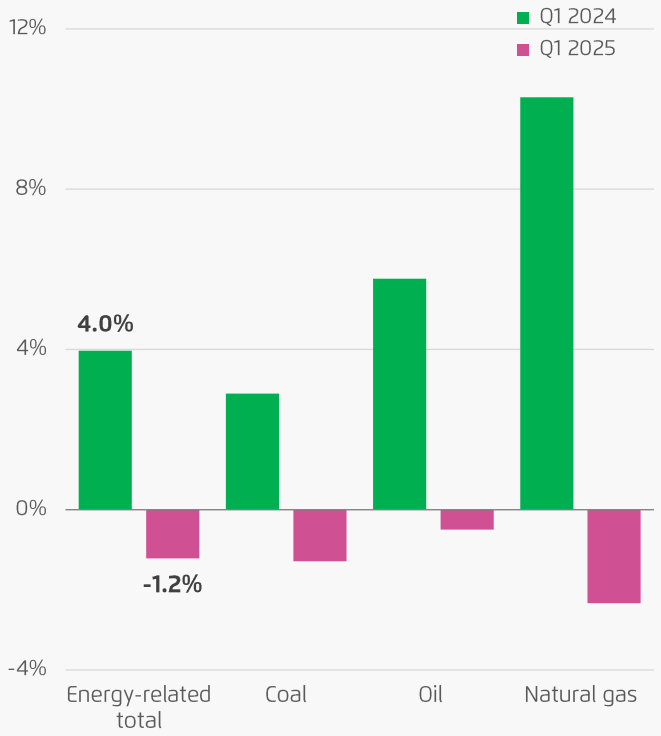
YoY monthly change of fuel combustion CO_2 emissions, 2020–Q1 2025



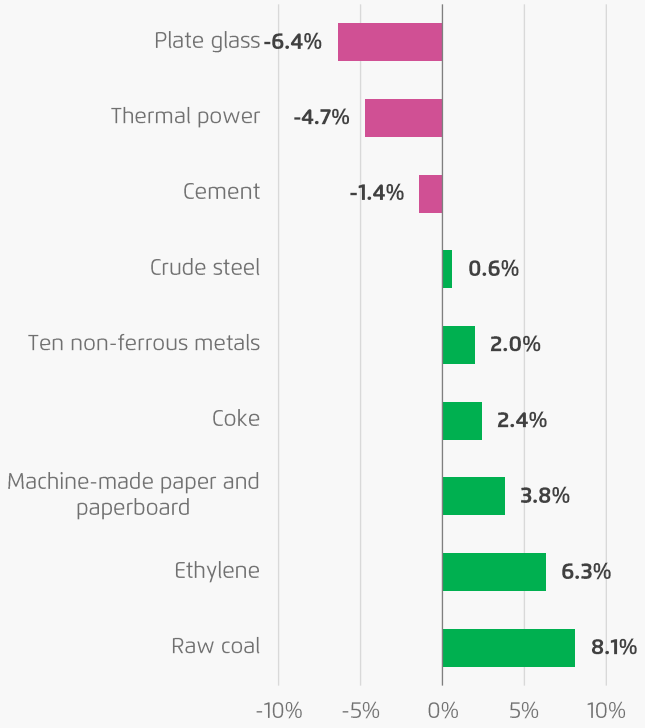
 Source: Agora's own estimation

The emission decline in Q1 2025 marks the first time a reduction has been driven primarily by structural growth in clean energy

YoY growth rate of carbon emissions by fuel type in Q1 2024 and Q1 2025



YoY growth rate of output by key coal consuming sectors in Q1 2025



Structural clean energy shift drives emission decline:

- **Clean energy meets demand growth:** In Q1 2025, a 2.5% rise in power demand was fully covered by solar, wind, hydro and nuclear – while thermal power output dropped 4.7%.
- **Emissions fall due to structural shift:** For the first time, emission reductions stemmed from structural clean energy growth – not economic slowdowns or external shocks.
- **Continued progress calls for reform:** Sustaining and deepening this decline will require ongoing efforts to green and modernise China's power and industrial sectors.

 Source: NBS, CEC, and own estimation.

Chapter 3:
Energy overview

Key data and facts in 2024

+4.6% In 2024, China's **primary energy production** rose 4.6% to 4.98 billion tonnes of coal equivalent (tce), led by strong growth in electricity (15.8%) but also increase in coal, oil and gas production. With output slightly outpacing demand, energy self-reliance improved marginally.

+4.3% In 2024, China's **primary energy consumption** rose 4.3% to 5.96 billion tce, a deceleration of 1.5 percentage points compared to the previous year. The slowdown points to emerging structural adjustments in the energy mix and a moderation in industrial activity, reflecting broader economic rebalancing trends.

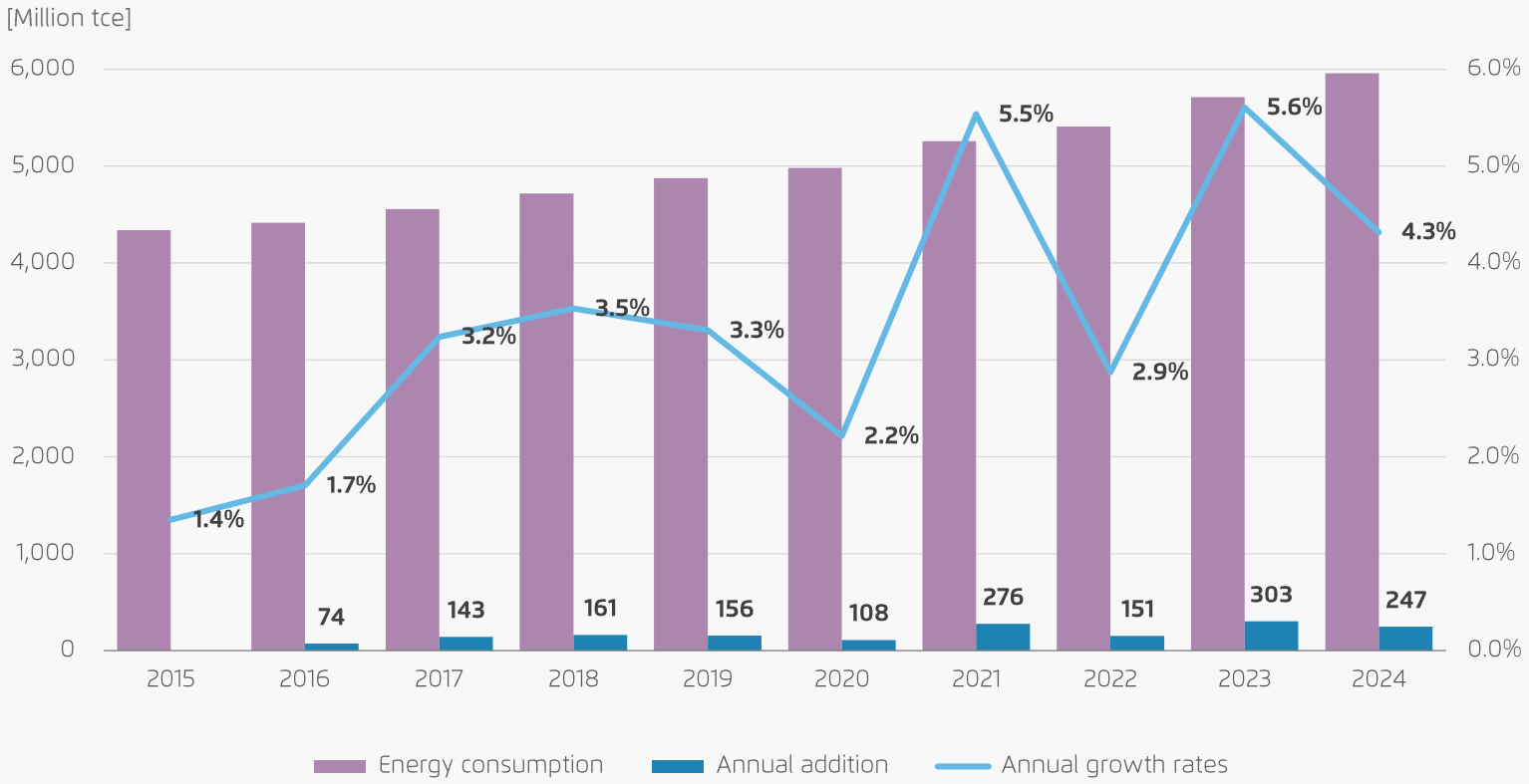
53.2% **Coal's share** in China's energy mix fell to 53.2% in 2024, down from 55.3% in 2023, reflecting the shift towards cleaner energy. However, coal use still rose noticeably rose, highlighting the challenge of reducing absolute consumption despite renewables growth.

84% In 2024, China's **energy self-sufficiency** held at around 84%, backed by eight years of fossil fuel growth. The trend not only reflects concerted efforts to strengthen supply stability, but also underlines the need to align energy security with long-term climate goals.

 Source: NBS, and own estimation.

China’s primary energy consumption

Total primary energy consumption, annual addition and annual growth rate, 2015–2024

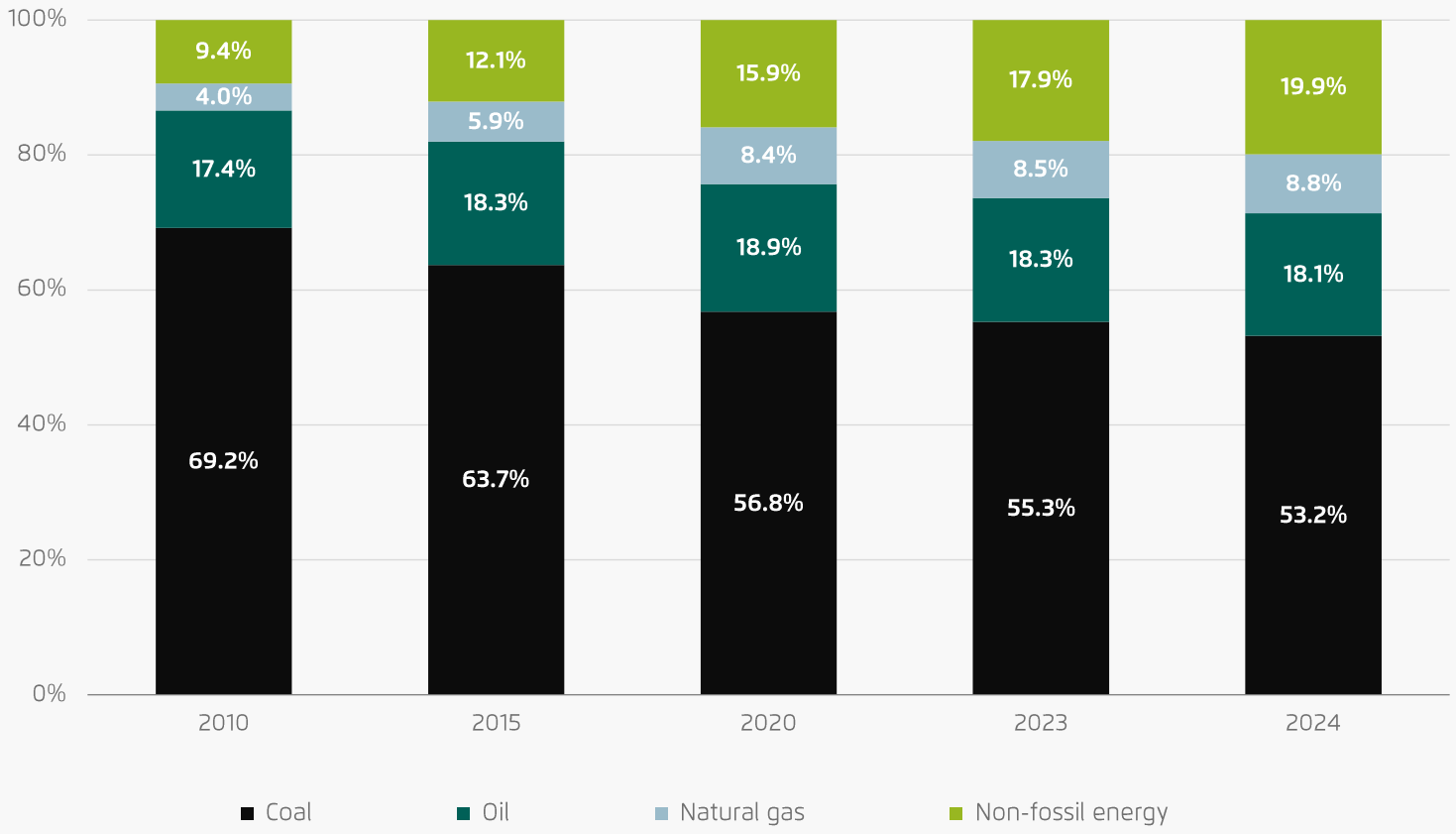


China’s energy consumption exhibits three defining characteristics:

- **Scale:** As the world’s largest energy consumer, China accounts for nearly 30% of global demand, highlighting its central role in global energy.
- **Growth momentum:** Since 2015, China’s energy consumption has grown steadily. From 2021 to 2024, it added an average of 244 million tce annually – roughly equal to the UK’s entire yearly energy consumption.
- **Sustained trajectory:** Since 2020, energy demand has grown at an average annual rate of 4.6%. This trend is expected to continue, stabilising at 4–5% through 2025.

China’s energy structure by fuel type

China’s primary energy consumption structure by fuel type



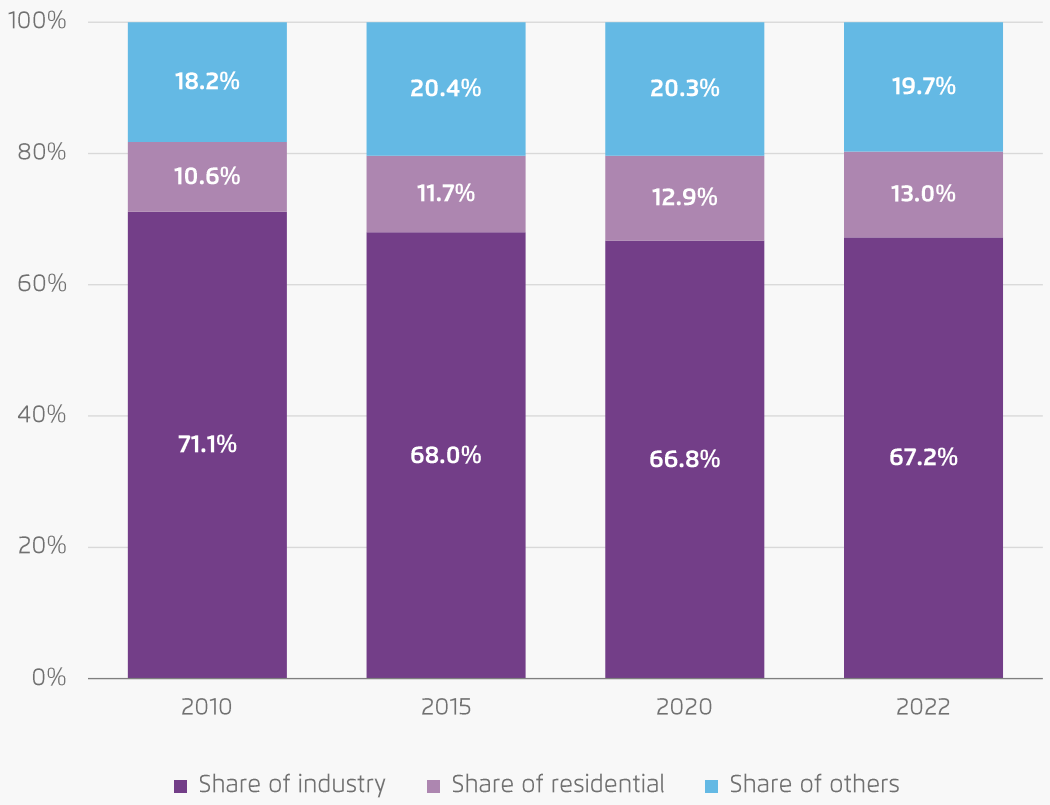
Structural shift in China’s energy mix:

- **Coal’s declining share:** From 2010 to 2024, coal’s share in China’s primary energy mix fell by 16 percentage points – signalling a shift away from the most carbon-intensive fuel, though it remains dominant.
- **Rise of cleaner sources:** Over the same period, natural gas gained nearly 5 points, and non-fossil energy (renewables and nuclear) rose by over 10 points, showing strong low-carbon momentum.
- **Implication for energy strategy:** This rebalancing reflects China’s ambitions to boost energy security through diversification while advancing a more sustainable energy system.

 Source: NBS and Agora’s own estimation

China’s energy structure by sector

China’s energy consumption structure by sector

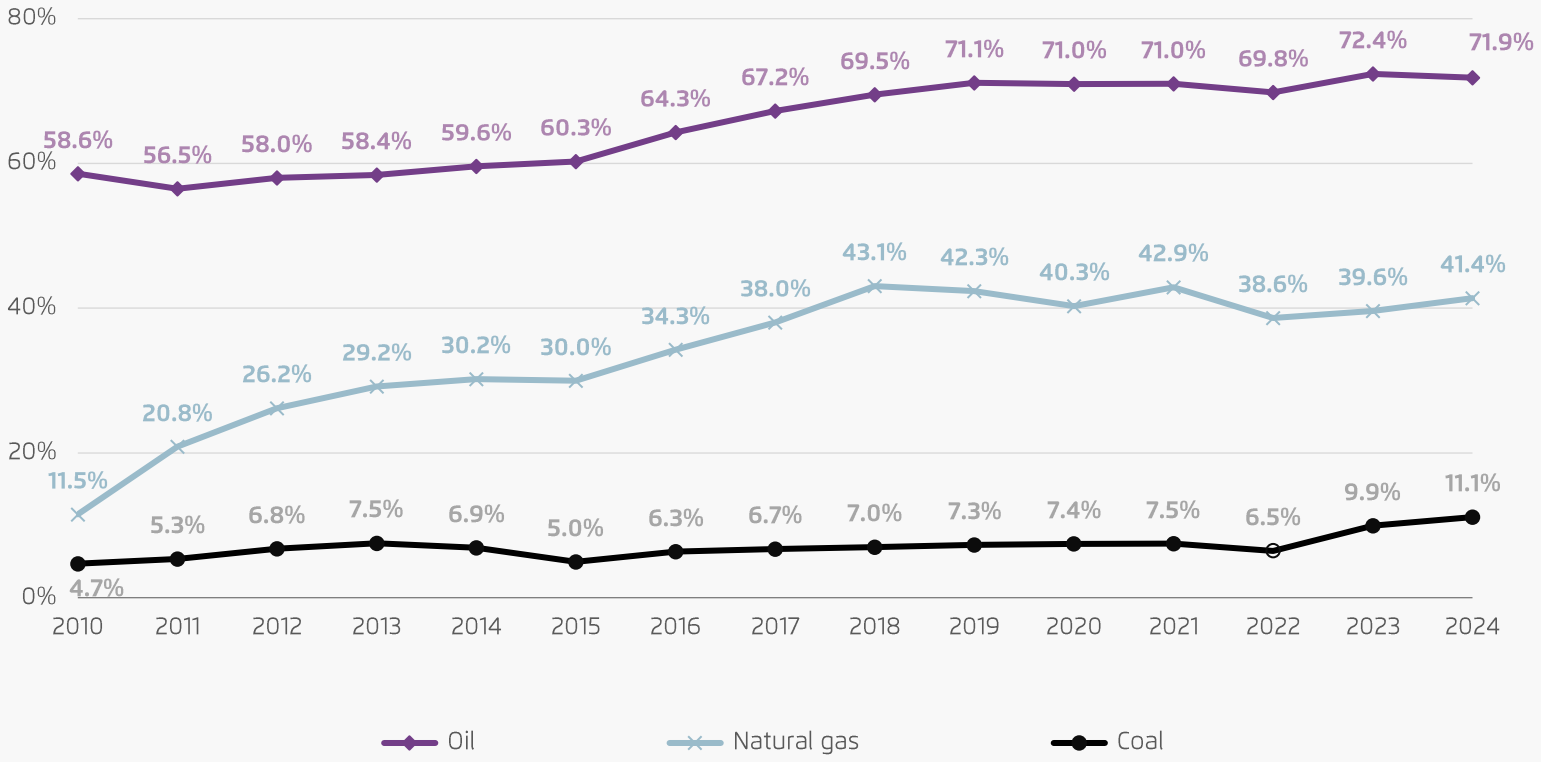


Industry dominates China’s energy demand:

- **Industry remains the dominant consumer:** Since 2015, industry has consistently dominated China’s primary energy consumption, highlighting the sector’s pivotal role and the urgent need for deep energy transformation.
- **Modest growth in residential demand:** The residential sector has experienced only modest growth, with its primary energy consumption share rising by just 1.3 percentage points between 2015 and 2022, indicating limited structural change.
- **Other sectors holds steady:** Commercial, construction, transport and agriculture have collectively maintained a stable 20% share, with little variation over time.

China’s dependency on energy imports

China’s dependency rates for imports of oil, gas, and coal, 2000–2024



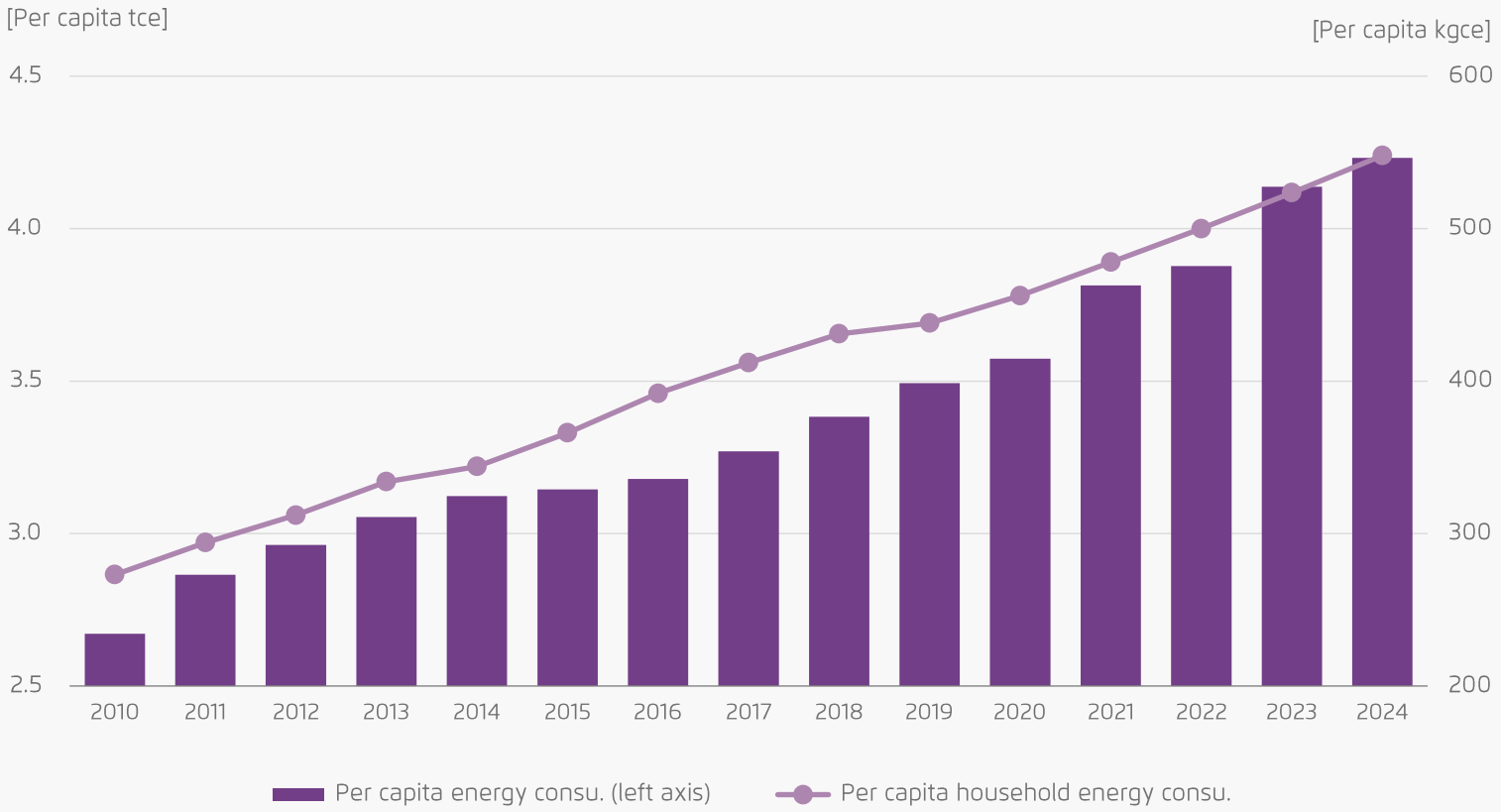
Shifting patterns in China’s fossil fuel import dependence:

- **Gas import dependence edged up:** Since 2018, China’s natural gas import dependence has hovered between 40–45%, but rose steadily over the past three years – up 2.6 points overall.
- **Oil import dependence stabilises:** Oil import dependence peaked at 72.4% in 2023 before easing to 71.9% in 2024, returning to near-2019 levels after rapid growth from 2015 to 2019.
- **Coal imports surged again:** Falling global coal prices have driven a sharp increase in China’s coal imports over the past two years, pushing import dependence noticeably higher.

 Source: CNPC ETRI, NBS, and own estimation.

China’s per capita energy consumption and household energy consumption

China’s per capita energy consumption and household energy consumption



Both indicators continued along steady upward trajectories:

- **Per capita energy use accelerates:** From 2020 to 2024, per capita energy consumption rose at 4.6% annually – up from 2.4% in 2016–2020 and 3.1% in 2010–2015.
- **Household growth remains steady:** Per capita household energy use grew at a stable 4.7% annually during 2020–2024, similar to 4.5% in 2015–2020 and below 6% in 2010–2015.
- **Non-household demand drives growth:** The growing gap between per capita total and household energy use points to rising demand from industry, transport and services.

 Source: BP, Energy Institute, NBS and Agora’s own estimation.

Chapter 4:
Coal

Key data and facts in 2024

+1.2%

In 2024, China's **national coal production** rose 1.2% YoY, down from 3.4% in 2023, reaching 4.78 billion tonnes. As global coal output grew by nearly 1% in 2024, China's share in global production edged up slightly to 52%.

+1.7%

In 2024, China's **national coal consumption** rose 1.7% YoY, slowing from 5.6% in 2023. Nevertheless, China still accounted for 56% of global coal consumption that year.

+14.4%

In 2024, China's **coal imports** jumped 14.4% YoY to a record 543 Mt. With the average import price falling from CNY 785 per tonne in 2023 to CNY 683 per tonne, the total expenditure remained nearly unchanged.

53.2%

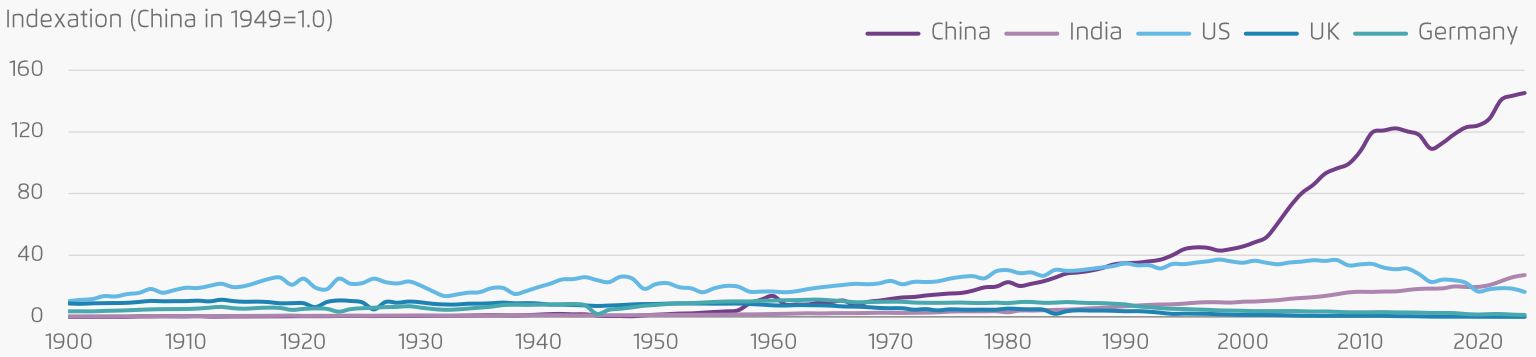
Coal's share in China's energy mix declined to 53.2%, down from 55.3% in 2023. Yet coal consumption still grew 1.7% YoY, underscoring the difficulty of cutting absolute coal use despite a growing clean energy share.

Source: NBS, China Customs and Agora's own estimation

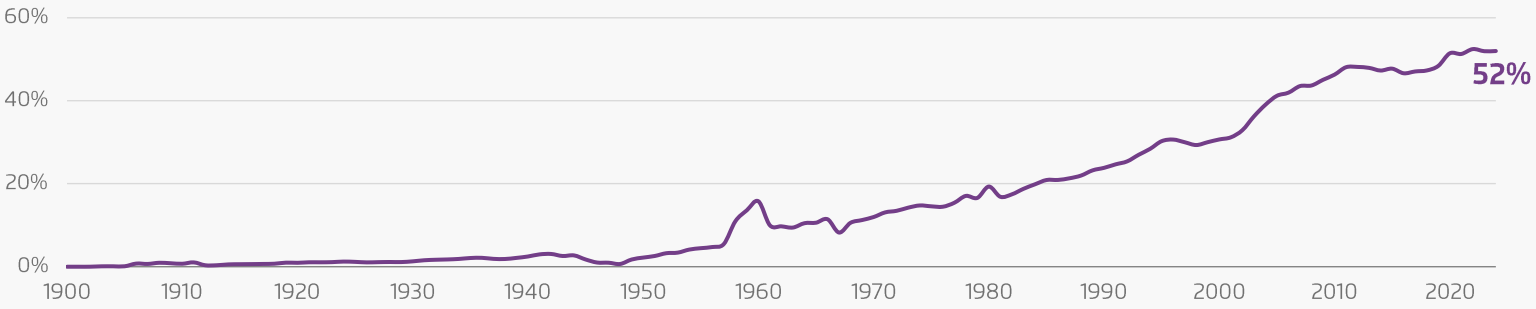
Note: As of 2 July 2025, the NBS revised coal's share in China's 2023 energy mix from the originally reported 55.3% to 54.8%, this revision is not reflected in the analysis presented in this slide deck.

Coal production

Coal production by major producing country, 1900–2024



China’s share of global coal production, 1900–2024



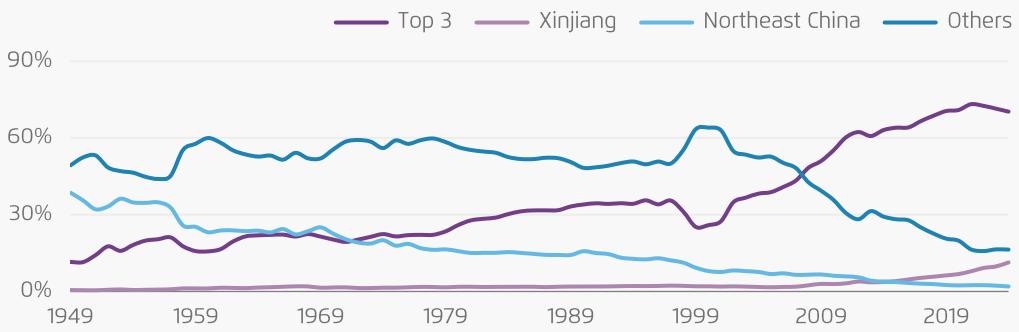
China’s rise to dominance in global coal production:

- **From marginal to massive:** China’s coal output grew from just 0.521 Mt in 1901 to 4.78 billion tonnes in 2024 – a 146-fold increase since 1949.
- **Largest producer since 1985:** China became the world’s leading coal producer in 1985 and has accounted for over half of global output annually since 2020.
- **Scale drives self-reliance:** This scale of production has supported a vast coal supply chain, backed by major investment in mining, transport and regional hubs – boosting self-reliance and shaping global coal markets.

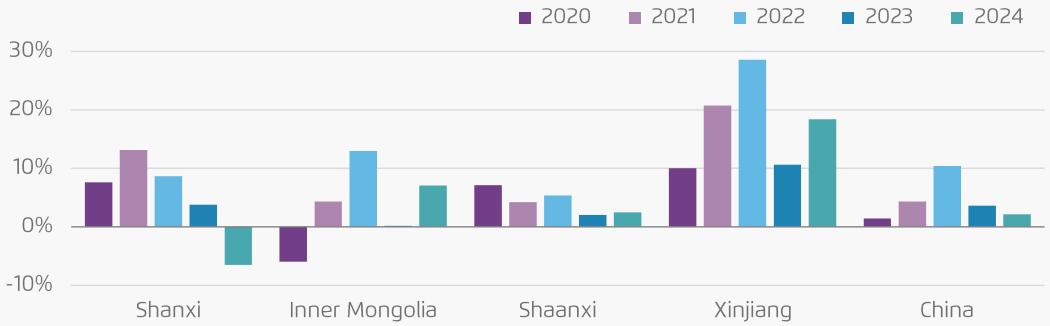
 Source: NBS, Elspeth Thomson (2003), Energy Institute, the Shift Data Portal (2019), CCERA and UK Energy Trends December 2024

Top 4 coal regions: the past, present and future of China’s coal industry

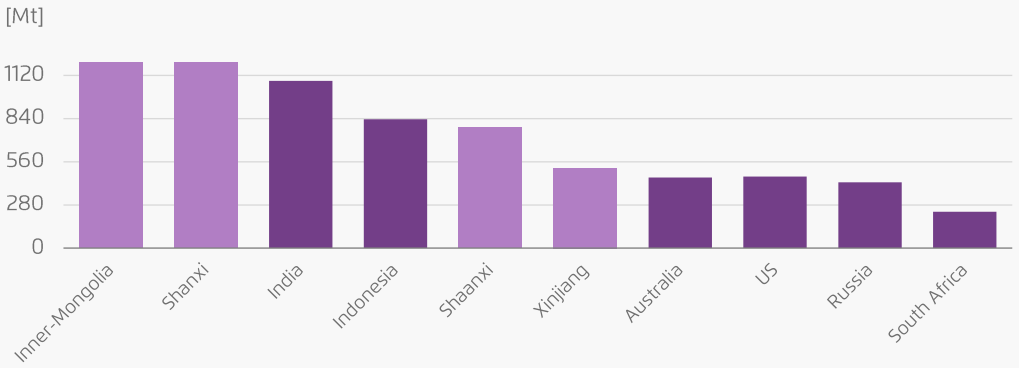
Share of national coal production by region, 1949–2024



YoY change of coal production, 2020–2024



Ranking the top 4 coal regions with major coal countries by output, 2024



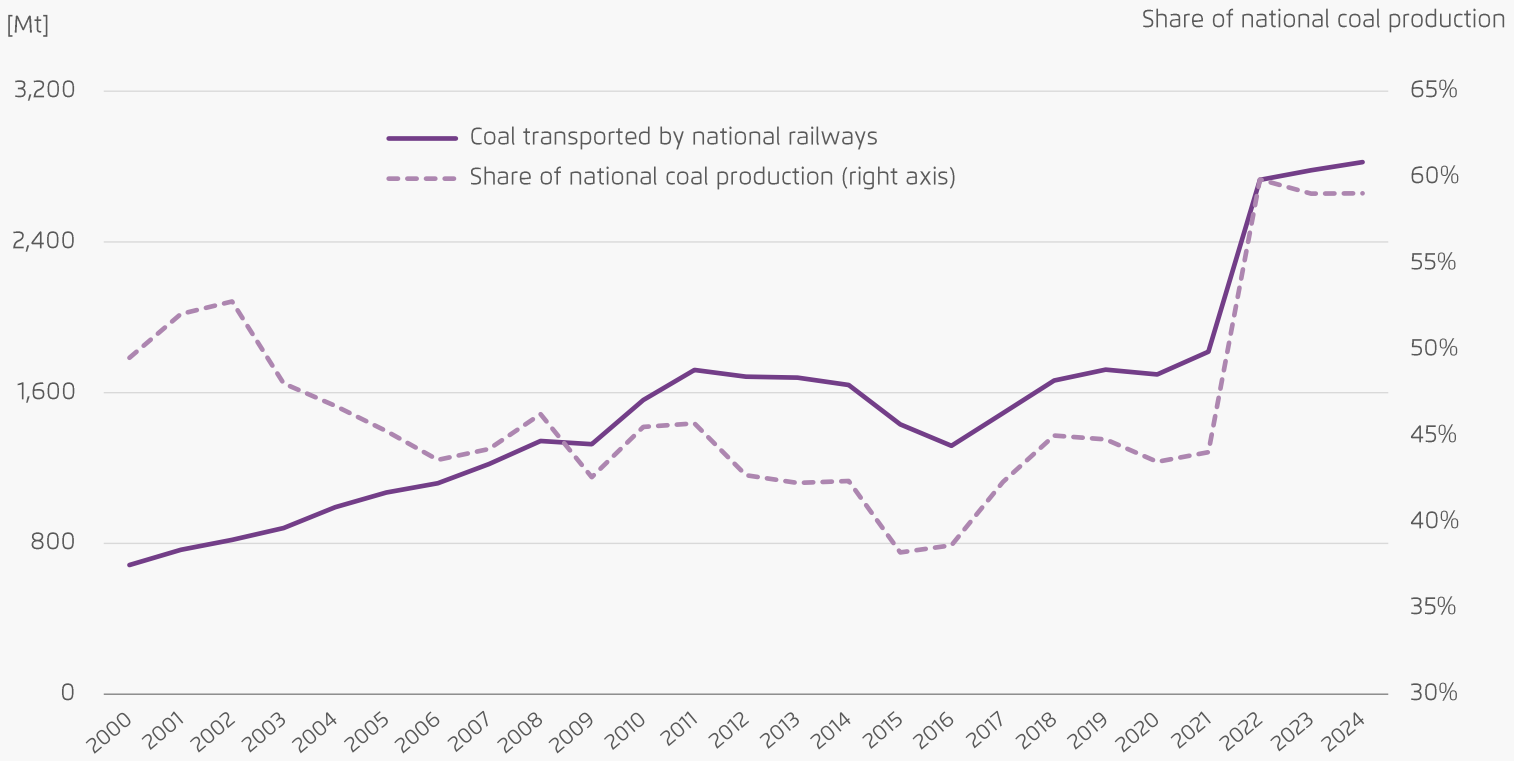
Regional concentration and strategic shifts in coal production:

- → Over 80% of national coal output come from the top 4 regions, showing rising concentration.
- → Each of top 4 regions would rank among the world’s top 10 coal producers if they were countries themselves.
- → Xinjiang’s coal output has grown at double-digit rates annually since 2020, with its strategic role in coal supply rising rapidly – driven by local demand and easing rail transport constraints.

 Source: NBS, CCERA, IEA and Energy Institute. Note: Top 3 coal regions = Inner Mongolia, Shanxi and Shaanxi.

China’s coal transport is steadily growing, driven by rising rail volumes and expanded infrastructure

Coal transported by national railways, 2000–2024



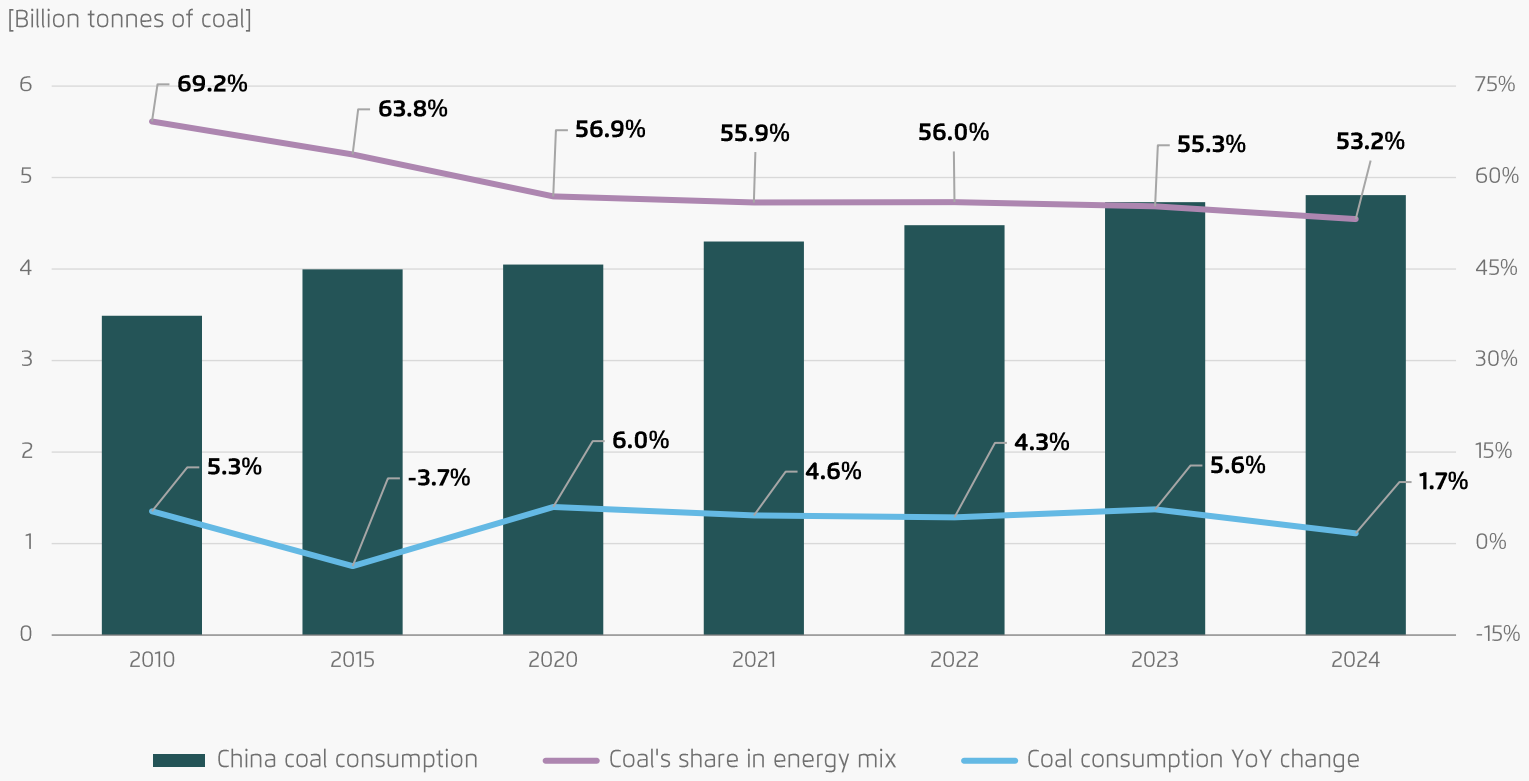
Modes of coal transport in China:

- **Railways** account for approximately 55–60% of total coal transport tonnage in China, with an average freight rate of about CNY 0.1 per tonne-kilometre (tonne-km).
- **Trucks** handle 25–30% of the tonnage, with freight rates ranging from CNY 0.25–0.65 per tonne-km, depending on haul distance.
- **Waterways** represent 15–19% of tonnage, splitting into a) marine transport (coastal and oceanic shipping): approx. 630 Mt in 2023, at CNY 0.05 per tonne-km; and b) inland waterways: approx. 760 Mt in 2023, at CNY 0.06 per tonne-km.

 Source: NBS, National Railway Administration and various industrial sources

China’s national coal consumption shows signs of plateauing

China’s coal consumption growth decelerated in 2024

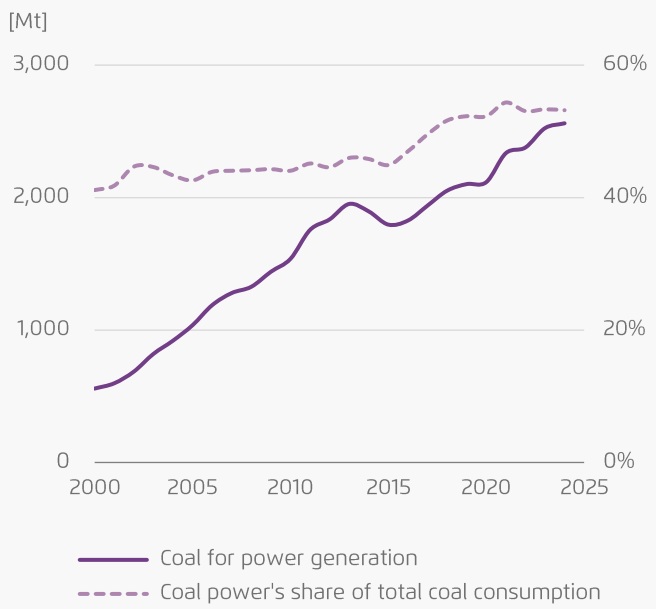


Coal’s persistent role amid a shifting energy mix:

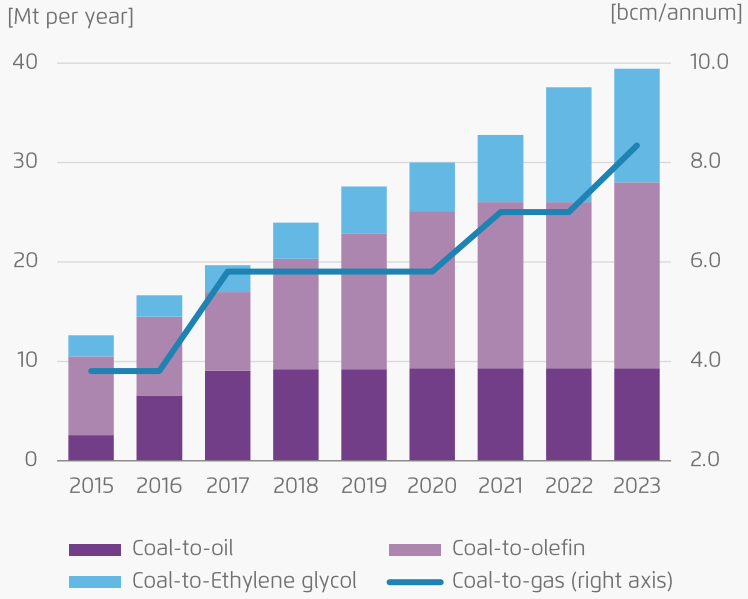
- **Coal’s share continues to decline:** Coal’s share in China’s primary energy mix fell from 69.2% in 2010 to 53.2% in 2024, driven by diversification and the growth of cleaner energy sources.
- **Absolute consumption still rising:** Despite the declining share, coal use has increased for eight consecutive years since 2017, driven by rising power demand and growth in energy-intensive sectors, including coal-to-chemicals.
- **Outlook clouded by uncertainty:** Data quality and future economic growth add uncertainty.

Prospects of coal consumption by sector

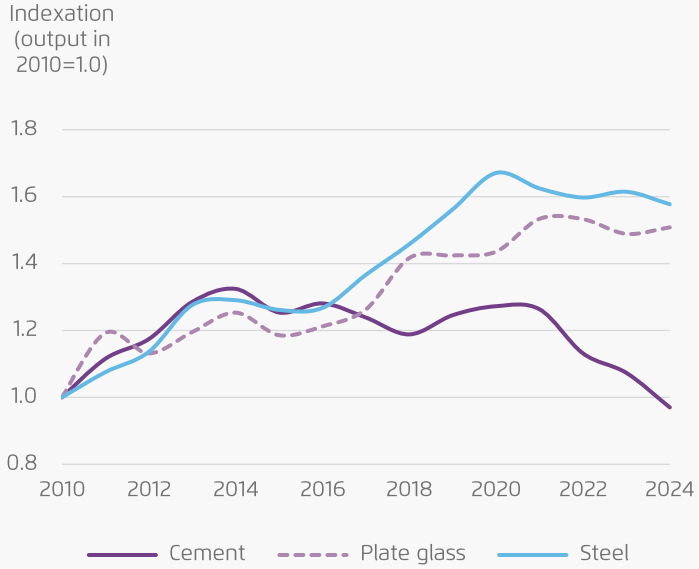
Coal consumed for power generation, 2000–2024



Modern coal chemical capacity expansion, 2015–2024



Production trends of major coal-intensive commodities, 2010–2024



→ Coal consumption by sector reveals a clear structural shift in market demand, highlighting the evolving roles of power generation, industry and emerging chemical applications.

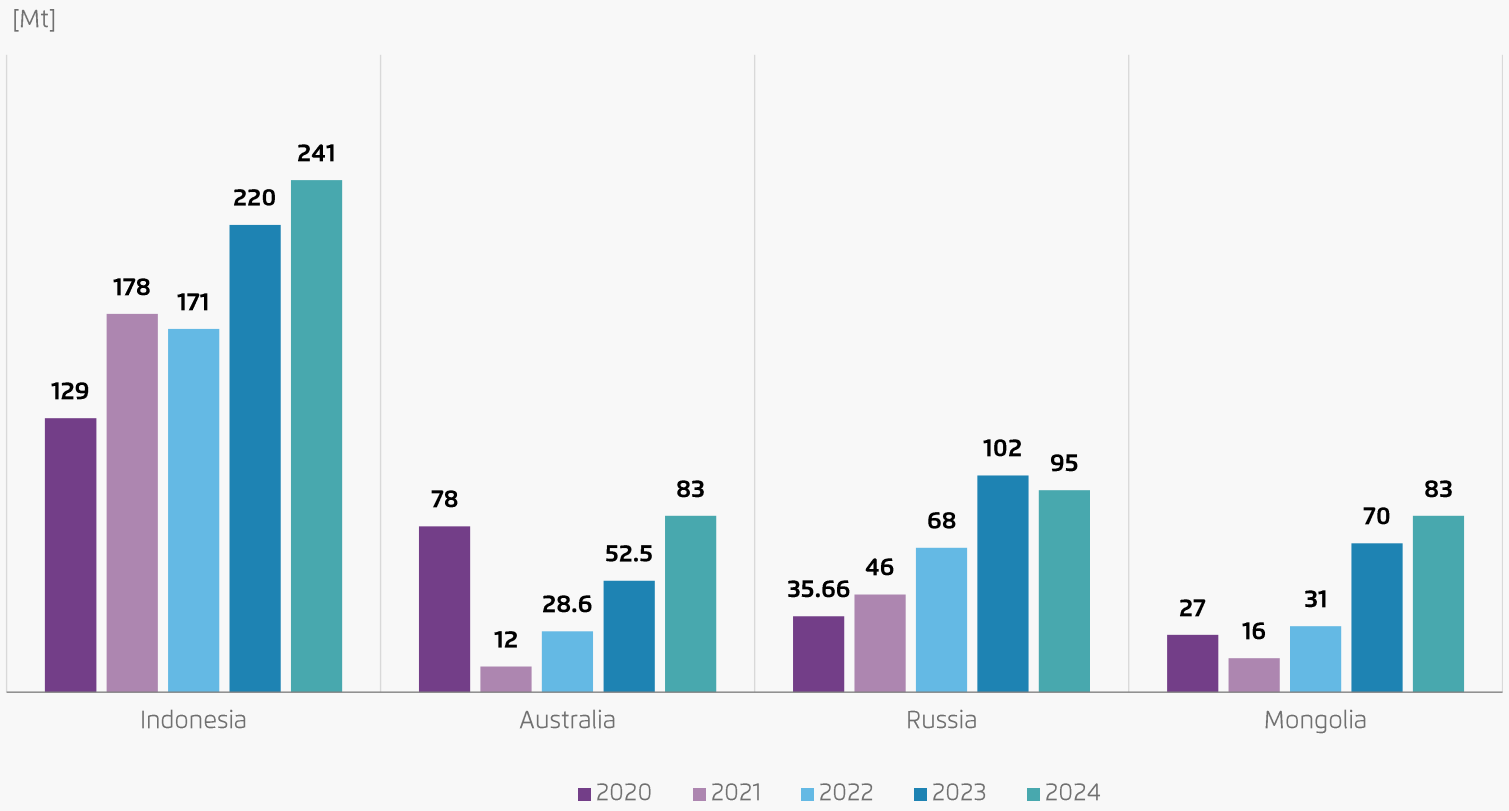
→ Modern coal chemical manufacturing has experienced robust and sustained growth in recent years, supported by generally favourable local government attitudes and the central government's 2022 feedstock exemption policy.

→ A prolonged slump in the real estate sector has led to a notable decline in coal use within the metallurgy sector, particularly impacting steel and cement-related demand.

Source: NBS, update of Kevin Tu (2024). Prospects of the Chinese Coal Chemical Industry in an Increasingly Carbon-constrained World, various industrial sources and Agora's own estimation

China’s coal imports have risen in recent years due to high domestic prices, tighter production controls and more competitive international coal prices

China’s coal imports by country, 2020–2024



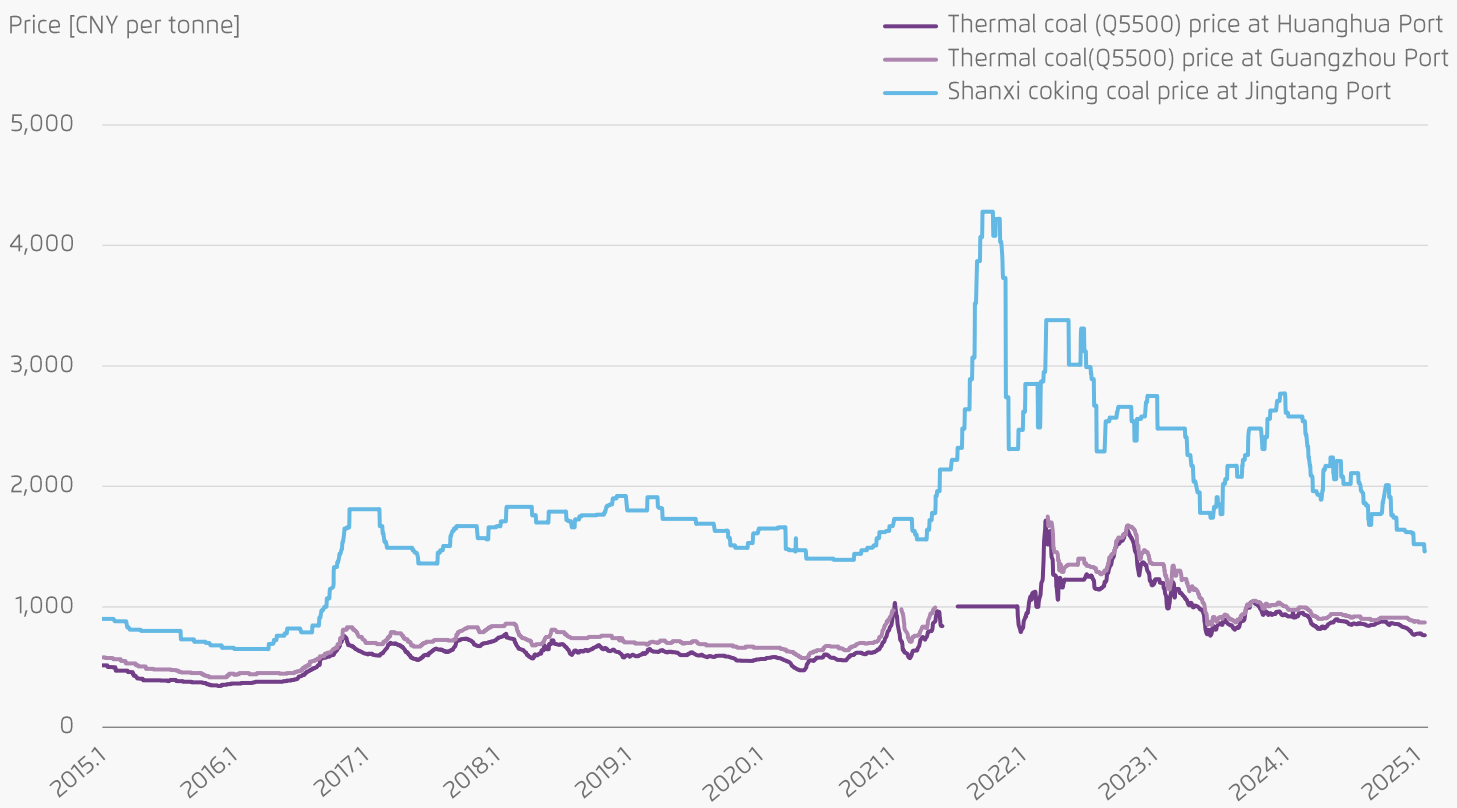
China as the world’s largest coal importer:

- **Rising imports to manage price and supply:** In 2024, China imported approx. 543 Mt of coal (14.4% YoY increase) driven by efforts to stabilise prices after domestic coal costs hit record highs in 2022.
- **Indonesian coal gains share:** Imports from Indonesia surged due to their cost advantage over domestic coal.
- **Shifting global supply-demand balance:** Global coal supply has outpaced demand, shaping a more favourable import environment for countries like China.

 Source: CCTD and China Customs

Coal prices are fluctuating widely, reflecting the general trend of volatile fossil fuel costs

Thermal and coking coal price indexes in China, Jan 2015–Jan 2025



China's coal price trajectory:

- **Boom-and-bust dynamics:** Coal prices in China surged from late 2021 to late 2022, partly driven by the European fossil energy crisis. The spike underscores the market's sensitivity to global shocks.
- **Transition dilemma:** High coal prices reduce incentives for coal regions to pursue a just transition. When prices fall, financial constraints often stall progress, leaving regions stuck in a cycle of dependence.
- **Global impact:** As China's coal consumption plateaus, even modest shifts will ripple across global energy markets, shaping prices, emissions and transition timelines worldwide.

 Source: Various industrial sources

Chapter 5:
Oil and gas

Key data and facts in 2024

+1.8% In 2024, China's **oil production** by enterprises above designated size rose by 1.8% YoY to 212.8 Mt, extending the steady growth trend in domestic output that began in 2019.

+1.0% In 2024, China's **oil consumption** is estimated to have grown by 1.0% YoY. Meanwhile, refined oil product consumption declined by about 2% YoY, driven primarily by the growing adoption of electric vehicles and LNG-powered heavy-duty trucks.

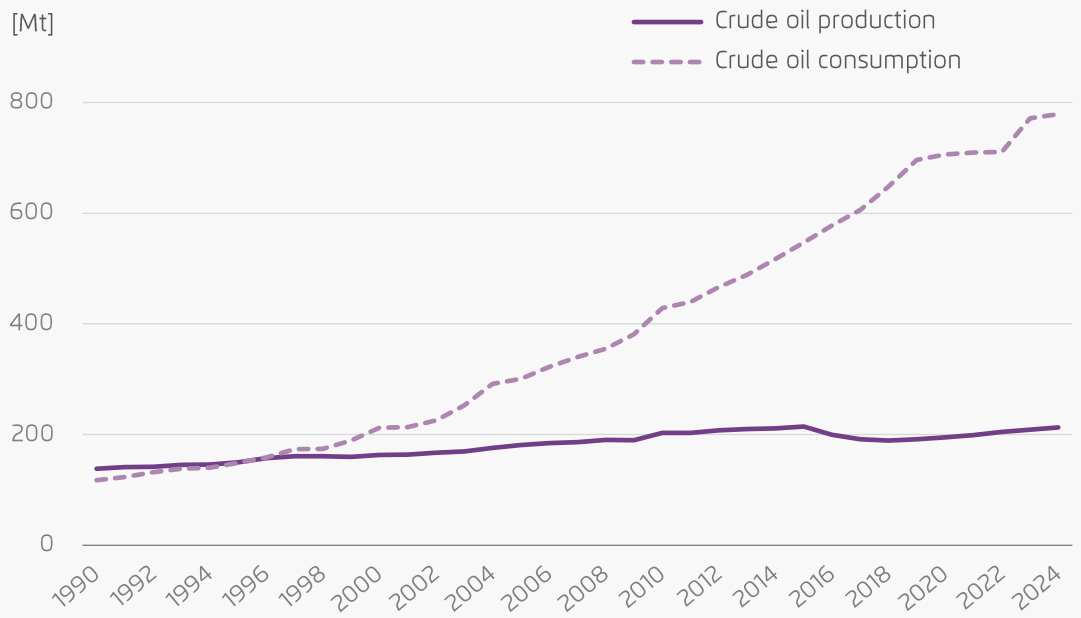
+6.2% In 2024, China's natural **gas production** by enterprises above designated size grew by 6.2% YoY to 246 billion cubic metres (bcm), supported by continued investment in domestic exploration.

+7.3% China's natural **gas consumption** increased by 7.3% in 2024, reaching 420 bcm. The growth was rising across all major sectors: residential heating and cooking, industrial manufacturing, power generation and chemical production.

 Source: NBS, NEA, CNPC ETRI and Sinopec

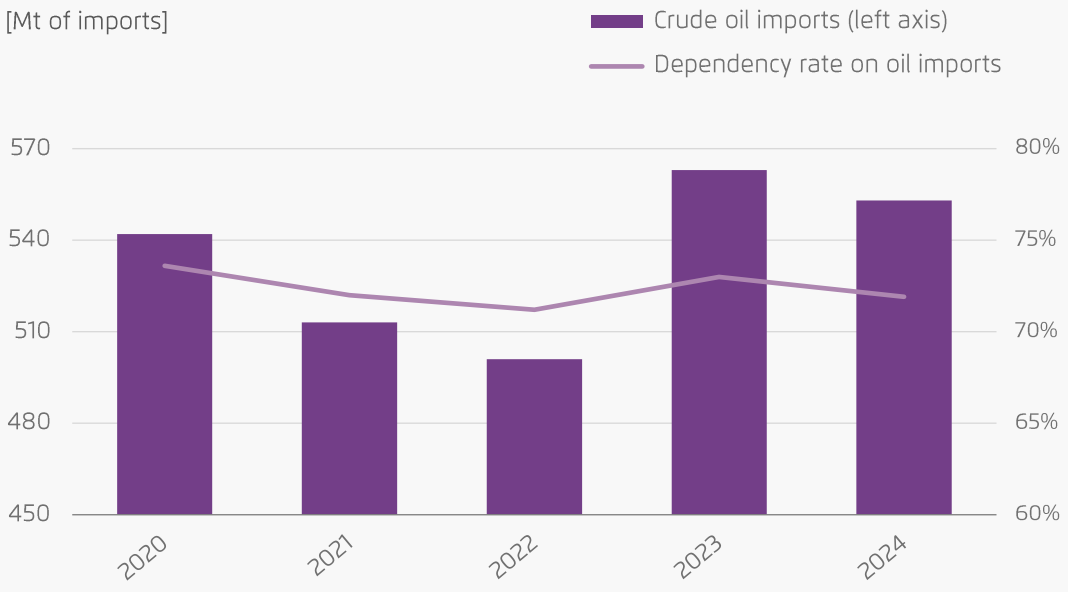
Oil production, consumption and imports

China’s crude oil production versus consumption, 1990–2024



→ Since losing its long-cherished energy self-reliance status in 1993, it has taken China three decades to begin stabilising the gap between domestic crude oil production and consumption.

China’s crude oil imports vs dependency rate, 2020–2024

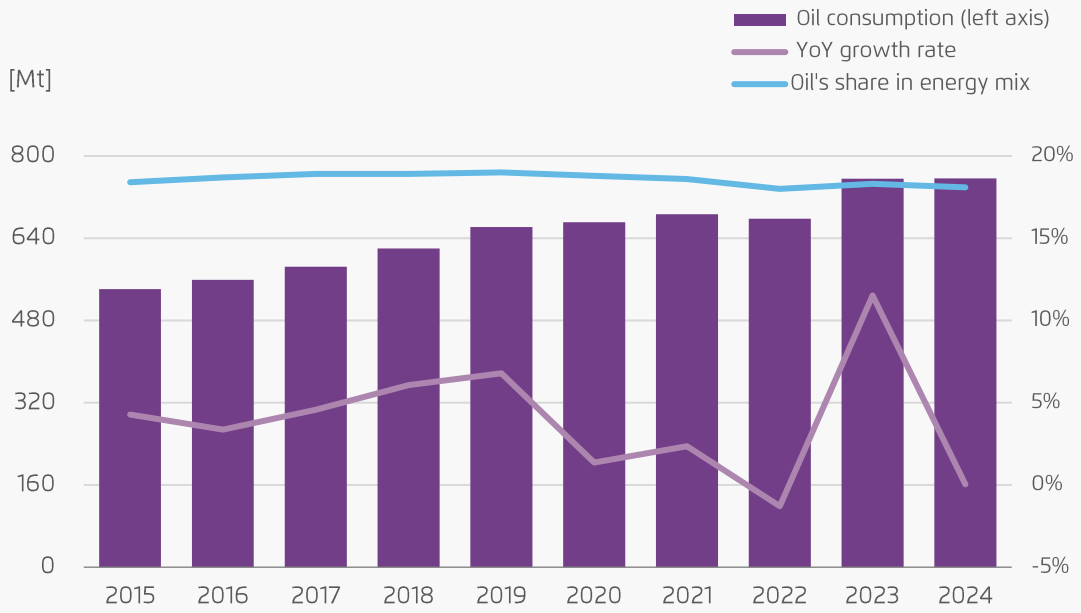


→ China’s oil import dependency has fluctuated in recent years, highlighting the challenge of reducing oil use while pursuing economic growth and a low-carbon transition.

 Source: China Customs and NBS

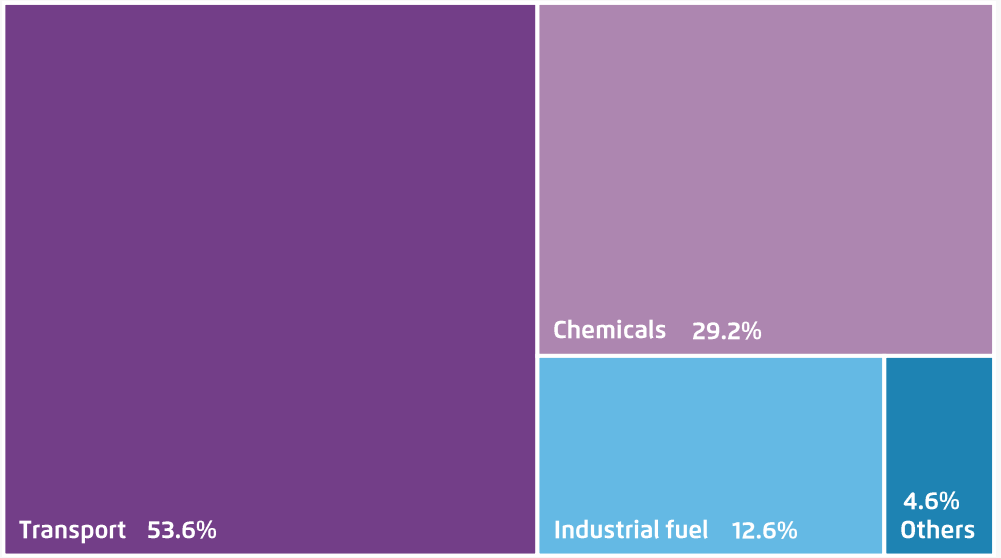
Oil’s share in energy mix vs sector breakdown

China’s oil consumption trend and oil’s share in national primary energy mix, 2015–2024



→ Despite rising demand in recent years, oil’s share in China’s energy mix has declined by 1 percentage point since 2019, reflecting the faster growth of clean energy.

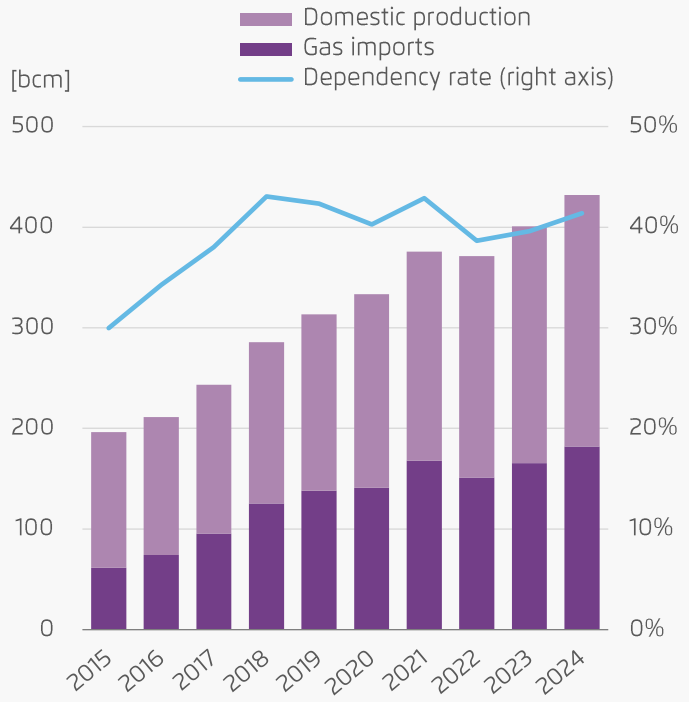
Oil consumption by sector, 2024



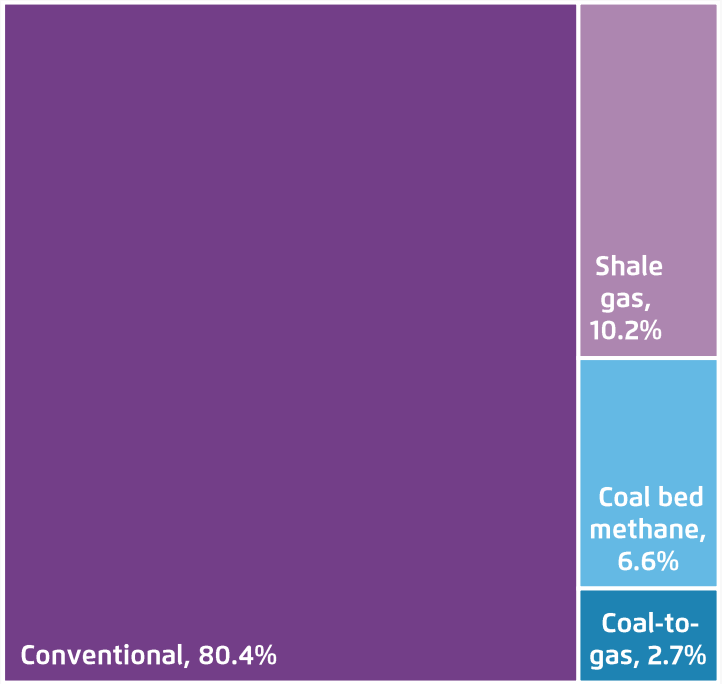
→ The transport sector remains the most dominant oil consumer, while demand from the chemical sector is now growing rapidly.

Natural gas supply

China’s natural gas supply and import dependency, 2015–2024



China’s gas production by type, 2024



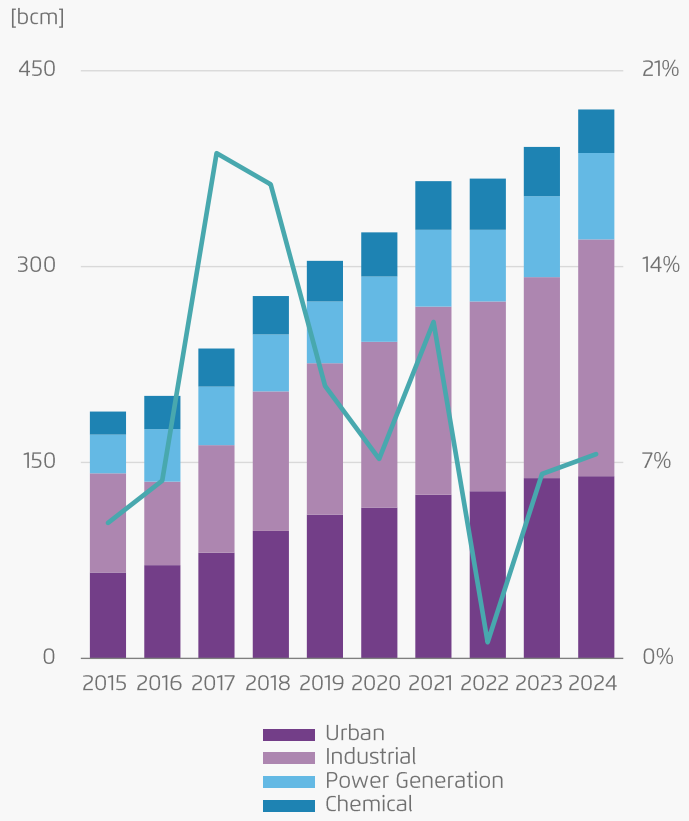
China strengthens gas supply amid rising energy security concerns:

- **Expand domestic supply for energy security:** China is ramping up natural gas supply – particularly of unconventional sources – to meet rising demand and address growing energy security risks.
- **Rising import dependency:** At the same time, gas imports have grown sharply – from 33% of total consumption in 2015 to 43% in 2024.
- **Methane emissions remain a policy gap:** Methane emissions from gas production require more focussed policy intervention.

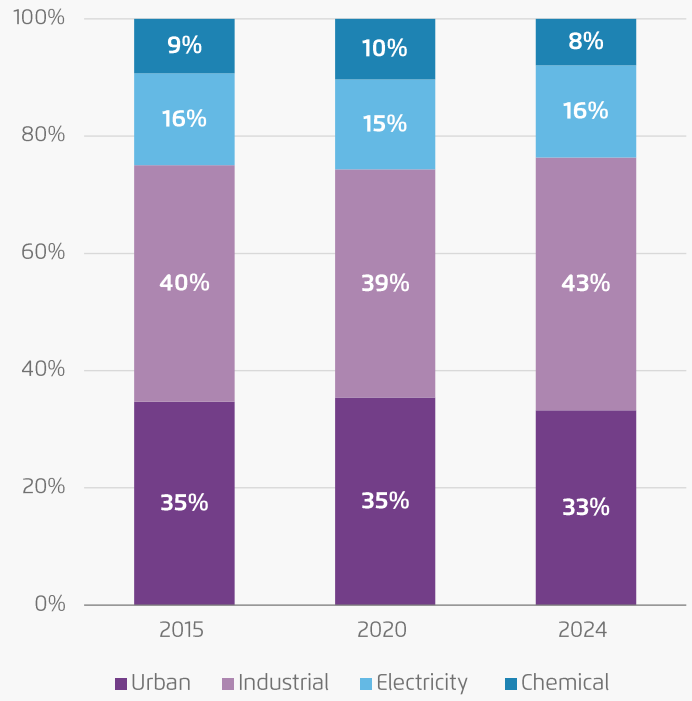
 Source: NBS, CNPC ETRI, Sinopec, MNR, China Customs, NEA and Agora’s own estimation

Natural gas consumption

China’s natural gas consumption by sector, 2015–2024



China’s natural gas consumption mix, 2015 versus 2020 versus 2024



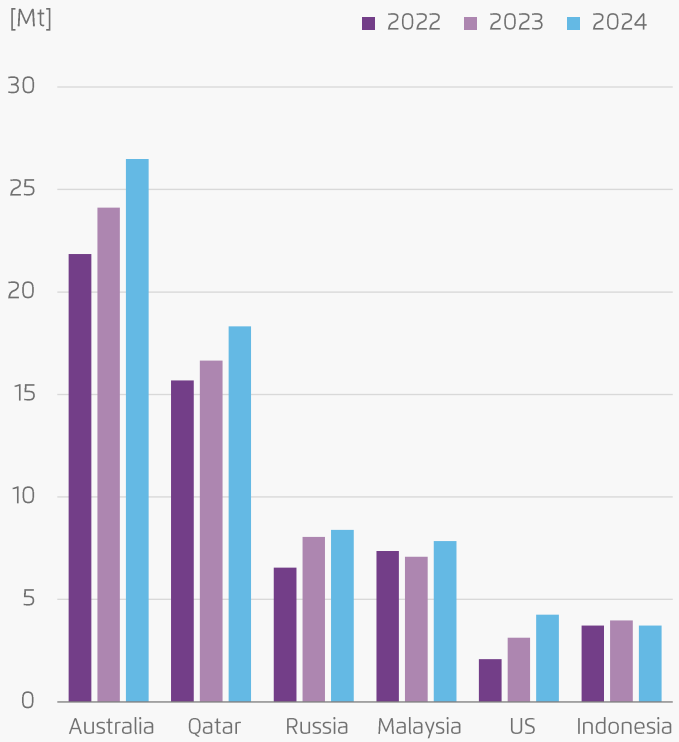
Sustained growth and relatively stable demand structure:

- **Steady consumption growth:** China’s natural gas consumption rose by 7.3% in 2024 to 420 bcm.
- **Demand driven by industry and cities:** Growth was broad-based, led by urban gas and industrial use, which together make up over 75% of total demand.
- **Stable sectoral mix:** The sectoral mix has remained relatively stable over the past decade, reflecting a rather consistent consumption pattern despite strong growth.

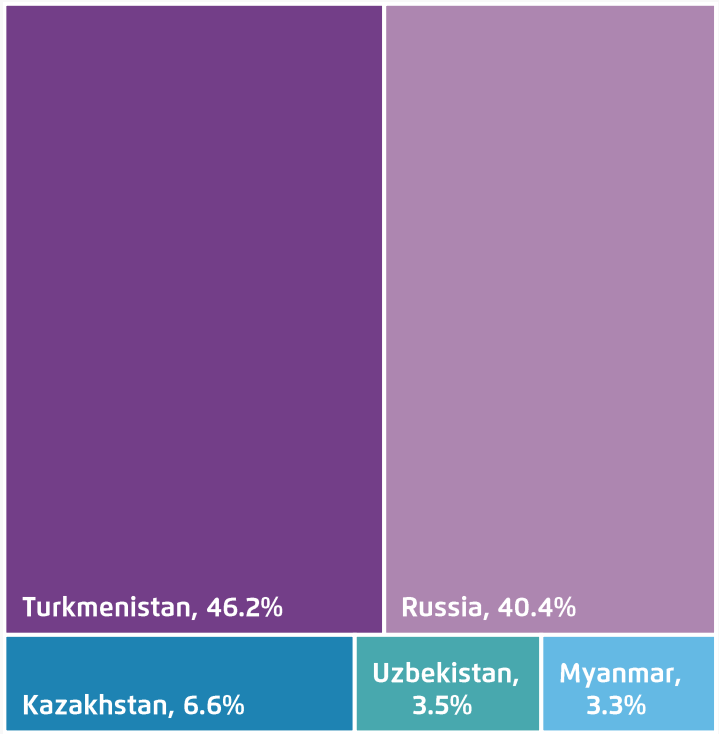
 Source: NBS, CNPC ETRI, Sinopec, NDRC and Agora’s own estimation

Natural gas imports

China’s LNG imports by country of origin, 2022–2024



China’s pipeline gas imports mix by country, 2024



China LNG and pipeline gas imports continue to grow:

- **LNG imports rebound:** LNG imports rose by 7.5% YoY in 2024 to 76.7 Mt, reflecting a rebound in demand and improved price conditions.
- **Supplier concentration persists:** Australia, Qatar, Russia and Malaysia accounted for 79% of total LNG imports in 2024, underscoring continued reliance on a concentrated group of exporters.
- **Pipeline flow increases:** Pipeline gas imports grew 13.1% in 2024, boosted by stronger flows via the Power of Siberia and Central Asia routes.

Chapter 6:
Power system transformation

Key data and facts in 2024

~50%

In 2024, China accounted for approximately 46% of **global wind power capacity** and nearly 50% of **global solar capacity**, highlighting its central role in scaling up renewable energy. This dominant share underscores China's leadership in driving the global clean energy transition and advancing international climate mitigation efforts.

42%

In 2024, China's **aggregate wind and solar capacity** reached 1,406 GW, reflecting a robust 34% YoY increase and accounting for 42% of the country's total power capacity. In contrast, coal power capacity grew modestly to 1,195 GW (+2.6% YoY). These figures signal a decisive shift in China's power mix toward a renewables-oriented energy era.

55%

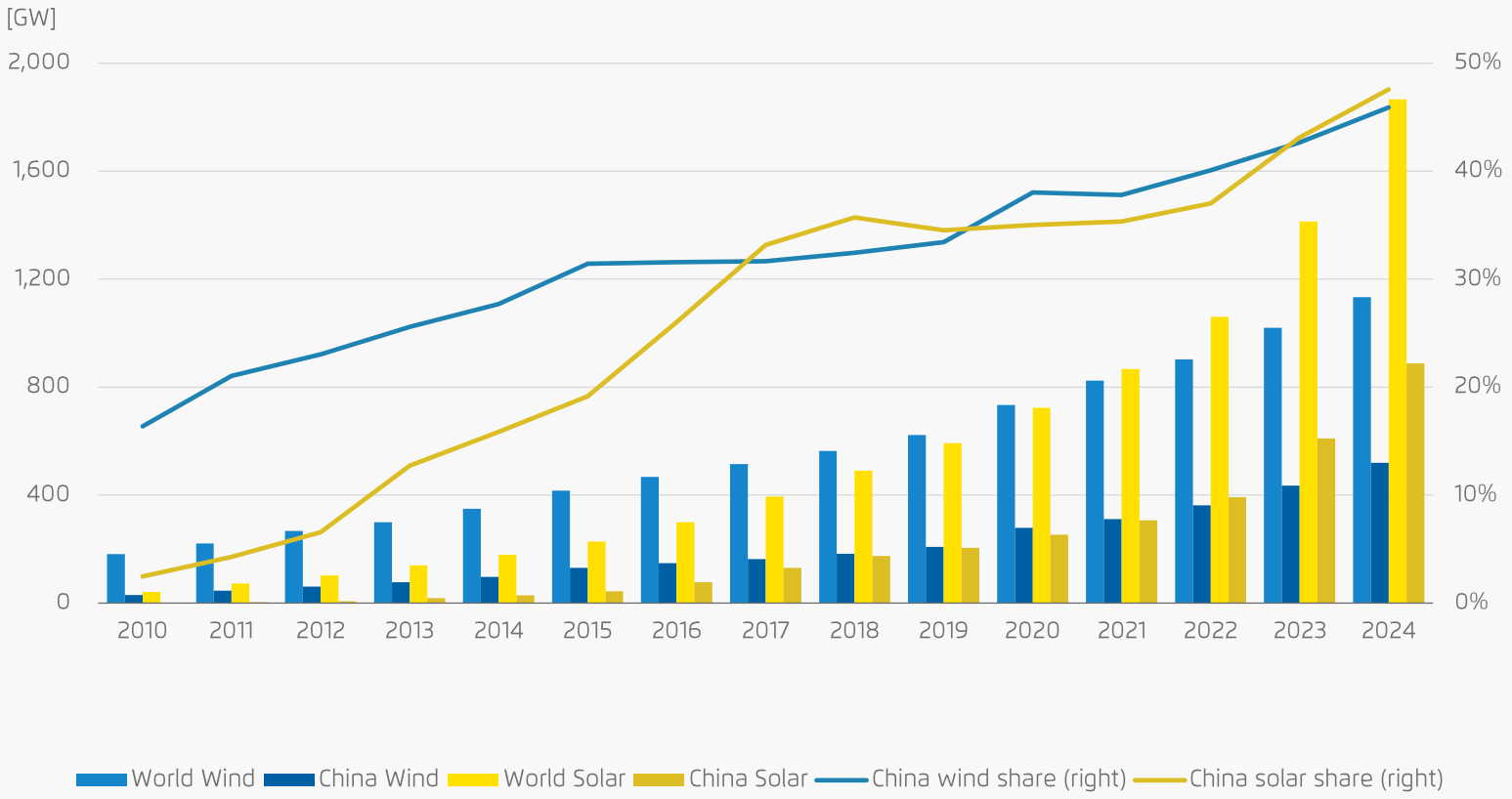
As of 2024, **thermal power** remained dominant, accounting for nearly 63% of total electricity generation, with coal alone contributing 55%. In contrast, wind and solar combined generate just 18.5%, underscoring the need for decisive policy action to support deep decarbonisation of China's power sector.

+6.8%

China's **power demand** remained robust in 2024, growing by 6.8% YoY. Tertiary and residential consumption saw particularly strong increases – approaching double-digit growth – intensifying the pressure on renewable energy deployment to scale rapidly and meet the rising demand sustainably.

China’s wind and solar expansion stands out globally, positioning the country as a driving force in the international clean energy transition

China’s rising importance in global wind and solar market, 2010–2024



Trends in China’s renewable development:

- **Global leader in capacity:** By 2024, China held 46% of global wind and nearly half of global solar capacity, leading the clean power transformation.
- **Accelerated growth rate:** China’s Compound Annual Growth Rates (CAGR) of wind and solar capacity in 2010–2015, 2016–2020, 2021–2024 were 42%, 24% and 30% – consistently outpacing global rates by 7 to 18 points.
- **Solar takes the lead:** While wind initially drove early expansion, solar has outpaced it since 2020.

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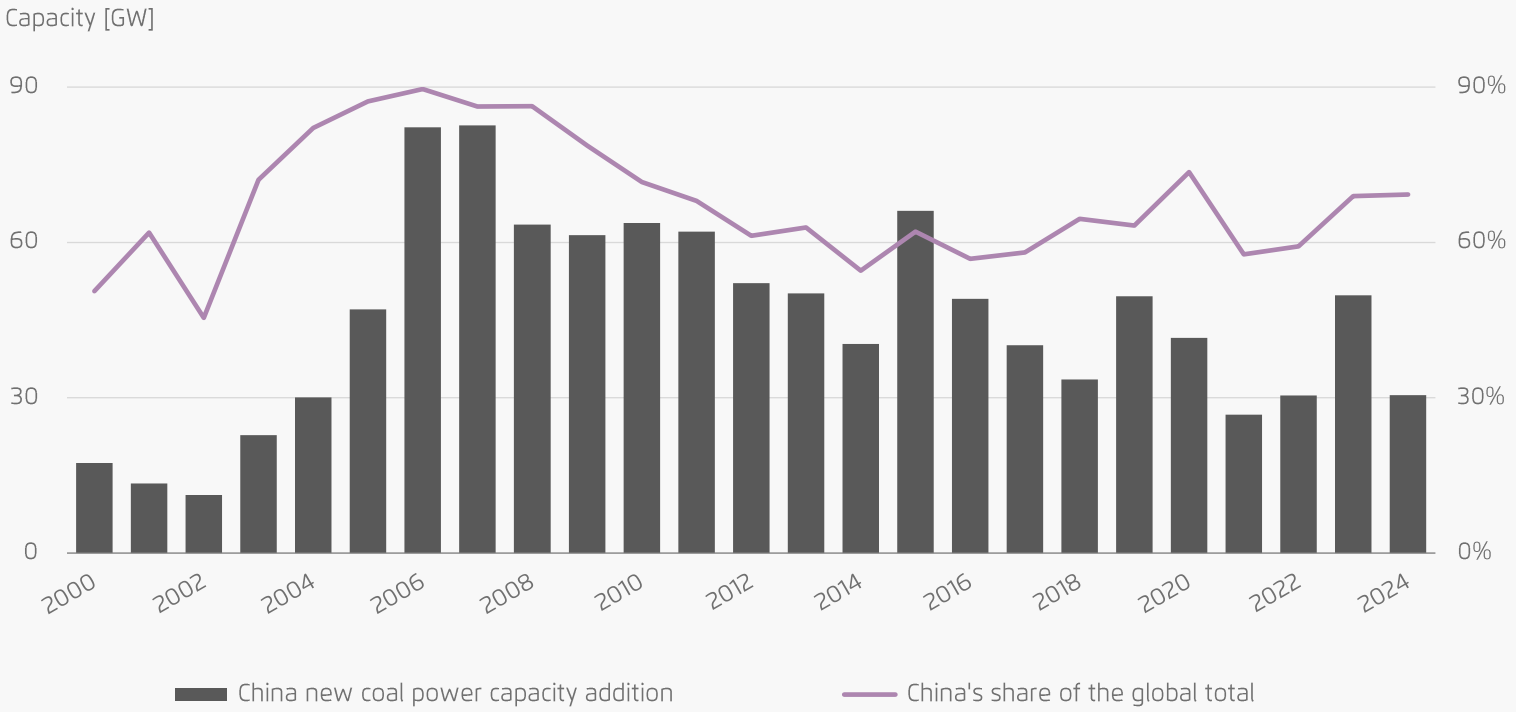
Despite booming renewables, China still leads in new coal power capacity addition – revealing a core contradiction in its energy strategy

China’s new coal power capacity addition, 2000–2024

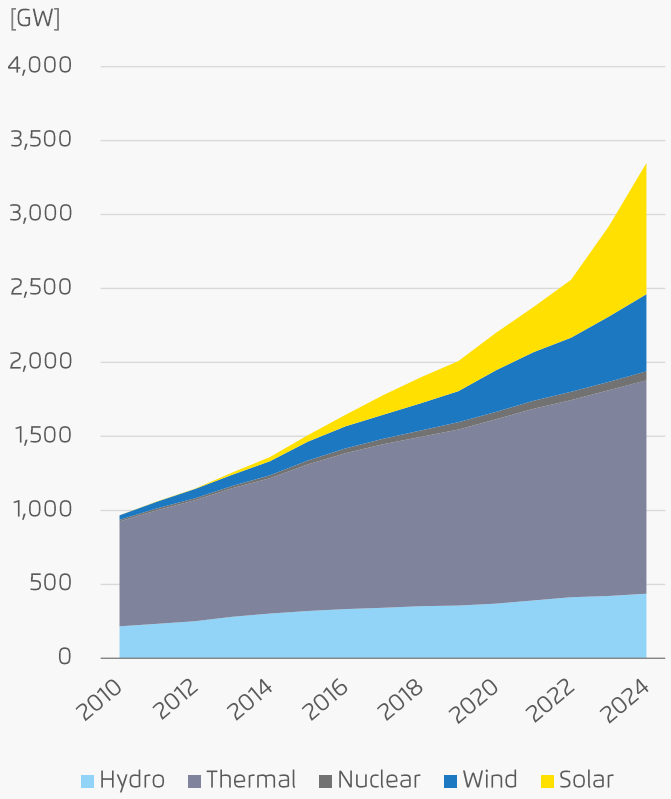


China’s coal power trend:

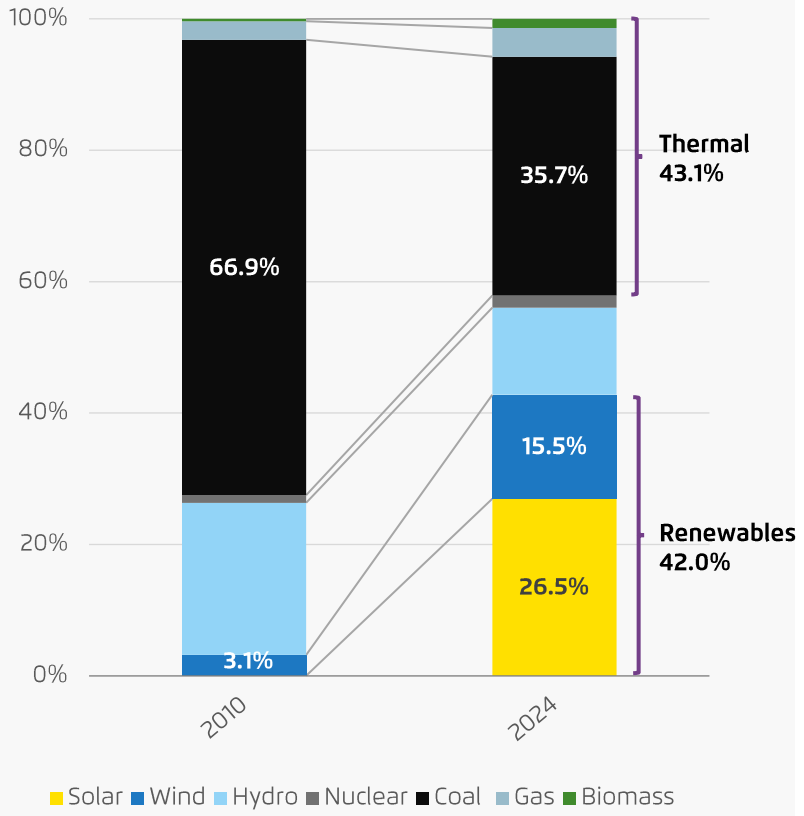
- **Massive buildout:** Since 2000, China has added over 1,100 GW of new coal power capacity – more than twice the total added by the rest of the world combined.
- **Ongoing expansion:** Coal plant approvals continue, with a sharp rise in 2024 as 94.5 GW of new capacity began construction.
- **Structural dependence:** Coal still generates over half of China’s electricity, driven by energy security concerns and surging demand.

Installed capacity of wind and solar surpassed that of thermal power in the early 2025

China's installed capacity, 2010–2024



Power capacity mix: 2010 vs 2024



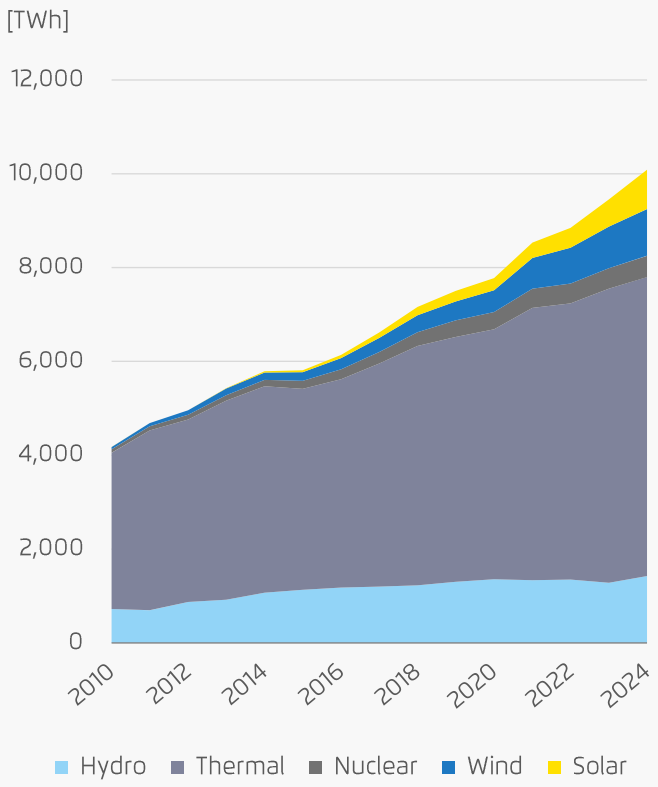
Evolving power mix and capacity milestones:

- → **Coal down, renewables up**: From 2010 to 2024, coal's share fell by 33 points, while wind and solar rose by 39 points.
- → **Stable minor sources**: Gas and other thermal power held steady at 4.4% and 3.3% over the past five years.
- → **Renewables take the lead**: In 2024, wind and solar trailed thermal by just 1.1 points; by March 2025, they had overtaken it in installed capacity.

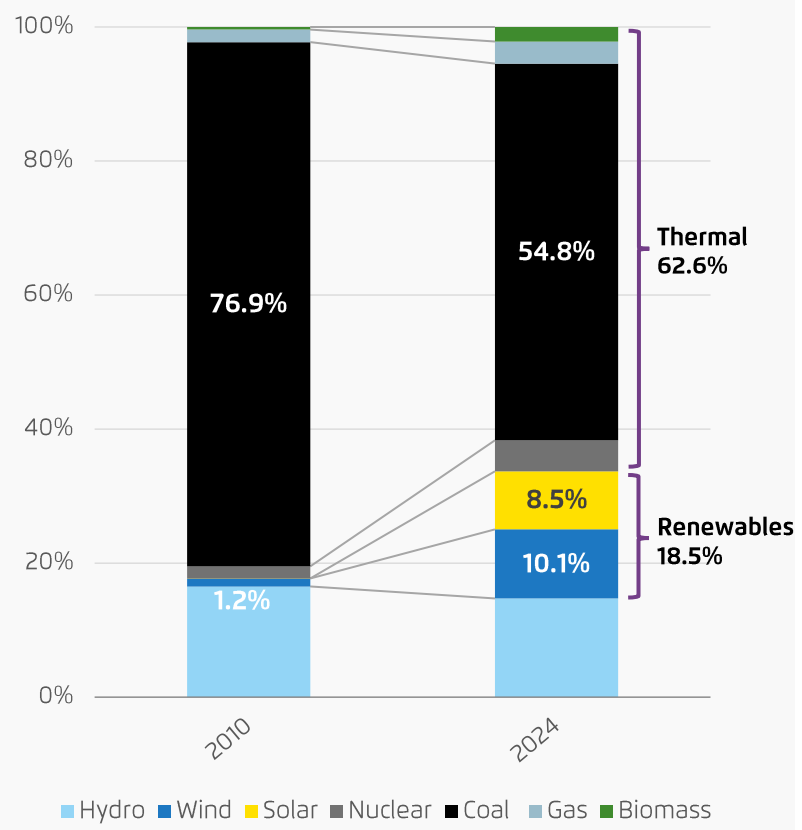
 Source: NEA, CEC, various media sources and Agora's own calculation

China’s power generation is shifting, with renewables surging but coal still dominant – signaling a transition in progress, not yet complete

China’s power generation by fuel, 2010–2024



Generation mix snapshots

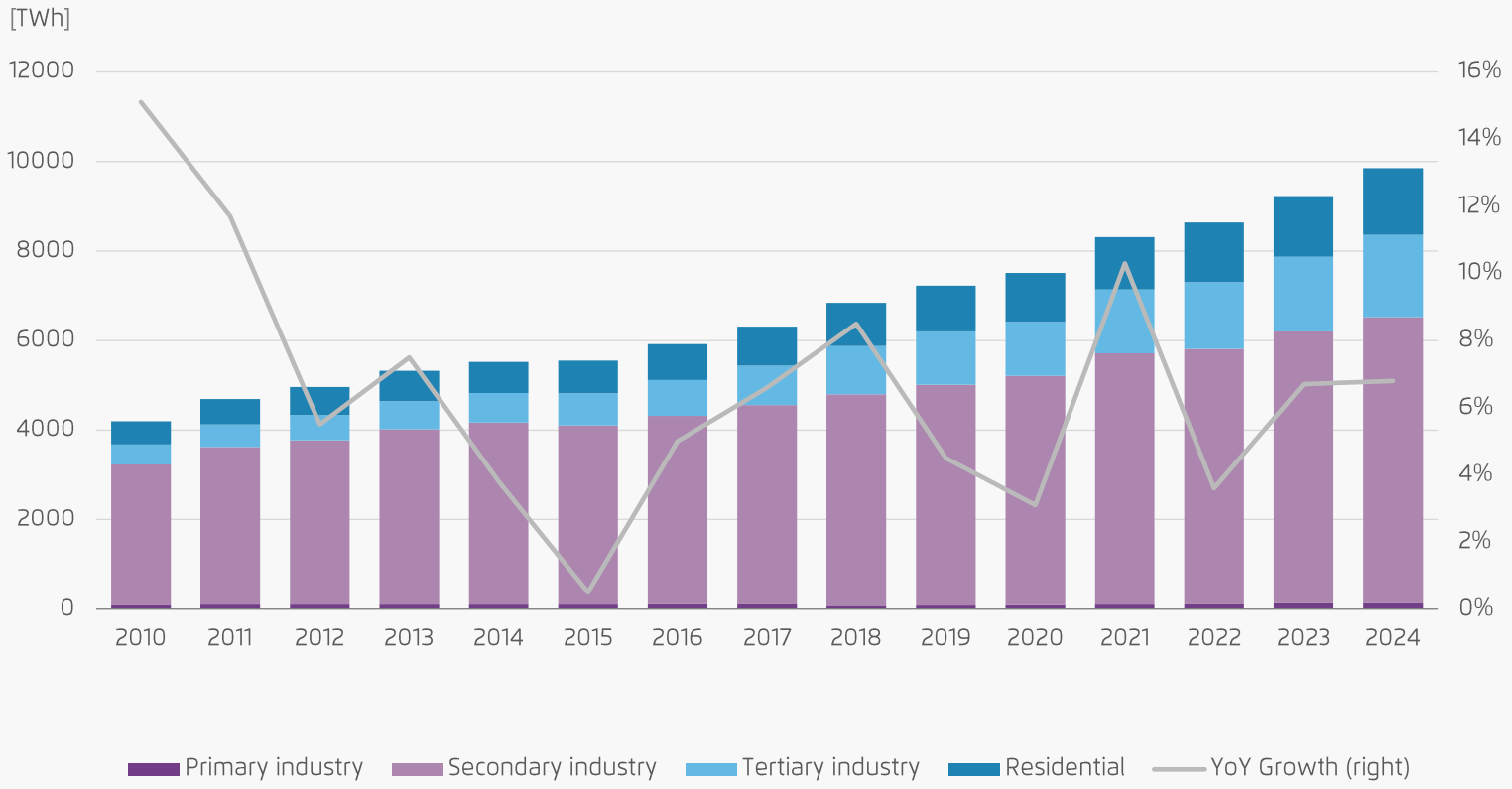


Gap between renewable capacity and generation:

- **Generation lags behind capacity:** Despite rapid growth in capacity, wind and solar still generate less than one fifth of China’s electricity, highlighting the gap between capacity expansion and actual power generation.
- **Strong momentum, under-tapped potential:** Although electricity generation from wind and solar is growing far faster, it remains supplemental to meet electricity demand, reflecting the urgent need for decisive policy measures to translate this growth into full-scale replacement.

China’s power consumption continues to climb steadily, bringing more pressure to ensure that clean energy keeps pace with consumption

China’s electricity consumption by sector, 2010–2024

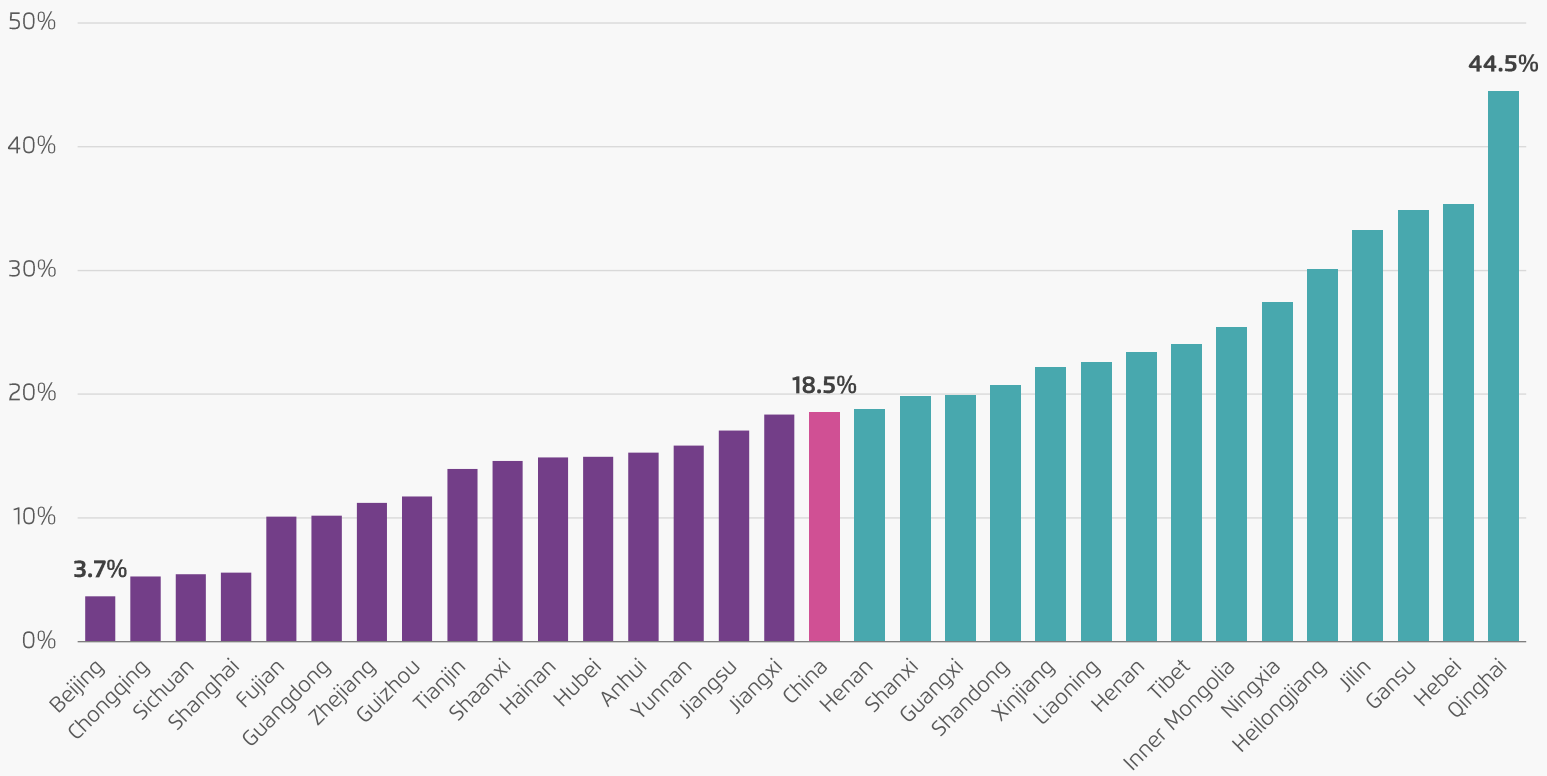


Sustained power demand growth challenges China’s clean transition:

- **Rising demand pressures the transition:** China’s electricity demand continues to grow steadily, driven by electrification, digital infrastructure, industrial shifts and more frequent extreme weather.
- **Strong growth:** From 2010 to 2024, electricity consumption rose at a compound annual growth rate of 6.3%.
- **Massive annual growth:** In 2024 alone, China’s annual electricity production increased by 624 TWh, surpassing Germany’s total annual demand by over a third.

Distribution Grid Integration of Distributed Renewables (DGIDR) represents the next critical frontier for research and power sector reform in China

Share of variable renewables in power generation by province, 2024



Why DGIDR matters:

- **Regional variation = policy potential:** Uneven deployment of variable renewables across China creates strong potential for focused research and policy pilots.
- **System weak points:** Distribution grids and distributed renewables are key weak links in China's power system transformation.
- **Agora China's focus:** Ongoing research is exploring this critical frontier.

 Source: NEA, NBS, CEC, various media sources and Agora's own calculation

Chapter 7:
Industry decarbonisation

Key data and facts in 2024

>1/4

Industry contributed over a quarter of China's fuel combustion **CO_2 emissions**, yet they hold significant potential for rapid abatement. Aligning industrial activity with renewable energy generation can accelerate decarbonisation and enhance clean power integration.

>60%

As the largest consumer of both power and heat, industry accounts for over 60% of China's fuel combustion **CO_2 emissions** when indirect emissions are included. This makes it a key candidate for deep electrification and low-emission heat solutions.

96
CNY/t

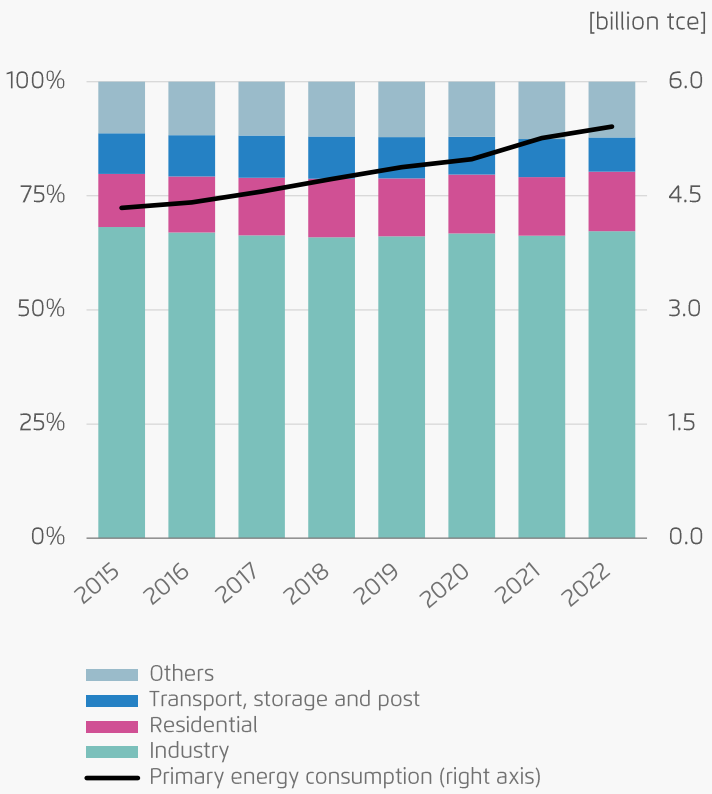
China's average **carbon price** reached a record high of CNY 96 in 2024. However, after the steel, cement and aluminium sectors were added to the national carbon market, prices dropped by 36% in May 2025. Market demand for low-carbon products remains sluggish.

2,594
Mt CO_2

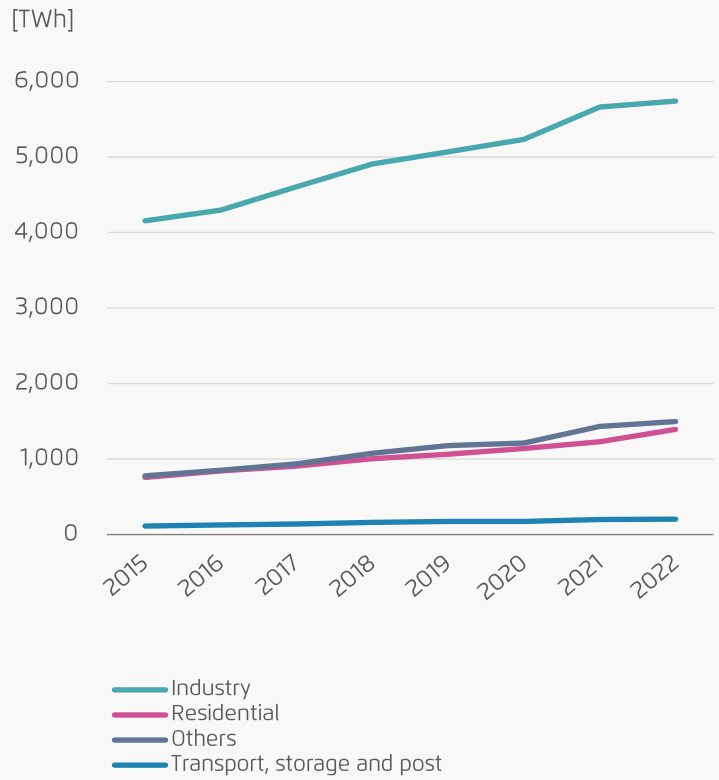
Green public procurement could cut up to 2,594 Mt of carbon emissions from steel and cement alone. Alongside other government incentives, it boosts green product competitiveness, lowers investment risk and drives demand for climate-friendly materials.

Industry’s dominant role

China’s primary energy consumption and sector proportions, 2015–2022



Electricity consumption by sector, 2015–2022

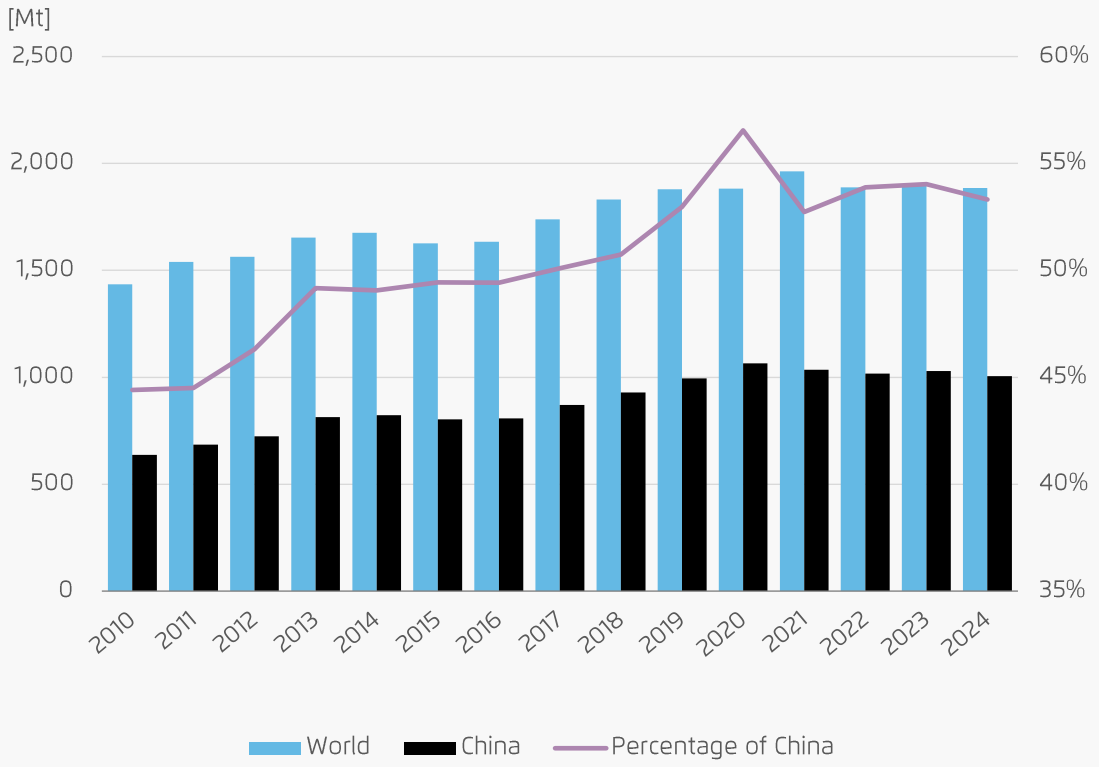


Industry’s role in China’s energy transition:

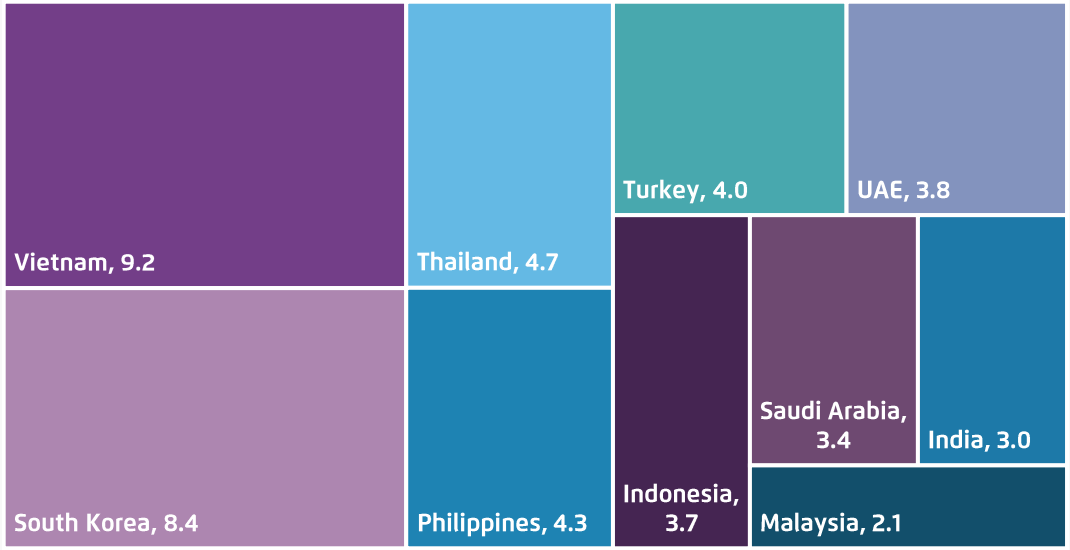
- **Central role in energy demand:** As the largest consumer of energy and electricity, industry is central to achieving China’s dual carbon goals.
- **Enabler of renewable integration:** The sector holds significant potential to support the energy transition through increased use of renewable electricity.
- **Tackling process emissions:** Cutting process emissions will be key to industry’s contribution to national climate mitigation efforts.

Chinese steel manufacturing in the world

Crude steel production, 2010–2024



Top 10 export destinations (in Mt) of Chinese steel

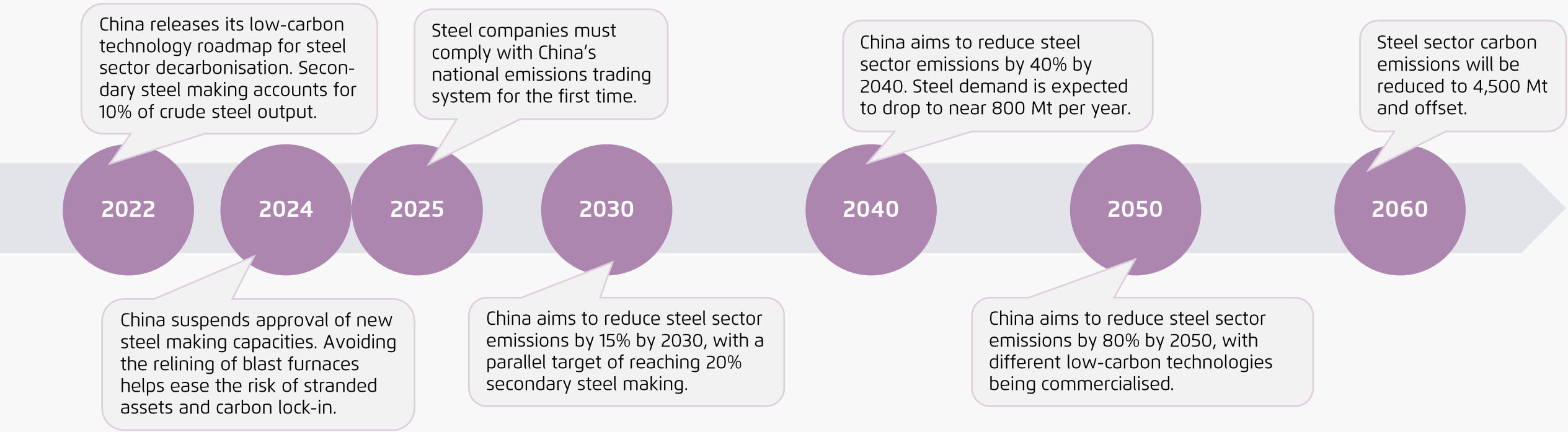


→ China has been the world's largest steel producer since 1996.

→ Southeast Asia and the Middle East are major destinations for China's steel exports.

Pathways for iron and steel sector decarbonisation in China

China is intensifying efforts in efficiency, resource recycling, process optimisation, technological innovation, product upgrades and carbon capture utilisation and storage (CCUS) to drive the steel sector toward carbon neutrality by 2060.

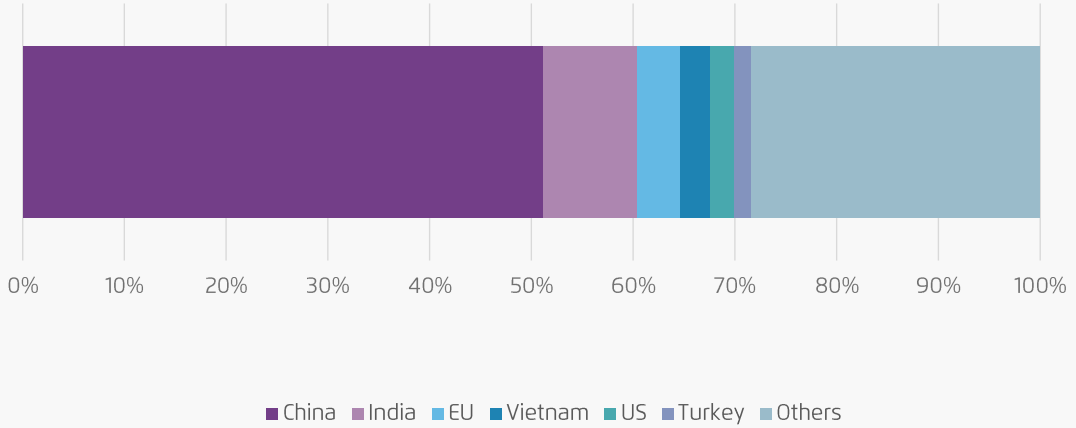


Cement decarbonisation in China

Cement production: China versus world, 1985–2024

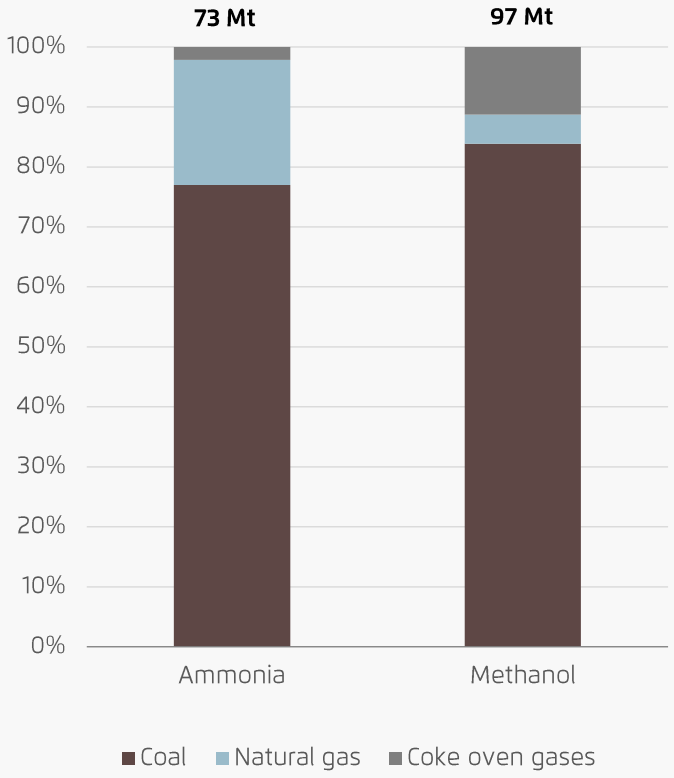
Global cement production mix by major economy, 2022

- China has been the world's top cement producer for nearly 40 years, with output peaking in 2014. Since 2021, production has declined, and China aimed to peak cement emissions before 2023.
- Looking ahead to a projected decrease in demand through 2050, the sector is boosting energy efficiency, using cleaner fuels, lowering the clinker ratio, and advancing CCUS.

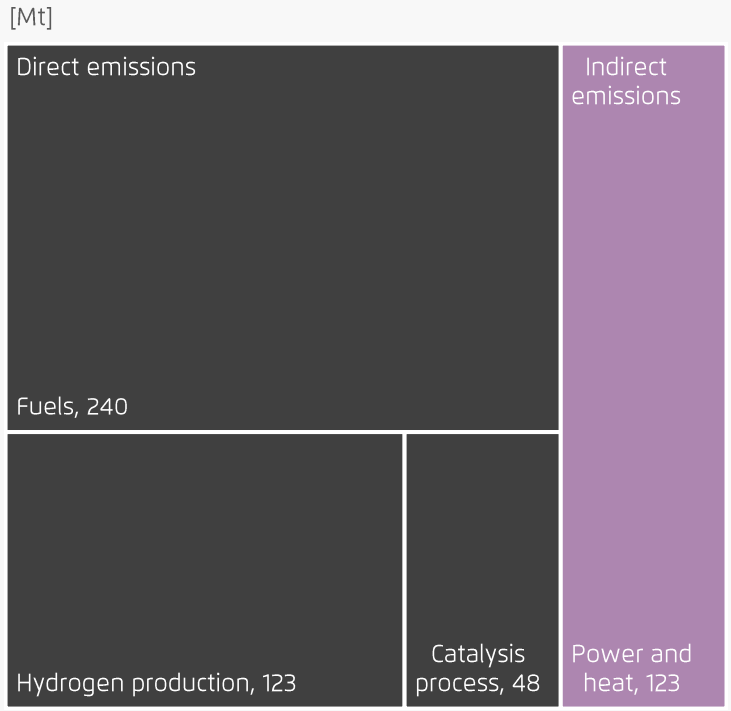


Decarbonising the chemical sector is complex, requiring renewable hydrogen, circular material use and a redefined role for chemicals in the economy

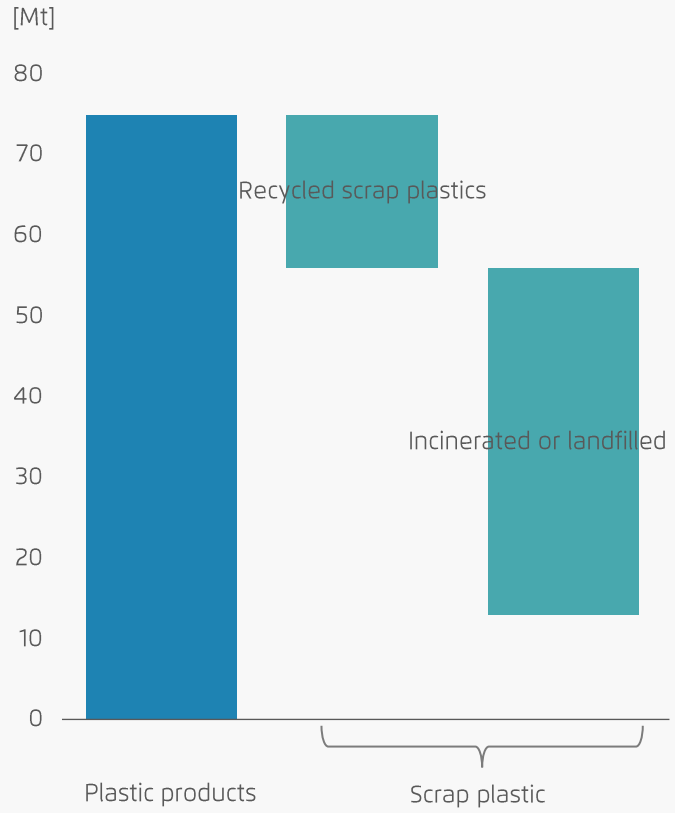
China's ammonia and methanol production by fuel type, 2024



Petrochemical sector's emissions mix, 2022



62 Mt plastics are collected annually, with only 30% recycled



 Source: Plastic Recycling Association of CRRA, various industrial sources and Agora's own estimation

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Chapter 8:
Hydrogen economy

Key data and facts in 2024

125 kt

By 2024, China's **renewable hydrogen** capacity reached 125,000 tonnes – exceeding the 2025 target – with another 850,000 tonnes under development. Yet it accounts for less than 5% of total output, as coal-based hydrogen still dominates, especially in ammonia and methanol production.

2,200 km

Pipeline projects spanning 2,200 km from resource-rich Northwest China to eastern demand centres are accelerating hydrogen adoption in sectors like steel and refining. This growing infrastructure also encourages investment in green hydrogen and its derivatives.

72%

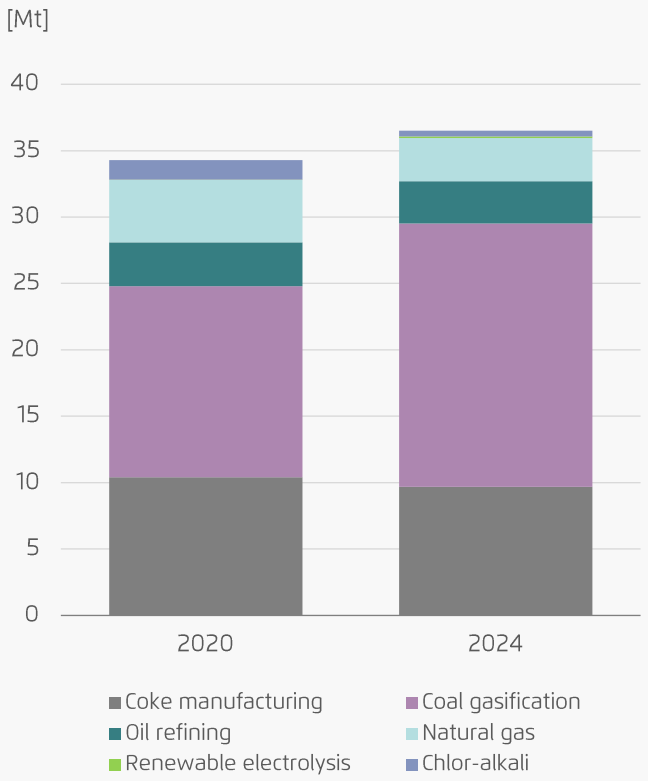
Coal-based hydrogen still accounts for 72% of national supply, underscoring the urgency of halting new capacity and beginning a phased coal exit. High costs continue to hinder large-scale adoption of green ammonia and methanol.

80%

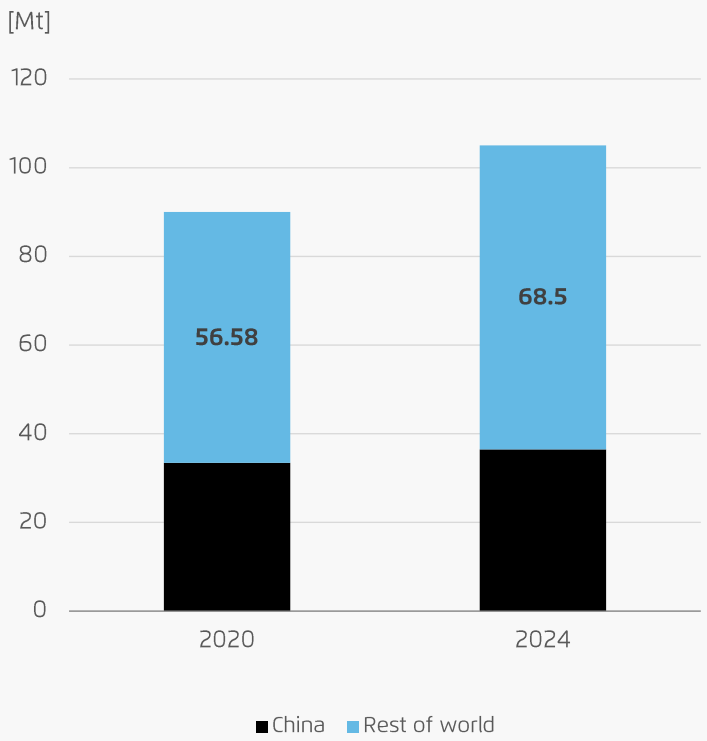
China accounts for 80% of global installed water **electrolyser capacity** and 70% of electrolysis-based hydrogen capacity. Yet only a quarter is powered by renewables, underscoring the need for better planning and stronger integration with clean energy to avoid emissions lock-in.

Hydrogen production: China leads global supply but remains heavily reliant on fossil fuels

China's hydrogen production by source, 2020 versus 2024



China as the world's largest hydrogen producer, 2020 versus 2024

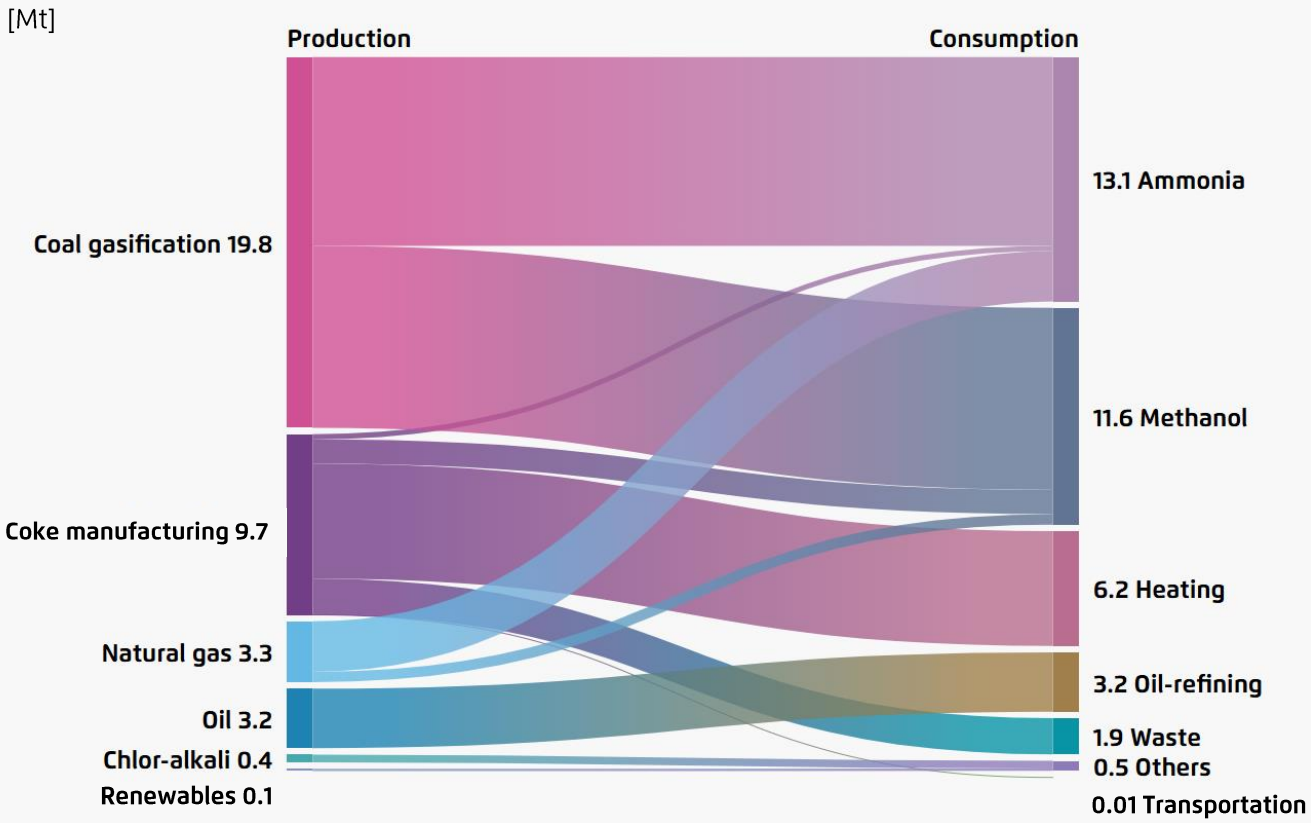


China's hydrogen production at a crossroads:

- Despite policy support and rising renewable hydrogen capacity, coal-based hydrogen has grown more rapidly over the past four years, driven by coal's pivot from power to chemicals.
- Expanding renewable hydrogen must go hand in hand with phasing down coal-based production to avoid stranded assets.
- A coordinated transition would cement China's leadership in the hydrogen economy, while showcasing Power-to-X as a key climate and industrial solution.

Renewable hydrogen holds vast potential for decarbonising downstream sectors

China hydrogen flow, 2024



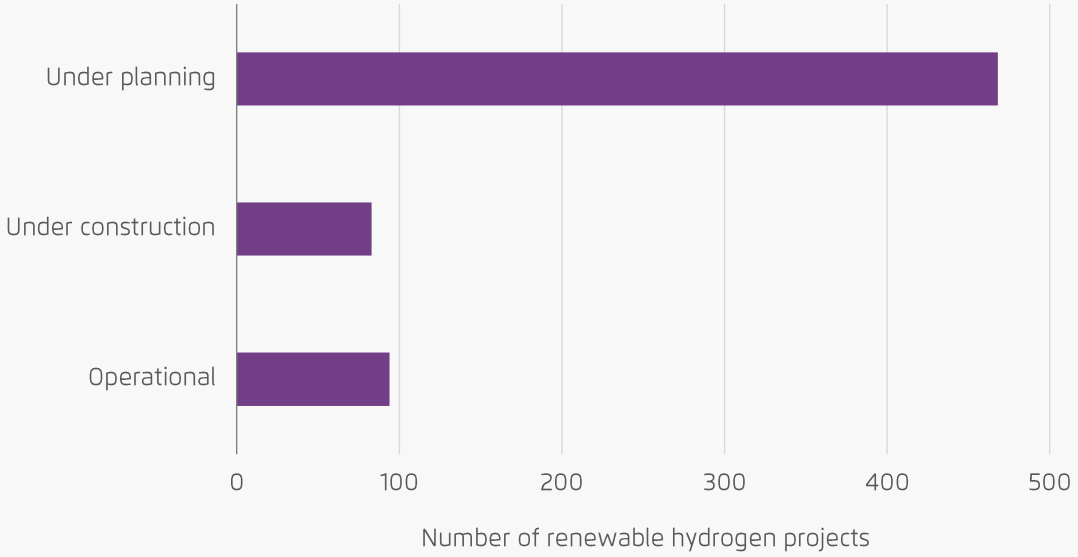
Unlocking renewable hydrogen's role in industrial decarbonisation:

- → **Replacing fossil-based hydrogen** with renewable alternatives in China's large-scale ammonia, methanol and oil refining industries would significantly cut emissions and accelerate chemical sector decarbonisation.
- → **Up to 8.1 Mt per year of hydrogen** could be redirected as industrial feedstock, including as a reducing agent in primary steel production, unlocking major emission abatement potential.
- → **Fuel cell vehicle clusters** in demonstration cities have positioned China's heavy-duty vehicles as emerging off-takers of clean, by-product hydrogen. This reflects government support for hydrogen use in transport, indicating official expectations for continued growth towards 2030.

 Source: NEA, China Hydrogen Alliance, IEA and Agora's own calculation

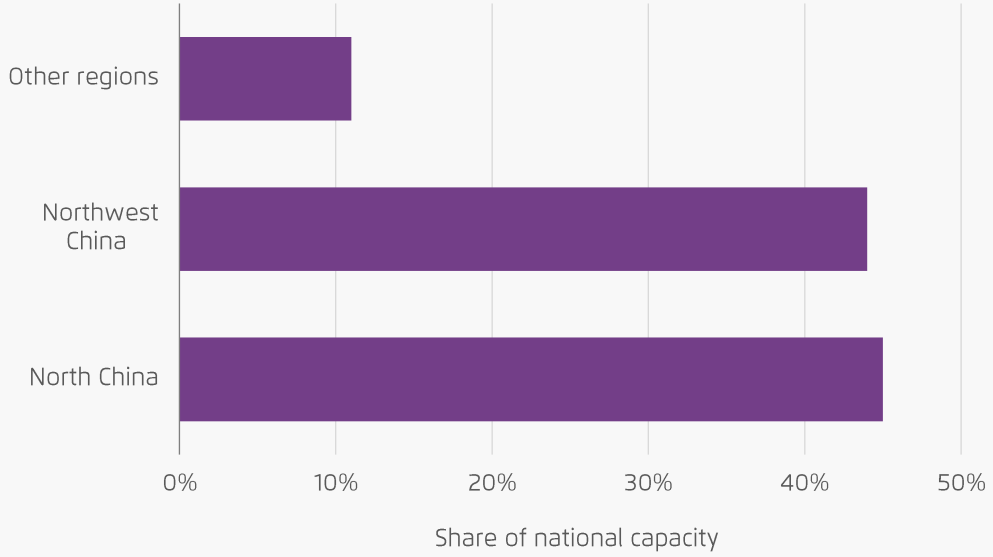
A snapshot of renewable hydrogen development in China

Number of renewable hydrogen projects in China, 2024



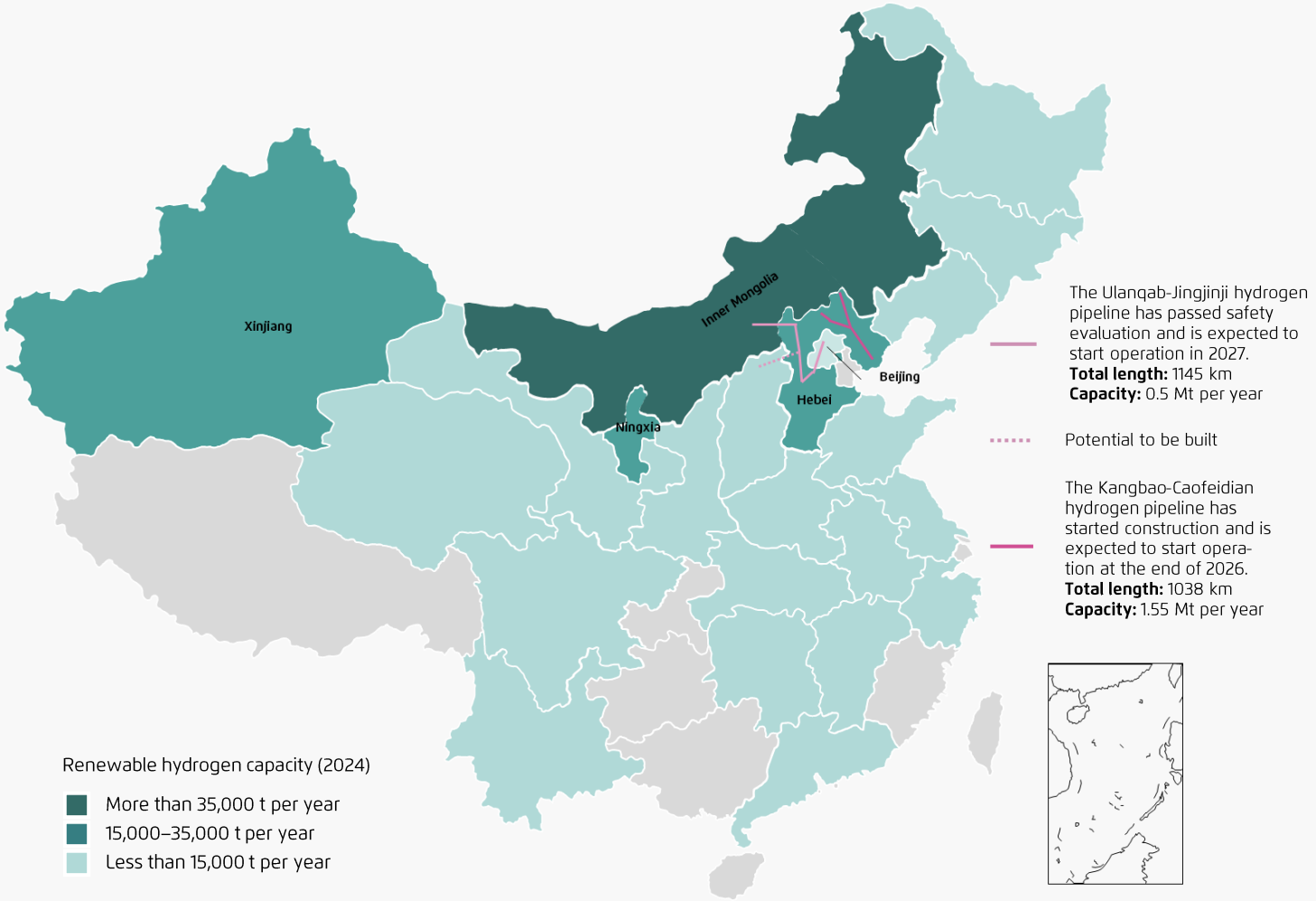
- Over 90 hydrogen projects are currently operational in China, including 35 commissioned in 2024.
- An additional 83 projects are under construction, with many more in various stages of planning.

Renewable hydrogen capacity mix by region, 2024



- Operational renewable hydrogen projects have a combined capacity of 125 kt per year, with 48 kt per year added in 2024 alone.
- Installed water electrolyser capacity reached 500 kt per year, with actual hydrogen output estimated at around 320 kt in 2024.

Renewable hydrogen capacity and infrastructure map in China



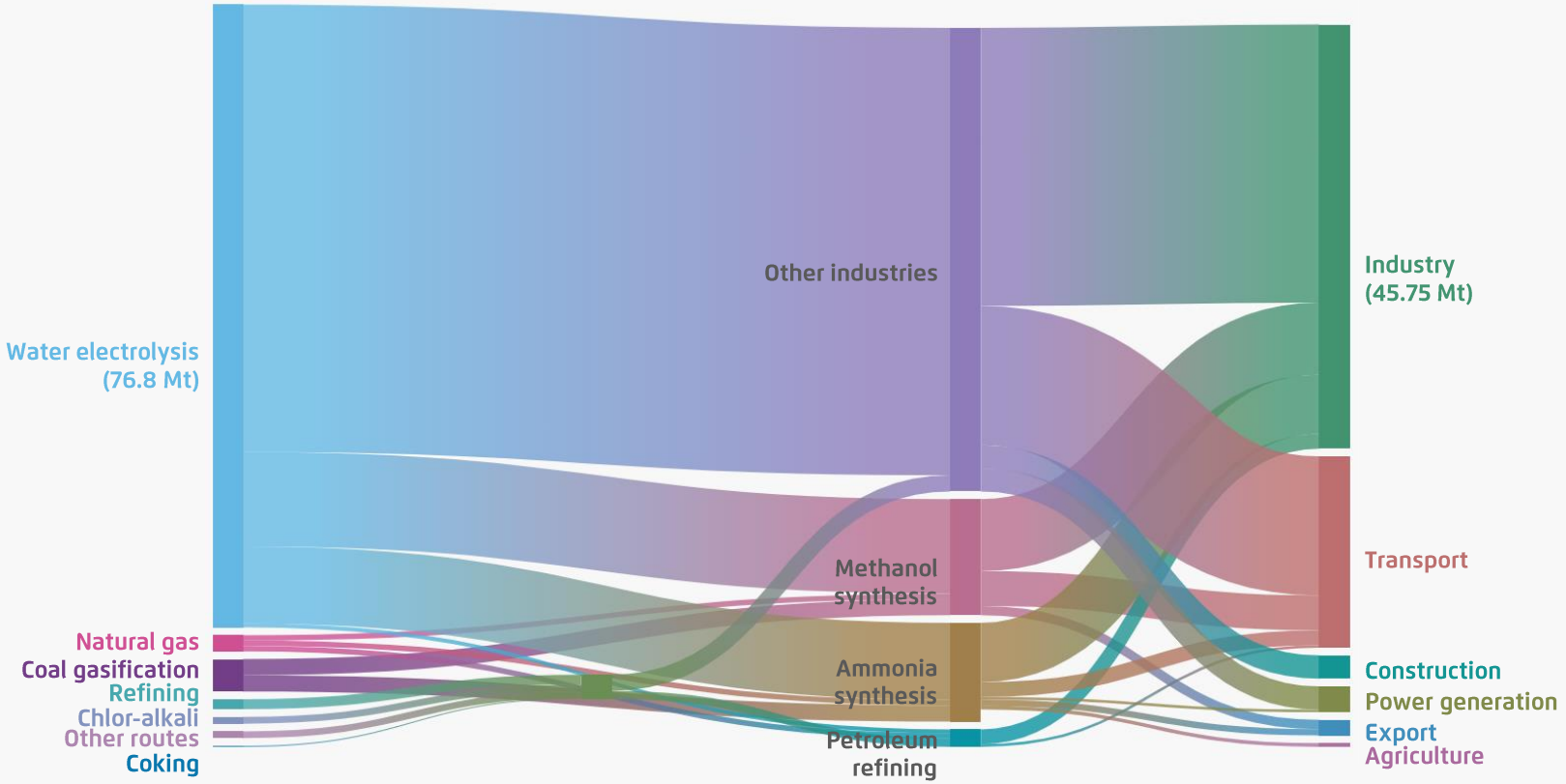
The evolving landscape of renewable hydrogen in China:

- **Regional focus:** Renewable hydrogen projects are concentrated in northern and north-western China, with growing potential in offshore wind-powered production.
- **Key applications:** Current deployment centres on energy storage and the production of green chemicals such as ammonia and methanol.
- **Expanding infrastructure:** Momentum picked up in 2024, with 2,200 km of dedicated hydrogen pipelines and 400 km of hydrogen-blended pipelines in the planning stage.
- **Cost outlook:** In 2024, the average production cost of green hydrogen stood at CNY 29.3 per kg (~USD 4.1), while the average end-user price reached CNY 51.2 per kg (~USD 7.2).

 Source: China Hydrogen Alliance, China EV100 Hydrogen Centre and Trendbank

China’s hydrogen outlook for 2060: renewable hydrogen is set to play a pivotal role in achieving carbon neutrality goals

2060 China hydrogen supply and demand forecast



No-regret applications of renewable hydrogen across sectors:

- **Industry:** As a reaction agent in direct reduced iron manufacturing and a feedstock for ammonia and other chemical production
- **Transport:** For long-haul aviation and maritime shipping where electrification is limited
- **Power generation:** As seasonal backup to support grid reliability and balance supply-demand

 Source: Adapted from the baseline scenario of Sinopec EDRI (2023). China Hydrogen Industry Outlook Report and Agora Industry

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