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Air Quality Briefing

China's air pollution shifts west: industrial relocation outpaces clean energy transition

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CREA
Centre for Research on Energy and Clean Air

CREA is an independent research organization focused on revealing the trends, causes, and health impacts, as well as the solutions to air pollution.

China's air pollution shifts west: industrial relocation outpaces clean energy transition – China Q1 2025 Air Quality Briefing

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About CREA

The Centre for Research on Energy and Clean Air (CREA) is an independent research organisation focused on revealing the trends, causes, health impacts, and solutions to air pollution. CREA uses scientific data, research, and evidence to support the efforts of governments, companies, and campaigning organisations worldwide to move towards clean energy and clean air, believing that effective research and communication are the keys to successful policies, investment decisions, and advocacy efforts. CREA was founded in Helsinki and has staff in several Asian and European countries.

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Key Findings

- **Pollution pressure is shifting towards western areas that are not prioritised in air pollution control policies.** In Q1 2025, although average PM2.5 levels in China declined by 5%, provinces such as Guangxi, Yunnan, and Xinjiang saw significant increases of 32%, 14%, and 8%, respectively. This shift reflects both the westward relocation of industrial activity and the influence of non-industrial sources like sandstorms and biomass burning. It signals growing air quality risks in non-priority areas, including ones traditionally regarded as clean-air strongholds.
- **Western provinces saw the most pronounced increases in energy-intensive production,** with pig iron (+10.5%), crude steel (+5.8%), and non-ferrous metals (+4.2%) all rising notably—highlighting a clear shift of heavy industrial capacity westward. This expansion remains tied to coal-heavy steelmaking and conventional coal chemical processes, offsetting gains from cleaner power structure.
- **Heavy pollution episodes are rebounding in inland regions.** While the national average percentage of heavily polluted days decreased, northwestern and central Yangtze River provinces such as Ningxia, Shanxi, and Hubei experienced localized increases. These areas showed concurrent rises in both heavily polluted days and de-weathered PM2.5 concentrations, pointing to persistent structural emission sources rather than meteorological anomalies.
- **Western and central non-key regions should be integrated into the core of air quality management as industrial activity expands westward.** Looking ahead to the 15th Five-Year Plan, China has the opportunity to embed stronger air quality controls into its broader industrial transformation agenda, positioning air quality as a key metric of regional resilience and competitiveness. Key priorities include accelerating clean energy deployment and enhancing regional decarbonisation coordination to prevent pollution from shifting into previously low-pollution areas.

Air pollution shifts west

In the first quarter of 2025, China made notable progress in air pollution control. The national average concentration of PM2.5 declined by 5% year-on-year, and other major pollutants closely linked to industrial activity and fossil fuel combustion—such as SO_2, NO_2, and PM10—also showed overall declines or remained stable. Particulate pollution, in general, eased across most regions. A key driver was a 4-percentage-point drop in the share of coal-fired power in the national electricity generation mix, signaling that structural optimisation of the power sector is beginning to play a critical role in the "dual reduction" of pollution and carbon emissions, especially amid ongoing industrial electrification.

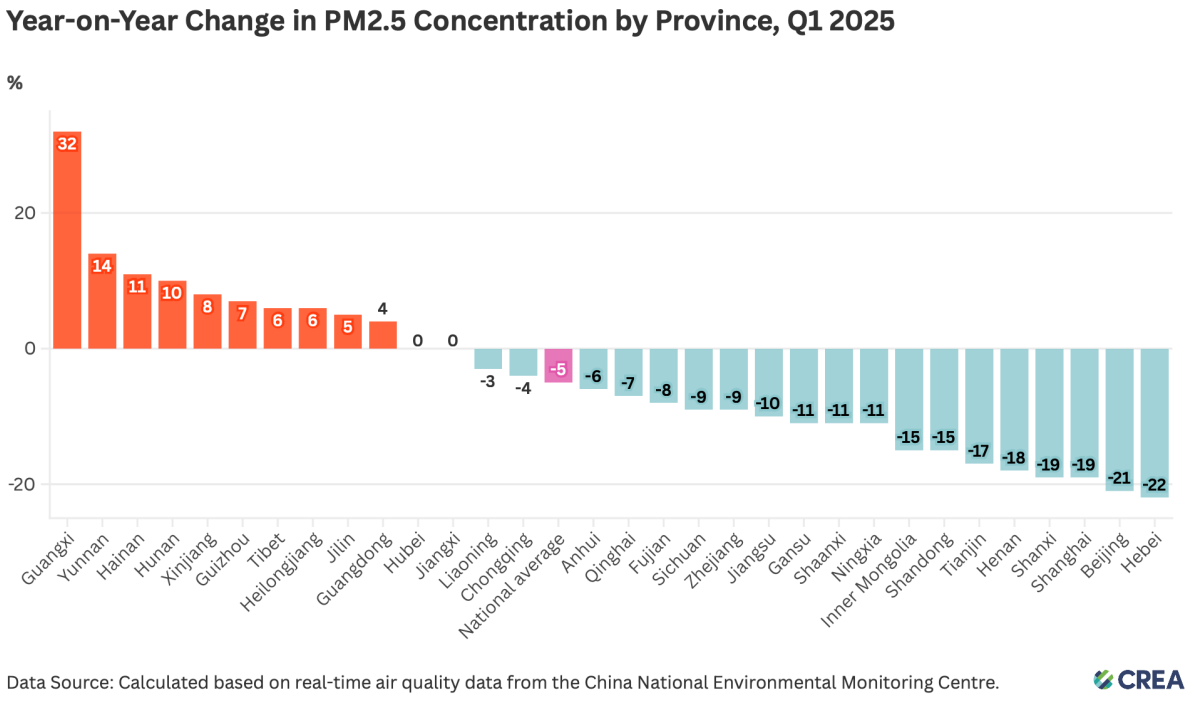
However, behind the overall improvement lie persistent challenges. PM2.5 levels nationwide still exceeded the national air quality standard by 18%, and nearly three-quarters of provincial-level regions failed to meet compliance targets—indicating that winter remains a season of acute health risk due to particulate pollution. At the same time, ozone pollution followed an opposite trend, increasing by 4% year-on-year, and is now emerging as the major counterpressure in China's air quality governance, reinforcing a dual challenge of winter PM2.5 and summer ozone.

A more structural concern is the notable shift in China's pollution map. Provinces experiencing worsening air quality in Q1 were mainly located in areas outside of China's priority control regions for air pollution, and most of them in the west of the country. For instance, Xinjiang surpassed Henan to become the most polluted region in the country, with an average PM2.5 concentration of 70 $\mu g/m^3$—8% higher than the previous year, double the national standard, and 14 times the WHO's annual guideline value.

The composition of pollution also reveals elevated health risks. In Xinjiang, the PM2.5 to PM10 ratio reached 0.71, indicating that fine particles—more harmful to human health—constituted the dominant fraction. Meanwhile, NO_2 levels rose by 1% while SO_2 declined by 13%, suggesting that although coal desulfurisation efforts are showing results, the rebound in industrial activity and increased transport demand are driving up emissions of nitrogen oxides and particulates. After controlling for weather effects, 9.2 percentage points of the PM2.5 increase in Urumqi were attributable to anthropogenic sources, with meteorological factors contributing less than 1%—highlighting the strong industrial and human-driven nature of the pollution surge.

In addition to Xinjiang, PM2.5 levels also rose sharply in several other provinces previously considered air quality "safe zones." Guangxi (+32%), Yunnan (+14%), Hainan (+11%), and Hunan (+10%) all recorded significant year-on-year increases. In Guangxi and Hainan, the deterioration was mainly driven by meteorological factors, while in Yunnan, the increase stemmed from rising anthropogenic emissions tied to intensified industrial activity. The fact that these regions—long seen as ideal for residential and health-friendly living—are now under mounting pressure from pollution spillover, highlights the urgency of strengthening governance in non-traditional pollution areas.

Figure 1. Year-on-year change in PM2.5 concentration by province, Q1 2025



Data Source: Calculated based on real-time air quality data from the China National Environmental Monitoring Centre.

Over the past few years, energy-intensive industries have increasingly migrated westward, concentrating resource-heavy manufacturing in western provinces. This shift was originally intended to promote the integration of clean energy with industrial production in the west, and reduce overall carbon intensity—an approach aligned with China's dual goals of

pollution and carbon reduction[1] [2]. However, the rapid pace of industrial expansion has outpaced the capacity of some receiving regions to adapt in terms of energy structure and environmental governance.

Xinjiang exemplifies this growing imbalance. As one of the most active provinces in coal capacity expansion, it has seen cumulative investment in coal chemical projects approach RMB 500 billion, with total planned investments expected to exceed RMB 1 trillion under the 15th Five-Year Plan[3]. The continued dominance of high-emission, energy-intensive industries, combined with increased transport activity and transboundary dust events, has led to more severe particulate pollution.

Meanwhile, recent policy shifts in agricultural practices have introduced new seasonal challenges. Since early 2025, the previous blanket ban on straw burning has been relaxed to a more flexible "limited burning" framework, as outlined in the No. 1 Central Document[4] . Provinces such as Hunan, Sichuan, Guangxi, Jilin, and Yunnan are piloting time-and zone-specific burning policies[5]. Agricultural biomass burning re-emerged as a contributor to particulate pollution, underscoring the need for consistent regulatory enforcement.

In contrast, some historically polluted provinces have made notable progress. In Q1 2025, Henan—previously the most polluted province in 2024—reduced its PM2.5 concentration by 18%. Beijing and Shanxi also achieved reductions of 21% and 19%, respectively. Yet, meteorologically adjusted data suggest that anthropogenic emissions remain a major driver of pollution in these regions, indicating that current improvements are still fragile and require sustained efforts.

[1] **State Council of the People's Republic of China.** (May 17, 2020). *Guiding Opinions of the CPC Central Committee and the State Council on Promoting Large-Scale Development in Western China in the New Era.* Retrieved from https://www.gov.cn/zhengce/2020-05/17/content_5512456.htm

[2] **People's Daily Online.** (June 24, 2024). *Coordinating West-to-East Power Transmission and Local Power Utilization in the West.* Retrieved from http://paper.people.com.cn/zgnyb/html/2024-06/24/content_26066463.htm

[3] **Sina Finance.** (January 4, 2025). *Guotai Junan Securities: Coal Chemical Industry Booming in Xinjiang May Usher in a Golden Era.* Retrieved from https://finance.sina.cn/2025-01-04/detail-inecuivy7995890.d.html

[4] **State Council of the People's Republic of China.** (February 24, 2025). *Opinions of the CPC Central Committee and the State Council on Further Deepening Rural Reform and Advancing Comprehensive Rural Revitalization.* Retrieved from https://www.gov.cn/zhengce/202502/content_7005158.htm

[5] **Eco China Network.** (October 17, 2024). *Eco Headlines | Multiple Provinces Explore Time-Limited Straw Burning—Is the Era of Total Bans Over?* Retrieved from https://mp.weixin.qq.com/s/AKjWy3L-mRUGtKYooiHrjg

Environmental risks from westward shift of heavy industry

In the first quarter of 2025, China saw a general easing of particulate pollution, driven by a combination of improved power mix and reduced activity in energy-intensive industries. The share of coal-fired power in the electricity mix declined by 4 percentage points year-on-year, while national production of cement and flat glass fell by 1.4% and 6.4%, respectively—indicating a reduced environmental burden from traditional heavy industries and a more favorable context for emissions reduction.

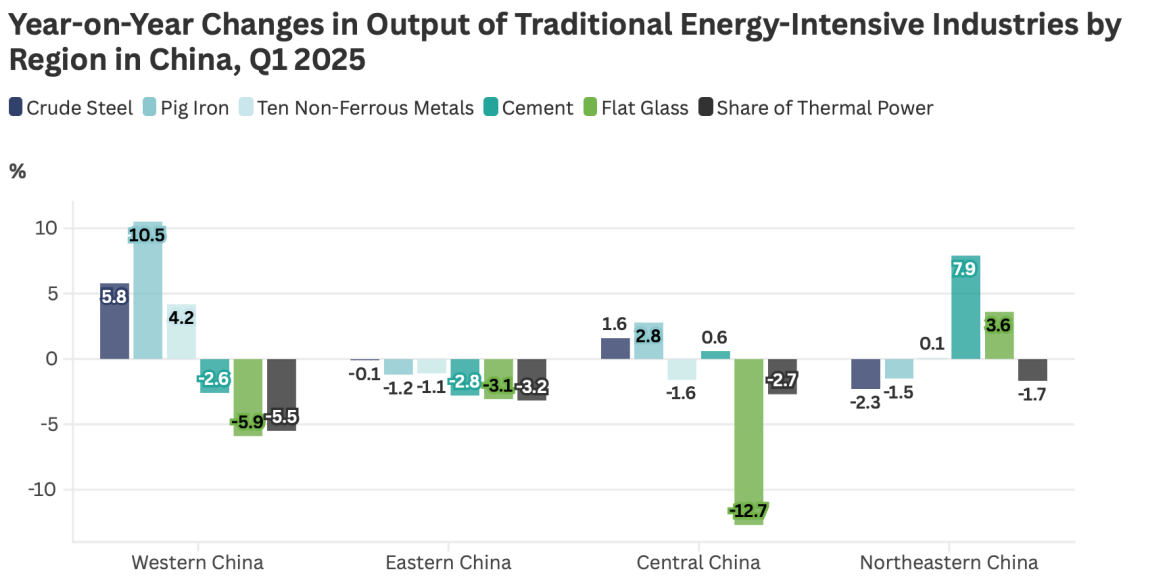
Beneath this overall trend, however, regional patterns are undergoing a notable restructuring. Western China emerged as the region with the sharpest increase in the output of energy-intensive steel and non-ferrous metal products. Production of pig iron (+10.5%), crude steel (+5.8%), and non-ferrous metals (+4.2%) all recorded significant growth, signaling a westward shift in heavy industrial capacity. Although the region also saw the largest drop in the share of coal-fired power (–5.5%), the pollution pressures associated with industrial expansion are offsetting much of the gains made on the energy side.

The surge in pig iron production in western China is particularly concerning. Its 10.5% year-on-year increase not only outpaced other regions but also significantly exceeded the growth rate of crude steel (+5.8%) within the region. Since pig iron is a primary input for crude steel, this trend suggests continued reliance on carbon-intensive, long-process blast furnace methods. This structural gap reflects persistent challenges in green steelmaking and raises the risk of a rebound in carbon intensity as industrial capacity moves west. In contrast, eastern and northeastern provinces saw parallel declines in pig iron and crude steel production, indicating a shift toward lower-carbon pathways.

Compared to the west, eastern China experienced a near-universal decline in output of energy-intensive products, along with a 3.2 percentage point drop in coal-fired power's share—suggesting a concurrent period of industrial contraction and energy transition. The northeastern region, however, presented a more mixed picture. While overall heavy industry slowed, production of cement (+7.9%) and flat glass (+3.6%) rebounded, likely linked to renewed infrastructure activity. At the same time, the region saw the smallest

decline in share of coal-fired power (–1.7%), underscoring the slow pace of energy restructuring and its limited support for industrial decarbonisation.

Figure 2. Year-on-year changes in output of traditional energy-intensive industries by region in China, Q1 2025



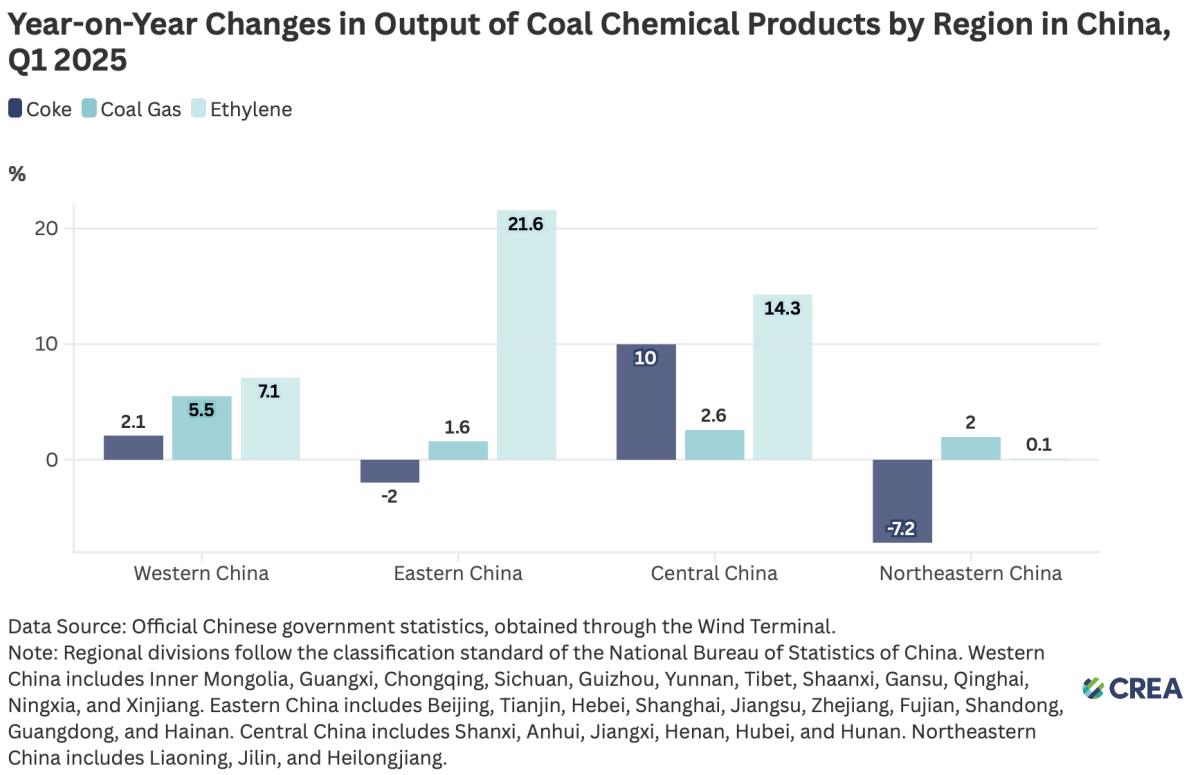
Data Source: Official Chinese government statistics, obtained through the Wind Terminal.
Note: Regional divisions follow the classification standard of the National Bureau of Statistics of China. Western China includes Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang. Eastern China includes Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan. Central China includes Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan. Northeastern China includes Liaoning, Jilin, and Heilongjiang.

Beyond the resurgence of traditional heavy industries in the west, China also witnessed broader momentum in coal-based chemical sectors during Q1 2025, which is gradually reshaping the regional pollution landscape. Driven by falling coal prices and energy security concerns, modern coal chemical projects—especially coal-to-olefins—have accelerated construction. In 2024, coal-to-olefins became the leading segment by capacity among coal chemical projects under development. In Q1 2025, national production of ethylene, a common olefin, grew by 6.4% year-on-year, outpacing traditional coal-based products such as coke (+2.9%) and coal gas (+1.9%), thereby marking it as a new engine of coal chemical expansion.

While traditional coal chemical growth—represented by coke and coal gas—was concentrated in western and central provinces, modern coal chemicals such as ethylene

saw more growth in eastern and central regions. Nevertheless, western provinces recorded higher increases in pollution levels despite slower coal chemical output growth. This may be due to the continued dominance of energy-intensive, high-emission technologies in industrial production—leading to higher pollution intensity per unit of output and increased difficulty in environmental management.

Figure 3. Year-on-Year changes in output of coal chemical products by region in China, Q1 2025



Data Source: Official Chinese government statistics, obtained through the Wind Terminal.
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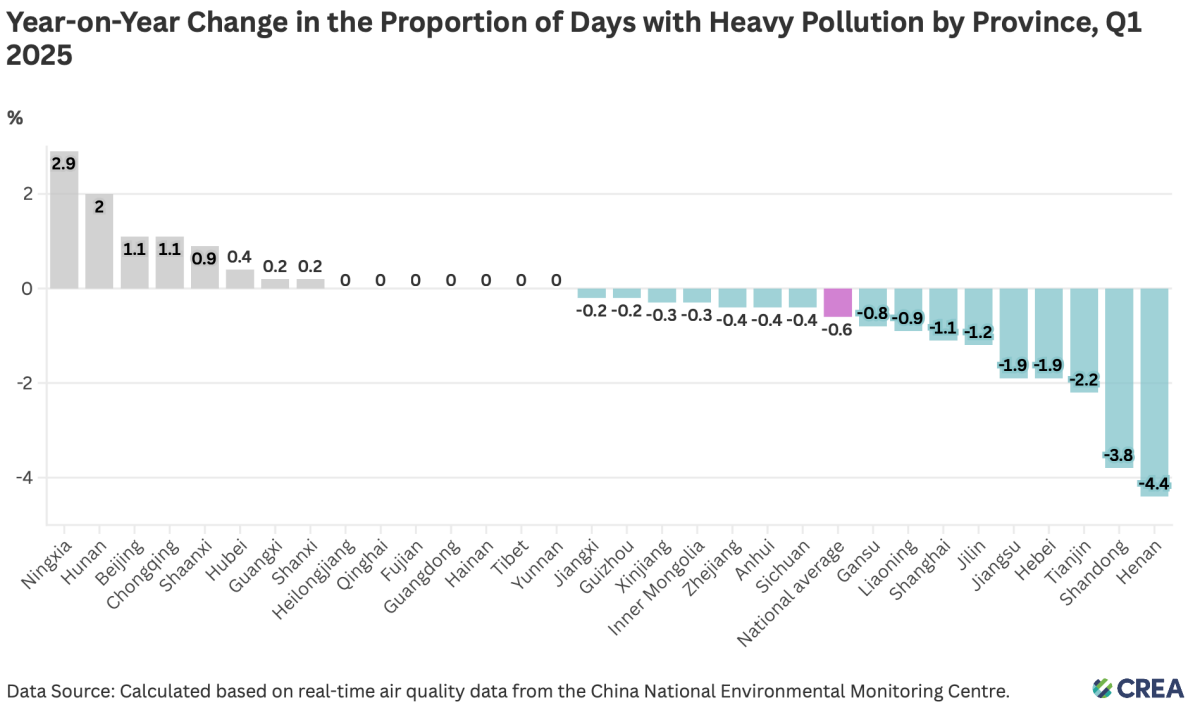
Rise in heavy pollution days in inland regions

The national average proportion of heavily polluted days (classified as severe or worse) declined by 0.6 percentage points year-on-year in Q1 2025, indicating a continued trend of overall air quality improvement. However, several provinces in the Northwest and the middle reaches of the Yangtze River experienced a rise in such days, signaling a localized rebound in pollution levels. On the other hand, the Beijing-Tianjin-Hebei region—excluding Beijing—achieved the most significant improvement, suggesting that coordinated governance is beginning to yield results in legacy industrial areas.

Figure 4. Year-on-year change in the proportion of days with heavy pollution by province, Q1 2025



Data Source: Calculated based on real-time air quality data from the China National Environmental Monitoring Centre.

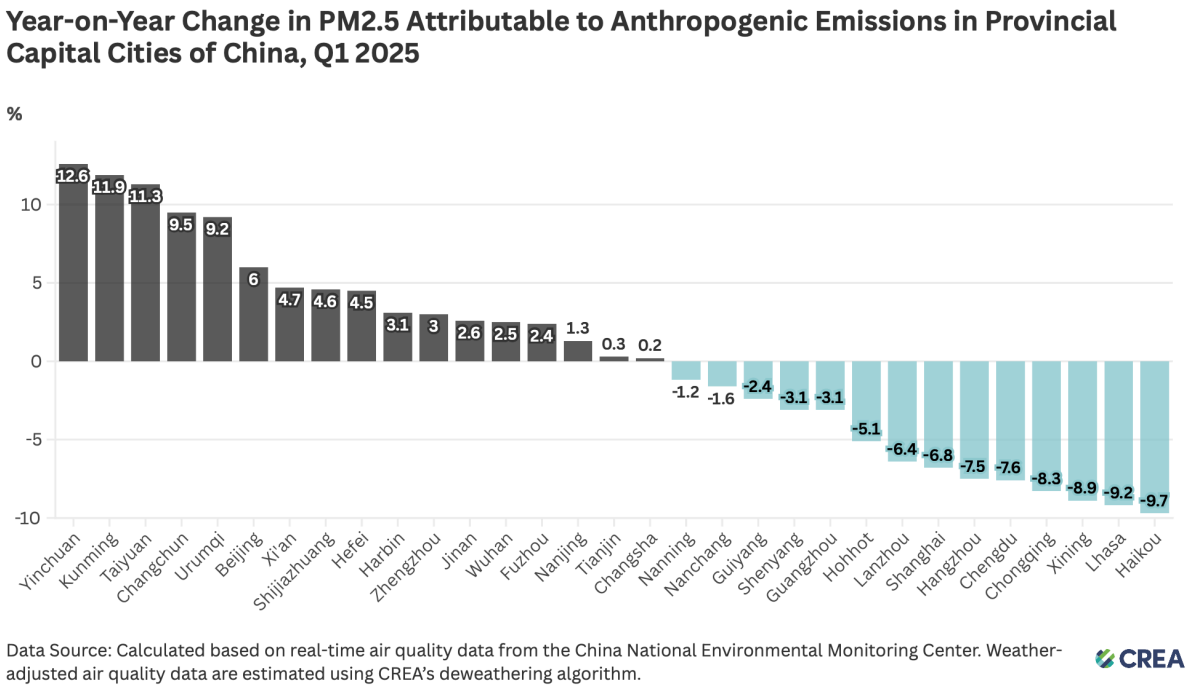
Geographic and climatic conditions play a critical role in the accumulation of pollution across different regions. Northern areas are prone to long-range dust transport from desert zones, while the Yangtze River basin is constrained by basin topography and high-humidity, stagnant weather patterns that favor the buildup and persistence of pollution episodes. In the first quarter of 2025, higher-than-average temperatures in

Mongolia and northern China led to reduced snow cover and lower surface moisture content, creating conditions favorable for the occurrence of dust storms. In addition, a series of strong cold air outbreaks and intensified winds in mid-March increased surface wind stress over source regions, further accelerating dust mobilization[6].

However, provinces that recorded an increase in the proportion of heavily polluted days also showed marked rises in PM2.5 concentrations driven by anthropogenic emissions. Meteorologically adjusted data indicate that Ningxia, which saw the largest rise in heavy pollution days nationwide, also had the highest contribution from human-driven PM2.5 increases in its capital city, Yinchuan. Similarly, the provincial capitals of Shanxi, Shaanxi, Hubei, and Hunan—where the proportion of polluted days also rose—ranked among the highest in PM2.5 increases attributable to anthropogenic sources. This suggests that these regions are characterized not only by meteorological and geographic conditions that favor the formation of sustained heavy pollution events, but also with high emission intensity playing a significant role.

[6] **Joint Research Center for Air Pollution Control.** *Expert Commentary: A New Round of Dust Storms Hits Northern China, Promptly Elevating PM10 Levels in Beijing.* Retrieved from https://mp.weixin.qq.com/s/nxuLwgYcIemHDLcCd318BA

Figure 5. Year-on-year change in PM2.5 attributable to anthropogenic emissions in provincial capital cities of China, Q1 2025



Data Source: Calculated based on real-time air quality data from the China National Environmental Monitoring Center. Weather-adjusted air quality data are estimated using CREA's deweathering algorithm.

Beyond meteorological drivers, persistent pollution from transportation and industrial sources also contributed significantly to deteriorating air quality. Provinces that recorded increases in the proportion of heavily polluted days were those with rapidly rising road freight activity. For example, year-on-year growth in highway freight volume reached 15% in Hubei, and 8% in both Beijing and Ningxia, adding to traffic-related air pollution emissions.

Moreover, several of these regions also saw substantial increases in heavy industrial output. In Ningxia, for instance, pig iron, crude steel, and non-ferrous metal production rose by 2,283%, 39%, and 14% year-on-year, respectively—adding considerable pressure to total pollution loads. These facts underscore a critical point that heavy pollution episodes cannot be attributed to unfavorable weather conditions alone. Effective mitigation must focus on fundamental pathways to control local emission sources at their origin sustainably, through accelerating industrial upgrading and advancing regional clean transitions.

Policy recommendations

To respond to the shifting geography of pollution, China's air quality governance should evolve from a focus on eastern "key control zones" toward a nationally coordinated, regionally responsive system that supports equitable and sustainable development.

First, future policy frameworks, especially under the upcoming 15th Five-Year Plan, should formally include western and central provinces in core air quality governance. This includes allocating dedicated targets, funding, and oversight capacity to these regions, where industrial expansion is accelerating. Strengthening environmental impact assessments for new investments, linking them to land-use planning and energy access, can help prevent cumulative pollution risks at the source.

Second, energy transition efforts should prioritize clean power infrastructure and industrial electrification in coal-dependent provinces. Support measures such as fiscal incentives, power grid investment, and public-private partnerships can accelerate the replacement of outdated processes in key sectors like steel, coal chemicals, and non-ferrous metals. Eastern provinces should be encouraged to support these efforts through technical cooperation, investment flows, and joint pollution reduction targets.

Finally, air quality management should be more directly aligned with regional development strategies. Integrating air quality into local talent, health, and urban competitiveness indicators will help ensure that cleaner air translates into tangible benefits for residents. Establishing national guidance on air quality-linked performance assessments can incentivize local governments to prioritize long-term public well-being alongside economic growth.