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China's Carbon Triangle: Climate Change and the Unwinding of the Land-Finance- Real Estate Development Model

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Abstract

China produces over 30 percent of global carbon emissions, making Xi Jinping's 2020 declaration that his country would be carbon neutral by 2060 one of epic significance. A core challenge facing China's decarbonization is shifting its economic model to break the "carbon triangle" of land, finance, and real estate. This nexus is central to the country's political economy and accounts for a significant amount of China's carbon emissions, yet it is incredibly inefficient in producing real value as millions of apartments lay vacant. Despite official acknowledgement of the need to shift away from real estate and infrastructure investment, pivoting has proven difficult for the country's leaders. Yet, as with most issues in China, national-level features can obscure fascinating and contradictory patterns happening in its provinces and cities.

Policy Implications and Key Takeaways

- China is shifting away from real estate as growth model. This is hugely important, as the real estate sector came to account for nearly a quarter of the country's GDP and much of its growth. While such a shift has been long-awaited with many prior attempts to deprioritize real estate, it is only recently with commitments like the "three red lines" that we have seen developers pulling back. Further, real estate fever, a belief that property is an investment that is safe and always increases in value, has finally broken.
- The major surprise in unwinding the carbon triangle is in how the government is trying to navigate this shift away from real estate as a growth model. To be clear, the country is not shifting away from growth altogether. For nearly two decades, Chinese and external observers have called for increases in domestic consumption as the path forward for the country. In specific policy terms, this is usually couched as expanding the country's social safety net. Yet Xi Jinping, for all of the caricatures of him as a traditional Red Marxist/Maoist, seems quite skeptical of welfarism. Instead of a shift towards domestic consumption, advanced manufacturing is taking the lead: with high tech goods such as semiconductors gaining some attention, but with most of the action in the clean energy space of solar, batteries, and electric vehicles (EVs).

- Local governments need revenue, lease land to developers who build apartments [often selling before construction is complete in “pre-sales”], and people buy because of a lack of other attractive savings options (given the state of the Chinese stock market and capital controls)
- The shift away from real estate is particularly complicated because of the “carbon triangle of finance, real estate, and construction. Incentives have generated overbuilding, with tens of millions of empty units and millions more unfinished. This construction is wasteful not just of land and labor but is spewing carbon emissions. Globally, cement and steel production are the source of between 10–15 percent of total emissions, and China represents about half of global production of both products.
- Chinese emission reductions from the industrial and construction sector are politically difficult but real. Coupled with rapid expansion of clean electricity production and electrification of industrial and commercial processes, China looks likely to peak its carbon emissions this year or indeed to have already peaked in 2023.

Introduction

China's rapid development has improved the lives of hundreds of millions, but the country's hyperfocus on growth statistics has also generated many negative consequences such as falsification, corruption, and local debt.¹ In addition, it has turned China into the world's leading emitter, by far, of carbon pollution. In 2022, China emitted 29 percent of total greenhouse gas pollution, more than the United States, EU, and India combined.² Yet the fundamentals of China's economic model are shifting, in ways that significantly affect emissions.

Before the Paris Agreement in 2015, China said its CO₂ emissions would peak around 2030. Then, on September 22, 2020, President Xi Jinping surprised everyone at the United Nations with a new pledge: China would ramp up its efforts, aiming to achieve carbon neutrality by 2060. These "30–60" targets are now major features guiding China's economic and environmental planning.

While China's rapid development has created a diversified economy that has placed it amongst the world's "middle income" countries, the drivers of much of this growth have been particularly carbon intensive. Tan and Cochran refer to China having two growth models: investment and exports.³ Exports capture most of the global attention, as earlier debates about the China shock are once again in vogue under the rhyming idea of "overcapacity."⁴ However, for most of the past two decades, investment has been the larger engine of China's growth.

Chinese investment statistics are spectacular in documenting the scale of building that was going on. By 2019, the Penn World Tables estimated China's total capital stock at almost exactly \$100 trillion (nearly three times India's \$34T) versus just over \$12 trillion in 2000.⁵ Even beyond normal levels of investment, until just the past few years, whenever global demand or internal growth has faltered in the recent decades, China's government has unleashed pro-investment stimulus. Such investment could be throttled up through direct government spending or relaxation of financial restrictions on the government-controlled banking sector and assist in maintaining the country's growth trajectory.

Two key components of this investment have been infrastructure and real estate. The resulting construction was impressive: vast expanses of highways, shiny airports, an enviable high-speed rail network, and especially apartments. These apartments housed the swelling urban population, and new buildings

replaced dilapidated ones. The boom pushed land-holding state-owned enterprises to turn from their core business and try to participate in the gold rush.⁶

However, the scale of construction has been so prodigious that it has far exceeded demand for housing. Tens of millions of apartments sit empty—almost as many homes as the United States has constructed this century. Many cities are ringed by whole complexes of unfinished concrete shells sixteen stories tall. Real estate, which constitutes a quarter of China's GDP, has become a \$52 trillion bubble that fundamentally rests on the foundational belief that it is too big to fail.⁷ The reality is that it has become too big to sustain, either economically or environmentally.

In late 2020, the Chinese government acted to mitigate the real estate bubble by restricting the ability of overleveraged developers to add to or rollover their debts. Known as the “three red lines,” these guidelines limited the financing moves available to developers with poor standing on three key financial ratios: liability-to-asset ratio, net-debt-to-equity ratio, and cash-to-short-term borrowing ratio.⁸ Most famously, the hugely indebted real estate firm Evergrande collapsed, defaulting with over \$300 billion in debt, eventually entering into bankruptcy. But it was far from alone as Kaisa, Fantasia, and Modern Land, among others, all also failed to repay creditors in 2020 and 2021.

The past four years have seen construction activity decline, as have property prices, deeply affecting individuals, companies, and localities. While the economic risks of deflating this bubble are well-known in broad terms at least, its implications for the climate are less generally acknowledged. China's steel and cement sectors account for about 7 percent of global CO₂ emissions on their own, equivalent to India's total emissions. Scaling back the construction sector is of clear global importance. Alongside the incredibly critical if obvious rapid expansion of clean electricity generation, the easing of the construction mania that has gripped China for the past two decades is increasingly leading to beliefs that the country's emissions might already be near or even at a peak.⁹

Most of the discussion of China's changing political economy—especially what it means for the climate takes place at the national level, yet this ignores wide variance in the social dynamics, material resources, economic situation, and energy systems of different provinces. This essay lays out some of the challenges facing China as it reshapes its political economy, first at a broader national level before beginning to explore patterns in the provinces.

National Background

Chinese policy for decades has prioritized growth and development to legitimize the continued rule of the Chinese Communist Party. An endless stream of figures, statistics and numbers, all of which pointed toward China's increasing wealth and power, are omnipresent, deeply embedding this developmentalist perspective in people's worldviews. Growth largely arose from increased agricultural productivity, leading to bumper harvests and allowing hundreds of millions of people moving away from the agricultural sector into manufacturing and services. Chinese farmers became migrants on a vast scale, twelve million people per year, moving to more populated areas to build housing, factories, and the attendant infrastructure of urban life. Connecting Chinese laborers with machines to help power their production turned China into the now cliché "workshop of the world."

These workshops produced materials for domestic consumption but also for export. The export-orientation of Chinese manufacturing, following in the trail of Japan and other "Asian tigers," pushed firms to economize their activities. This export orientation is often credited with helping to avoid some of the inefficiency traps of import-substitution industrialization, where infant industries are protected from external competition until they scale to the point of standing on their own but often fail to approach the technological frontier and stagnate. To aid in this industrialization effort, the country controlled and managed the value of its currency and exchange rates in order to maintain their competitiveness, at the expense of limiting their purchasing power in acquiring imports.

This balancing act was difficult. China needed to import machinery since it was so lacking in capital goods. On the other hand, the reduced value of the currency helped disincentivize sending capital abroad and in so doing paired with the country's capital controls to keep money circulating domestically rather than seeking greater (or safer) returns abroad. It also made foreign direct investment (FDI) particularly attractive as the exchange rates were favorable for multinational corporations considering setting up operations in China. Financial repression—keeping both external options closed off with capital controls and interest rates low—sacrificed citizens' purchasing power to keep control of the currency value to maintain export competitiveness and decrease financial risk, either the prospect of capital flight or speculative attack from outside, but mainly to push domestic investment. Particularly in

the wake of the Asian Financial Crisis, China built up massive reserves to protect itself from future iterations of such a shock.

Under these constraints, investors searched for avenues where their savings could earn returns. Capital controls kept the search inside of the country. Equities markets were highly volatile as were those for other commodities. However, real estate quickly became seen as an investment that could only go up in value. After all, the underlying fundamentals of investments in real estate in a rapidly urbanizing country are strong—a hundred million households looking for shelter represents an impressive source for demand, especially with the low quality of the existing housing stock in Chinese cities coming out of the disasters of the planned economy. For decades, investments in Chinese real estate were incredibly lucrative. However, even this massive demand was overcome by the might of the Chinese construction industry powered by speculative capital. These bets were increasingly viewed as not particularly risky as the sector also came to be seen as politically sensitive. With so much of Chinese household wealth held in real estate, allowing its value to decline was seen as politically untenable, and, indeed, central and local governments consistently stepped in to protect home values at various moments.¹⁰

To be sure, the Chinese government managed urbanization, in particular restricting migration to the largest metro areas and especially the capital given politics. The economic draw of different cities varied dramatically based on their natural resource endowments, industrial specializations, and geographic location. Yet while all cities built, many built far past actual demand—both in terms of residences as well as the urban infrastructure to support them—with the latter often being funded by corporations set up by local governments for this purpose (local government financing vehicles, LGFVs).

This building was incentivized in large part because of the political system focused local actors—party secretaries, governors, and mayors—to attend to maximizing particular performance indicators. In previous work, I've described this system as possessing a “limited, quantified vision,” which created blind spots where problems such as corruption, pollution, and falsification were allowed to accumulate.¹¹ But the principal issue was over-investment in pursuit of GDP growth. Construction directly increases GDP, even if what is being constructed barely gets used. But development-incentivized local cadres faced an additional constraint. The central government

alone maintained taxing authority, and finding the revenue to pay for their own salaries, let alone public goods and services, has always been difficult. Land conversion was their solution.

Land sales became a critical budget fixer for heavily indebted Chinese local governments, providing about 30 percent of revenue in 2021. In 2022, however, with the softer real estate market, this income stream plummeted by nearly a third. Consequently, government deficits broke records—8.96 trillion yuan in 2022—just as they faced some 3.65 trillion yuan in debt repayments. A long-discussed property tax continued to face resistance from the propertied middle classes and the officials in their circles. With limitations on where they could build and facing the local land monopolist, developers bid up the prices of land leases at auctions. By then building on that land, they helped local officials both by providing revenue directly and by contributing to GDP.

Over the past four years, as the country has finally started to drain some water from the bloated real estate sector. The indebtedness of both LGFVs and developers has shifted from a theoretical worry to a real matter of public outcry and concern. Crowdsourced data from WeNeedHome showed mortgage boycotts spreading like wildfire in fall 2022, with hundreds of properties across one hundred different cities facing actions.¹² Protests, mortgage strikes, and defaults have materialized, and confidence in the government's stewardship of the economy and the country has surely taken a hit—both domestically as well as overseas.

In broad terms, many have described Xi Jinping's efforts to promote "new quality productive forces" as his preferred solution to the problem of economic growth amidst a lagging real estate sector rather than relying on consumer consumption via expansion of a social safety net, which despite his rhetorical calls for common prosperity, Xi seems to view with skepticism. This skepticism and turn to manufacturing rather than consumer-driven growth is worth remarking on, as it too has climate implications. After all, service industries tend to be associated with less emissions, all else equal, than do manufacturing activities for a given level of economic activity. Yoga instructors and baristas do not create greenhouse gasses like welders and chemical production facilities.

In August 2021, Xi Jinping gave a speech to a rapt audience of the Central Finance and Economic Affairs Commission. After noting other countries'

high levels of inequality, social disintegration, and political polarization, Xi acknowledged his sense that China faced similar threats because of its own income gaps, especially between rural and urban areas. “Dividing the cake well” needed to become a key focus instead of merely relying on growth alone to provide opportunities for the poor. He spoke of the growth of a large middle class where workers can move forward.

Despite often being presented in the West as a devoted Marxist, Xi has reversed the redistributive policies of his predecessors, particularly Hu Jintao and Wen Jiabao. As the law professor Wei Cui noted, Xi cut taxes and made Beijing more reliant on regressive revenue sources for income, all while putting forward nothing in the way of progressive transfers amid a “resolute refusal to build a welfare state.” Indeed, even in the “common prosperity” speech that was his ostensible leftward lurch, Xi’s conservatism comes through:

We should not bite off more than we can chew and make promises that we cannot keep. The government cannot cover everything, and the focus is on strengthening fundamental, inclusive and basic living protection and efforts. Even if the level of development is higher and the financial resources are stronger in the future, we still cannot set too high goals and provide overprotection; we should resolutely prevent falling into a “welfare” trap and raising idlers.

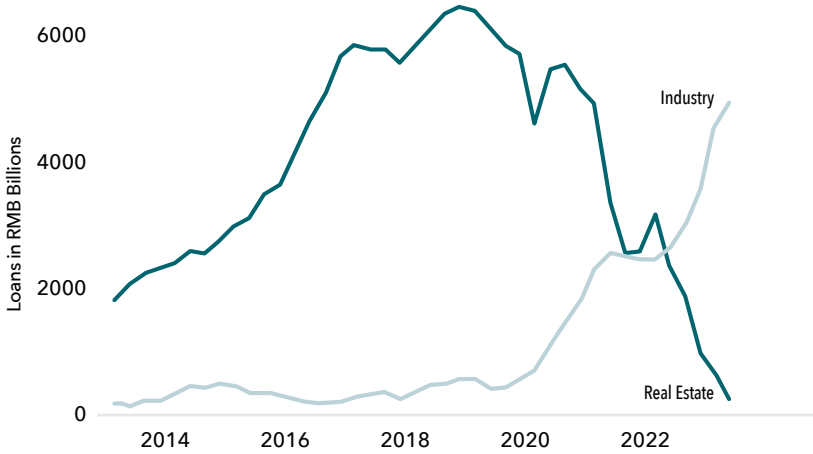
This research project was initiated expecting to explore patterns of fiscal, emissions, and other data as the country transitioned away from real estate towards a domestic consumption growth model. Academic and policy explorations of the political economy challenges in such a scenario tend to be siloed, sticking with either a climate focus or fiscal one. Climate-oriented studies of Chinese urban development tend to be technical in their orientation, measuring the size of emissions benefits from policy interventions such as high-speed rail stations, vehicle electrification, or road diets.¹³ Another set examine under what conditions and to what extent official designations, such as “eco-city” or “low-carbon city,” have beneficial environmental outcomes on emissions or other important parameters.¹⁴ Fiscal analyses, on the other hand, tend to focus on economic outcomes and the political dynamics between the center and local governments and state-society relations.¹⁵ Fiscal transfers, land

revenues, and local debt have long been examined in the literature, and some studies have connected these issues to population pressures—in positive and negative directions, the latter tending to use the “shrinking cities” moniker.¹⁶ Yet few have explicitly linked these worlds by looking at how China’s political economy shapes its approach to climate change and decarbonization.¹⁷

However, and interestingly, the decline of real estate and other urban infrastructure investment that has taken place over the past few years has led to an important but underwhelming decline in steel and cement production. While I previously posited that a decline of construction in the real estate sector to a level more consistent with sustainable replacement and upgrading could yield a full gigaton of carbon reductions, cement and steel production have only ebbed rather than cratered. This discrepancy is in part because of other sources of demand for these materials—namely industrial manufacturing facilities—have replaced declines in the construction. Recent estimates for March 2024 compared with the prior year have 40 MtCO₂ reduction from lower steel and cement output, which would annualize to an emissions reduction closer to half a gigaton.¹⁸ Steel usage in the real estate sector has dropped from 412 Mt in 2020 to 251 Mt in 2022 with 2023 estimates coming in at roughly 200 Mt.¹⁹ Cement production for the first half of 2024 was only 0.85 billion metric tons, and full year estimates project a total around 1.85 billion tons, which would be the lowest in 15 years.²⁰

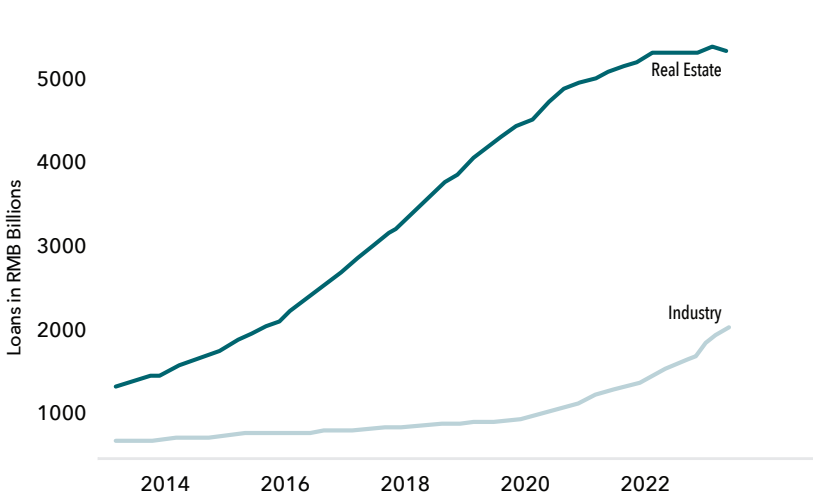
What we have seen in China instead of a pro-consumption push has been a rush towards advanced manufacturing, both for domestic use and export, which is seen as an important component of the country’s growth going forward. Often focused on three new industries—solar panels, batteries, and EVs—the efforts on advanced manufacturing seem to dovetail with a decarbonization agenda given the significance of clean electrification to any reasonable plan to reduce emissions. And, while clearly these sectors are of massive significance to global decarbonization efforts, they remain dwarfed by the size of the real estate sector in China’s own economic activity. This can be seen in a pair of images of loan data. While Figure 1a clearly suggests a massive shift in loans away from real estate and towards industry, it is important to keep in mind that this depicts year-on-year changes of loans. Figure 1, on the other hand, shows the full stock of loans and its shape, which highlights that while the changes seen in Figure 2 are real—a shift is taking place towards more

FIGURE 1. Year-on-Year changes Show Loans Shifting from Real Estate to Industry



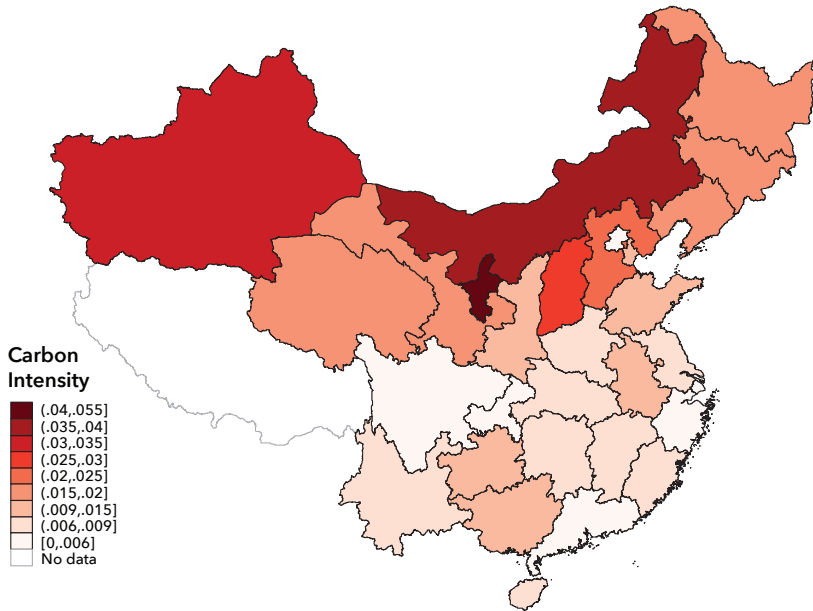
Source: PBOC, CEIC

FIGURE 2. Total Loans Retain Real Estate Tilt



Source: PBOC, CEIC

FIGURE 3. Map of Carbon Intensity (Emissions/GDP) in 2021



Source: PBOC, CEIC

loans being directed to industry, the massive scale of loans to these sectors indicates how difficult it will be to transition away from real estate.

The complex of finance, land, and real estate deeply affects China's emissions and the possibility of the country and the world in meeting its climate targets. Obviously, the extent to which producing housing for people requires emitting greenhouse gasses can make those emissions justified. However, much of the speculative housing and construction booms have produced structures that are of little direct utility. Beyond direct emissions, constructing empty buildings wastes both labor and land, with the latter critical for agriculture as well as under increasing pressure from acreage-hungry renewable energy sources like solar and wind.

Provincial level variation goes a bit further. China's northern industrial heartland (e.g. Inner Mongolia, Hebei, and Shanxi) is particularly carbon-intensive in its economic activities, as well as being the chief locations where coal is mined. On the other hand, eastern and southern provinces tend to still rely

on energy imports—largely in the form of coal, though a small but increasing portion as electricity being sent directly via ultrahigh voltage (UHV) power lines (only some of which derives from coal combustion)—for their energy security. One simple depiction of provincial level variation is provided in Figure 3, a map of carbon intensity, or emissions estimates divided by estimates of local GDP.²¹ China has not released official statistics on emissions in years, so these are estimates based on energy and process (read: cement) emissions from China Emissions Accounts and Datasets series (CEADs).

TABLE 1. Key Provincial Metrics

Province	CO ₂ Emissions (2021)	GDP (2021)	Electricity Generation, TWh (2021)	Non-Fossil Generation Share, percent (2021)
Beijing	80.14	41045.6	473	5.1
Tianjin	155.55	15685.1	800	4.7
Hebei	885.51	40397.1	3513	23.2
Shanxi	613.73	22870.4	3926	17.8
Inner Mongolia	843.40	21166	6120	20.1
Liaoning	545.67	27569.5	2258	33.7
Jilin	204.63	13163.8	1026	28.8
Heilongjiang	287.54	14858.2	1201	21.0
Shanghai	194.07	43653.2	1003	3.4
Jiangsu	817.68	117392.4	5969	18.9
Zhejiang	442.20	74040.8	4223	27.8
Anhui	385.35	42565.2	3083	11.1
Fujian	299.82	49566.1	2951	41.6
Jiangxi	245.41	29827.8	1563	20.4
Shandong	947.16	82875.2	6210	15.0

(continued)

Province	CO ₂ Emissions (2021)	GDP (2021)	Electricity Generation, TWh (2021)	Non-Fossil Generation Share, percent (2021)
Henan	483.74	58071.4	3039	19.1
Hubei	361.05	50091.2	3292	55.2
Hunan	310.87	45713.5	1742	41.6
Guangdong	629.74	124719.5	6306	26.4
Guangxi	288.03	25209.1	2082	42.6
Hainan	45.65	6504.1	391	35.0
Chongqing	165.28	28077.3	991	31.3
Sichuan	314.90	54088	4530	85.3
Guizhou	265.86	19458.6	2368	38.9
Yunnan	234.37	27161.6	3770	87.9
Shaanxi	339.10	30121.7	2740	16.7
Gansu	189.45	10225.5	1897	46.9
Qinghai	56.38	3385.1	996	84.9
Ningxia	235.32	4588.2	2083	23.3
Xinjiang	520.71	16311.6	4684	21.5

While carbon intensity has some utility as a measure of an economy's carbon-ness, the atmosphere is principally concerned with totals rather than ratios. Table 1 thus presents key emissions, economic, and electricity data for 30 provincial-level units (Tibetan data is missing).²² The four highest emitting provinces—Shandong, Hebei, Inner Mongolia, and Jiangsu—each emit over 800 million tons of CO₂, which would individually place them between Japan (1000 MT) and Indonesia (725 MT) in the top 10 of polities world-wide.²³

Conclusion

China's rapid development over the past four decades is unprecedented historically both in its pace and in the number of people affected by improved economic realities. Its scale and rewriting of the economic record books have profound implications for the world, from reopening debates about industrial policy and tariffs to geopolitics. But while the short-run debates of the next few years may be focused on such issues, the broader trajectory of the twenty-first century around the world is likely to be shaped by climate change. The trillion tons of carbon pollution that we've collectively dumped into the atmosphere are warming the planet like a weighted blanket.²⁴ China's immense emissions and their future trajectory are perhaps the key question about the future of the planet's climate.

There are hopeful signs that global emissions are near or at their peak. China alone represents one-third of global carbon emissions, and as most of the major industrialized economies already have declining emissions, if China's emissions were to decline as well, global emissions would likely fall. And data from the first half of 2024 look like Chinese emissions might have peaked last year. While industrial manufacturing has expanded more than expected, the shift away from real estate and infrastructure construction that is at the heart of the carbon triangle is leading to reduced carbon pollution. Paired with increased uptake of clean electricity, some analysts are predicting that 2023 will turn out to be China's actual carbon peak and not just another local maximum.²⁵

However, the sustainability of this greening of China will depend on the economic transformation away from the carbon triangle. National level economic growth has been stable if a bit weak during the past year. The recent third plenum held in July 2024 did not include any dramatic policy moves that might suggest a return to real estate as a growth engine, yet it also did not push forward clear solutions to the problems of local finances that many provinces, cities, and counties face now that the gravy train of land finance has stopped.

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Notes

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