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China in the Energy Transition: A Global Game Changer

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China in the Energy Transition: A Global Game Changer

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Introduction

The shifting balance of global energy is increasingly tied to the way nations navigate questions of development, sovereignty, and sustainability. China has historically stood as one of the four great cultural centers of the Eastern Hemisphere, alongside Europe, the Middle East, and India. However, it has always been geographically isolated due to the Himalayas, the largest mountain range on Earth, that separate China from India and the rest of the world. To overcome this and strengthen their geopolitical role in global commerce, Chinese have focused on the Silk Road and various maritime routes, to enable the country's exchanges, facilitating the rapid diffusion of goods, services and innovations.

Among the various conceptions of global order in Asia, China has advanced the longest-standing and most clearly articulated model, that deviates furthest from the Westphalian paradigm. At the same time, it has followed one of the most intricate historical paths: starting from its ancient civilization and the imperial structures of classical antiquity, moving through the communist revolution and reaching its current position as a modern superpower. As a population giant and an economic competitor to commercial global leaders, China floods the global markets with goods via a mind-blowing export mechanism, leads colossal infrastructure projects that connect continents, and continuously asserts their role as (one among) the leaders of the world.

In recent decades, energy has become both the cornerstone and catalyst of China's development and geopolitical strategy. Access to secure energy resources has underpinned its industrial evolution, while energy diplomacy has enabled Beijing to deepen strategic ties across Asia, Africa, and Europe.

At the same time, the global push towards energy transition, mainly driven by climate imperatives and the need for technological innovation, has elevated energy into a decisive field of competition. China's dominance in manufacturing of renewable technologies, electric vehicle supply chains, and green infrastructure financing, (particularly through the Belt and Road Initiative), positions it not only as a consumer of global energy flows but most importantly as a shaper of their future direction. The ability to create and influence energy corridors, dictate technological standards, and control critical minerals, confers geopolitical leverage, making energy transition not just an environmental necessity, but a strategic asset in China's broader ambition to redefine the current global order.

It is undeniable that China has never been a country indifferent to global leadership. Its geographical position, immense territory, abundant natural resources, and massive population, endow it with a distinctive geopolitical weight. A turning point in its historical evolution, as well as for the entire world, was its integration into the globalized economy. China's reemergence as a major power in the twenty-first century, revives the historical question of global supremacy: the confrontation between an established power (aka USA) and a rising one.

China's role in the global energy transition is increasingly pivotal. As the world grapples with the dual challenges of ensuring energy security and meeting stricter climate goals, China's strategies (ranging from clean energy investments to navigating complex geopolitical trade dynamics) offer a lens into both opportunities and challenges on a global scale.

This report is divided into five sections, each exploring critical dimensions of China's energy landscape, technological innovations, international influence, and future outlook.

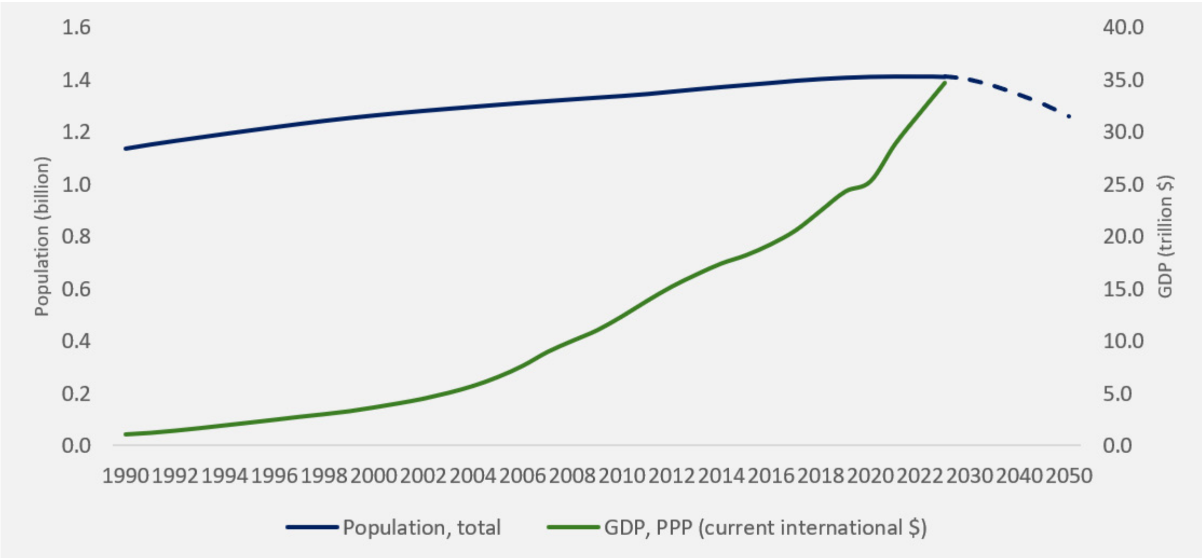


Figure 1. Evolution of population and GDP per capita in China. Source: Data elaborated from World Bank [1]

China's rapid economic and industrial transformation over the past two decades has not only redefined its domestic landscape but also positioned the country as a key player in the global geopolitical scene. This transformation is underpinned by robust GDP expansion, demographic shifts, sweeping policy reforms, and a deliberate moves towards technological innovation and sustainable practices.

Over the last 20 years or so, China experienced extraordinary GDP growth, with annual rates that in the early 2000s often exceeded 9–10% (see Figure 1). This economic dynamism was fueled by a series of ambitious policy reforms, a strategic shift toward opening up domestic markets, and an export-led growth model that turned the nation into the "world's factory". Massive investments in infrastructure and industrial capacity catapulted China into a new era, paving the way for a modern manufacturing base that has become critical to global supply chains.

At the same time, China's demographic trends played a critical role in driving its economic engine. With a population of approximately 1.4 billion, a predominantly young and dynamic workforce underpinned the mass labor supply necessary for rapid industrial development (see Figure 2).

1 FAQ - Moving Towards the Enhanced Transparency Framework | UNFCCC

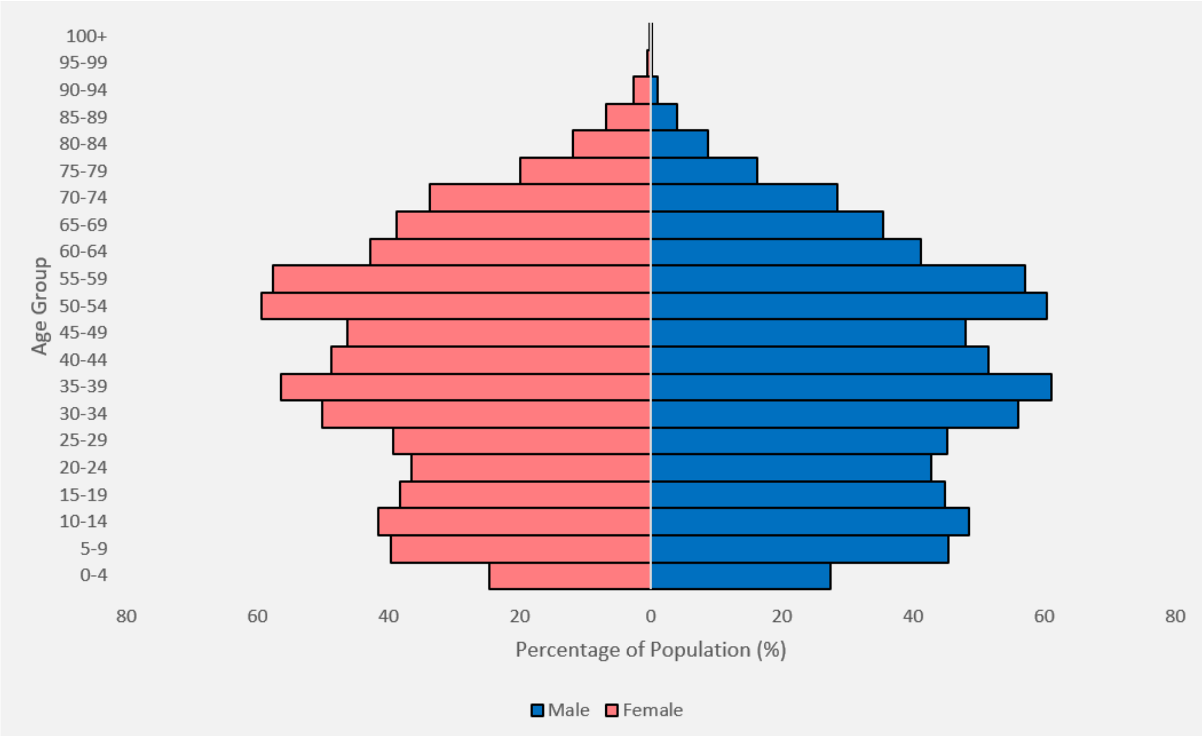


Figure 2. China's population pyramid for year 2024. Source: Data elaborated from World Bank [1]

Over the past decades, substantial internal migration from rural areas to urban centers created bustling metropolises that supported a diversified economic landscape. As the economy matured, this workforce evolved, shifting from labor-intensive roles to more technology-driven positions. In parallel with these changes, increasing urbanization fostered domestic consumption and spurred the growth of modern service sectors, reflecting a broader trend towards a knowledge-based economy.

Policy initiatives have been instrumental in accelerating this transformation. Programs such as "Made in China 2025"[2] aimed to upgrade traditional manufacturing by focusing on high-tech sectors such as robotics, aerospace, renewable energy and electric vehicles [2].

These initiatives not only diversified China's industrial portfolio but also emphasized the integration of clean technologies into production processes. Today, Chinese industries are widely recognized for their significant investments in automation, smart manufacturing, and digital infrastructure; developments that have enhanced production efficiency and reduced environmental impacts associated with heavy industry.

The expansion of China's industrial capacity has been remarkable. In 2000 China accounted for 6% of global industrial production, while in 2030 China is expected to account for 45% of global industrial production.

2 Made-in-China-Backgrounder.pdf

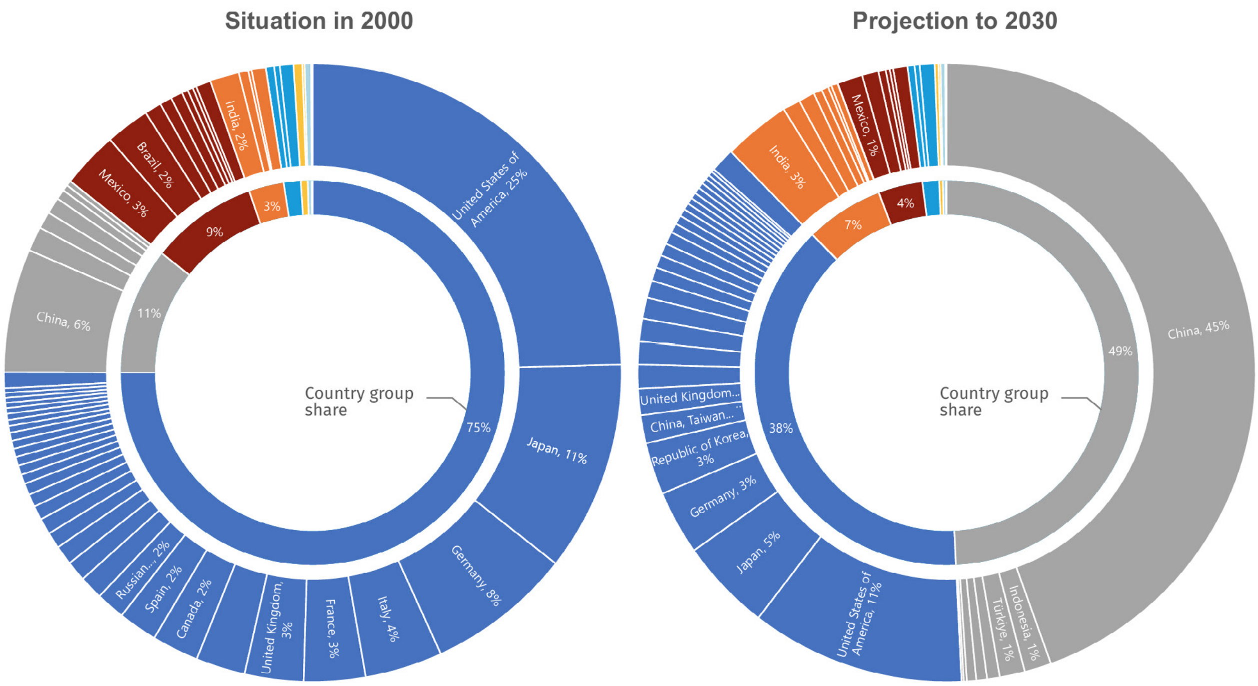


Figure 3. Past and future structure of global industrial production. Source: Data elaborated from UNIDO [3]

Regions such as the Pearl River Delta, Yangtze River Delta, and Bohai Economic Rim evolved into major industrial hubs, attracting vast amounts of capital dedicated to building industrial parks and state-of-the-art manufacturing facilities. However, over time, there has been a clear shift from resource-intensive production to technologically advanced, sustainable practices. Significant investments in renewable energy technologies, spanning solar, wind, and electric vehicle production, have not only bolstered China's domestic clean energy markets but have also cemented its position as a global leader in the renewables' supply chain.

Meanwhile, the energy sector has been continuously transforming following China's industrial evolution. According to the Key China Energy Transformation Outlook 2024 [4] findings, the country has pursued four interdependent transformations: in energy supply, demand, technology, and system management. These shifts are neither abstract goals nor isolated technical changes; they are deeply structural and align with China's broader modernization strategy.

The so-called "energy supply revolution", has seen China increase its non-fossil energy share from around 10% in 2013 to nearly 18% by 2023. At the same time, its reliance on coal, though still dominant, has significantly declined in percentage terms. This deliberate diversification is also a reflection of China's intent to align energy security with sustainability.

3 [The Future of Industrialization - UNIDO]
4 [China Energy Transformation Outlook 2024]

In the context of the energy transition, these shifts are especially noteworthy. The adoption of automation, robotics, and digital monitoring within manufacturing has improved energy efficiency and reduced overall carbon emissions, aligning industrial practices with global climate goals. Simultaneously, China's proactive approach to addressing an aging population through automation and increased R&D into artificial intelligence, ensures that its industrial productivity remains competitive in a rapidly evolving global market. At the same time, heavy investments in green hydrogen, battery storage, carbon capture, smart grids, digital twin applications and AI-based demand-forecasting are being intensified, showing a confluence between energy reform and China's broader digital transformation ambitions.

As China continues to evolve from a traditional manufacturing powerhouse into a leader in industrial innovation and sustainable development, its influence on the global energy transition has become increasingly significant. The country's dual emphasis on maintaining economic momentum while integrating renewable energies into its industrial fabric, serves as both a blueprint for emerging economies and a challenge for established players navigating the complexities of a greener and more technologically integrated future.

China’s energy strategy & landscape

01 China’s current energy profile: **Data & trends**

Over the past decade, China has embarked on redesigning its energy consumption model to one that reflects not only technological advancement but also a switch in the followed economic pathway.

As depicted in Figure 4, there is a downward trend in both total energy consumption and fossil fuel consumption per unit of GDP. In 2013, energy consumption per unit of GDP stood at approximately 0.62 tonnes of standard coal equivalent (tce) per 10,000 Chinese Yuan (RMB), while fossil fuel consumption was around 0.53 tce/10,000 RMB. By 2023, these figures were reduced to 0.48 and 0.35 tce/10,000 RMB respectively, reflecting a gradual decoupling of economic growth from fossil energy use and a swift towards “cleaner” energy sources. The broadening gap between the two lines, from 0.09 in 2013 to 0.13 tce/10,000 RMB in 2023, underscores the country’s progress in integrating non-fossil energy into its economic output.

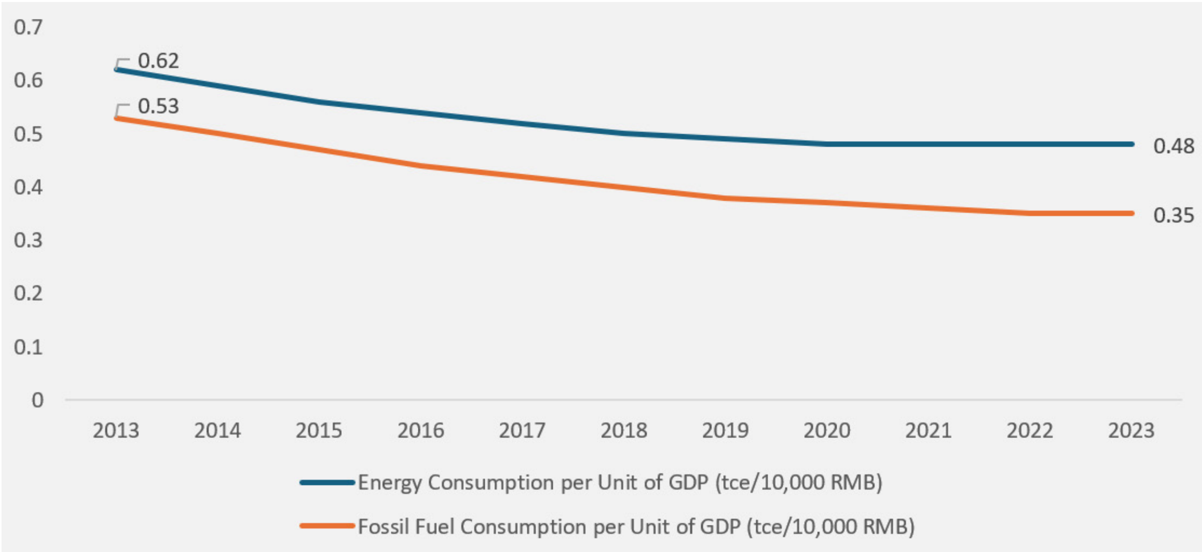


Figure 4. Energy consumption per unit of GDP change. Source: Data elaborated from China Energy Transformation Outlook 2024[4]

Simultaneously, the structure of primary energy consumption has undergone a meaningful shift. The share of non-fossil energy sources rose from 10.2% in 2013 to 17.9% in 2023 (see Figure 5). Coal, while still dominant, saw its share dropping from 67.4% to 55.3%. In 2023, the gap between coal and non-fossil fuels in China's primary energy consumption stands at 37.4% points, underlying that coal remains dominant though gradually declining in the country's energy mix.

China's industrial sector, for long the backbone of its economy, has seen significant benefits from energy efficiency. Through the retirement of outdated and inefficient production facilities, the promotion of advanced manufacturing, and the scaling of low-carbon technologies, key industrial benchmarks have significantly improved. For example, coal consumption per kilowatt-hour of electricity generated in thermal power plants dropped by 7.4% from 2013 to 2022. Likewise, the energy consumption per tonne of produced electrolytic aluminum has reached levels on par with the best global practices, underscoring a broader trend of modernization in core industries.

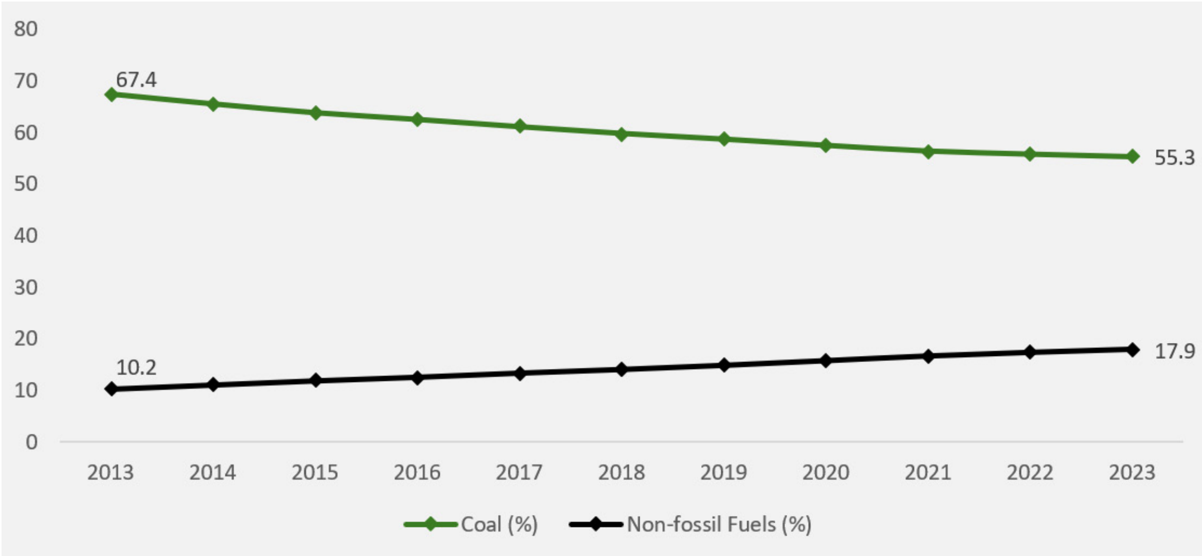


Figure 5. Share of non-fossil energy and coal share in total primary energy consumption. Source: Data elaborated from China Energy Transformation Outlook 2024 [4]

A dramatic rise in electric vehicle adoption confirms that the green shift further extends in the transportation sector (responsible for around 10% of China's energy use). Since 2013 China's electric vehicle fleet has grown exponentially, supported by targeted policies, market incentives, and infrastructure expansion. The electrification of transport represents a strategic lever not only for emissions reduction but also for industrial innovation and urban air quality improvement.

China's energy mix in 2025 illustrates a complex tapestry of renewables, coal, nuclear, and natural gas. In recent years, China has steadily diversified its energy portfolio to reduce reliance on fossil fuels while leveraging its manufacturing prowess to lead the global renewable energy sector. At the same time, coal remains the most significant part of the energy mix. Despite ambitious renewable targets, coal-fired power plants still contribute substantially to the grid, a legacy of decades of economic growth driven by industrial expansion.

China's energy landscape has undergone significant transformation since 2000. Total energy supply more than doubled, driven primarily by coal, which remains dominant. However, oil and natural gas use has also grown steadily. Meanwhile, renewable sources such as wind, solar, and hydro have expanded, especially since 2010, reflecting China's investment in clean energy. In electricity generation, coal's share dropped from over 70% in 2000 to just above 40% by 2023. Hydropower has remained relatively stable, while solar and wind energy have surged, especially after 2015. Nuclear and bioenergy have also made incremental gains. Overall, China is gradually shifting from a coal-heavy system to a more diversified energy mix, although fossil fuels still play a major role in meeting its vast energy needs.

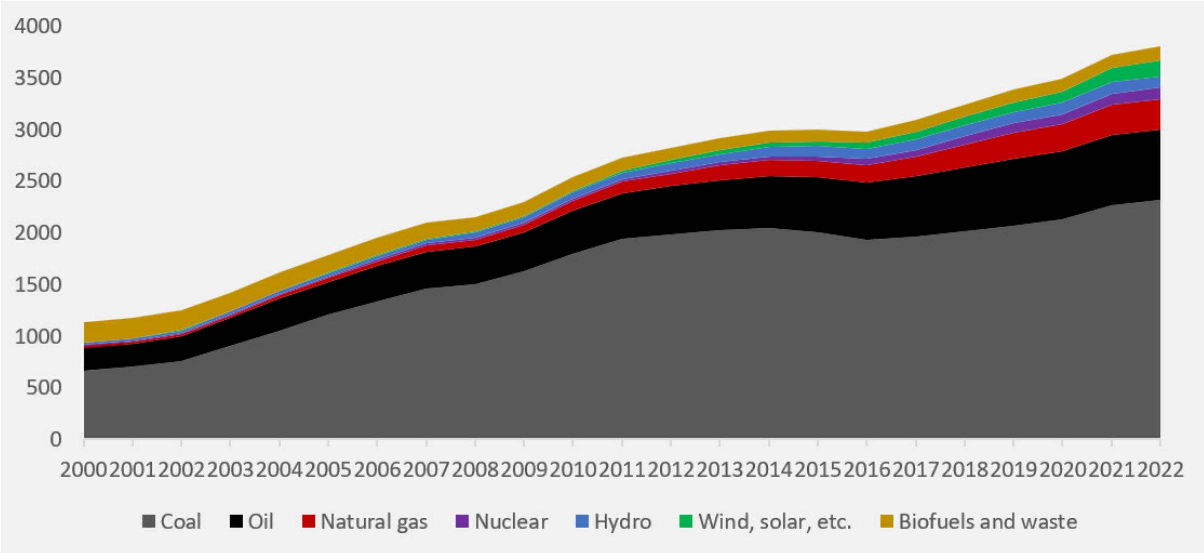


Figure 6. Total energy supply (mtoe) in China. Source: Data elaborated from IEA [5]

In recent years, renewables have surged forward [6]. Solar and wind installations have proliferated, buoyed by strong government subsidies and private-sector investments. Solar power, in particular, has seen dramatic cost reductions due to economies of scale, advanced manufacturing techniques, and supportive policy measures. Wind power has also benefited from technological advances and geographic advantages in northern and coastal regions. Hydropower continues to play a major role, with large-scale projects like the Three Gorges Dam setting benchmarks for capacity and operational efficiency.

Yet, the country's energy pathway remains mixed. While nuclear power has been earmarked for expansion as part of efforts to secure a low-carbon future, public debate around safety, waste disposal, and high capital costs persists. Natural gas, often promoted as a "bridge fuel", has seen increased imports and domestic production; however, geopolitical tensions and supply chain issues pose challenges to its long-term viability as a cornerstone of energy security.

5 China - Countries & Regions - IEA
6 China's Renewable Energy Boom: A Record-Breaking Shift or Still Chained to Coal?

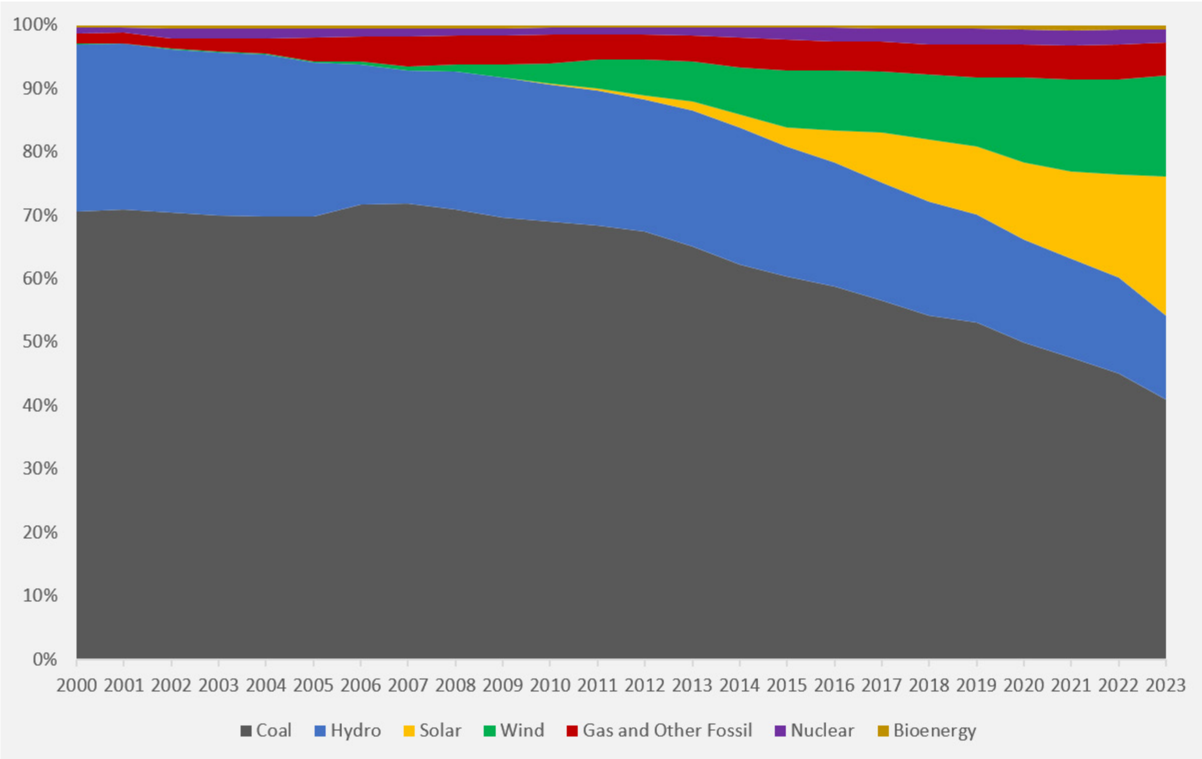


Figure 7. Share of installed capacity for electricity generation in China. Source: Data elaborated from Ember-Climate [7]

The data reveal that the pace of clean energy growth is impressive (both in total energy supply and electricity generation), but the reliance on coal remains stubbornly high [5] , as evidenced in Figures 6& 7. This dichotomy stems from the need to balance energy reliability, rapid economic growth, and environmental sustainability. China's vast geographical diversity implies that energy solutions must be region-specific, what works in resource-rich western provinces may not be applicable in eastern densely populated urban centers.

Additionally, the energy transition in China is marked by significant investment in infrastructure[8]. Grid modernization and energy storage projects are key to ensure that intermittent renewable sources can be integrated smoothly into the national grid. Despite these efforts, regional disparities in energy availability and quality remain a concern. Urban areas often enjoy more robust, modern grids, while rural regions may still face challenges, making the energy transition a subject of ongoing policy refinement and targeted investments.

7 [China | Energy Trends | Ember]
8 [China's evolving footprint in global energy development finance – Analysis - IEA]

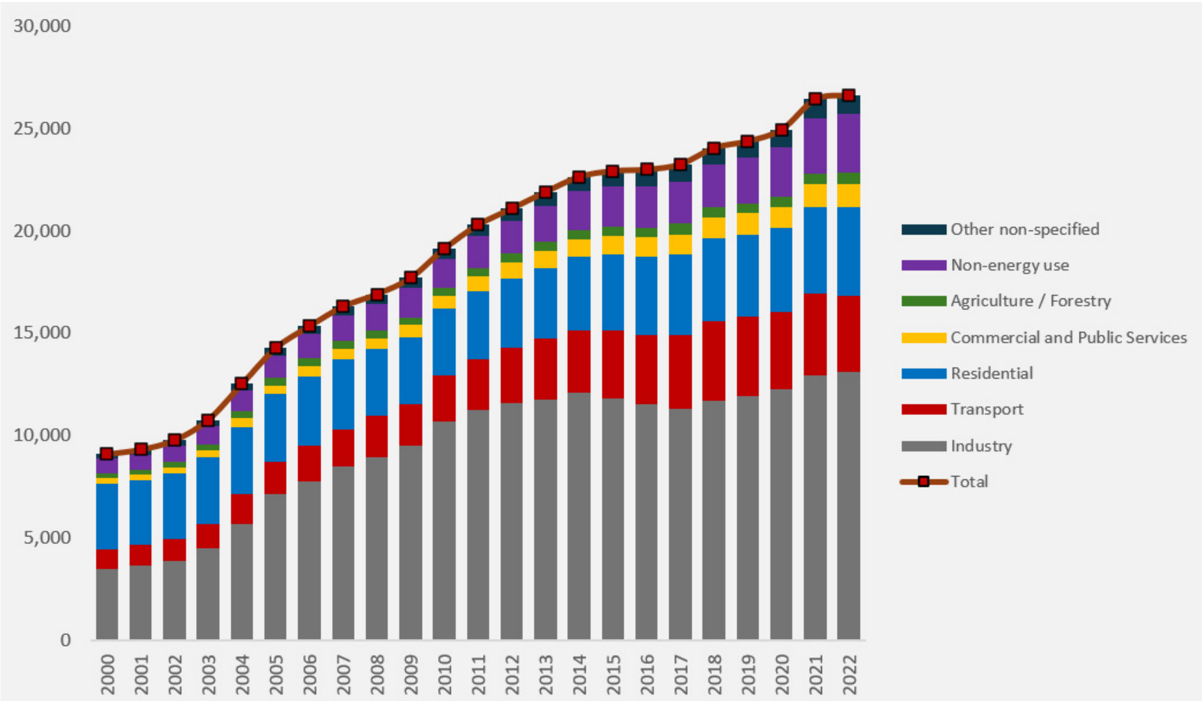


Figure 8. Final energy consumption (in GWh) by sector in China. Source: Data elaborated from IEA [5]

A key aspect of China's strategy is its extensive deployment of ultra-high voltage (UHV) transmission lines, which enable long-distance transport of renewable electricity from western regions to densely populated eastern cities [9]. While Europe and the United States focus more on smart grid technologies and decentralized energy systems, China's UHV approach highlights a centralized model that may offer lessons for large-scale grid integration elsewhere [10].

Finally, overall energy consumption more than tripled over the last two decades, driven primarily by the industrial sector (see Figure 8), which remains the dominant consumer. Transport and residential use also show steady growth, reflecting economic development and urbanization. From around 2015, growth slowed but remained upward. While economic growth has fueled energy demand, the rapid expansion raises sustainability concerns, singaling also the need for a shift towards cleaner energy sources, more efficiency in high-consumption sectors, and decoupling growth from fossil fuel-based energy consumption.

9 'A bullet train for power': China's ultra-high-voltage electricity grid
10 The Belt and Road City: Geopolitics, Urbanization, and China's Search for a New International Order on JSTOR

02 The 2060 carbon neutrality goal: **Can China deliver?**

Central to China's energy strategy is the ambitious goal of achieving carbon neutrality by 2060[11]. This target is embedded within the framework of successive Five-Year Plans [12], which have increasingly prioritized green energy investments, emissions reductions, and technological innovation. The latest Five-Year Plan [13] outlines significant policy shifts aimed at reducing the country's carbon footprint while maintaining robust economic growth.

China's approach to achieving the 2060 target involves a multi-pronged strategy. Policy measures include lower emissions standards, increasing the share of renewables in the energy mix, and launching ambitious reforestation programs. Financial incentives are being deployed to encourage industries to adopt cleaner technologies, while state-backed funding supports research and development in breakthrough technologies such as carbon capture and storage (CCS) [14].

However, the path to carbon neutrality is not without challenges. One of the primary obstacles is balancing economic growth with environment related objectives. Many regions in China still depend on coal not only as an energy source but also as a key driver of local economies[15]. The energy transition in these regions requires careful planning to avoid economic disruptions, which has led to a non-coherent approach in coal phase-out policies.

11 Carbon Neutrality in China – China-Europe
12 What is a "Five-Year Plan"? Understand China's Policies | National Policy | Feature | Our China Story
13 Towards carbon neutrality and China's 14th Five-Year Plan: Clean energy transition, sustainable urban development, and investment priorities - ScienceDirect
14 Will China take the lead in carbon capture and storage technologies? | Science|Business
15 TOWARDS A JUST TRANSITION: HOW GREENING CHINA'S ECONOMY WILL IMPACT ITS REGIONS - UNDP

Another challenge lies in the political and economic implications of rapid decarbonization. The energy sector is intricately linked with China's geopolitical standing, and any significant shift in the energy mix could have broader implications for international trade and diplomatic relations. For example, China's stance at major global forums such as COP29 and its participation in IPCC discussions are closely scrutinized. The country is under increasing pressure to demonstrate tangible progress, and its international commitments are both a source of pride and a cause for domestic debate.

Moreover, while investments in clean energy are soaring, uncertainties remain regarding the sufficiency of these investments to offset ongoing reliance on fossil fuels. Industry experts debate whether the current pace of infrastructure modernization, technology development, and regulatory reforms will be enough to meet the carbon neutrality target within the designated timeframe[16]. Nevertheless, the government's recent policy shifts[17], indicate a determined effort to harness both market mechanisms and regulatory frameworks to drive the transformation.

The dynamic nature of China's energy policy landscape suggests that the country is aware of the inherent tensions of this transition. Initiatives that integrate local energy policies with national goals are being implemented to tailor global solutions to regional conditions. Moreover, strategic partnerships with international energy firms and technology providers are expected to bring in expertise and accelerate innovation.

16 Carbon neutrality can help China maintain its development | World Economic Forum

17 China's Energy Law 2025 | FiscalNote

China’s clean energy boom

01 Solar supremacy: **China’s unrivaled dominance**

China’s ascendancy in the solar energy arena has been nothing short of transformative. The country not only leads to solar panel production but also to the deployment of solar farms across diverse landscapes. This section examines how China has achieved its solar supremacy and how it is leveraging this leadership to integrate with international markets and particularly the European Union.

At the heart of China’s dominance in solar energy is a combination of robust government support and private-sector innovation. Large-scale subsidies, favorable tax policies, and dedicated research funding have created a fertile environment for rapid technological development. Chinese companies have benefited from economies of scale, driving down the cost of solar panels and making them more competitive on the global market. This competitive edge has allowed China to flood international markets with affordable, high-efficiency solar solutions.

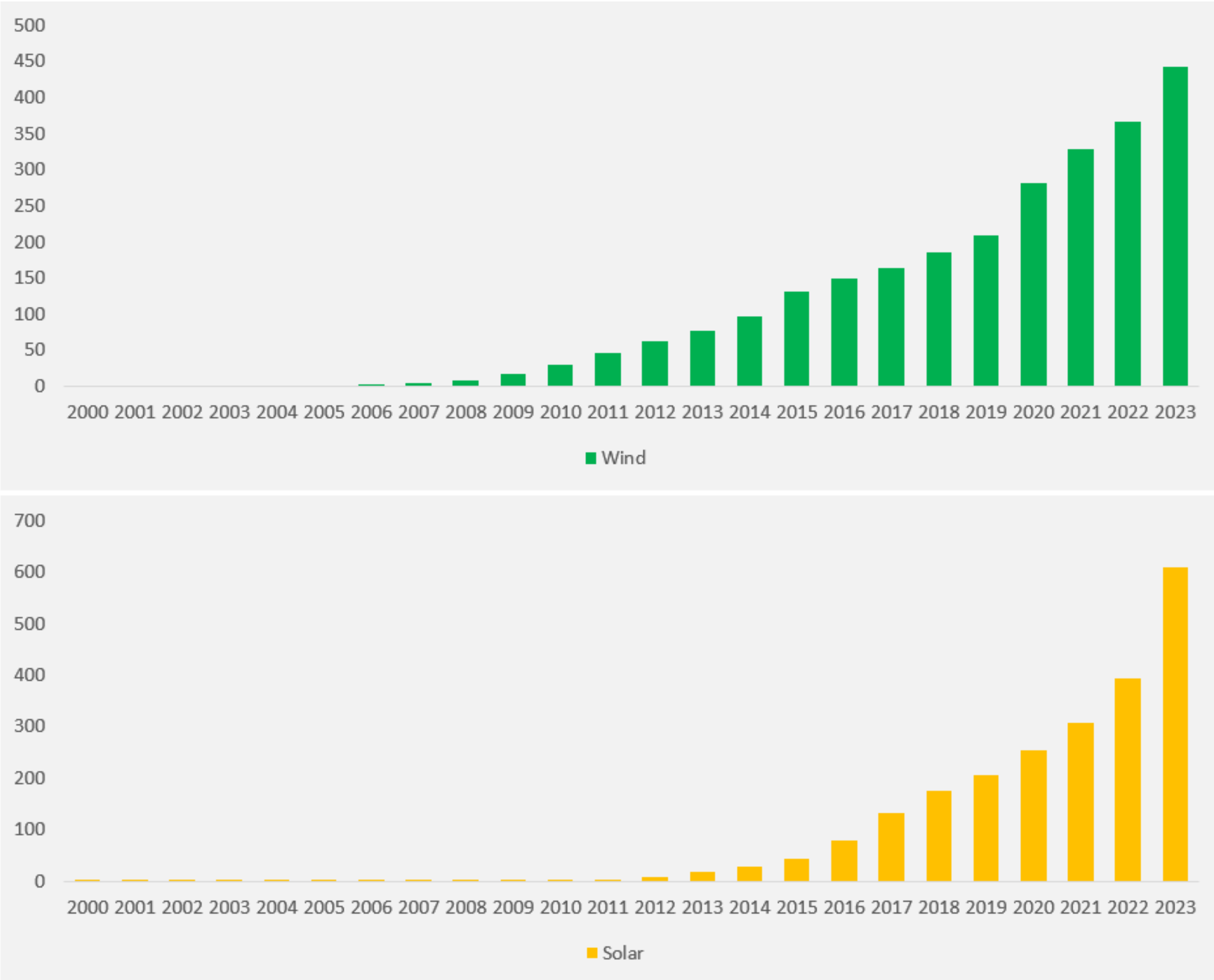


Figure 9. Evolution of installed RES (GW), wind (top) and solar (bottom) in China. Source: Data elaborated from Ember-Climate [7]

The rapid expansion of solar capacity is also supported by aggressive domestic targets. Government mandates for renewable energy integration have spurred extensive solar installations, both in urban settings and remote, underutilized areas. The proliferation of solar farms in regions with high solar insolation has not only contributed to cleaner energy generation but also created local jobs and stimulated economic growth in rural areas. Notably, as of 2023, China has over 600 GW of installed solar PVs (see Figure 9).

Furthermore, China's goal to integrate with the EU market illustrates a sophisticated export strategy. Chinese solar panels and related technology are being incorporated into large-scale European renewable projects. This partnership is mutually beneficial: China secures a steady demand for its products while European countries accelerate their transition away from fossil fuels. Such transcontinental collaborations underscore China's commitment to playing a central role in the global renewable energy revolution.

Apart from China's solar boom, it is worth mentioning that wind power is also rapidly growing with installed capacity of wind power reaching over 400 GW in 2023 (see Figure 9). With these two pieces of the puzzle, the country has experienced a renewable energy boom over the past few years. This growth is expected to continue in the future as the energy transition moves along in China.

Figure 10. Three Gorges Dam

02 Hydropower & Nuclear: **Balancing clean energy**

While solar power garners significant attention, China's portfolio also includes hydropower and nuclear energy, each contributing unique strengths to the overall grid. Hydropower remains a foundational element of China's renewable energy strategy. Large hydropower projects, such as the Three Gorges Dam [18], not only generate vast amounts of electricity but also provides crucial grid stability. The continued development of smaller, localized hydro projects has helped to balance supply and demand fluctuations, particularly in regions with variable renewable energy output.

18 Three Gorges Dam: Was China's project worth building? | CNN

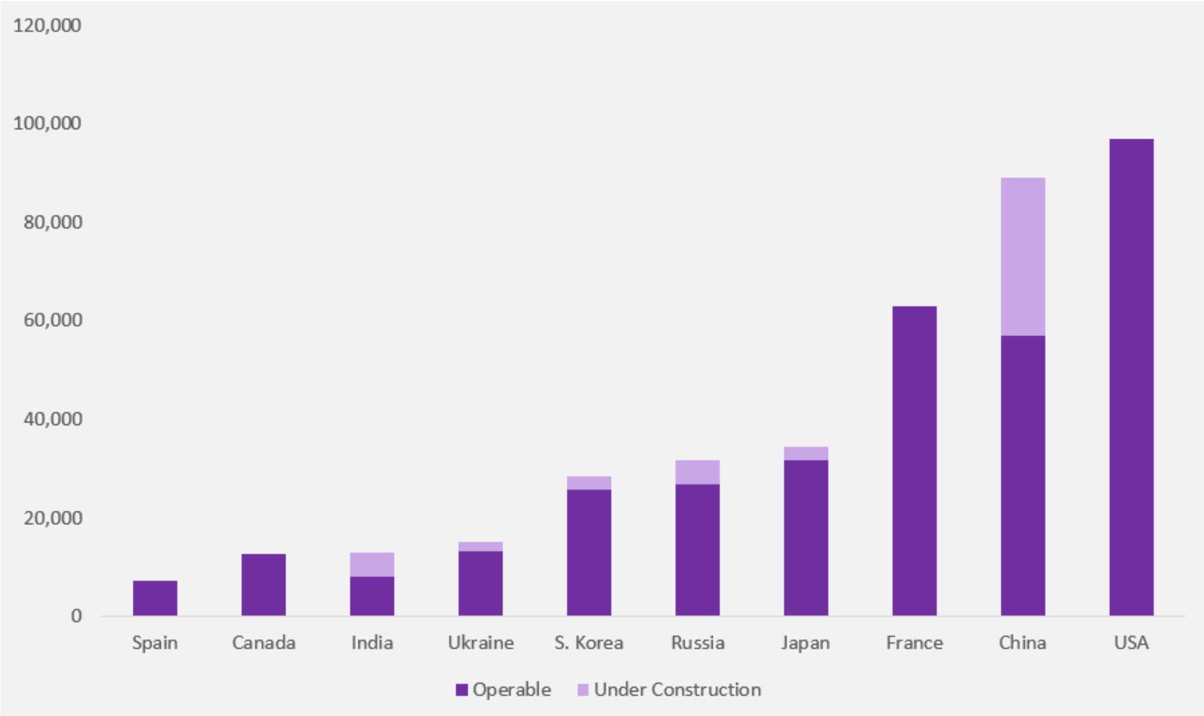


Figure 11. Capacity (in MW) of operable and under construction power plants in various countries. Source: Data elaborated by World Nuclear Association [20].

Nuclear energy, meanwhile, represents a more controversial but necessary facet of China's clean energy agenda. The expansion of nuclear capacity is driven by the need for a stable, low-carbon energy source that can complement the intermittent nature of solar and wind power. Despite concerns over safety and waste management, the government is moving forward with a series of new reactor designs and construction projects. With the nuclear power plants that are under construction (see Figure 10), China will be ranked second behind the US in terms of nuclear powerplant capacity [19]. These nuclear projects are seen as essential to achieving the country's long-term carbon reduction goals, even as they spark debates about environmental risks and public acceptance.

The dual approach of leveraging both hydropower and nuclear energy illustrates China's recognition that no single energy source can meet the diverse demands of its growing economy. Hydropower provides a renewable, long-established source of clean energy, while nuclear energy offers a high-output, low-emission alternative that can operate continuously. This diversified strategy is critical in ensuring energy reliability, particularly during peak demand periods or when weather conditions impact solar and wind production.

19 China - Reactor Database - World Nuclear Association
20 Nuclear Generation by Country - World Nuclear Association

03 Green Hydrogen: **The next big leap?**

Looking to the future, green hydrogen is emerging as the next frontier in China's renewable energy strategy[21]. Hydrogen produced through electrolysis using renewable energy sources promises to revolutionize sectors that are hard to decarbonize, such as heavy industry and long-haul transportation. Recognizing this potential, the Chinese government has outlined an ambitious roadmap for scaling up hydrogen production. This includes incentives for research and development, subsidies for pilot projects, and frameworks for international collaboration. Government incentives play a crucial role in accelerating the adoption of hydrogen technologies[22]. By subsidizing early-stage projects and offering tax breaks for companies investing in hydrogen infrastructure, China is positioning itself at the forefront of this burgeoning market. International collaborations further amplify these efforts, as Chinese firms partner with global technology providers and research institutions to advance hydrogen production methods and improve efficiency.

The strategic emphasis on green hydrogen also reflects the country's broader environmental goals. As China continues to reduce its reliance on coal and other fossil fuels, hydrogen offers a versatile, clean alternative energy carrier that can be integrated across multiple sectors. Pilot projects in major industrial hubs have already demonstrated the viability of hydrogen-powered systems, and the potential for scaling these solutions nationally is immense.

21 WEF_Green_Hydrogen_in_China_A_Roadmap_for_Progress_2023.pdf

22 China Accelerates Hydrogen Energy Development with 33 New Policies


H2 HYDROGEN
ZERO EMISSION
CLEAN ENERGY OF THE FUTURE

Clean technology & innovation

01 Battery storage & EVs: **China's tech giants leading the charge**

China's aggressive EV market expansion is pronounced (as depicted in Figure 13) and is further supported by national policies and consumer incentives. Subsidies, tax breaks, and investments in charging infrastructure have combined to create an environment conducive to rapid EV adoption. Major urban centers have seen a dramatic increase in electric bus fleets and taxi services, which are helping to reduce congestion and improve air quality. Moreover, export strategies are in full swing, as Chinese manufacturers leverage competitive pricing and technological superiority to penetrate international markets. This has positioned China not only as a domestic leader but also as a key exporter of EV technology worldwide (see Figure 14).

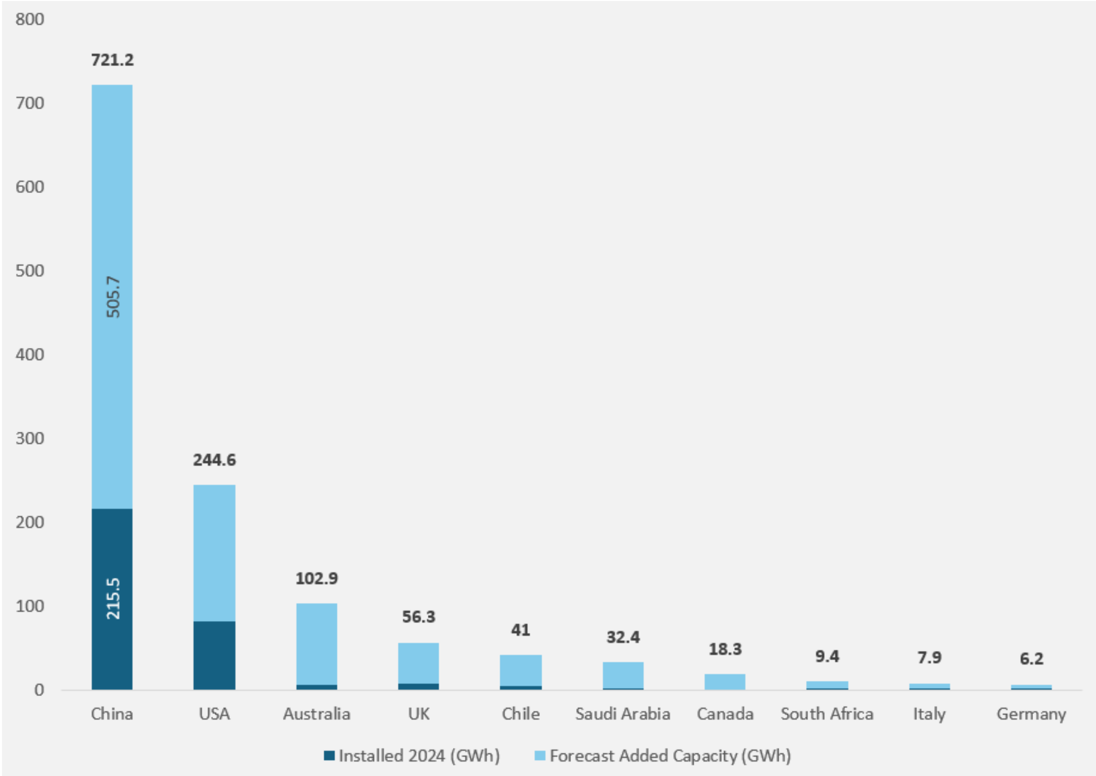


Figure 12. Top 10 Countries by battery storage capacity (GWh) from 2024 till 2027. Source: Data elaborated by Visual Capitalist [23]

Chinese EV manufacturers have produced innovations that have not only driven down costs (as depicted in Figure 12) but also extended battery life and improved safety standards. The company's global supply chain, bolstered by extensive research and development, has allowed it to capture a significant share of the international market. Another example comes from the integration of battery technology with vehicle manufacturing to produce a broad range of electric vehicles—from passenger cars to commercial fleets. These integrated solutions exemplify how technological innovation can translate into real-world applications that drive economic growth and environmental sustainability.

China's aggressive EV market expansion is pronounced (as depicted in Figure 13) and is further supported by national policies and consumer incentives. Subsidies, tax breaks, and investments in charging infrastructure have combined to create an environment conducive to rapid EV adoption. Major urban centers have seen a dramatic increase in electric bus fleets and taxi services, which are helping to reduce congestion and improve air quality. Moreover, export strategies are in full swing, as Chinese manufacturers leverage competitive pricing and technological superiority to penetrate international markets. This has positioned China not only as a domestic leader but also as a key exporter of EV technology worldwide (see Figure 14).

23 Top 20 Countries by Battery Storage Capacity - Visual Capitalist

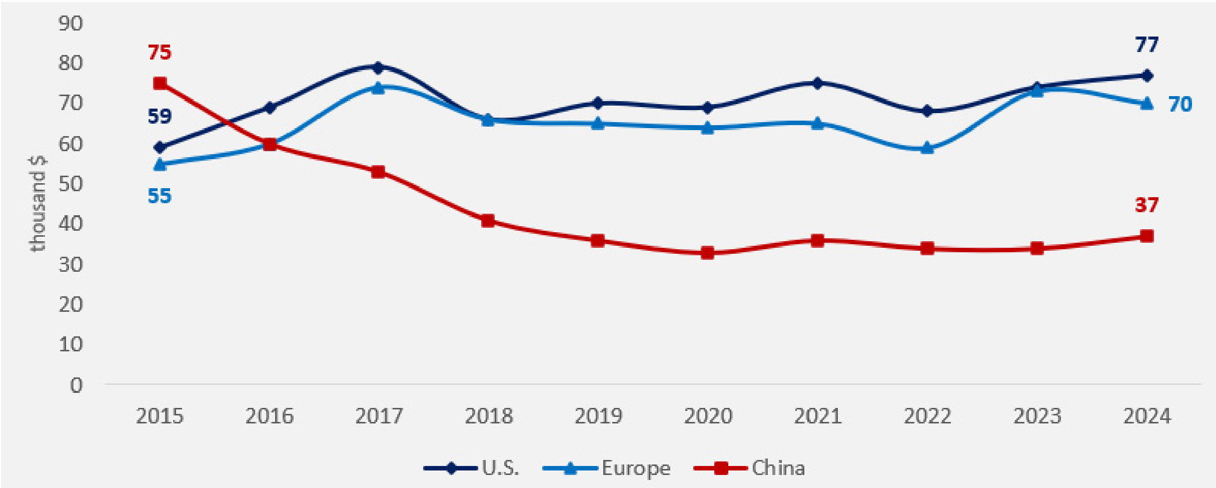


Figure 13. Average retail price of EVs in China, US and Europe. Source: Data elaborated by JATO [24]

Figure 14. EV battery manufacturing capacity (in GWh) by region. Source: Data elaborated by IEA [25]

24 Closing the gap: the progress towards affordable EVs and the rising competition from China - JATO
25 Trends in electric vehicle batteries – Global EV Outlook 2024 – Analysis - IEA

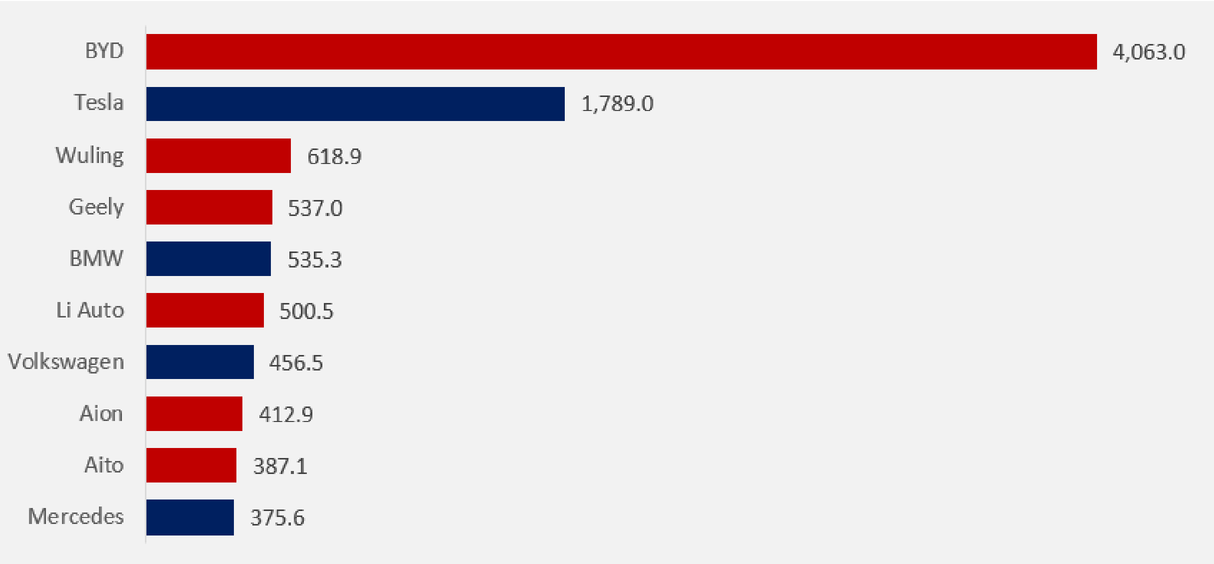


Figure 15. EV sales by brand for 2024. Source: Visual Capitalist

02 Smart grids & AI: **The digital transformation of energy**

Another transformative aspect of China's energy innovation is the integration of smart grids and artificial intelligence (AI) in energy management. As renewable energy penetration increases, the traditional grid infrastructure faces significant challenges in managing variable outputs and ensuring reliability. In response, China is investing heavily in smart grid technologies that utilize AI algorithms to predict demand, optimize energy distribution, and rapidly respond to outages or fluctuations. Smart grids enable a more decentralized and responsive energy network. By integrating sensors, real-time data analytics, and machine learning algorithms, these grids can dynamically adjust energy flows, significantly reducing losses and improving overall efficiency. Urban centers, in particular, benefit from smart grid technologies by achieving more precise control over energy consumption and integrate renewable sources more effectively. Moreover, smart grids are key enablers of intelligent cities initiatives, where energy, transportation, and communication systems converge to create sustainable urban environments.

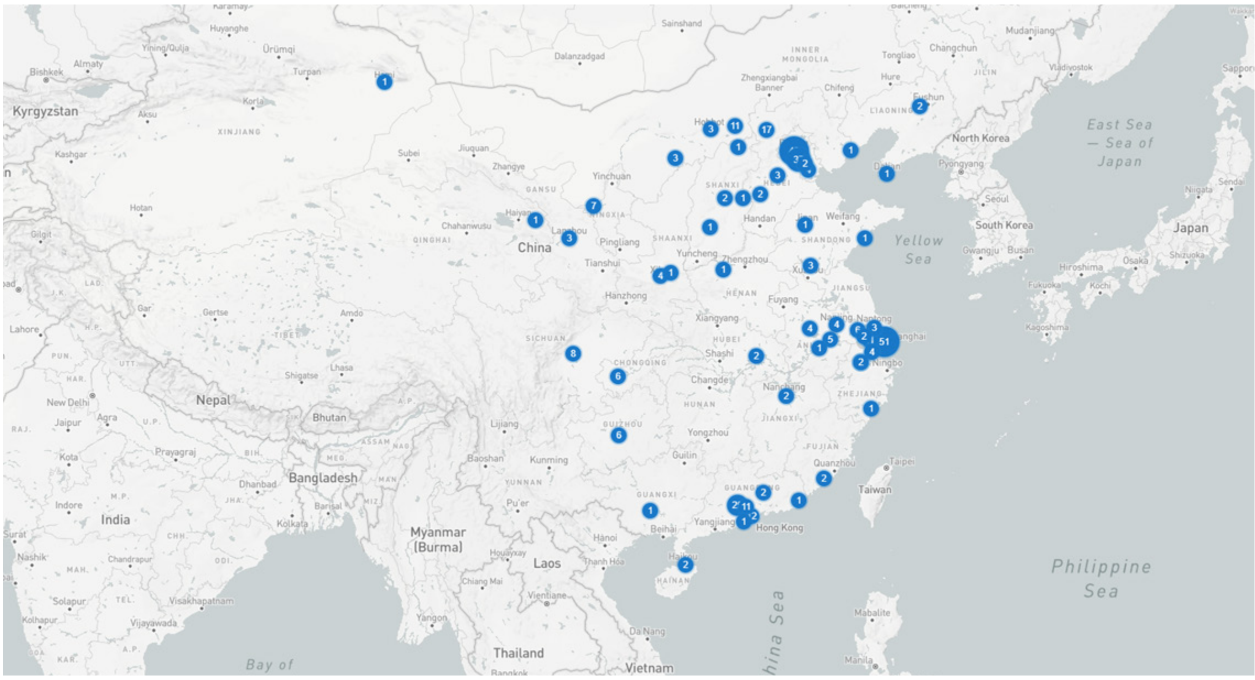


Figure 16. Locations of China's data centers. Source: Data elaborated by DataCenterMap [26]

AI-powered energy management systems are increasingly being deployed across industrial and municipal sectors. These systems analyze vast amounts of data, from weather patterns to consumer behavior, to optimize energy generation and distribution. The result of all this process is a more resilient grid that can accommodate high levels of renewable penetration while reducing the need for expensive infrastructure upgrades. Additionally, the use of AI in predictive maintenance and fault detection helps reduce downtime and extend the lifespan of energy assets.

In the context of a rapidly changing energy landscape, the digital transformation represented by smart grids and AI is vital. It not only supports the integration of intermittent renewable energy sources but also enhances the overall resilience and efficiency of the energy system. The strategic convergence of digital technologies with traditional energy systems marks a new era in China's clean energy revolution, one that is likely to set benchmarks for the rest of the world.

This extensive use of data and data-driven methods in all these applications, has created the demand for the construction of data centers (as evidenced in Figure 15), which in turn have driven the rise of energy demand in China. Specifically, it is estimated that in 2023 the electricity consumption of data centers in China was around 70-130 TWh, while it is expected to reach 180-340 TWh in 2027 and 260-470 TWh in 2030 [27].

Finally, it is noteworthy to mention that clean energy technologies contributed more than 10%to China's economy in 2024 (based on an analysis by Carbon Brief and CREA). This is almost equal to $1.9 trillion in green sales and investments. As Figure 17 shows, EVs and batteries are the biggest contributors, while renewable industries follow with wind-solar accounting for $508 billion combined.

26 China Data Centers
27 Electricity 2025 - IEA

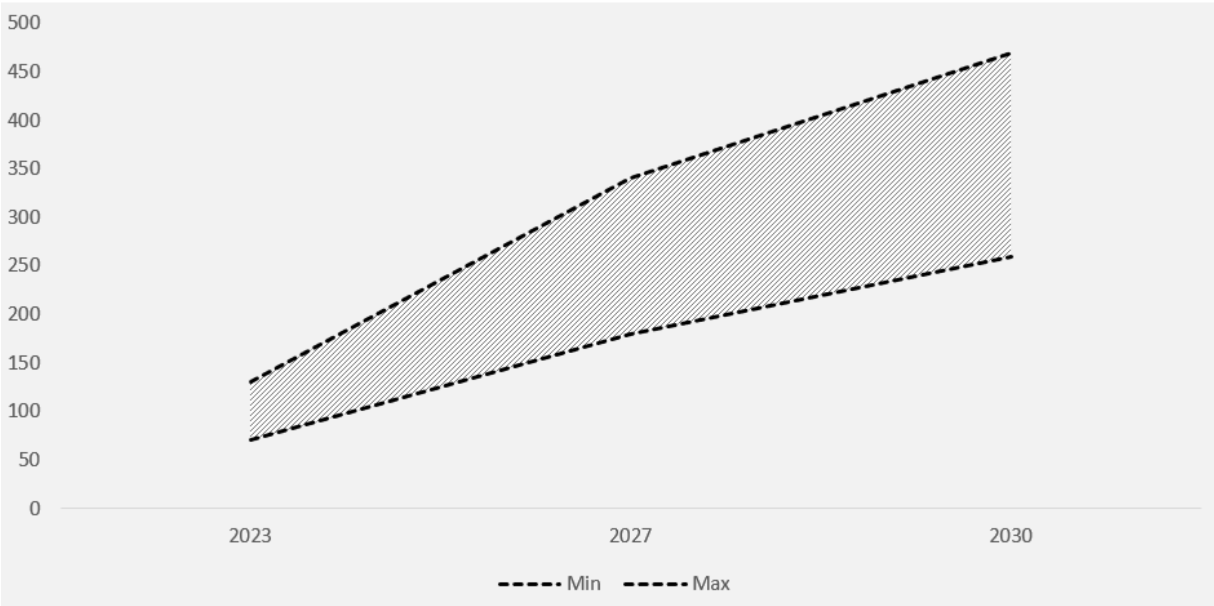


Figure 17. Estimated electricity consumption by data centers in China and forecast. Source: Data elaborated by IEA [28]

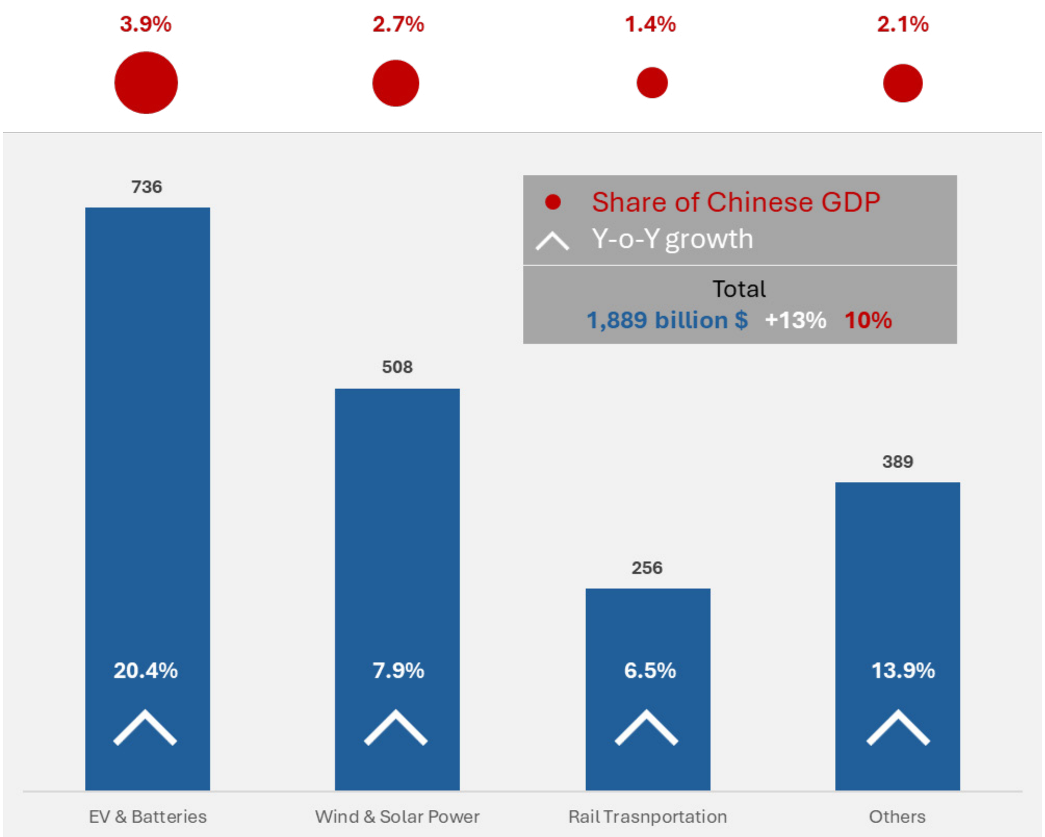


Figure 17. Estimated electricity consumption by data centers in China and forecast. Source: Data elaborated by IEA [28]

28 [Chart: Clean Energy Tech Now Contributes 10% to Chinese GDP | Statista]

China's global energy influence

01 Belt & Road energy expansion: **A green or dirty strategy?**

Since its launch in 2013, China's Belt and Road Initiative (BRI)[29] has evolved into a sprawling web of transcontinental influence. What began as an infrastructure investment strategy has been formed into a multidimensional project aimed at reshaping trade, transportation, and global energy flows across Asia, Africa, and Europe. At the heart of this expansive vision lies energy, a domain not only of economic cooperation but also of geostrategic leverage. Over the past decade, energy investments under the BRI have followed a trajectory marked by initial dependence on fossil fuels, gradual reorientation toward renewable alternatives, and ongoing tensions between economic ambition and environmental targets.

29 China's Massive Belt and Road Initiative | Council on Foreign Relations

In its first phase, the BRI's energy footprint was unmistakably carbon-heavy. By 2020, approximately 75% of all energy-related investments under the BRI were directed toward fossil fuel infrastructure: coal-fired power plants, oil pipelines, and gas processing facilities. These projects, while responding to the urgent electrification needs of developing countries, risked exacerbating long-term carbon lock-in and undermined global decarbonization efforts. Indeed, a 2023 policy assessment estimated that if current trends continued, energy projects under the BRI alone could account for between 7% and 17% of the remaining global carbon budget for the 1.5°C target by 2030. [30]

This fossil-heavy orientation was mainly a reflection of China's domestic industrial surplus in sectors such as coal and cement, the outward push of its state-owned enterprises (SOEs), and the immediate development priorities of host countries. It also provided a platform for China to expand its influence through bilateral agreements that often included long-term repayment schemes, equity stakes in energy infrastructure, and access to key logistics nodes. The port of Piraeus in Greece, operated by China's COSCO, exemplifies how energy logistics and strategic control converge in the BRI framework.

30 China Belt and Road Initiative (BRI) Investment Report 2024

However, as China began to frame itself as a leader in global climate governance, especially after President Xi Jinping's 2020 pledge for carbon neutrality by 2060, the contradictions became increasingly difficult to ignore. The reputational gap between China's green discourse and its overseas energy investments created a credibility problem, both within multilateral climate fora and among its developing partners. In 2021, Beijing formally announced the termination of support for new overseas coal projects. This political and strategic shift was heralded as a turning point and signaled a tentative transition toward a so-called "Green BRI".

This green pivot has been uneven but real. In 2024, Chinese firms installed 24 GW of new energy capacity across BRI-participating countries. For the first time, renewables accounted for 52% of this capacity, with solar power leading (8 GW), followed by hydropower (5 GW). These figures suggest a tangible shift, especially when compared to the fossil-heavy trends of the previous decade. Notably, renewable energy investments under the BRI reached a record $11.8 billion in 2024, further reinforcing China's effort to redefine its energy diplomacy.

Yet challenges remain. Despite the halt in new coal financing, around 19 GW of coal-fired capacity remains in the development pipeline, much of it linked to pre-2021 bilateral agreements. Moreover, the green transition in BRI energy investment still faces structural constraints: many projects are delivered by SOEs with a preference for large-scale, centralized infrastructure, often overlooking decentralized renewable systems or community-scale initiatives that would better serve rural or fragile contexts. Governance practices also continue to suffer from a lack of transparency, with limited engagement of local institutions in the design, ownership, and oversight of energy projects.

In parallel, China has expanded its efforts to support green technology integration within BRI infrastructure. Recent initiatives have included the deployment of digital twins, smart grid infrastructure, and green hydrogen pilot projects. However, these technologies are often implemented selectively and remain secondary to conventional utility-scale systems. For a truly green BRI to take root, China would need to move beyond symbolic investments and instead support comprehensive ecosystems' development, including regulatory reform, capacity building, and multilateral engagement mechanisms.

An additional layer to China's BRI energy strategy is its use as a geopolitical leverage mechanism. Energy is not merely a sector of investment; it is an instrument of long-term influence. By embedding itself in the energy architecture of host nations, through both hard infrastructure and financial ties, China secures durable entry points into regional politics, trade routes, and policy frameworks. This blend of infrastructure and strategic alignment is mostly visible in the control of port logistics, pipelines, and cross-border electricity grids.

Within this context, China's Belt and Road Initiative is no longer proceeding uncontested. An emerging counter-framework, the India–Middle East–Europe Economic Corridor (IMEC), was formally announced at the 2023 G20 Summit and is rapidly gaining attention as the West's strategic response to Beijing's expansive connectivity ambitions. While still in its formative stages, IMEC is deliberately framed not just as a logistical alternative, but as a geoeconomic bulwark against China's infrastructural and political penetration into the West. By offering a multipolar, climate-aligned, and digitally integrated model, IMEC stands in stark contrast to the BRI's coal-intensive, state-led architecture.

Backed by the United States, the European Union, India, and key Gulf states, IMEC reflects a coalition-based effort to reassert influence over critical trade corridors, particularly in regions where China's BRI has already gained significant ground. Its emphasis on hydrogen pipelines, undersea data cables, and multimodal transport, mainly rail and maritime, signals an intentional pivot toward resilience, transparency, and sustainability. In geopolitical terms, IMEC is not merely an infrastructure project; it is a strategic containment mechanism designed to limit the reach of China's infrastructural diplomacy, particularly in Europe and the Eastern Mediterranean.

Central to this counter-strategy is India's maritime and logistical expansion, exemplified by the acquisition of Haifa Port by Adani Ports in 2023 and the long-term Maritime India Vision 2047. With projected investments exceeding €900 billion, India's blueprint for regional connectivity aims to elevate its port infrastructure, double cargo capacity, and establish the country as a major shipbuilding and energy logistics hub. This vision aligns seamlessly with IMEC's objectives and positions India as both a regional integrator and a strategic counterweight to China's influence along the East-West axis.

Taken together, these developments suggest the emergence of competitive connectivity as the new front line of global influence, where infrastructure corridors represent not only commercial opportunity but geopolitical alignment and environmental models. Whether the Belt and Road can adapt to this evolving landscape, or whether it will increasingly be seen as a legacy of China's fossil-fueled diplomacy, remains an open question.

02 Energy trade wars: **China vs. the World**

Over the last three decades a persistent widening trade imbalance of U.S. imports from China has been reported, particularly since the early 2000s, while exports to China have increased only modestly. This growing gap has resulted in a pronounced negative trade balance for the U.S. in this sector.

What we observe is a structural asymmetry that reflects China's rise as a global manufacturing hub, producing and exporting vast quantities of solar panels, batteries, and electrical equipment to meet global and U.S. demand. Meanwhile, the U.S. has remained a net consumer of these goods and a comparatively limited exporter to China in the same categories. The upward trend in imports, with sharp inflections in the mid-2000s and again after 2010, aligns with the globalization of supply chains and the rapid expansion of renewable energy technologies in the U.S., many of which depend on components produced in China.

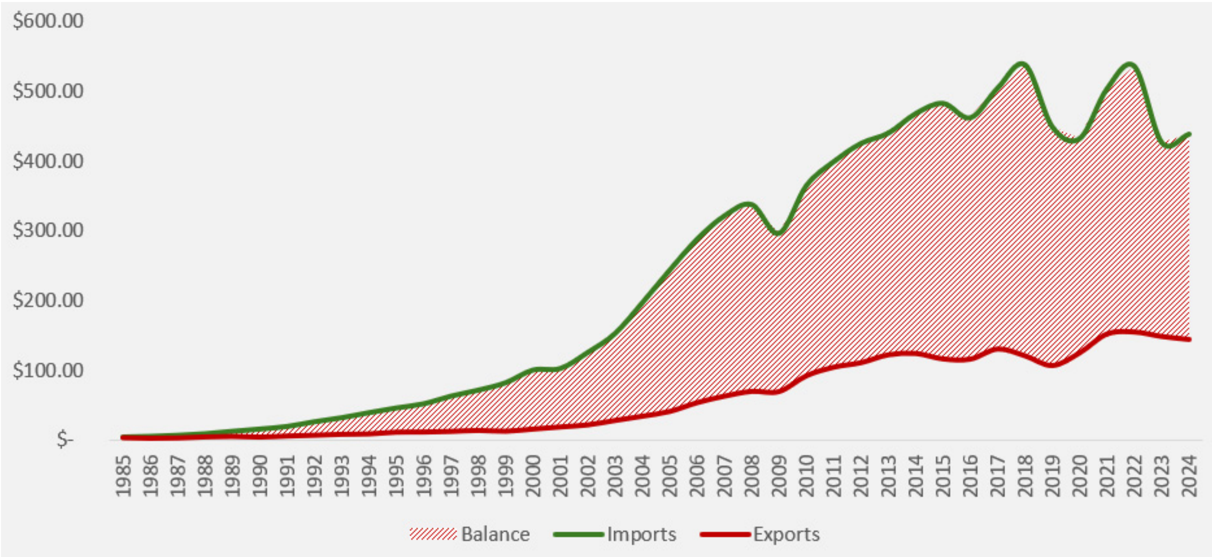


Figure 19. US-China trade in billion USD. Source: Data elaborated by US Census Bureau [31]

Figure 16 does not merely chart a trade imbalance; it serves as a visual indicator of deep interdependence and mounting geopolitical friction between the two largest economies in the world. It underscores the U.S. growing vulnerability to disruptions in energy-related supply chains. To narrow the widening trade gap and reduce strategic dependency, the US has increasingly sought to reassert control over critical industries, such as the clean energy manufacturing, positioning itself to regain leverage in a global economy shaped by technological competition and supply chain vulnerabilities.

In this direction, the United States made an agreement with the Ukraine in May 2025 that established a jointly managed Reconstruction Investment Fund aimed at rebuilding Ukraine's infrastructure and natural resource base. Under the terms of the deal, Ukraine contributes 50% of revenues from new mineral, oil, and gas projects, while maintaining full ownership and decision-making rights over its resources. Importantly, future U.S. military aid will be counted as capital toward the fund—signaling a shift in how defense support is monetized in economic diplomacy.

The agreement also gives U.S. companies the right to negotiate mineral offtake agreements on market-based terms, reflecting a more collaborative approach than earlier proposals that demanded repayment in resources. This switch toward resource-based alliances—rather than traditional military agreements—underlying how the new wave of tension between the U.S. and China is playing out, not over conventional flashpoints, but over access to the **critical mineral resources**. Tariffs, export controls, and strategic investments are becoming the new instruments of leverage in a world increasingly defined by clean technology and contested supply chains. [32]

In early April, the United States significantly intensified its protectionist trade stance under the renewed leadership of President Donald Trump. The administration introduced a comprehensive set of tariffs targeting imports from a wide range of countries, with particular emphasis on goods originating from China (as shown on Figure 20).

31 [US-China Trade – US Census Bureau]
32 https://www.csis.org/analysis/what-know-about-signed-us-ukraine-minerals-deal

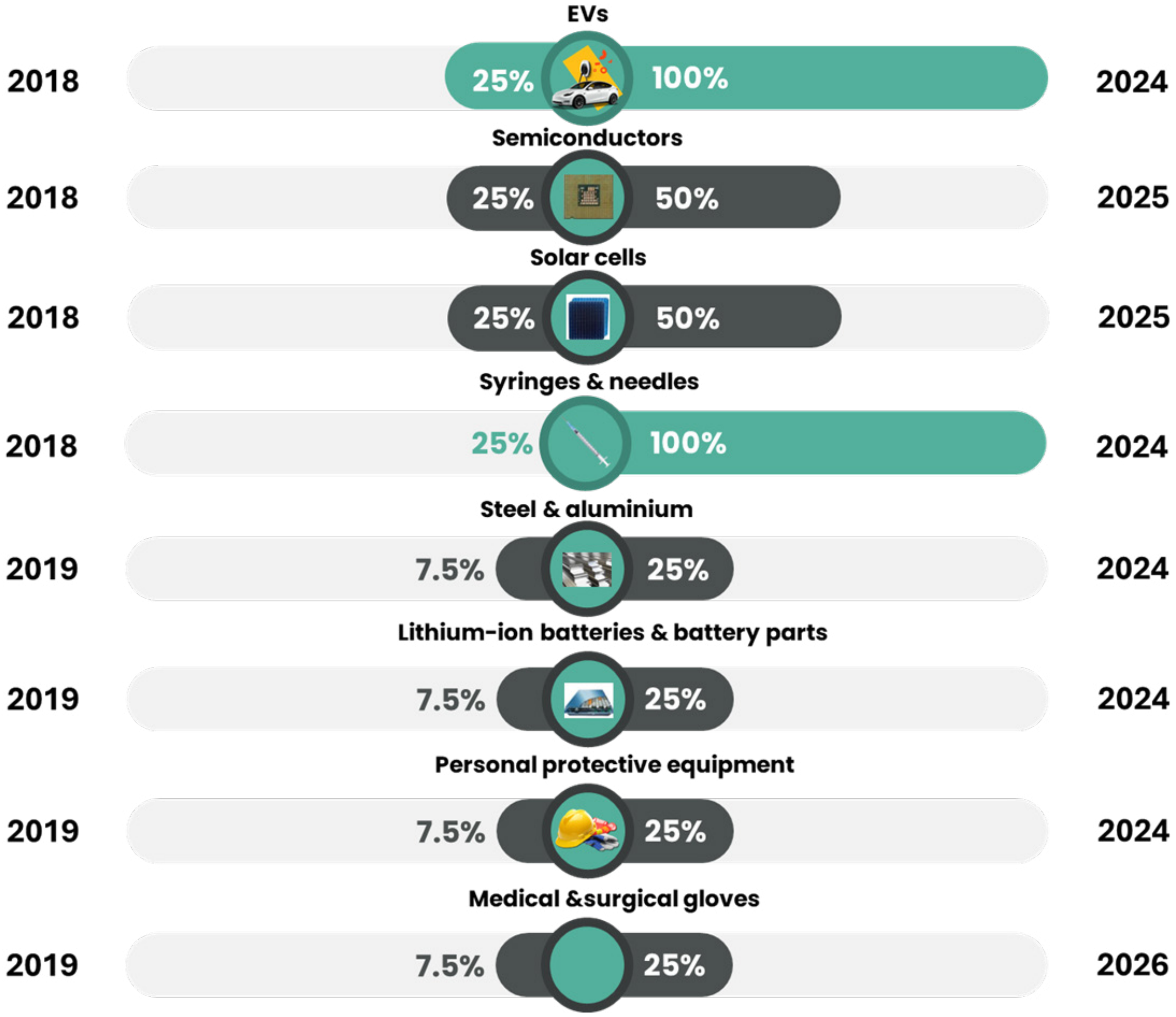
Figure 20. America's rate increase of tariffs on China.

The measures encompassed key industrial sectors, including electric vehicles, steel, aluminum, semiconductors, and consumer electronics, as well as everyday consumer products (as shown on Figure 21).

Framed as a strategy to promote domestic manufacturing and address long-standing trade imbalances, the tariffs were met with concern from economic analysts and industry leaders. Many warned that such broad trade restrictions could lead to higher costs for consumers and exacerbate vulnerabilities in critical supply chains, especially in areas vital to the clean energy transition, where the U.S. continues to rely heavily on international sourcing. [33]

China's response was swift and precisely targeted. In mid-April 2025, Beijing announced export licensing restrictions on six critical rare earth metals, all of which are essential for the production of electric vehicle motors, wind turbines, defense systems, and high-performance electronics. These restrictions could delay shipments by up to 45 days, sending shockwaves through international markets and drawing renewed attention to China's overwhelming dominance in the global supply of these minerals. [34]

33 https://www.nytimes.com/2025/03/13/business/economy/trump-tariff-timeline.html
34 A Timeline of Trump's On-Again, Off-Again Tariffs, The New York Times


EVs
2018
25%
100%
2024
Semiconductors
2018
25%
50%
2025
Solar cells
2018
25%
50%
2025
Syringes & needles
2018
25%
100%
2024
Steel & aluminium
2019
7.5%
25%
2024
Lithium-ion batteries & battery parts
2019
7.5%
25%
2024
Personal protective equipment
2019
7.5%
25%
2024
Medical &surgical gloves
2019
7.5%
25%
2026

The interplay between China's export restrictions and the U.S. tariff policies illustrates the complex dynamics of global trade and energy transition. As nations strive to secure critical resources for clean energy technologies, geopolitical tensions and environmental considerations become increasingly intertwined. The situation underscores the need for international cooperation and sustainable practices to navigate the challenges of a rapidly evolving global economy.

The strategic significance of these raw materials has grown exponentially in recent years. Wind power depends on neodymium and other rare earth magnets; EV batteries require massive amounts of lithium, nickel, cobalt, graphite, and aluminum. According to international projections, demand for lithium is expected to grow 42-fold between 2020 and 2040, while demand for other minerals such as nickel and cobalt is anticipated to increase by a factor of 20 to 25. [35] In virtually every case, China leads the world, not just in mining, but most importantly in processing and refining these minerals, making it the most powerful actor in the clean tech materials supply chain. [36]

But this dominance carries a heavy ecological price. Extracting and refining critical minerals often causes severe environmental damages. In places like the Salar de Atacama in Chile, lithium extraction consumes nearly 65% of the region's available water, displacing Indigenous farmers and pastoral communities. Meanwhile, rare-earth mining operations in China and elsewhere generate radioactive waste, raising public health concerns and further complicating the narrative of a "green" energy future. These environmental realities have reignited debates around the sustainability of current supply chains and underscored the urgency of developing circular economies, ethical sourcing frameworks, and global standards for responsible extraction.

What is unfolding between the U.S. and China is not simply a trade dispute; it is a high-stakes contest over who will control the necessary materials for the global energy transition. In this new era, the rivalry between two superpowers is being fought less with arms, and more with export controls, industrial policies, and mineral diplomacy. Whether the future will be shaped by confrontation or cooperation remains to be seen, but it is increasingly clear that the pathway to a cleaner world runs through the contested terrain of strategic resources.

35 https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary
36 https://www.nytimes.com/2025/04/16/climate/rare-earths-critical-minerals-china-united-states.html


May
Jun

Industry insights & future outlook

As global manufacturing dynamics evolve, the energy systems that support industrial growth must also adapt to meet new demands and challenges. With China now accounting for more than 31% of global manufacturing value added (as shown on Figure 17), a double percentage compared to the U.S. share, the industrial energy landscape is undergoing a critical phase of transformation. Moving forward, the energy sector must shift from a resource-intensive model to one that is technology and innovation-led, aligning with broader ambitions for sustainability, energy security, and economic resilience. [38]

This transition demands a new generation of productive forces powered by innovation in clean technologies, integrated systems, adaptive mechanisms and flexible infrastructure. The future of energy is moving ahead of a story of extraction and centralization to a narrative of decentralization, diversification, and digital integration. Instead of one-directional, fossil-fuel-dependent energy systems, we are witnessing the emergence of multidimensional energy ecosystems, where electricity, hydrogen and ammonia coexist to decarbonize traditionally hard-to-abate and heavy-emitting sectors.

37 Databases | UNIDO Statistics Portal
38 The Future of Industrialization - UNIDO

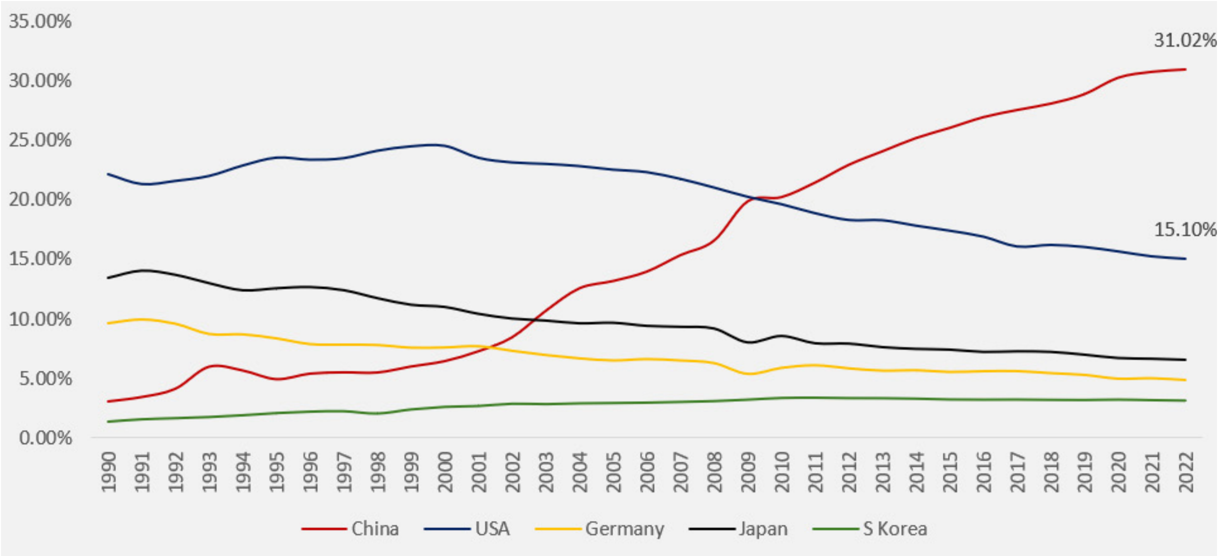


Figure 21. Share of world manufacturing value added. Source: Data elaborated by UNIDO [37]

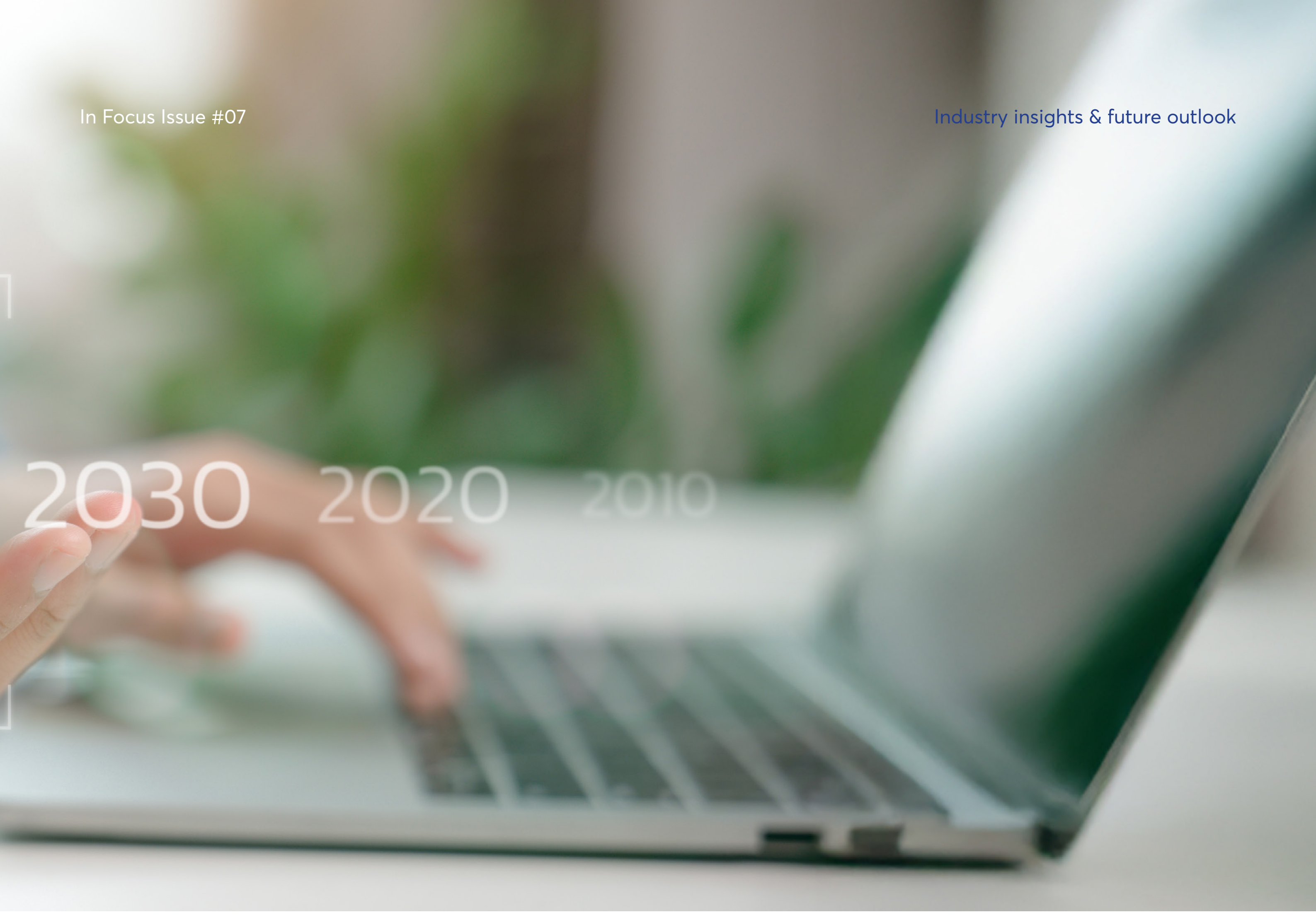
A cornerstone of this shift is the integration of renewable energy sources. Hydropower bases are evolving into hybrid energy platforms, synchronizing with wind and solar resources to ensure consistency of supply. Former coal mines are being repurposed as hubs for geothermal, storage, and even hydrogen production. In the same vein, oil and gas fields are no longer just sites of extraction but are being reimagined as energy innovation clusters, combining solar, thermal, and geothermal systems to decarbonize upstream operations.

Another crucial frontier is the coupling of energy carriers: electricity, heat, hydrogen, and carbon. Low-cost renewables are being harnessed not just for direct consumption but to power integrated energy-chemical clusters, especially in China's western provinces. These clusters are designed to produce green hydrogen, ammonia, and methanol, transforming them into both domestic energy solutions and export commodities. As this system matures, price signals from carbon markets and electricity markets must become harmonized to reinforce investment in low-carbon infrastructure.

Meanwhile, the relationship between energy production and end-users is being redefined. Distributed solar systems are increasingly tailored to urban and rural landscapes alike, supported by emerging technologies such as Building-Integrated Photovoltaics (BIPV) and lightweight, flexible solar panels. Inspired by successful models in Europe and the U.S., community-shared solar projects, virtual power plants, and rural wind cooperatives are expanding access to clean energy while embedding energy resilience at the local level. Green industrial microgrids (customized to deliver electricity, heat, cooling, and hydrogen) are fast becoming the operational backbone of low-carbon industrial parks.

The offshore frontier also holds immense promise. Floating wind farms in deep-sea locations are now being linked with multi-use platforms that combine aquaculture, green hydrogen production, and ammonia synthesis. These hybrid marine infrastructures embody the direction of modern energy thinking: multidimensional, modular, and maximally efficient.

Supporting this wave of transformation is a suite of next-generation technologies, which are rapidly progressing from the R&D stage towards commercial maturity. Offshore wind, next-gen photovoltaics, long-duration energy storage, and green hydrogen are not just enabling decarbonization, they are giving rise to entirely new markets, business models, and industrial ecosystems.



The focus now must be on scaling breakthroughs in materials science, component manufacturing, and systems integration, so that energy innovation can ripple across supply chains, from upstream resource production to end-use efficiency.

This energy-industrial shift also has important geopolitical implications. As the world races to localize supply chains and decouple strategic sectors from vulnerable dependencies, energy security has taken on a new meaning. It is no longer just about oil and gas; it is about mastery over clean energy inputs, control over green technology value chains, and leadership in setting the rules for the emerging low-carbon economy.

In this context, China's industrial ascendancy cannot be separated from its energy strategy. Its dominance in deployment of renewables, rare earth processing, and green hydrogen investments, positions it not only as a manufacturing giga-hub but as a system integrator of the global energy transition. In response, advanced economies are seeking to reassert control over critical infrastructure, reindustrialize their energy sectors, and reclaim strategic autonomy. The outcome of this race will define not only who powers the world, but how.

Conclusion

Over the last three decades, China has transformed from a domestic energy consumer into a leader of the energy transition, currently dominating sectors such as solar manufacturing, green hydrogen, battery storage, and shaping the directions of international energy trade, mainly through the Belt and Road Initiative.

Duality of ambition

While China's energy strategy promotes green technologies, it simultaneously preserves significant fossil fuel infrastructure. This dualism reflects a complex balancing act between domestic economic needs and international climate commitments.

Technological transformation over resource dependence

China's energy transition is shifting away from raw resource dependency towards a high-tech paradigm, emphasizing smart grids, AI integration, flexible renewables, and clean industrial ecosystems.

Green infrastructure and regional imbalance

Major investments in grid modernization and renewables are reshaping the national energy architecture. Yet, uneven existing infrastructure between urban and rural regions remains a challenge, suggesting the need for a more inclusive approach.

Geopolitics of supply chains

Control over critical minerals and rare earths is now a pillar of China's international leverage. The recent tariff wars and export restrictions, reflect a deepening strategic rivalry with the U.S., where clean energy supply chains are increasingly securitized.

Global energy diplomacy redefined

Through the BRI, China has exported both green and gray energy models. Recent moves toward implementation of renewables, indicate a green rebranding, but fossil-heavy legacies persist, raising questions about the credibility of a truly "Green BRI".

The 2060 carbon neutrality challenge

Achieving carbon neutrality will require more than infrastructure deployment; it demands structural reform in pricing, regulation, and cross-sector integration. Whether China can deliver, will depend on its ability to synchronize economic momentum with environmental stewardship.

HAEE

HELLENIC ASSOCIATION
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A Decade of Energy Transition:

Adapting for Tomorrow

HAEE ENERGY
TRANSITION SYMPOSIUM
10 years

in 3-5 June
2025

Thalia Valkouma

faria renewables

Chantavas Aristotelis

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George Vourliotakis

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50 YEARS IN GREECE Deloitte.

Eleni Bairami

ECO HELLAS

Clean Technology & Innovation

Thalia Valkouma

President & CEO,
Faria Renewables

The pressing global environmental challenges

As the global push towards a sustainable energy future accelerates, **clean technology** and **innovation** have emerged as **key drivers of the energy transition.** The world faces the pressing challenges of climate change and environmental degradation, and countries are increasingly turning to clean technology and innovation to drive their energy transition. Among the most influential players in this upgrowth is China, a global game changer in developing and deploying green technologies. The country's rapid advancements in clean energy solutions are not only reshaping its own energy landscape but also positioning China as a leader in the global race towards a sustainable, low-carbon future.

China, with its strong manufacturing base, technological expertise, and ambitious policy support, has emerged as one of the world's most influential players in the clean technology sector. The country's commitment to addressing climate change is evident in its long-term energy plans, which include aspiring renewable energy targets, significant investments in clean energy infrastructure, and a focus on technological innovation.

The Role of China in Clean Technology Innovation

China plays a significant role in clean technology innovation, emerging as a global leader in various aspects of the sector. Its prominence in the clean technology sector is achieved through various key ways, which include strategic **investments in research and development** (R&D), **policy support and incentives** on renewable energy and sustainability to encourage the development and adoption of clean technologies, **expansion of renewable energy capacity** leading the world in the deployment of renewable energy sources and **international collaboration** with other countries on clean technology initiatives, sharing knowledge and technologies through partnerships and joint ventures, which enhance global innovation.

The country has made **substantial strides in renewable energy production**, acting as a **manufacturing hub,** with solar and wind power leading the charge. As one of the world's largest manufacturers of solar panels, China has revolutionized the solar industry, making solar energy more accessible to global markets. Equally important is the development that has been demonstrated in the manufacturing of wind turbines, both onshore and offshore.

China's **innovation in electric vehicles (EVs) and energy storage technology** is also an area where the country has taken the lead. China is the largest market for EVs, driven by government policies aimed at reducing pollution and dependency on fossil fuels. The development of EV infrastructure, including charging stations, is also rapidly advancing. Large-scale energy storage, on the other hand, is essential to balancing the intermittent nature of renewable energy sources like solar and wind. By developing advanced battery technologies and energy storage solutions, China is helping to **solve one of the most critical challenges of the energy transition, ensuring a reliable and stable supply of clean energy.**

Innovative Technology

Clean technology encompasses innovations aimed at minimizing environmental impact through the use of renewable resources, waste reduction, and enhanced energy efficiency. This field covers a wide array of sectors, including renewable energy generation—such as solar and wind power—electric vehicles, energy storage systems, and sustainable building materials. **The primary objective of clean technology is to replace or improve traditional, polluting methods with alternatives that can help combat climate change and promote a more sustainable economic framework.**

In this landscape, FARIA Renewables, a partnership between FARIA Group and Capenergie 5 Fund, plays a crucial role in the development, operation and management of Renewable Energy Source (RES) projects. The company focuses on utilizing advanced renewable technologies, including offshore and onshore wind, photovoltaics, hybrid systems, energy storage, green hydrogen, and other innovative energy solutions throughout Europe, particularly starting from Greece. Through this approach, FARIA Renewables aims to influence the future of energy.

As part of this global transformation, China's advancement in clean technology serves as a reference. **FARIA Renewables works together with companies from China, focusing on deploying the most efficient and sustainable cooperation framework.** At the same time, the company ensures that potential partners fully comply with all applicable safety, quality, and ESG standards, as defined by European legislation and international best practices.

The transition to a sustainable energy future relies heavily on international collaborations, common targets, and cooperative efforts. As the global community faces the pressing challenges of climate change and resource depletion, all of us at all levels must unite to share knowledge, technologies, and best practices.

By establishing shared goals, we can collectively mobilize resources and expertise to drive innovation in renewable energy, energy efficiency, and sustainable practices. Ultimately, a cooperative approach is essential for creating a cohesive and effective response to the shifting landscape of energy production and consumption, paving the way for a cleaner, more sustainable future for all.

Conclusion

As the world accelerates its transition to a sustainable energy future, clean technology and innovation are of pivotal importance to achieving the goal of a low-carbon, resilient, global economy. **FARIA Renewables, with its commitment to renewable energy projects across Europe and worldwide, is playing a key role in this transformation.** Drawing inspiration from global leaders, **FARIA Renewables is exploiting pioneering technologies and strategic partnerships to develop and operate a diverse portfolio of clean energy solutions.** Through its core activity, FARIA Renewables is not only contributing to the global energy transition but **also helping to create a more sustainable future** for generations to come. It is essential that we collectively **invest in cooperation to ensure progress and innovation.** Avoiding or even ceasing trade disputes is a crucial step towards a shared future of prosperity, in which we all move forward together, and no one is left behind.


Sharing energy
At Faria Renewables, we are driven by respect and love for the communities we serve.
We strive to unlock the country's potential and bring it closer to the future we envision together.
We move forward by harnessing the power of energy.
Energy that powers growth, that puts life into motion, that connects nature with human activity.
Our goal is to be part of a better world.
A world full of possibilities and opportunities for all.
For us, energy is power to be shared.
Faria
renewables

From PV dominance to green gases. How China alters the RES landscape

Eleni Bairami

Owner and Managing Director, ECO Hellas

At the end of the 2000s, photovoltaic panel production was largely a European affair. The leading companies in the sector were located in central Europe, mainly in Germany, while even Greece saw tens of millions of euros invested in export-oriented projects.

However, the situation changed dramatically from 2012 onwards with the massive entry of Chinese companies into PV production. As a result, prices fell by up to 40%, automatically making European companies -including Greek ones- uncompetitive. The industry is now dominated almost exclusively by Chinese producers, with all that this implies for the dependence of the European green transition on China.

These facts are particularly relevant at a time of intense economic turmoil in the shadow of the imposition of US tariffs. Europe's pursuit of energy independence, combined with the logic of in- and near-sourcing of production in critical sectors, is changing the design of the entire spectrum of renewable energy sources.

In this environment, the role of so-called "green gases" is crucial, as they can provide a convincing answer to the question of European energy autonomy, complementing photovoltaic and wind energy. In central Europe, their share in the energy mix is already significant.

Similarly, in Greece, green gases have been gaining significant ground recently, acting, among other, as a solution to stabilize the system due to the high variability of other RES production methods, as well as a lever for implementing circular economy practices.

However, the Chinese factor has the potential to radically change the balance in this area of the green transition. It is indicative that in 2025, electricity production from bioenergy in China is expected to reach approximately 59.74 billion kWh, according to a relevant study by Statista. The same study forecasts annual growth of 0.24% (CAGR 2025-2029), demonstrating that China is showing increasing interest in bioenergy with a view to promoting sustainable energy solutions in line with its environmental goals.

Such a development on such a massive scale is bound to have a direct impact on Europe, acting as a catalyst for change across the entire value chain. Given that, following the imposition of US tariffs, Chinese companies are looking for fertile ground in the European market, one cannot rule out a "Chinese invasion" of the green gas sector similar to that of photovoltaics.

This is not necessarily a negative turn of events, but European companies and regulatory authorities need to be prepared. This initially translates into a functional and enforceable regulatory framework that will fully define the rules of the game. This is something that, especially in our country, needs to be done as soon as possible. At the same time, it requires flexibility from the European ecosystem of manufacturers and installers/implementers of projects related to "green gases," so that they are prepared for the new situation and can take advantage of any opportunities that the mass entry of suppliers and potential investors from China brings to the European market.

Advanced transport biofuels in China: Sustainable Aviation Fuel (SAF) market and sustainability

George Vourliotakis

Head of Unit,
Energy Policy & Planning

exergia
CLIMATE CHANGE CONSULTANTS

Advanced biofuels-produced from non-food feedstocks such as cellulosic materials, agricultural residues, municipal waste, and industrial byproducts, can provide a crucial solution for reducing greenhouse gas (GHG) emissions from transportation, especially in modes where electrification is difficult such as heavy duty transport, aviation and maritime.

China exhibits a rapidly growing transport sector and has prioritized advanced biofuels as a key component of its renewable energy strategy to achieve carbon peaking by 2030 and carbon neutrality by 2060 (the so-called 'Dual Carbon' Policy). In particular for aviation, China is experiencing a rapid growth in aviation fuel demand, of the order of 40 million tons in 2024 . The Carbon Peaking Action Plan (2030) promotes the use of advanced biofuels and sustainable aviation fuel (SAF) through the potential introduction of domestic SAF blending mandates (2–5% by 2030), which is believed can stimulate an up to 1-2M tonnes/year domestic SAF demand. Nonetheless, delays in official announcements on the domestic mandate for SAF, leads the Industry to also explore potential export opportunities. In this direction, the issue of sustainability is of particular importance, considering the strict relevant framework both in the EU (RED III, ReFuelAviation) and globally (CORSIA, IATA Net Zero roadmaps).

Feedstock sustainability is a key element and China focus on non-food feedstocks agricultural residues and waste to avoid food-security conflict. Used cooking oil (UCO) is currently a major source of feedstock for biodiesel in China and is expected to be the major feedstock for SAF at least in the next decade. However, the certification process is under scrutiny; while Chinese waste-based biofuels are often certified by international schemes, audits in China are conducted locally, and European authorities cannot directly inspect Chinese facilities, limiting transparency. On the supply side, there is significant potential for the exploitation of several alternative to oil-based sustainable feedstocks, such as agriculture and forestry waste, municipal organic solid waste, industrial wastes, etc. Innovative approaches to establish effective and sustainable technical routes are needed in tandem with the formulation of a favourable policy environment to eventually allow for production capacity scale-up and the related industry to take off.

The international dimension of the aviation market calls for exploration of synergies between global market actors. Several areas of collaboration between the EU and China could support SAF deployment and trade, including the strengthening of efforts on harmonization of sustainability standards and traceability, joint investment and technology partnerships, industrial and policy dialogue, etc.

1 https://www.reuters.com/business/energy/chinas-crude-oil-imports-may-grow-1-2025-cnpc-says-2025-01-21/

EXERGIA has been severely engaged with the European Commission for the last 10 years supporting the formulation of specific aspects of RED II its implementation in transport. Our activities cover technology, regulatory, policy and strategy aspects. Recently we supported the European Commission to identify the industrial capacity of Europe to provide the required quantities to meet the ambitious energy and transport decarbonization targets of 2030 and 2050 . Further, EXERGIA has a long successful collaboration with both (a) key international development donors and governmental bodies (in Europe, Africa and South East Asia) analysing national and regional policies and market conditions for the deployment of low carbon transport policies and has supported beneficiaries to set a related course of action, and with (b) the private sector (including refineries, fuel suppliers, farmers and feedstock producers) to navigate the complex policy and regulatory landscape and to formulate appropriate corporate strategies (e.g. via feasibility analysis on feedstock, technology, market, etc.) responding to the current challenges.

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China's Growing Influence in Global Energy: A Balancing Act for Europe

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China's position in the world energy market has become increasingly important in recent years, changing the way countries act on matters of energy security and sustainability. With the world focusing on the transition to renewable energy and cleaner solutions, China is seen as one of the main producers of technologies such as solar panels and batteries among other things. In this case, Europe faces a complex situation, especially since it seeks to reduce its dependence on Russian energy sources.

Following the geo-political tensions that were observed in the annexation of Crimea and, most recently, in the conflict in Ukraine, the European Union has been willing to minimize its reliance on Russian oil and gas. In this context, the importance of renewable energy is even more evident, as the countries look for ways to invest in clean technologies to ensure their energy security. Nevertheless, as Europe strives to achieve energy independence, it is now confronted with a new challenge: the dependence on China's supply chain for key components.

The current statistics show that China is the leader in the market, accounting for the manufacturing of more than 80% of the world's solar panels, as wells as dominating the production of lithium-ion batteries that are essential for energy storage and electric vehicles. This dominating position in the renewable energy industry means that China has the power to influence the market.

What does this mean for Europe? In case of any disruptions in the supply chain, whether because of diplomatic relations or changes in trade policies, the EU's renewable energy goals may be at risk. This situation shows a weak point in the EU's energy policy, and it opens important questions about the balance between energy security and the promotion of a low-carbon economy.

To address these challenges, the EU is actively looking for ways to bolster its energy independence. One possible strategy would be to increase the production of the key components in the region and strive to build a strong supply chain within Europe itself. Nevertheless, such an initiative necessitates a real economic and industrial policy revolution in the EU, which is something that the member states are not willing to accept and put into practice. But even if they do, it will require time, significant amounts of money and human labor, which the EU lacks.

The solution is not simple, nor easy to find. Diversification in the supply chain, combined with development of certain manufacturing activities that the EU has the capabilities to implement and strategic partnerships with other nations, could be the key first pillar. This strategy should be amplified through robust diplomacy, with EU rising as a reliable force of stability in global geopolitical tensions, acting as a link for the trade balance between the East & the West. This balancing act demands a consistent, cohesive EU external policy.

Greece has a strategic advantage, as an EU member state that maintains close business relations with China; at the same time, the country faces both opportunities and threats, especially in the energy transition process. Our effort towards transitioning to renewable energy sources and reducing our carbon footprint largely depends on Chinese technology and investments, which may create major challenges in the event of a rupture in relations between China and the EU and the relevant supply chain.

In such a scenario, Greece will have difficulty securing the technology and materials it needs to meet the set renewable energy targets. Deterioration in relations can lead to tariffs, trade restrictions or other forms of economic barriers, which will increase the cost of renewable energy technologies and components from China. Additionally, geopolitical fallout may lead to investment risks and could affect the funding required for the new energy projects and innovations that are necessary for a successful transition.

Thus, it is imperative that Greece maintain support for stability and good faith in commercial relations between the European Union and China. Simultaneously, the country should continue to advance investments in RES and BESS through existing commercial ties, which will contribute to a reduced reliance on gas supplies.

China's Crucial Role in Shaping the Future of Global Decarbonization

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China's meteoric rise as a global economic superpower has placed the country as the second largest economy in the world, with projections on becoming the world's leading economy in the following years. The rise of its economy was built on low-cost production capacity, industrialization and economies of scale, but it has certainly come with a cost. The country's energy mix mostly consists of fossil fuels, producing significant carbon emissions. When it comes to electricity generation, fossil fuels accounted for c.62% of total generation in 2024 (according to Ember).

Despite China's leading position in renewable energy capacity additions, it still adds significant capacity of coal power plants in order to retain the lost-cost base for its industrial production. Consequently, China accounts for the staggering c.33% of world's carbon emissions, while Europe is responsible for c.7%.

The overwhelming percentage of emissions highlights China's role in the energy transition, signaling that the country will be the main driver for global targets. Europe's effort to lead the way in decarbonization, either through policies, regulation or tariffs, represents a rather small portion compared to the rest of the world. Unless China introduces stricter rules and a concrete roadmap for reducing the dependency on fossil fuels, the records in RES capacity additions will not make a significant difference.

China also holds the keys to the global decarbonization efforts, regarding the supply chain and the processing of raw materials used for green technologies, including rare earths. For example, almost 80% of the solar panels imported by Europe are sourced from China. Europe has benefitted from this commercial affair, as it has been able to import low-cost materials, parts and other components used in renewable energy technologies, speeding up the renewable energy capacity additions while improving the returns for the companies and investors. On the other hand, Europe has been tightly dependent on those imports, indicating that a potential disruption in the supply chain could engager the decarbonization rate of Europe. This is also the case for other regions of the world considering that China has a c. 66% market share in rare earth element and relevant control in other raw materials and processed metals such as cobalt, aluminum, steel, lithium and others that are crucial for the energy transition.

Nowadays, the overall environment is facing significant turbulence, due to trade wars escalation, threatening the stability of the supply chain and changing the global trade routes on such a scale that could derail all decarbonization efforts. The induction of tariffs may lead to price hikes that could also damage the returns and discourage investment appetite and the rollout of green energy technologies.

Consequently, China, due to its prominent position in the global economy, is playing a crucial role in the energy transition. Primarily, from its role as a significant emitter, where it has to accelerate its efforts to decarbonize its economy to achieve the common goals. Unless China does so, efforts from other regions may be undermined as the effect on the emission reduction will not be as significant as required. Lastly, the energy transition goes also through China's dominance in raw and processed materials, as the country exports the vast majority to other countries for developing the green technologies.

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