EU-CHINA ENERGY MAGAZINE

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EU-China Energy Cooperation Platform

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About ECECP

EU-China Energy Cooperation Platform was launched on 15 May 2019.

The overall objective of ECECP is to

'enhance EU-China cooperation on energy. In line with the EU's Energy Union, the Clean Energy for All European initiative, the Paris Agreement on Climate Change and the EU's Global Strategy, this enhanced cooperation will help increase mutual trust and understanding between EU and China and contribute to a global transition towards clean energy on the basis of a common vision of a sustainable, reliable and secure energy system.'

Phase I of ECECP (2018 – 2021) was implemented by a consortium led by ICF, with National Development and Reform Commission – Energy Research Institute and CECEP Consulting Company.

Phase II (2021 – 2023) was implemented by a consortium led by ICF, and with National Development and Reform Commission- Energy Research Institute.

Phase III (2024 – 2029) is implemented by a consortium led by GOPA Worldwide Consultants and with GIZ.

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ECEC

Dear All,

Hello and welcome to the September issue of the EU-China Energy Magazine.

This month, we're focusing on one of the biggest drivers of the clean energy transition: electrification. Powered by green electricity, it's bringing profound changes to our economy, and in this issue, we delve into the policies, market mechanisms, and key sectors at the heart of this shift.

Our first article, from the Florence School of Regulation, offers a deep dive into industrial electrification. It explores how the right policies at both the EU and national levels can provide the certainty needed to accelerate investment.

Shifting our focus to China, as the long-awaited new Nationally Determined Contribution (NDC) was announced at the time we were going to press, we held back the publication of this issue and included an article that examines what China's 2035 NDC means for the future of climate action.

We then turn to heavy industry, focusing on the steel sector—one of the toughest 'hard-to-abate' decarbonisation challenges in China. We explore how technologies like electric arc furnaces and circular economy approaches could cut emissions, while also being realistic about the deep structural barriers that remain.

The success of all this depends on a clean, flexible, and reliable power system. Our fourth article tackles a pressing issue: China's continue reliance on coal is affecting markets and the economics of renewables. It considers how market reforms could help redefine coal's role to that of a flexible backup, rather than the system's mainstay.

Finally, it's not just about supply; the demand side is equally important. As electrification grows, the demand for cooling is soaring. We feature an analysis from the International Energy Agency on how we can meet this rising demand sustainably through energy efficiency, better urban planning, and targeted incentives.

Taken together, these articles offer a snapshot of the complex and exciting landscape of electrification. I hope you find the issue both interesting and insightful.

Dr. Flora Kan
ECECP Team Leader
28 September 2025

NEWS IN BRIEF

Click on the headlines to learn more.

ECECP highlight some recent key energy news headlines in the EU and China

EUROPE NEWS

Policy Initiatives

EU: New guidance on EV battery data sharing

The European Commission has issued guidance to help Member States implement Article 20a(3) of the revised Renewable Energy Directive on battery-related data sharing. It mandates cost-free, real-time sharing of EV battery data such as state of charge, health, and location, for users and authorised third parties, accessible via charging points, cables, or online updates. The aim is to enhance transparency and enable smart and bidirectional charging, and so integrate EV batteries more effectively into existing energy systems. The move is expected to facilitate new services for EV owners, such as smarter driving apps and improved battery performance monitoring.

EU: Public consultation opens for Electrification Action Plan and the Heating and Cooling Strategy

The European Commission is inviting input from various stakeholders for proposals that are set to be released in early 2026. The Electrification Action Plan aims to accelerate the transition from fossil fuels to clean electricity across sectors such as transport, industry, and buildings. Meanwhile, the Heating and Cooling Strategy seeks to enhance energy efficiency and decarbonise heating and cooling systems. Both initiatives are closely interlinked, and will ensure progress towards a decarbonised energy system based on electrification and energy efficiency, driven by the expansion of homegrown clean energy. The deadline for input from stakeholders is 20 November 2025.

EU: New regulations due on new energy market integrity and transparency

A new set of rules is being drafted under the amended REMIT Regulation (EU) 1227/2011 to strengthen transparency and fairness in wholesale energy markets. The move follows a public consultation period that finished in mid-September 2025, and will include a Delegated Regulation to improve oversight of inside information platforms and reporting mechanisms to ACER, and a revision of the Implementing Regulation to enhance data reporting while reducing the burden on market participants. The rules are expected to be adopted in early 2026, with a transition period for implementation.

Netherlands: New action plan to add 2 GW of offshore wind in 2026

The Dutch government has announced a EUR 1 billion Offshore Wind Energy Action Plan to add 2 GW of new offshore wind capacity in 2026. The initiative follows an earlier decision to delay tenders for two offshore wind parks due to challenging market conditions. The plan outlines the introduction of a contracts-for-difference (CfD) scheme and the creation of a guarantee fund to support long-term power purchase agreements. The Netherlands continues to face pressure to meet its renewable energy targets, having extended a target for 21 GW of offshore wind capacity by two years to 2032, citing higher costs and supply chain constraints.

Austria: National hydrogen strategy targets domestic production and imports

Austria has launched a national hydrogen strategy to position itself as a European hub for green hydrogen. While supporting domestic electrolysis development, the strategy relies on imports to secure a reliable, long-term hydrogen supply. The government plans to partner with Germany, Italy, Algeria and Tunisia to advance the Southern Hydrogen Corridor, a 3 400 km pipeline designed to transport hydrogen from North Africa to Central Europe. To back implementation, two new regulations are expected to be introduced this year: the Hydrogen Investment Subsidies Regulation, which will allocate EUR 20 million for electrolysis infrastructure, and a Hydrogen Certification Regulation to ensure compliance with EU standards for renewable fuels.

Market / Business

EU: Industrial alliance on SMRs unveils Strategic Action Plan

The European Industrial Alliance on Small Modular Reactors (SMRs) adopted its first five-year Strategic Action Plan at its second General Assembly. The plan lays out ten targeted actions to accelerate SMR development in Europe by the early 2030s, addressing market demand beyond electricity generation, supply chain revitalisation, R&D and skills, financial mechanisms, and regulatory simplification. It also emphasises fuel and waste management, safety, public engagement and security. Launched in February 2024, and bringing together over 350 stakeholders including industry, researchers and policymakers, the Alliance coordinates with the European Commission, Nuclear Europe and the Sustainable Nuclear Energy Technology Platform (SNETP) to facilitate concrete SMR projects and deployment.

EU: First tripartite contracts for wind and energy storage

Commissioner for Energy and Housing Dan Jørgensen has announced the EU's first two sectoral tripartite contracts, focused on offshore wind and supporting grid networks, as well as energy storage. These contracts aim to bring together public authorities, clean energy developers, and industrial consumers to create stable domestic demand, while mitigating high energy costs, and supporting investment in critical infrastructure. The wind contract underpins the EU's plans to install 88 GW of offshore renewables by 2030 and 360 GW by 2050, while the storage contract responds to the projected need for 200 GW capacity by 2030. Further contracts are being explored for biomethane, data centres and energy efficiency.

EU: Airlines to benefit from EUR 100 million ETS emission allowances for SAF uptake in 2024

The European Commission is to allocate free EU ETS emission allowances to airlines for their use of sustainable aviation fuels (SAF) in 2024. This marks the first year implementing the dedicated ETS support mechanism introduced in the most recent amendment to the EU ETS Directive, which sets aside 20 million allowances (at a unit price of EUR 75), worth around EUR 1.5 billion, to accelerate SAF uptake. For 2024, about 1.3 million allowances valued at EUR 100 million were distributed among 53 operators. Combined with the EUR 25 million benefit from zero carbon pricing on SAF, total ETS support for the use of SAF in 2024 amounts to EUR 125 million.

EU: Solar market faces first decline since 2015

The new mid-year solar PV EU market analysis from SolarPower Europe anticipates a slight fall in EU annual solar PV installations by 1.4% to 64.2 GW in 2025, marking the first decline in a decade. The downturn is driven mainly by a drop in residential rooftop installations, as the energy crisis and a reduction in related support schemes affect key markets in Austria, Belgium, Czechia, Hungary, Italy, and the Netherlands, alongside weaker corporate PPA activity. Despite this, the EU is on track to meet its RePowerEU 2025 solar target of 400 GW, reaching 402 GW by year-end.

Technology Innovation

Germany: Transnet BW develops new hybrid grid booster tech

A state-backed project led by TSO Transnet BW, with Karlsruhe Institute of Technology and Ulm University, has successfully developed and tested a hybrid grid booster combining battery storage and a hydrogen-capable gas turbine. Initiated under the HydrogREenBoost project, the system proved technically and economically viable, stabilising the grid during high demand and offsetting fluctuating renewable output. In tests, the battery system ramped up to rated power within 2.4 seconds, with the hydrogen turbine taking over after 25.4 minutes, ensuring a constant, low-emission power supply. It acts as a safety buffer that ensures efficient use of transmission grids, avoiding expensive redispatch measures, and representing a key solution for efficient use of the existing transmission grid.

Germany: Factor2 Energy secures funding to advance CO_2-based geothermal power

German climate-tech company Factor2 Energy has secured USD 9.1 million in seed funding. The funding will accelerate development of its CO_2-based geothermal power system and a pilot plant to demonstrate scalability. The technology injects CO_2 into deep porous geological formations — either natural reservoirs or those used for carbon capture and storage — where it absorbs geothermal heat and circulates naturally via the thermosiphon effect. At the surface, the heat is converted into electricity production via a direct-drive CO_2 turbine. After expansion, the CO_2 can be cooled down and reinjected, thus creating a closed cycle that enables continuous power generation. The approach has the potential to double power output compared with conventional geothermal systems and can be applied to a broad range of geological sites.

Finland: World's largest sand battery commissioned

Finland has officially commissioned the world's largest sand battery, a 1 MW / 100 MWh thermal energy storage system developed by Polar Night Energy. Located in Pornainen, the system contains around 2 000 tonnes of crushed soapstone, storing surplus renewable electricity as heat and supplying it to the local heating network, thereby almost eliminating the use of oil for local heating. The battery can participate in electricity reserve markets, charging according to electricity prices and Fingrid's reserve market signals. With its large storage capacity, it can help optimise consumption over days or weeks, enhancing grid flexibility and supporting the more stable integration of renewable energy.

Projects Investments

EU: EUR 17.5 billion financing initiative backs energy efficiency effort for SMEs

The European Investment Bank (EIB), backed by the European Commission, is launching an EUR 17.5 billion financing initiative to support energy efficiency and decarbonisation in more than 350 000 small and medium-sized enterprises (SMEs) across Europe. The programme will use a mix of existing and new debt and equity instruments, and is expected to mobilise over EUR 65 billion in investment by 2027. A 'one-stop shop' portal will streamline access to financing for SMEs. The initiative is part of the EU's broader efforts to reduce the energy efficiency investment gap for smaller firms.

EU: EUR 76.3 million awarded to three cross-border renewable projects

The European Commission has awarded EUR 76.3 million in Connecting Europe Facility (CEF) energy funding to three cross-border renewable energy projects (CB RES) under the 2024 CB RES call. The support includes EUR 18.7 million to link the district heating networks of the twin cities of Zgorzelec (Poland) and Görlitz (Germany); EUR 32.5 million for a new 200 MW onshore wind farm on the Estonia - Latvia border; and EUR 25 million for pre-construction studies for a planned 1.2 GW offshore wind farm in Estonian waters, under a statistical transfer agreement with Luxembourg. These projects aim to boost regional clean energy cooperation. The next CB RES call for works and studies is expected in November 2025.

EU: Landmark Bornholm Energy Island Project gets EUR 645 million grant boost

The European Commission has signed a EUR 645.2 million grant agreement under the Connecting Europe Facility (CEF) to support the Bornholm Energy Island (BEI) hybrid offshore project. As the world's first hybrid direct current interconnector, the project aims to connect multiple offshore wind farms via a single hub on the Danish island of Bornholm in the Baltic Sea. Delivering 3 GW of renewable electricity to Denmark and Germany, the project will significantly enhance cross-border energy integration. The funding will facilitate the construction of converter stations and a submarine cable system, marking a significant step toward a more resilient and sustainable European energy system.

Spain: Government to boost grid investment to over EUR 13.5 billion by 2030

Spain has adopted a royal decree introducing urgent measures to strengthen its electricity system, including a major boost to grid investment. The government will temporarily raise annual investment caps on electricity networks by 62% until 2030, lifting limits from 0.13% of GDP for distribution and 0.065% for transmission. The change will allow an additional EUR 7.7 billion for distribution networks and EUR 3.6 billion for transmission. Coupled with new high-voltage transmission planning, the package is expected to mobilise EUR 13.5 billion in investments by 2030. These measures are intended to prepare the grid for surging demand, forecast to reach 27.7 GW by the end of the decade.

Sweden: EUR 19.9 billion framework proposed for new nuclear reactors

The Swedish government has proposed a financial framework totaling EUR 19.9 billion over 12 years to support new-build nuclear reactors, as outlined in its 2026 draft budget. The plan will allocate annual price guarantees of between EUR 90 million and EUR 270 million for up to 40 years once the reactors enter service, aimed at enabling loans to project participants, with first contracts expected within two years. The proposal complements recent legislation allowing state loans and two-way Contracts for Difference to support nuclear projects of up to 5 GW capacity, although it remains subject to approval by both Parliament and the European Commission.

Poland: Preparations begin for country's first nuclear plant

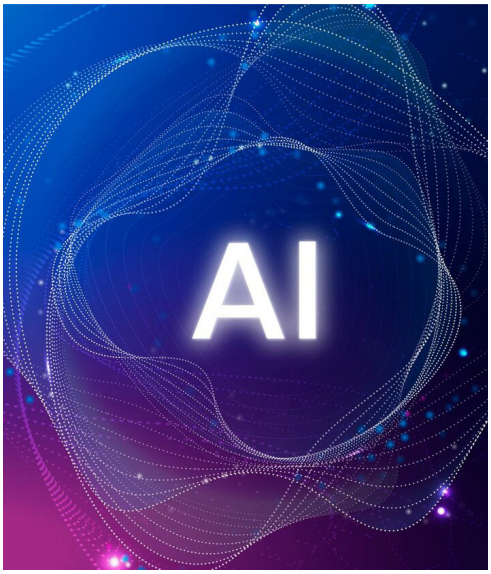
Poland has approved preparatory works for its first nuclear power plant (NPP), granting a permit to state-owned Polskie Elektrownie Jądrowe (PEJ) to begin site development in Lubiatowo-Kopalino. The plant will feature three AP1000 units, to be constructed by the Westinghouse-Bechtel consortium. Under Poland's draft Nuclear Energy Programme, the first reactor is scheduled to begin commercial operation in 2033. With an estimated investment of around USD 49 billion, the project is set to become one of the largest infrastructure undertakings in the country's history.

CHINA NEWS

Policy Initiatives

China announces 2035 Nationally Determined Contributions

At the UN Climate Summit in September 2025, China's president Xi Jinping announced a ramping up of the country's climate response, with its new 2035 Nationally Determined Contributions . By 2035, China plans to cut economy-wide net greenhouse gas emissions by 7%-10% or more from peak levels; raise the share of non-fossil fuels in total energy consumption to over 30%; expand its wind and solar power capacity more than sixfold compared to 2020 levels, with a target of 3 600 GW; scale up total forest stock volume to over 24 billion cubic meters; make new energy vehicles the go-to in new vehicle sales; expand the National Carbon Emissions Trading Market to cover major high-emission sectors; and establish a climate adaptive society.



China unveils guidance to boost AI+Energy integration

China has unveiled a roadmap to accelerate the integration of artificial intelligence (AI) in the energy sector, aiming to strengthen energy security, improve efficiency, and drive the green transition. By 2027, China plans to establish an AI-energy innovation system, advance computing-power and electricity coordination; deploy five or more specialised AI models in power, coal, oil and gas; develop over ten replicable demonstration projects; explore 100 AI application scenarios; and set 100 technical standards. By 2030, China aims to have established world-leading AI applications in energy, including advanced coordination of computing power and electricity supply.

China targets 180 GW of new energy storage by 2027

China's NDRC and NEA have jointly announced an action plan to install over 100 GW of new battery-based energy storage by 2027. The initiative is expected to drive CNY 250 billion in investment and support the country's fast-growing renewable capacity. China has already surpassed its 2025 goal of 30 GW two years early, adding 37 GW/91 GWh in 2024 alone. By June 2025, total new energy storage exceeded 100 GW, overtaking pumped hydro for the first time, according to the China Energy Storage Alliance.

China launches two-year plan to boost power equipment sector

China's National Energy Administration has issued guidelines to accelerate the modernisation of its energy equipment industry, with an emphasis on energy security and the low-carbon transition. The plan prioritises innovation, digital integration and greener technologies, while pushing for stronger supply chain resilience. By 2030, China aims for self-reliance in key energy equipment, with globally competitive capabilities in advanced manufacturing. The guidelines support smart and efficient energy exploration, low-carbon power conversion, cost-effective energy storage, and reliable energy transmission, which are essential to building a clean and secure energy system.

China adopts Atomic Energy Law

China's lawmakers adopted the Atomic Energy Law on 12 September 2025 during a session of the Standing Committee of the National People's Congress. The law, comprising 62 articles across eight chapters, aims to support research, development, and the peaceful use of atomic energy. A key provision establishes a nuclear security system to enhance safety across the sector. The law establishes a comprehensive legal framework with clear responsibilities and standards to guide the safe, orderly advancement of nuclear science and technology in the next stage of development in atomic energy. It will take effect on 15 January, 2026.

Market / Business

China to expand carbon market to major industries by 2027

China's top policymakers plan to extend its national carbon market to major industries including steel, aluminum and cement by 2027, accelerating progress toward its emissions peak target. Currently limited to power generation, the market's expansion will introduce absolute emissions caps rather than intensity-based limits. The reform is expected to increase demand in the carbon trading system and improve its effectiveness, aligning with global standards by 2030. Analysts see the move as a signal of China's renewed commitment to climate goals and a stronger carbon pricing mechanism.

China and Russia signs MoU on Power of Siberia 2 pipeline

China and Russia have signed a MoU for the Power of Siberia 2 gas pipeline, planned to deliver 50 bcm of gas annually from Russia via Mongolia to China over 30 years. The deal also covers increased supplies along existing routes, with Power of Siberia 1 volumes rising from 38 to 44 bcm, and Far Eastern and Sakhalin deliveries growing from 10 bcm to 12 bcm from 2027. The new project is to be led by Russia's Gazprom and China National Petroleum Corporation (CNPC). While the MoU confirms mutual intention to proceed, the commercial terms and construction timeline of the project are still being negotiated.

Wind and solar continue to drive capacity growth, but utilisation declines

China's NEA reported strong growth in power generation capacity in the first eight months of 2025, driven largely by renewables. Total installed capacity reached 3.69 TW, up 18% year-on-year. Solar capacity surged 48.5% to 1.12 TW, and wind rose 22.1% to 580 GW, together accounting for over 46% of the total. However, average utilisation hours for power generation in the first eight months of 2025 fell to 2 105 hours, which is 223 hours lower than the same period of 2024. This decline reflects structural changes as renewable capacity outstrips electricity demand. Some coal plants have reduced output to make room for renewables, contributing to the decline in utilisation of power generation capacity.

China's electrification rate to reach 35% by 2030

China's electrification rate reached 28.8% in 2024, up 0.9 percentage points from the previous year and already exceeding major Western economies, according to the China Electricity Council (CEC). The council expects the rate to rise about one percentage point annually during the 15th Five-Year Plan, hitting around 35% by 2030. Sectoral rates in 2024 included 27.7% for industry, 55.3% for buildings, and 43.6% for agriculture and rural households. Experts say future progress depends on clean energy as the dominant power source, along with integrated grids, storage, and wider electrification in end-use sectors.

Technology Innovation

China tests megawatt-scale airborne wind generator

China has successfully trialed the S1500, a megawatt-scale airborne wind turbine developed by Beijing SAWES Energy Technology. The 60-meter Zeppelin-like device uses high-altitude winds via twelve 100 kW turbine generators anchored to a tether to deliver power without needing a fixed tower. It reportedly cuts material use by 40% and reduces generation costs by 30% compared with traditional land-based wind turbines. The S1500 is designed for rapid deployment in remote areas or during emergencies. The entire unit can be moved within hours, making it suitable for deserts, islands, and mining sites.

China debuts world's first 25 MW grid-forming wind converter

SUNGROW Wind and China State Shipbuilding Corporation (CSSC) have launched the world's first 25 MW grid-forming wind power converter, a key technology milestone for large-scale offshore wind projects. The converter is engineered for extreme offshore conditions, including high wind speeds, humidity, and typhoons. Its advanced control system addresses grid fluctuations, offering rapid millisecond responses, low voltage ride-through, short circuit support, and autonomous black start capability. This innovation is seen as a strategic enabler for China's deep-sea wind industry, reducing technical barriers and paving the way for faster, more resilient offshore wind deployment.

Projects Investments

China commissions largest hybrid CSP-PV plant in Xinjiang

China's Three Gorges Group has commissioned a 1 GW hybrid concentrated solar power (CSP) and photovoltaic (PV) plant in Hami, Xinjiang, a milestone in large-scale renewable deployment. The facility combines a 100 MW Fresnel CSP unit with eight hours of molten salt storage and 900 MW of PV capacity, with a total investment of CNY 3.53 billion. During daylight hours, the PV arrays generate power while charging the thermal storage; at night or in low sunlight, stored heat powers turbines that stabilise the power output. The plant is expected to produce 2.07 TWh annually, enough for 830 000 households, and demonstrates a crucial technology for balancing intermittent renewable energy.

Huaneng Group launches world's largest coal-power carbon capture project

China's Huaneng Group has brought into operation the world's largest carbon capture project at a coal-fired power plant in Gansu province following a 72-hour trial. The project captures CO_2 from the desulfurised flue gas of the No 1 generating unit at the Zhengning power plant, with a capture rate exceeding 90% and a CO_2 purity of over 99%. Designed to capture 1.5 million tonnes of CO_2 annually, the project is built using only Chinese technology and equipment. The captured CO_2 will be used for geological storage, enhanced oil recovery and green fuel synthesis, completing the capture-utilisation-storage chain and marking a breakthrough in large-scale CCUS deployment in China.

Dongfang installs 26 MW offshore wind turbine for testing

On 29 August 2025, Dongfang Electric Corporation (DEC) completed the installation of a 26 MW offshore wind turbine at the Dongying Offshore Wind Power Equipment Testing Base, setting global records for single unit capacity and rotor diameter. The turbine, with a rotor swept area of 77 000 m, includes over 30 000 domestically produced components and is equipped with advanced anti-corrosion and typhoon-resistant technology. Designed for harsh offshore conditions, it can withstand super typhoons up to Level 17. Each unit can produce up to 100 million kWh annually, enough to power 55 000 households. The project marks a major step in China's development of offshore wind.

China begins work on UHV line from Xizang to Greater Bay Area

China has started work on a ±800 kV ultra-high voltage direct current (UHVDC) transmission project to carry clean energy from Xizang Autonomous Region to the Guangdong - Hong Kong - Macao Greater Bay Area. The 2 681 km line, with a total investment of about CNY 53.2 billion (USD 7.5 billion), will be the first to cross the Qinghai-Xizang and Yunnan-Guizhou plateaus. Scheduled for completion in 2029, it will have a capacity of 10 GW and will deliver over 43 TWh of green power annually, supporting one of China's most dynamic economic regions and advancing large-scale renewable integration.

China discovers major deep shale gas field in southwest

China Petroleum and Chemical Corp (Sinopec) has confirmed a major deep shale gas discovery in Chongqing Yongchuan of the southern Sichuan Basin, with proven reserves exceeding 124.6 billion cubic meters. The finding increases the total proven reserves of the Yongchuan field to 148.0 billion cubic meters, marking a significant boost to China's shale gas resources. Buried over 3 500 meters deep, the deposit underscores China's push to strengthen domestic energy security through expanded exploration of unconventional resources such as shale gas, shale oil, and underground coal gasification.

Unlocking industry electrification:

an overview of EU policies and regulatory framework

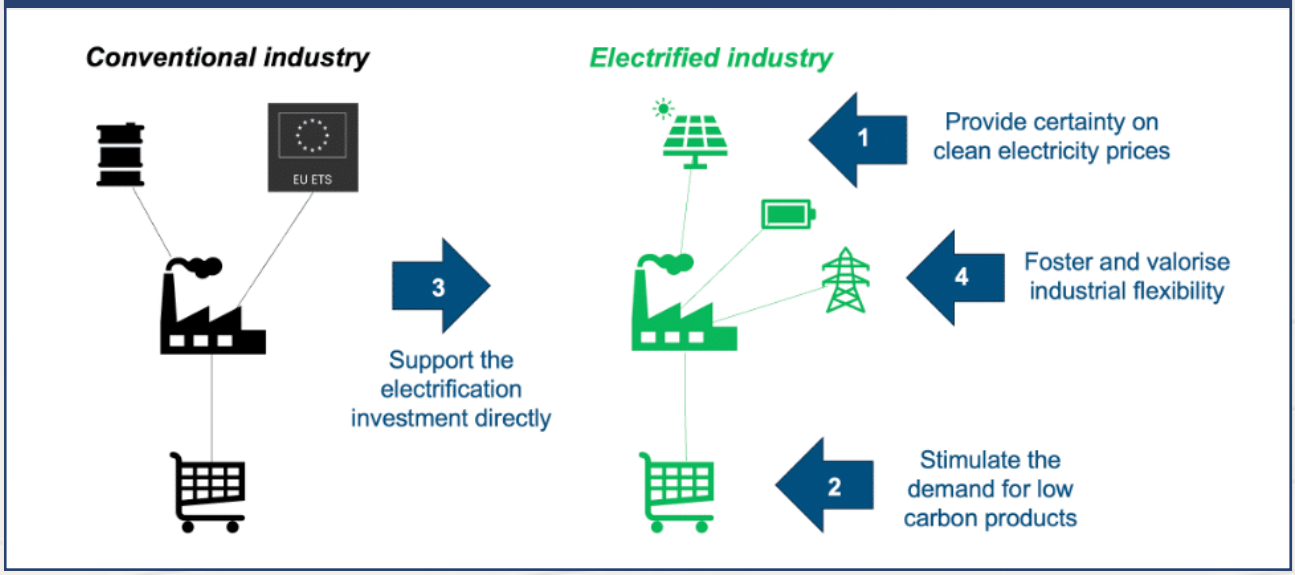
Industry decarbonisation, including through electrification, is becoming a core priority of EU policies. Following the Draghi report on EU competitiveness and the Antwerp declaration, the European Commission's president issued in summer 2024 her political guidelines, announcing a Clean Industrial Deal (CID), which would have included, inter alia, an Industrial Decarbonization Accelerator Act (IDAA) to 'support industries in the transition'. The CID[1] was then published in February 2025, confirming a strong focus on the decarbonization of energy-intensive industries such as steel, metals and chemicals.

Electrification is one of the main decarbonization pathways for energy-intensive industries. It is estimated that up to half of the fossil consumption of the EU industry could be electrified with current technologies (McKinsey, 2020). In particular, the latter are already broadly available for low-to-medium temperature heat processes (Compass Lexecon, 2024). However, the electrification rate of the EU industry has been stagnating over the past decades, at around 33%. Numerous barriers to electrification, explaining such a slow pace, were identified by the industry (see, for example, Eurelectric, 2025). This includes inadequate taxation levels (i.e., tax rates higher for electricity than for fossil fuels), high investment costs, increased and uncertain energy procurement costs, and pressure from international competition.

Public policies are today considered necessary to trigger and accelerate the industry electrification investments which are crucial to the energy transition. In this article we highlight four areas of action and provide an overview of the policy measures at the national and EU level.

1. For more information on the Clean Industrial Deal, see our Cover the Basics on the topic, available at: https://fsr.eui.eu/the-eu-clean-industrial-deal/.

Figure 1: Stylized representation of the four policy areas to support industry electrification (source: author).



A major risk for the energy-intensive industry willing to electrify lies in the volatility and uncertainty of future electricity prices. Industrial consumers can hedge such risk by investing directly in on-site renewable production assets, or by engaging in renewable corporate power purchase agreements (PPAs). They can, in this way, benefit from both long-term electricity price stability and renewable electricity sourcing, enhancing their public image and ESG performance.

The Electricity Market Design Reform (EMDR) of 2024 aims to foster the development of markets for PPAs in the EU.[2] In particular, the reform mandates Member States to improve the accessibility to the PPA market by, for example, setting up a public guarantees scheme to reduce buyers' default risk, or facilitating the aggregation of demand for PPAs. More recently, the CID foresees concrete actions, specifically targeting the industrial offtakers of renewable energy. A European Investment Bank pilot program should be set up in 2025 to offer financial guarantees for PPA offtakers, with a focus on small and medium size enterprises and energy-intensive industry. The Commission also plans to consider 'clean flexibility instruments based on PPAs', to support industrial PPAs, where industry commits to consume electricity with a 24/7 hourly matching[3] to the contracted clean electricity generation. As regards on-site projects or physical PPAs, speeding up permitting for industrial access to renewable energy is one of the actions planned under the IDAA.

Area 1 –

Provide certainty on clean electricity procurement prices

2. For more information on the Electricity Market Design Reform, see our summary of the initial Commission's proposal, available at: https://fsr.eui.eu/a-summary-of-the-proposal-for-a-reform-of-the-eu-electricity-market/.
3. The hourly generation profile of a renewable plant generally does not match perfectly with the hourly load profile of an industrial consumer. For example, a solar PPA cannot cover the load profile of a "baseload" consumer, in particular during night hours. 24/7 hourly matching refers to more complex forms of PPAs, aggregating various technologies, such as solar and wind (potentially in various locations), as well as electrical storage. The objective of such a PPA is to provide an energy output matching more closely the industrial buyer's load for each 24 hours of the day and each seven days of the week. While such PPAs are typically more expensive than the common single-technology PPAs, their advantage is to provide a higher degree of hedging (i.e., reduced exposure to short term markets), and a higher degree of decarbonization (i.e., clean electricity for any hour of the day). For more information, you can refer, for example, to "24/7 CFE Hedging analysis, Report for Eurelectiric" (Pexapark, 2023) , available at: https://www.eurelectric.org/wp-content/uploads/2024/06/eurelectric_pexapark_247-hedging-analysis.pdf.

Area 2 –

Stimulate the demand for low-carbon products

Decarbonisation of industrial production is also risky if the demand for decarbonized products[4] is low or uncertain. In particular, the price of clean products often remains less competitive than that of their conventional equivalents. This issue should be gradually removed with rising EU ETS prices and the implementation of the Carbon Border Adjustment Mechanism. However, specific policies can be implemented to increase the EU demand for decarbonized products, providing increased revenue certainty for industries investing in the decarbonisation of their processes.

The CID foresees numerous initiatives to foster the demand for clean products, both through public and private procurement. The Public Procurement Framework should be revised in 2026, to enable the use of non-price criteria on sustainability, resilience and local content. Such criteria should be introduced by the IDAA. Non-price criteria can also foster private demand for clean products, when included in product legislation or codes. The Commission will assess such possibilities. Product labelling is moreover identified as an important measure, both for public and private procurement. The IDAA should additionally introduce a voluntary label on the carbon intensity of industrial products.

Area 3 –

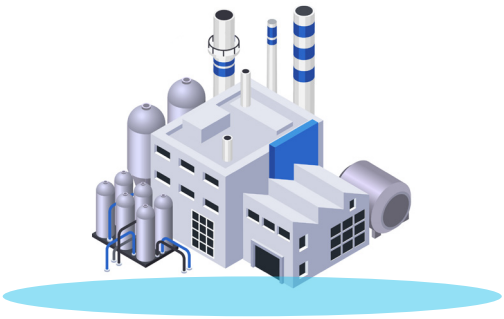
Support the electrification investments directly

Industrial electrification projects are typically capital-intensive and carry significant investment risks, as their returns depend heavily on future EU ETS and energy price developments. Indeed, changes in these prices eventually impact the relative competitiveness of the electrified industry, against competitors which did not electrify. Public support schemes can be relevant to safeguard electrification investments, as they can partly finance investment costs, and/or provide projects with revenue/competitiveness certainty through long-term operational cost support.

When implemented at the national level, large-scale support schemes must be notified to the European Commission, which then assesses whether they are compatible or not with the rules on the internal market. State aid guidelines have been issued over the years by the Commission, in order to streamline the process; support schemes that respect those guidelines are in fact automatically approved. The State Aid Guidelines for Climate, Environmental Protection, and Energy (CEEAG) provide the general framework; they allow for a broad scope of measures, including support to 'electrification' (article 4.1). The Temporary Crisis and Transition Framework (TCTF), adopted in 2022, provides more specific guidelines under Article 2.6, dedicated to 'decarbonisation of industrial production'. The Clean Industrial Deal State Aid Framework (CISAF), adopted in June 2025, will replace the TCTF, building on its experience.

4. By decarbonized product, we refer to an industrial product whose carbon footprint has been reduced through a change in its production process. For example, decarbonized steel can be produced using an electric arc furnace with low-carbon hydrogen direct reduction, or a blast furnace with a carbon capture and storage infrastructure.

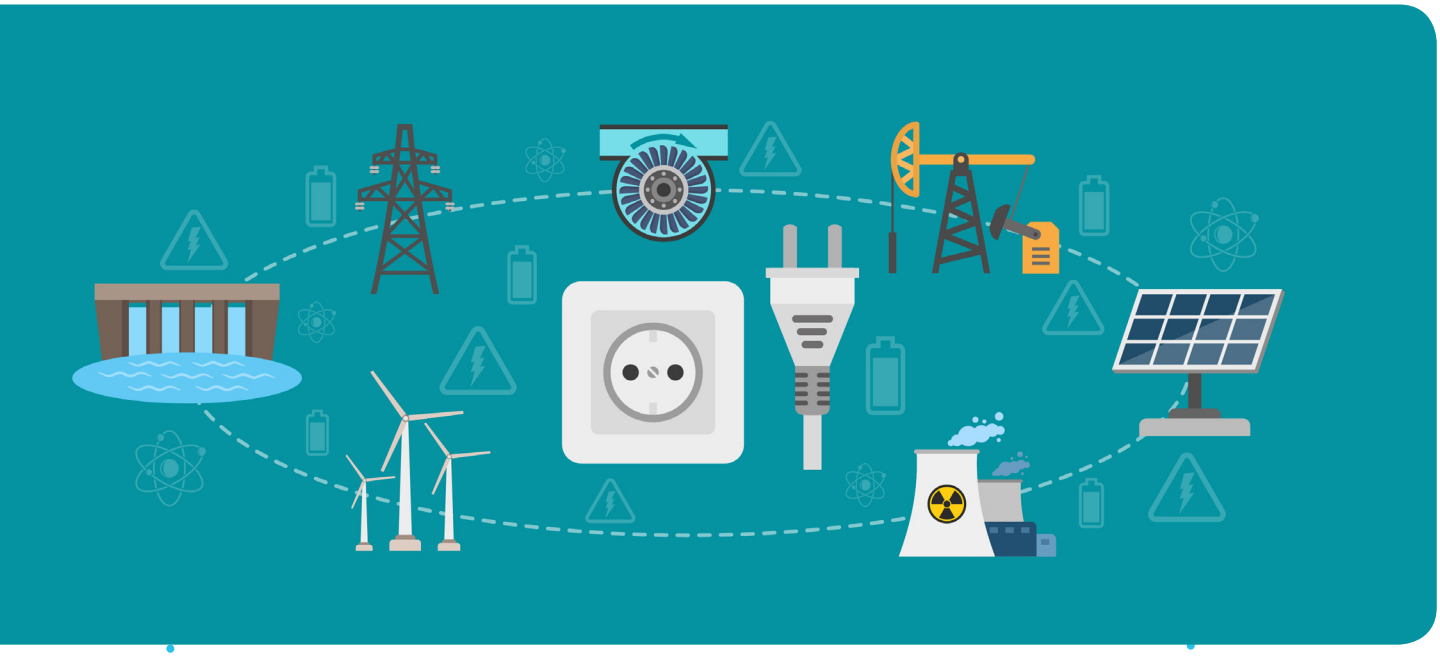
State aid schemes targeting industrial decarbonisation have differed in terms of perimeter (i.e., the technologies covered), support type, and budget. An overview of some large-scale State aid schemes dedicated to industrial decarbonisation is provided in Table 1. The type of support has evolved over the past years, with the implementation of more complex instruments such as Carbon Contracts for Difference (CCfD). Interestingly, the draft CISAF did not specify how State aid for industry decarbonisation should be allocated. Some stakeholders have, in response, argued that operational cost support through CfDs or CCfDs is needed, and should be more explicitly mentioned in the text (see, for instance, Eurelectric, 2025, and Eurometaux, 2025). The final CISAF specifies that such forms of support should be instead approved under the CEEAG.



In addition to national schemes, which do not yet cover all EU countries, a decarbonisation support scheme will be implemented at the EU level. Indeed, the CID foresees an Industrial Decarbonisation Bank, which aims at 100 billion euros in funding, derived from ETS revenues. The first pilot auction, whose Terms & Conditions were published in June 2025, has an available budget up to €1 billion. It will target mature industrial process heat electrification projects. The support will be auction-based and allocated as a fixed premium (€/tCO_2 abated) over 5 years.

Table 1 – Overview of State aid measures dedicated to industry decarbonization notified by EU Member States under the CEEAG or TCTF.

Country	Date	SA case	Legal basis	Budget (Bn€)	Support type
Slovakia	10/2022	SA.102385	CEEAG	1.1	Investment grant
Netherlands	07/2023	SA.104448	CEEAG	/	CCfD (12-15y)
Czech Republic	10/2023	SA.109055	TCTF	2.4	Investment grant
Germany	02/2024	SA.104880	CEEAG	4	CCfD (15y)
Germany	04/2024	SA.108729	TCTF	2.2	Investment grant
France	05/2024	SA.108810	TCTF	4	Investment grant
Italy	07/2024	SA.109439	TCTF	0.4	Direct grant + clawback
Netherlands	07/2024	SA.112112	TCTF	0.75	Direct grant + clawback (60%)
Austria	09/2024	SA.109730	CEEAG	2.7	Investment grant + transformation grant (10y)
Finland	12/2024	SA.113721	TCTF	0.2	Investment grant
France	12/2024	SA.112361	CEEAG	3	CCfD with pre-defined CO_2 reference price (15y)
Germany	03/2025	SA.116065	CEEAG	5	CCfD (15y)



An electrified industry can, and is expected to, provide significant flexibility to the electricity system. Appropriate market integration is crucial to foster this flexibility and can offer additional revenue streams for electro-intensive industrial consumers. How to do that is part of a much broader discussion on how to remove barriers to consumers' flexibility and pass on the right market signals (ACER, 2025). In this regard, the CID announced that guidance will be provided to Member States and retailers on how to promote remuneration of flexibility in retail contracts.

Area 4 –

Foster and valorise industrial flexibility for better system integration

The provision of industrial flexibility could also be fostered through the policy instruments mentioned in the previous three areas. First, industrial consumers receiving support for electrification (Area 3) could be required, for example, to qualify in a capacity market, an interruptibility scheme, or other national flexibility instruments (when technically possible). Second, when industrial consumers are supported in the acquisition of renewable generation on-site or through PPAs (Area 1), a high degree of matching of generation with the industrial load can be mandated. This would incentivise the adaptation of load patterns to renewable generation, or the uptake of co-located storage.

By **Emma Menegatti**

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Q&A:

What does China's new Paris Agreement pledge mean for climate action?

President Xi Jinping has personally pledged to cut China's greenhouse gas emissions to 7-10% below peak levels by 2035, while 'striving to do better'.

This is China's third pledge under the Paris Agreement, but is the first to put firm constraints on the country's emissions by setting an 'absolute' target to reduce them.

China's leader spoke via video to a UN climate summit in New York organised by secretary general António Guterres, making comments seen as a 'veiled swipe' at US president Donald Trump.

The headline target, with its undefined peak-year baseline, falls 'far short' of what would have been needed to help limit warming to well-below 2C or 1.5C, according to experts.

Moreover, Xi's pledge for non-fossil fuels to make up 30% of China's energy is far below the latest forecasts, while his goal for wind and solar capacity to reach 3,600 gigawatts (GW) implies a significant slowdown, relative to recent growth.

Overall, the targets for China's new 2035 'nationally determined contribution' (NDC) under the Paris Agreement have received a lukewarm response, described as 'conservative', 'too weak' and as not reflecting the pace of clean-energy expansion on the ground.

Nevertheless, Li Shuo, director of the China Climate Hub at the Asia Society Policy Institute (ASPI), tells Carbon Brief that the pledge marks a 'big psychological jump for the Chinese', shifting from targets that constrained emissions growth to a requirement to cut them.

Below, Carbon Brief unpacks what China's new targets mean for its emissions and energy use, pending further details once its full NDC is formally published in full.

What is in China's new climate pledge?

For now, the only available information on China's 2035 NDC is the short series of pledges in Xi's speech to the UN.

Xi's speech is the first time his country has promised to place an absolute limit on its greenhouse gas emissions, marking a significant shift in approach.

Xi had previously pledged that China would peak its carbon dioxide (CO_2) emissions 'before 2030', without defining at what level, reaching 'carbon neutrality' by 2060.

He also outlined a handful of other key targets for 2035, shown in the table below against the goals set in previous NDCs.

In his speech, Xi also said that, by 2035, 'new energy vehicles' would be the 'mainstream' for new vehicle sales, China's national carbon market would cover all 'major high-emission industries' and that a 'climate-adaptive society' would be 'basically established'.

This is the first time that China's targets will cover the entire economy and all greenhouse gases (GHGs), a move that has been long signalled by Chinese policymakers.

In 2023, the joint China-US Sunnylands statement, released during the Biden administration, had said that both countries' 2035 NDCs 'will be economy-wide, include all GHGs and reflect…[the goal of] holding the increase in global average temperature to well-below 2C'.

Subsequently, the world's first global stocktake, issued at COP28 in Dubai, 'encourage[d]' all countries to submit 'ambitious, economy-wide emission reduction targets, covering all GHGs, sectors and categories…aligned with limiting global warming to 1.5C'.

Responding to this the following year, executive vice-premier and climate lead Ding Xuexiang stated at COP29 in Baku that China's 2035 climate pledge would be economy-wide and cover all GHGs. (His remarks did not mention alignment with 1.5C.)

This was reiterated by Xi at a climate meeting between world leaders in April 2025.

The absolute target for all greenhouse gases marks a turning point in China's emissions strategy. Until now, China's emissions targets have largely focused on carbon intensity, the emissions per unit of GDP, a metric that does not directly constrain emissions as a whole.

Indicators	Targets for 2030		Targets for 2035
	First NDC (2016)	NDC 2.0 (2021)	NDC 3.0 (2025)
Emissions target	Peak CO2 'around 2030', 'making best efforts to peak early'	Peak CO2 'before 2030' and 'achieve carbon neutrality before 2060'	Cut GHGs to 7-10% below peak levels by 2035
CO2 intensity reduction (compared to 2005)	60-65%	>65%	-
Non-fossil share in primary energy mix	Around 20%	Around 25%	30%
Forest stock volume increase (compared to 2005)	Around 4.5bn cubic metres	6bn cubic metres	11bn cubic metres
Installed capacity of wind and solar power	-	>1,200GW	>3,600GW

The change aligns with China's broader shift from 'dual control of energy' towards 'dual control of carbon', a policy that replaces China's current tradition of setting targets for energy intensity and total energy consumption, with carbon intensity and carbon emissions.

Under the policy, in the 15th five-year plan period (2026-2030), China will continue to centre carbon intensity as its main metric for emissions reduction. After 2030, an absolute cap on carbon emissions will become the predominant target.

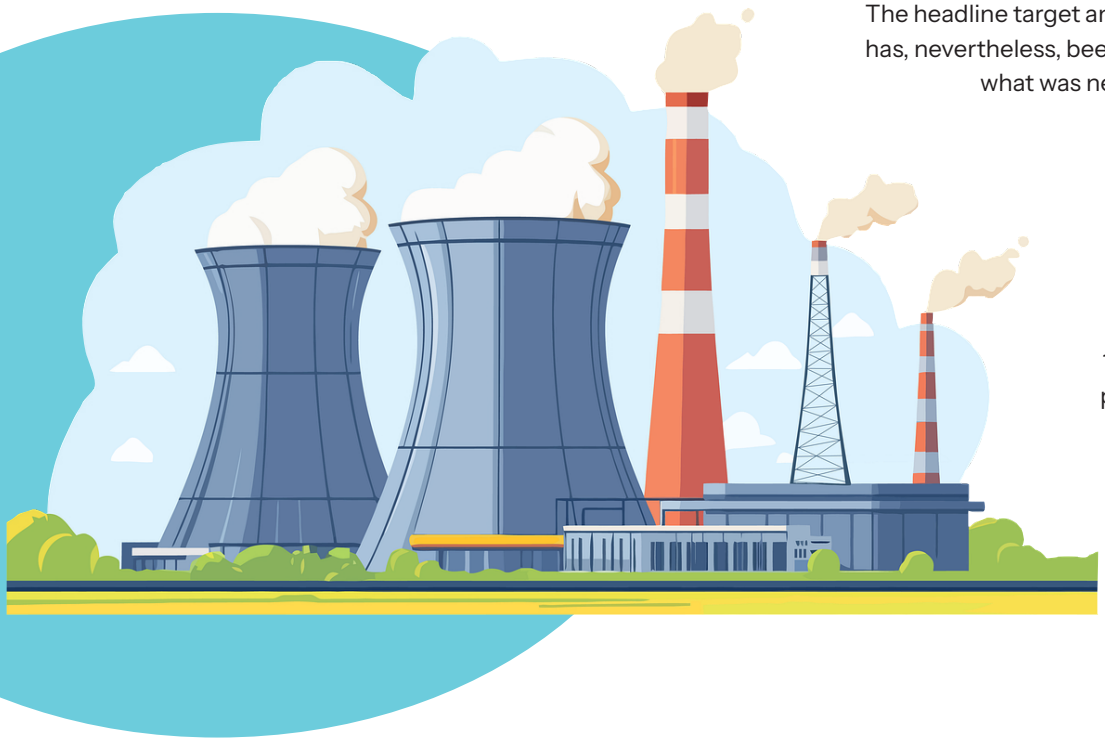
What is China's first 'absolute' emissions reduction target?

In his UN address, Xi pledged to cut China's 'economy-wide net greenhouse gas emissions' to 7-10% below peak levels by 2035, while 'striving to do better'.

This means the target includes not just CO_2, but also methane, nitrous oxide (N2O) and F-gases, all of which make significant contributions to global warming.

The reference to 'economy-wide net' emissions means that the target refers to the total of China's emissions, from all sources, minus removals, which could come from natural sources, such as afforestation, or via 'carbon dioxide removal' technologies.

Outlining the targets, Xi told the UN summit that they represented China's 'best efforts, based on the requirements of the Paris Agreement'. He added:



The headline target announced by Xi this week has, nevertheless, been seen as falling far short of what was needed.

A series of experts had previously told Carbon Brief that a 30% reduction from 2023 levels was the absolute minimum contribution towards a 1.5C global limit, with many pointing to much larger reductions in order to be fully aligned with the 1.5C target.

The figure below illustrates how China's 2035 target stacks up against these levels.

(Note that the timing and level of peak emissions is not defined by China's targets. The pledge trajectory is constrained by China's previous targets for carbon intensity and expected GDP growth, as well as the newly announced 7-10% range. It is based on total emissions, excluding removals, which are more uncertain.)

'Meeting these targets requires both painstaking efforts by China itself and a supportive and open international environment. We have the resolve and confidence to deliver on our commitments.'

China has a reputation for under-promising and over-delivering.

Prof Wang Zhongying, director-general of the Energy Research Institute, a Chinese government-affilitated thinktank, told Carbon Brief in an interview at COP26 that China's policy targets represent a 'bottom line', which the policymakers are 'definitely certain' about meeting. He views this as a 'cultural difference', relative to other countries.

Analysis by the Asia Society Policy Institute also found that China's GHG emissions 'must be reduced by at least 30% from the peak through 2035' in order to align with 1.5C warming.

It said that this level of ambition was achievable, due to China's rapid clean-energy buildout and signs that the nation's emissions may have already reached a peak.

Similarly, the International Energy Agency (IEA) said last October that implementing the collective goals of the first stocktake – such as tripling renewables by 2030 – as well as aligning near-term efforts with long-term net-zero targets, implied emissions cuts of 35-60% by 2035 for emerging market economies, a grouping that includes China.

In response to these sorts of numbers, Teng Fei, deputy director of Tsinghua University's Institute of Energy, Environment and Economy, previously described a 30% by 2035 target as 'extreme', telling Agence France-Presse that this would be 'too ambitious to be achievable', given uncertainties around China's current development trajectory.

In contrast, a January 2025 academic study, co-authored by researchers from Chinese government institutions and top universities and understood to have been influential in Beijing's thinking, argued for a pledge to cut energy-related CO_2 emissions 'by about 10% compared with 2030', estimating that emissions would peak 'between 2028 and 2029'.

(Other assessments have pegged relevant indicators, such as emissions and coal consumption, as peaking in 2028 at the earliest.)

The relatively modest emissions reduction range pledged by Xi, as well as the uncertainty introduced by avoiding a definitive baseline year, has disappointed analysts.

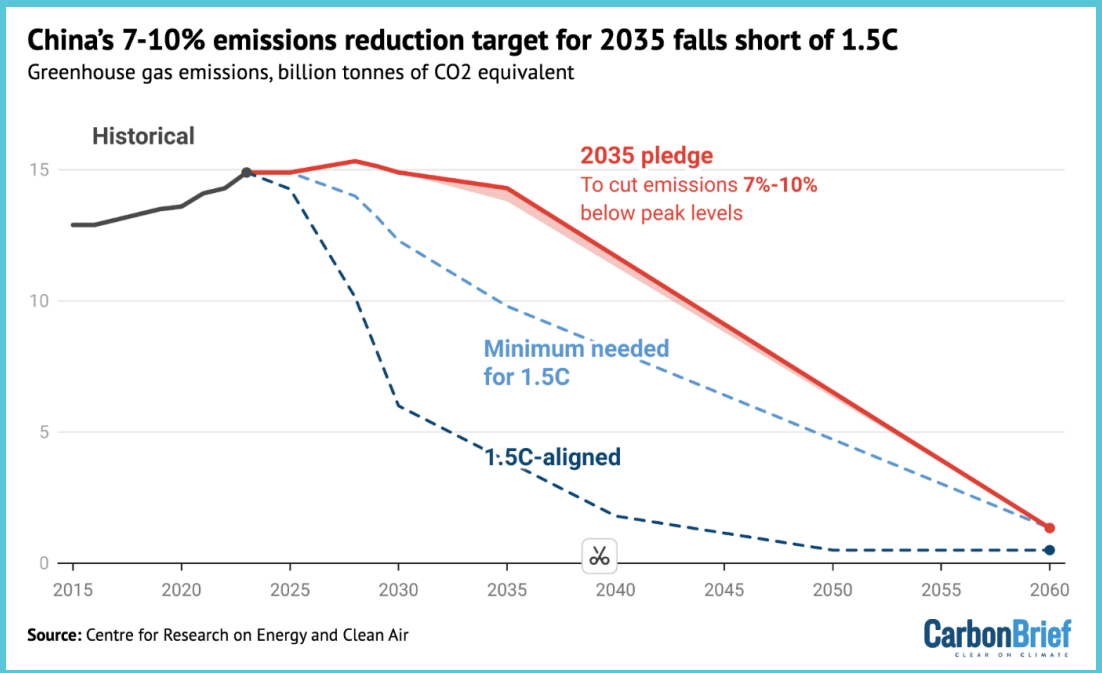
In a note responding to Xi's pledges, Li Shuo and his ASPI colleague Kate Logan write that he has 'misse[d] a chance at leadership'.

Li tells Carbon Brief that factors behind the modest target include the 'domestic economic slowdown and uncertain economic prospects, the weakening global climate momentum and the turbulent geopolitical environment'. He adds:

'I also think it is a big psychological jump for the Chinese, shifting for the first time after decades of rapid growth, from essentially climate targets that meant to contain further increase to all of a sudden a target that forces emissions to go down.'

Instead of a target consistent with limiting warming to 1.5C, China's 2035 pledge is more closely aligned with 3C of warming, according to analysis by CREA's Lauri Myllyirta.

Climate Action Tracker says that China's target is 'unlikely to drive down emissions', because it was already set to achieve similar reductions under current policies.



Economy-wide greenhouse gas emissions excluding removals, billion tonnes of CO_2 equivalent ($GtCO_2e$). The pledge pathway shows the 7-10% range of 2035 cuts, followed by an indicative straight line to 'carbon neutrality' in 2060, with an allowance for removals. The 'minimum needed' pathway cuts emissions to 30% below 2023 levels by 2035 and continues in the same way to 2060. The '1.5C-aligned' pathway is the average of scenarios from the IPCC. Source: Centre for Research on Energy and Clean Air (CREA).

What has China pledged on non-fossil energy, coal and renewables?

In addition to a headline emissions reduction target, Xi also pledged to expand non-fossil fuels as a share of China's energy mix and to continue the rollout of wind and solar power.

This continues the trend in China's previous NDC.

Notably, however, Xi made no mention of efforts to control coal in his speech.

In its second NDC, focused on 2030, China had pledged to 'strictly control coal-fired power generation projects', as well as 'strictly limit' coal consumption between 2021-2025 and 'phase it down' between 2026-2030. It also said China 'will not build new coal-fired power projects abroad'.

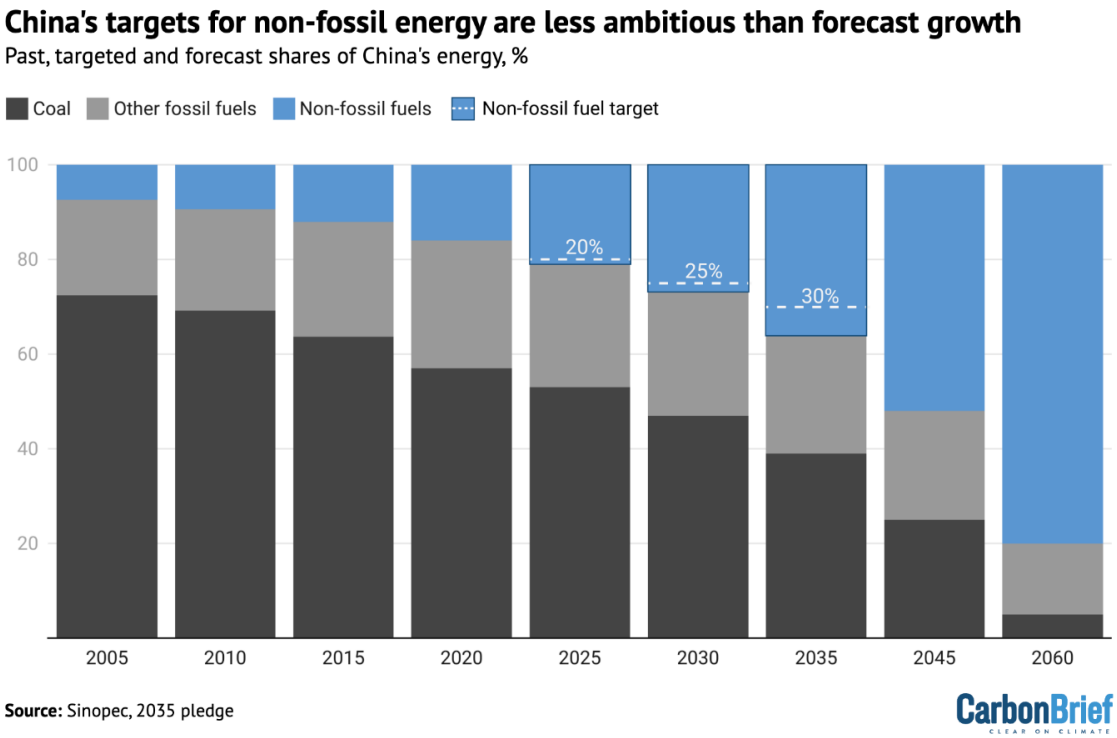
It remains to be seen if coal is addressed in China's full NDC for 2035.

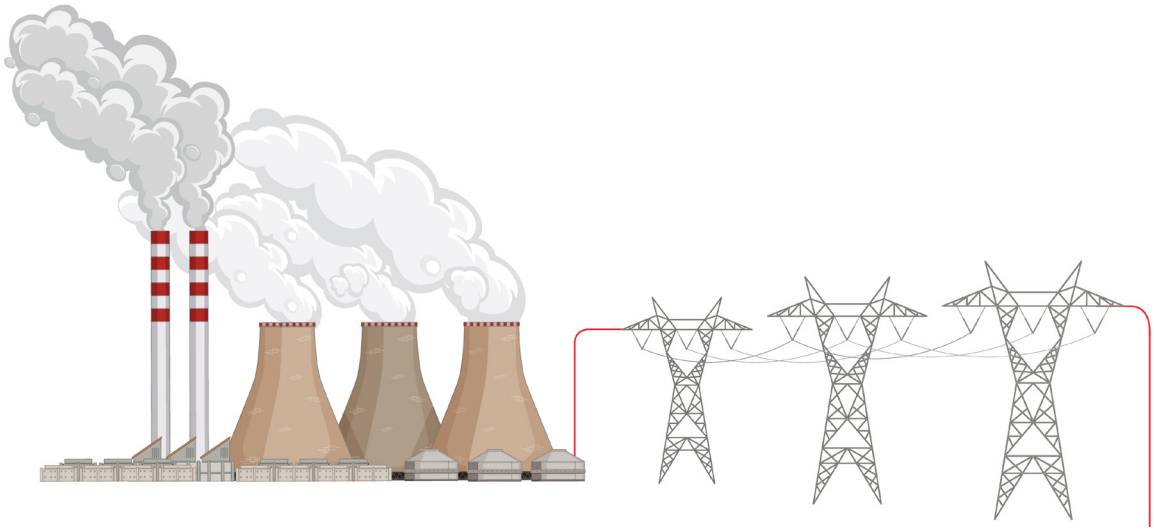
The 2030 NDC also stated that China would 'increase the share of non-fossil fuels in primary energy consumption to around 25%' – and Xi has updated this to 30% by 2035.

These targets are shown in the figure below, alongside recent forecasts from the Sinopec Economics and Development Research Institute, which estimated that non-fossil fuel energy could account for 27% of primary energy consumption in 2030 and 36% in 2035.

As such, China's targets for non-fossil energy are less ambitious than the levels implied by current expectations for growth in low-carbon sources.

Past, targeted and forecast shares of China's energy, by source, %.
(Source: Sinopec Economics and Development Research Institute, Xi's 2035-pledge speech.)





In a recent meeting with the National People's Congress Standing Committee – the highest body of China's state legislature – environment minister Huang Runqiu said that progress on China's earlier target for increasing non-fossil energy's share of energy consumption was 'broadly in line' with the 'expected pace' of the 2030 NDC.

On wind and solar, China's 2030 NDC had pledged to raise installed capacity to more than 1,200GW – a target that analysts at the time told Carbon Brief was likely to be beaten. It was duly met six years early, with capacity standing at 1,680GW as of the end of July 2025.

Xi has set a 2035 target of reaching 3,600GW of wind and solar capacity.

This looks ambitious, relative to other countries and global capacity of around 3,000GW in total as of 2024, but represents a significant slowdown from the recent pace of growth.

Given its current capacity, China would need to install around 200GW of new wind and solar per year and 2,000GW in total to reach the 2035 target. Yet it installed 360GW in 2024 and 212GW of solar alone in the first half of this year.

Myllyvirta tells Carbon Brief this pace of additions is 'not enough to even peak emissions [in the power sector] unless energy demand growth slows significantly'.

While the pace of demand growth is a key uncertainty, a recent study by Michael R Davidson, associate professor at the University of California, San Diego, with colleagues at Tsinghua University, suggested that deploying 2,910-3,800GW of wind and solar by 2035 would be consistent with a 2C warming pathway.

Davidson tells Carbon Brief that 'most experts within China do not see the [recent] 300+GW per year growth as sustainable'. Still, he adds that the lower levels outlined in his study could be consistent with cutting power-sector emissions 40% by 2035, subject to caveats around whether new capacity is well-sited and appropriately integrated:

'We found that 40% emissions reductions in the power sector can be supported by 3,000-3,800GW wind and solar capacity [by 2035]. Most of the capacity modeling really depends on integration and quality of resources.'

Renewable energy's share of consumption in China has lagged behind its record capacity installations, largely due to challenges with updating grid infrastructure and economic incentives that lock in coal-fired power.

In Davidson's study, capacity growth of up to 3,800GW would see wind and solar reaching around 40% of total power generation by 2030 and 50% by 2035.

Meanwhile, China will need to install around 10,000GW of wind and solar capacity to reach carbon neutrality by 2060, according to a separate report by the Energy Research Institute, a Chinese government-affilitated thinktank.

What does China say about non-CO_2 emissions?

This is the first time that one of China's NDC pledges has explicitly covered the emissions from non-CO_2 GHGs.

However, while Xi's speech made clear that China's headline emissions goal for 2035 will cover non-CO_2 gases, such as methane, nitrous oxide and F-gases, he did not give further details on whether the NDC would set specific targets for these emissions.

In China's 2030 NDC, the country stated it would 'step up the control of key non-CO_2 GHG emissions', including through new control policies, but did not include a quantitative emissions reduction target.

In preparation for a comprehensive greenhouse gas emissions target, China has issued action plans for methane, hydrofluorocarbons (HFCs, one type of F-gas) and nitrous oxide.

The nitrous oxide action plan, published earlier this month, called for emissions per unit of production for specific chemicals to decrease to a 'world-leading level' by 2030, but did not set overarching limits.

Similarly, the overarching methane action plan, issued in late 2023, listed several key tasks for reducing emissions in the energy, agriculture and waste sectors, but lacked numerical targets for emissions reduction.

A subsequent rule change in December 2024 tightened waste gas requirements for coal mines. Under the new rules, Reuters reports, any coal mine that releases 'emissions with methane content of 8% or higher' must capture the gas, and either use or destroy it – down from a previous threshold of 30%.

But analysts believe that the true challenge of coal-mine methane emissions may come from abandoned mines, which, one study found, have surged in the past 10 years and will likely overtake emissions from active coal mines to become the prime source of methane emissions in the coal sector.

As the demand for coal could be facing a 'structural decline', the number of abandoned mines is expected to grow significantly.

Meanwhile, the HFC plan did set quantitative targets. The country aims to lower HFC production by 2029 by 10% from a 2024 baseline of 2GtCO_2e, while consumption would also be reduced 10% from a baseline of 0.9gtCO_2e in this timeframe – in line with China's obligations under the Kigali Amendment to the Montreal Protocol on ozone protection.

From 2026, China will 'prohibit' the production of fridges and freezers using HFC refrigerants.

However, the action plan does not govern China's exports of products that use HFCs – a significant source of emissions.

By **Anika Patel** and **Simon Evans**

China's steel industry must decarbonise if the country is to reach net zero, but the road ahead is uphill

While steel has long been the backbone of China's industrial production, the industry is also one of the largest carbon emitters. The iron and steel sector alone contributes between 15% and 17% of China's total emissions, making it the second largest emitter after the power sector. More than half of the world's crude steel comes from China. As Beijing strives towards its 'dual carbon' goals (emission peak before 2030, carbon neutrality by 2060), it's clear that the steel sector must decarbonise fast. This article considers the challenges that lie ahead.

China is by far the largest producer of steel in the world. In 2024 alone, China produced more than 1 billion tonnes of steel –corresponding to roughly 53% of global production. It was the fourth year in a row that China surpassed the 1 billion tonnes threshold. India is next in line, producing 'only' 149.4 million tonnes, followed by Japan (84.0 mt) and the US (79.5 mt)[1].

Yet, China's steel output is as polluting as it is impressive. In 2023, it is estimated that the steel sector alone produced roughly 2.2 billion metric tonnes of carbon dioxide ($MtCO_2$)[2], representing about 65 % of total steel-related CO_2 emissions worldwide. For comparison, this is almost twice as much as the emissions of the entire continent of South America (1.1 billion $MtCO_2$), and slightly less than the emissions of the European Union in 2023 (2.51 billion $MtCO_2$)[3]. This is why decarbonising China's steel production is crucial not only for China's own 'dual carbon' goals, but for the planet as a whole. Failure could jeopardise global efforts to reach net zero.

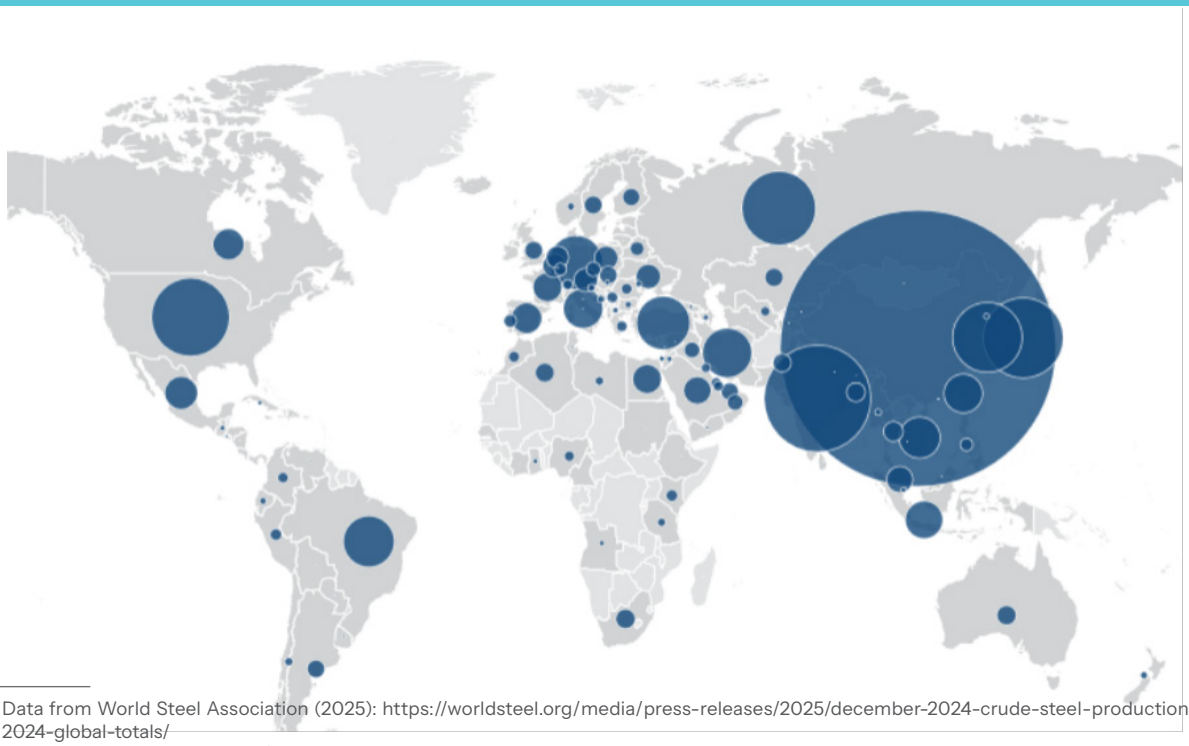
China's steel 'hard-to-abate' problems: overcapacity and carbon intensity

China's steel sector is facing two interconnected, 'oversized' problems: it produces too much, and it's too polluting.

▶ The imperative to curb overcapacity

The first major issue with China's steel sector is its overcapacity. Since 2022, crude steel production has consistently outpaced internal demand, following a crisis in China's real estate sector, which used to absorb a significant share of output. In 2024, domestic steel consumption was estimated at 863 million tonnes[4] – well below the billion tonnes of crude steel production. As a result, much of the excess steel was exported, flooding an already saturated global market. Even though exports

Figure 1. Total production of crude steel, 2024. (*Source: World Steel Association (2025)*)



1. Data from World Steel Association (2025): https://worldsteel.org/media/press-releases/2025/december-2024-crude-steel-production-and-2024-global-totals/
2. Statista, Carbon dioxide (CO_2) emissions from the iron and steel sector worldwide in 2023, by leading country, https://www.statista.com/statistics/1609255/global-steel-sector-emission-by-country/
3. Our World in Data, annual CO_2 emissions by world region, https://ourworldindata.org/grapher/annual-co-emissions-by-region
4. GMK Centre, 'Chinese steel market: consequences of the «great leap»', https://gmk.center/en/posts/chinese-steel-market-consequences-of-the-great-leap/

represent less than a tenth of China's total production, they have increased steeply in the past five years, reaching almost 111 million tonnes in 2024, up 23% year-on-year and more than double 2020 levels[5] (see Figure 2).

This mismatch between production and supply is set to continue, at least in the near future. According to the China Iron and Steel Association (CISA), in 2025 domestic crude steel demand will be 910 million tonnes, with production down to 950 million tonnes[6]. In 2024, the combined effect of sluggish demand and high production levels substantially eroded profit margins for most steel producers, and China's steel industry profits reached an historic low of CNY 29 billion, down from a peak of CNY 424 billion in 2021[7](see Figure 3).

This poses a question mark over the sustainability of the steel sector. Low profit margins will impact investment in the green transition, and the Chinese government has stepped up efforts to reduce excessive capacity and increase control over the industry. Yet, this may be easier said than done. The Chinese steel industry remains highly fragmented, with few large-scale producers. As a reference, the top 10 steel companies account for only 40% of China's crude steel production[8]. In addition, State-Owned Enterprises (SOEs) only account for about 40% of capacity, with the remaining 60% privately owned andless receptive to government oversight[9].

Figure 2. China's crude production vs Chinese exports (thousand tonnes), 2020-2024. *(Source: Worldsteel (2025))*

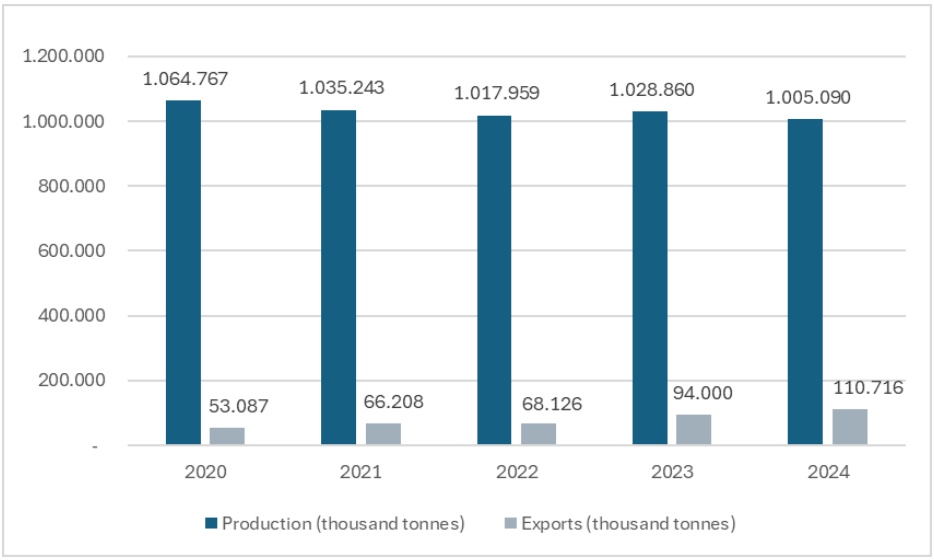
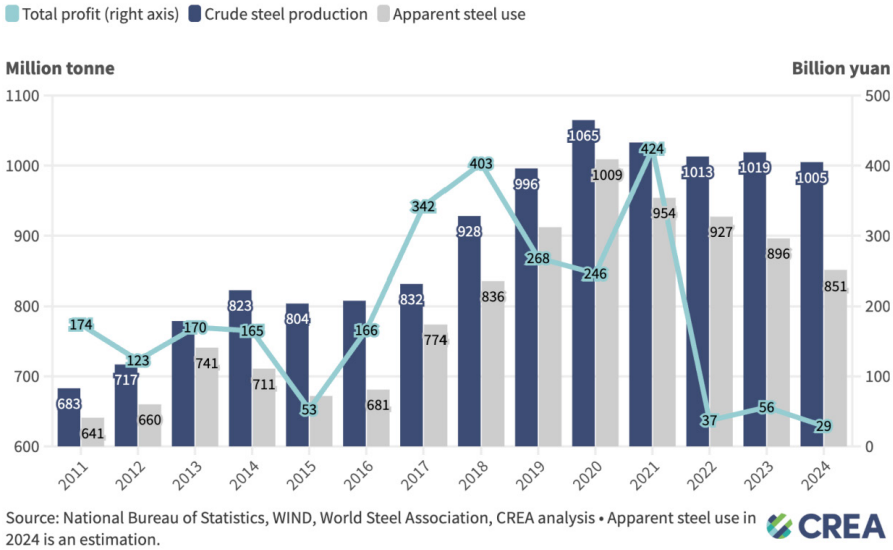


Figure 3: China's crude steel production, apparent steel use and sector profits, 2011-2024. *(Source: Centre for Research on Energy and Clean Air (February 2025))*



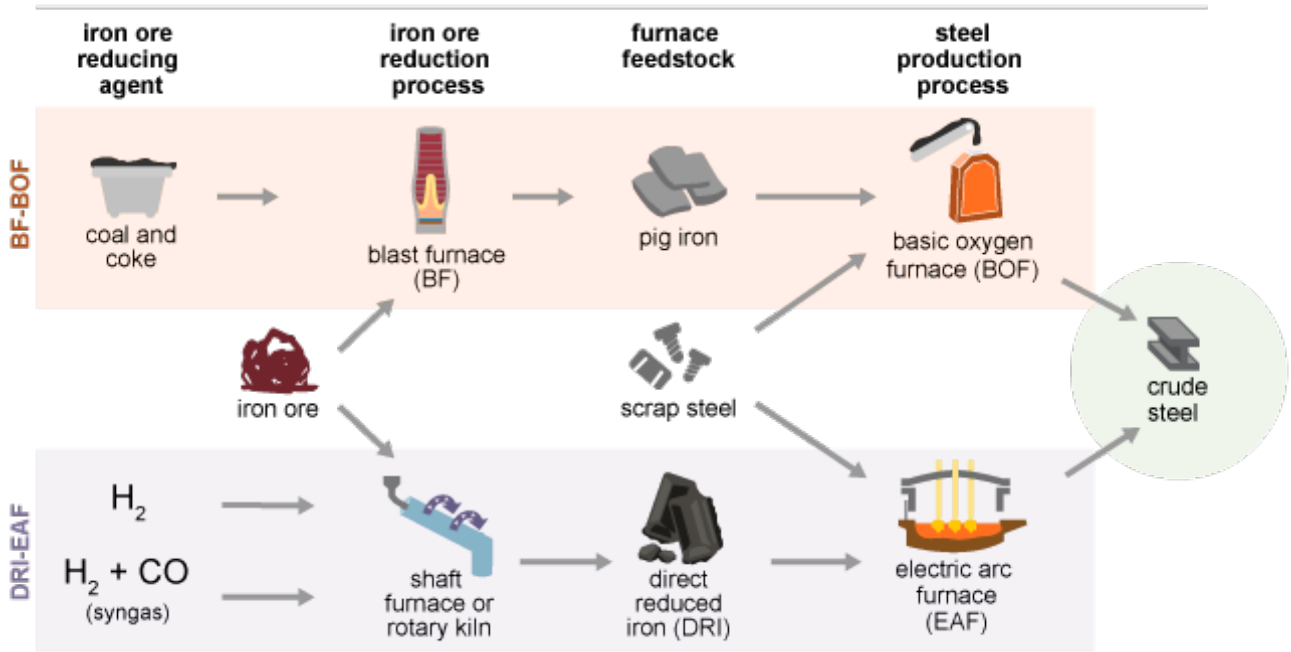
5. Xinyi Shen, Belinda Schaepe, 'Urge for reform: blast furnace glut in China erodes profitability and hinders green steel transition', Centre for Research on Energy and Clean Air (CREA), February 2025,. https://energyandcleanair.org/wp/wp-content/uploads/2025/02/CREA_China-Steel-Biannual-Review_2024-H2.pdf
6. 霍星羽 , 刘雪 ,' 中国钢铁工业协会党委书记何文波：制造业钢材消费比例持续提升 ', Shanghai Security News, 17 December 2023, https://news.cnstock.com/news,bwkx-202312-5164913.htm#:~:text=%E9%A2%84%E8%AE%A12025%E5%B9%B4%E6%88%91%E5%9B%BD%E9%92%A2%E6%9D%90,%E9%92%A2%E4%BA%A7%E9%87%8F9.5%E4%BA%BF%E5%90%A8%E3%80%82
7. See footnote 5.
8. Belinda Schaepe, 'Decarbonising China's steel sector: Challenges and Opportunities', Oxford Institute for Energy Studies, July 2024, doi: https://www.jstor.org/stable/resrep61832
9. Joseph Dellatte, 'Forging a Post-Carbon Industry. Insights from Asia', Institut Montaigne, October 2024, p.199. https://www.institutmontaigne.org/en/publications/forging-post-carbon-industry-insights-asia

Chinese steel is one of the most carbon-intensive in the world

The second problem facing China's steel sector is its high carbon intensity, which makes Chinese steel one of the most polluting in the world. This is due to the overreliance on coal for the iron- and steelmaking process, which results in high direct and indirect emissions. According to some estimates, in the mid-2010s China's carbon intensity was around 2 148 kg CO_2 per tonne of crude steel: for comparison, the equivalent figure in Germany was 1 708 kg CO_2/t, in the US it was 1 736 kg CO_2/t, and in Mexico it was 1 080 kg CO_2/t[10]. More recent studies have seen little change, with the carbon intensity of Chinese steel estimated at roughly 2.1 kg CO_2/t in 2023[11].

The root of the problem is the composition of China's fleet, which is highly reliant on blast furnaces-blast oxygen furnaces (BF-BOF) for iron- and steelmaking. The BF-BOF route relies heavily on coke as a reductant, which produces high direct CO_2 emissions during the steel production process. Blast furnaces make up around 90% of China's steel capacity. The remaining 10% consists of electric arc furnaces (EAF), which can reduce emissions by up to 97% compared to traditional BF-BOF if the process is powered by clean energy[12]. In EAF steelmaking, scrap steel is the main input, and electricity rather than coal melts the scrap to produce steel. In addition, new methods are being tested to produce green steel, such as direct reduced iron (DRI) and hydrogen-based steelmaking, often used in combination with other clean processes like EAF. However, most of the projects are still at the demonstration phase and have not yet scaled up to

Figure 4: BF-BOF and DRI-EAF steelmaking routes. (*Source: US Energy Information Administration*)



10. Ali Hasanbeigi, Marlene Arens, Jose Carlos Rojas Cardenas, Lynn Price, Ryan Triolo, 'Comparison of carbon dioxide emissions intensity of steel production in China, Germany, Mexico, and the United States', Resources, Conservation and Recycling, October 2016, pp. 127-139, doi: https://doi.org/10.1016/j.resconrec.2016.06.008
11. Ali Hasanbeigi, Hongyou Lu, Nan Zhou, 'Net-Zero Roadmap for China's Steel Industry', Global Efficiency Intelligence, March 2023, https://static1.squarespace.com/static/5877e86f9de4bb8bce72105c/t/6400854fbe41e5254fcfd5c3/1677755746536/China+steel+roadmap-2Mar2023.pdf
12. Ali Hasanbeigi,Cecilia Springer, Adam Sibal, 'China's Steel Transformation: From Blast Furnaces to Electric Arc Furnaces', Global Efficiency Intelligence, March 2025, https://static1.squarespace.com/static/5877e86f9de4bb8bce72105c/t/67efeaa0d84993542b2c82b0/1743776474910/China+EAF+study-+3.27.2025rev.pdf

become competitive. According to estimates for China, in 2023 roughly 100 million tonnes of steel were produced through EAF, compared to more than 918 million tonnes via the traditional BF-BOF route.

Of the many challenges facing the transition from BF-BOF to EAF steelmaking, the leading factor is the cost: coal-based processes are cheaper than cleaner ones, because coal is widely available and coke is relatively cheap. For reference, it costs roughly CNY 200 more to produce a tonne of steel from EAF than from BF-BOF[13], which makes green steel less competitive. Moreover, the Chinese blast furnaces fleet is relatively new, raising the risk of 'stranded assets' and reducing the incentives to transition to cleaner processes, as it would take time for such investments to yield returns.

The energy used in the steelmaking process is also problematic. Even though the share of coal-fired power in China's energy mix has decreased since the early 2000s, shifting from 70% in the early 2000s to roughly 60% in 2023[14], coal dominates China's electricity generation, with China accounting for 93% of all the new coal power projects to get under way in 2024[15].

Chinese policies to decarbonise the steel industry

The question of how to slash emissions from China's steel sector has long perplexed companies and policy-makers. Yet, the issue remains high on the government agenda, as evidenced by several high-level documents released during the 14th Five-Year Plan.

The only official target that applies to the industry as a whole was first set out in the Implementation Plan for Carbon Peaking in the Industrial Sector[16] in 2022, where it states that CO_2 emissions for the industrial sector (including steel) should peak before 2030 – in line with the overarching targets of the dual carbon goals. Other targets have been released for different segments of the industry's green transition, such as increasing EAF steelmaking to 15% by 2025[17] and to 20% by 2030[18], or reducing energy consumption by 1% in BF-BOF and 2% in EAF[19]. However, unlike in other heavy industries such as aluminium smelting, there is no absolute target for emission reduction – suggesting that the industry might not yet have reached peak emissions.

▶ Reducing overcapacity and guiding industrial restructuring

The primary policy move of the government has been to limit capacity expansion and drive industrial restructuring. Since 2014, MIIT has implemented a 'capacity swap' policy that prohibits new capacity additions and only allows upgrades to existing ones. Guidelines were set at 1.25:1 ratio for BF-BOF (meaning that new coal-based projects will require more capacity to be decomissioned than they contribute) and 1:1 ratio for EAF, in an effort to increase the share of the latter[20].

13. See footnote 5, p.9
14. Ember, 'Thinking beyond diversification: Next step in China's coal power transition', 5 August 2024, https://ember-energy.org/latest-insights/thinking-beyond-diversification-next-step-in-chinas-coal-power-transition/. Consulted on April 15, 2025.
15. Qi Qin, Christine Shearer, 'When coal won't step aside: The challenge of scaling clean energy in China', Centre for Research on Energy and Clean Air (CREA) and Global Energy Monitor (GEM), February 2025, https://energyandcleanair.org/wp/wp-content/uploads/2025/02/CREA_GEM_China_Coal-power_H2-2024_FINAL.pdf
16. MIIT, NDRC, MEE, '工业领域碳达峰实施方案', August 2022, https://www.miit.gov.cn/zwgk/zcwj/wjfb/tz/art/2022/art_df5995ad834740f5b29fd31c98534eea.html
17. MIIT, NDRC, MEE, '关于促进钢铁工业高质量发展的指导意见', 20 January 2022, https://www.gov.cn/zhengce/zhengceku/2022-02/08/content_5672513.htm
18. Halina Yermolenko, 'China aims to increase the share of EAF in steel production to 20% by 2030', GMK Centre, 5 March 2024, https://gmk.center/en/news/china-aims-to-increase-the-share-of-eaf-in-steel-production-to-20-by-2030/
19. NDRC, NEA, MIIT, MEE, SAMR, '钢铁行业节能降碳专项行动计划', 7 June 2024, www.ndrc.gov.cn/xxgk/zcfb/tz/202406/t20240607_1386774.html
20. SMM, 'China releases steel capacity swap policy', 8 January 2018, https://news.metal.com/newscontent/100775247/china-releases-steel-capacity-swap-policy-?utm_source=chatgpt.com

Nonetheless, the plan fell short of its target – which was intended to limit capacity to 1 billion tonnes – with China surpassing the threshold over the past five years. Then, in August 2024, the Ministry of Industry and Information Technology (MIIT) halted new capacity replacement projects for steel[21]. At the same time, the government made it clear that the steel industry will undergo substantial cuts, in an effort to curb overcapacity, as confirmed by policy documents indicating that, in 2025 and 2026, China will push for reduced output by forcing the closure of outdated and inefficient furnaces[22].

At the same time, China's National Development and Reform Commission (NDRC) has been promoting new technologies by means of the annual 'Catalogue for Guiding Industrial Restructuring[23]', which signals to investors what technologies are being encouraged or phased out. For instance, the 2024 Edition classifies as 'encouraged' gas-based DRI and hydrogen-based steelmaking, whereas it defines small-scale blast furnaces as 'obsolete'. Other guidelines also encourage the development of carbon capture, utilisation and storage (CCUS) as a way to avoid the economic loss incurred by early decommissioning[24]. Given that China's fleet of furnaces is relatively new, deploying CCUS on blast furnaces is seen as a way to reduce the carbon footprint of steel production without forcing BF-BOF capacity into early retirement.

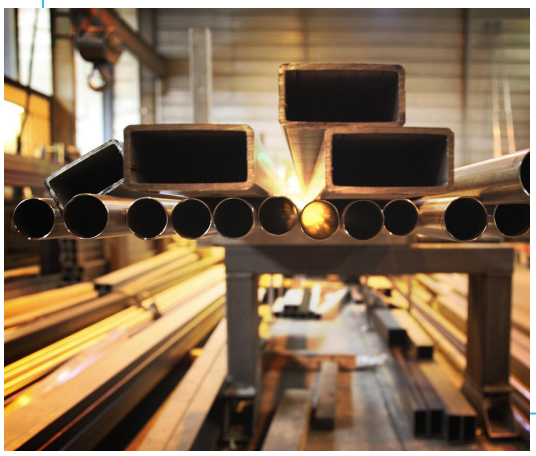
Embracing circularity and scrap steel

Another major policy move has been to increase the use of scrap steel – a critical input for EAF steelmaking which improves the circularity of the industry, with the 14th Five-Year Plan for Circular Economy[25] setting the annual target for scrap steel recycling at 320 million tonnes by 2025. This was accompanied by a strategy to increase scrap imports and make it a domestic industry. In 2021, China reversed its ban on scrap steel imports[26], allowing it to flow more freely into the country, and subsequently imposed a 40% export tariff on different types of scrap steel[27], thus discouraging their export abroad. Then, in late 2024, the government provided CNY 10 billion yuan in funding to support the establishment of a new large State-Owned Enterprise to recycle raw materials: the China Resource Recycling Group (CRRG)[28]. This new industry giant is bringing together the recycling segments of five different SOEs – including Baowu Group – with the aim of improving efficiency and increasing the recycling rates for raw materials.

21. Ministry of Industry and Information Technology (MIIT), '工业和信息化部办公厅关于暂停钢铁产能置换工作的通知', 20 August 2024, https://www.miit.gov.cn/jgsj/ycls/wjfb/art/2024/art_beae9b1682de4457b555b42c5f839f4f.html
22. Reuters, 'China aims to cut steel output, prune overcapacity, document shows', 28 August 2025, https://www.reuters.com/markets/commodities/china-aims-cut-steel-output-prune-overcapacity-document-shows-2025-08-28/
23. NDRC, '产业结构调整指导目录（2024 年本）', December 2023, https://www.ndrc.gov.cn/xxgk/zcfb/fzggwl/202312/t20231229_1362999.html
24. MEE, '关于推进实施钢铁行业超低排放的意见', April 2019, https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/201904/t20190429_701463.html
25. NDRC, '十四五循环经济发展规划', July 2021, https://www.ndrc.gov.cn/xxgk/zcfb/ghwb/202107/P020210707324072693362.pdf
26. Scrapware, 'China's Iron and Steel Scrap Standards for Imports Takes Effect', January 2021, https://www.scrapware.com/blog/chinas-iron-and-steel-scrap-standards-for-imports-takes-effect/
27. The full list of products under export tariffs, with normal and temporary rates, is available at: https://www.gov.cn/zhengce/zhengceku/202412/P020241228531750652541.pdf
28. Shanghai Metal Market, 'China Resources Recycling Group Established, New Opportunities for Steel Scrap Industry', November 2024, https://www.metal.com/en/newscontent/103035093

Expanding the National ETS to the steel sector

Finally, the Chinese steel industry has recently been included in the Chinese Emission Trading System (ETS). This was preceded by measures to improve the transparency of emissions data and carbon accounting, such as the establishment of a carbon footprint management system[29] for several industries, guidelines for emission reporting, and work plans to create a comprehensive carbon statistics system[30]. Then, in March 2025, the Ministry of Ecology and Environment (MEE) released the final Work Plan to include the steel, aluminium, and cement industries in the national carbon emission trading market[31], bringing China's ETS coverage from 40% (when it only included power generation) to 60% of total Chinese GHG emissions. The first implementation phase (2024-26) will provide free allocations so that companies can familiarise themselves with reporting obligations; then, from 2027 onward, a new phase will 'deepen and improve' regulatory mechanisms and quota allocations, and companies will start paying for their emissions based on their carbon intensity.



Nonetheless, in spite of its potential for emission abatement, the current design of the Chinese ETS has significant limitations. First, it does not impose an absolute cap on emissions, operating instead on a system of intensity-based benchmarks, where companies receive free allowances based on their production volumes. To put it simply, this design does encourage companies to become more efficient (i.e. reduce emissions per unit of output) but does little to curb total emissions if production continues to rise. Even when companies exceed the benchmark, those operators would only need to 'pay' for the difference by buying allowances from other companies on the secondary market[32].

29. The State Council, 'Plan focuses on carbon footprints', 11 June 2024, https://english.www.gov.cn/news/202406/11/content_WS6667b1ecc6d0868f4e8e7fbf.html
30. NDRC, '完善碳排放统计核算体系工作方案', 24 October 2024, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202410/t20241024_1393879.html
31. MEE, '全国碳排放权交易市场覆盖钢铁、水泥、铝冶炼行业工作方案', 26 March 2025, https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202503/t20250326_1104736.html
32. International Carbon Action Partnership, 'China officially expands national ETS to cement, steel and aluminum sectors', 10 April 2025, https://icapcarbonaction.com/en/news/china-officially-expands-national-ets-cement-steel-and-aluminum-sectors

Secondly, the price of carbon remains low, averaging just USD 13.33 per tonne in 2024[33] – for comparison, in the same year it was USD 70.07 per tonne in the EU[34]. A low carbon price reduces the financial incentive for companies to invest in expensive low-carbon technologies, and the surplus of allowances is helping to keep prices low and so is reducing investment in the sector.

Yet, this could change in the medium- to long-term. In August 2024, the State Council unveiled plans to switch from the control of carbon intensity to the control of total emissions as part of the 'dual carbon control' policy[35], which would be compatible with the introduction of an absolute cap on emissions in the ETS. The timeline suggests that the switch to total emissions control will happen after the 15th Five-Year period (2026-30), once China's emission peak has been reached. Moreover, the carbon price has already risen more than tenfold since the ETS's launch in 2021, suggesting further increases are likely.

China's steel industry in the context of CBAMs

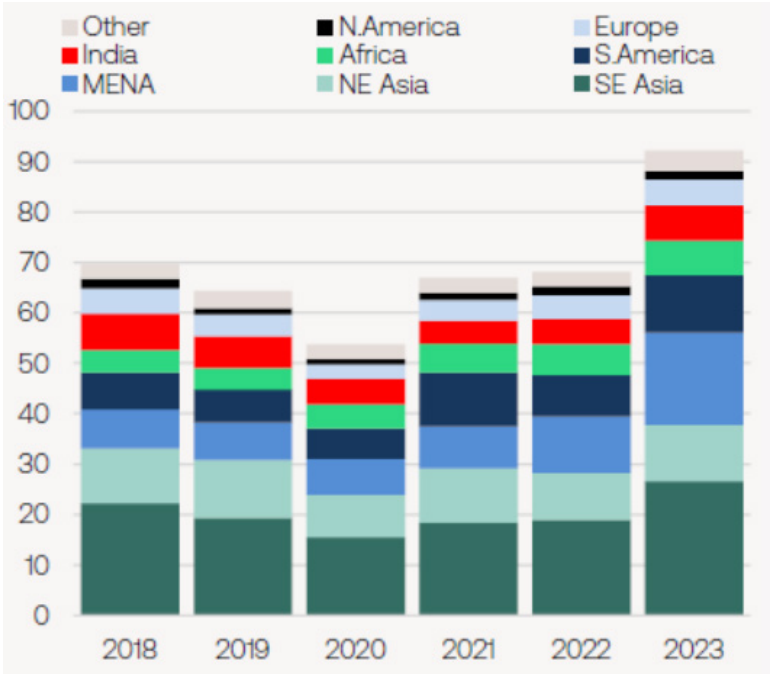
A push to decarbonise the steel industry could also stem from external factors, such as implementation of Carbon Border Adjustment Mechanisms (CBAMs) by China's trading partners. The instrument – a carbon tariff on embedded emissions of imports – would impose a carbon price (paid by the importers) on Chinese exports of steel to foreign markets, thus making it less competitive in case of large differences in the products' carbon intensity. Currently, the EU has already begun the implementation of its own CBAM (with the transitional phase ending in December 2025), and the UK, Canada and other countries have unveiled plans to follow suit[36].

33. International Carbon Action Partnership, 'Chinese National ETS', https://icapcarbonaction.com/en/ets/china-national-ets
34. International Carbon Action Partnership, 'EU Emissions Trading System (EU ETS)', https://icapcarbonaction.com/en/ets/eu-emissions-trading-system-eu-ets
35. The State Council, '关于印发加快构建碳排放双控制度体系工作方案的通知', August 2024, https://www.gov.cn/zhengce/content/202408/content_6966079.htm. Consulted on April 24, 2025.
36. Zero Carbon Analytics, 'Carbon Border Adjustment Mechanisms require coordinated global action', 7 November 2024, https://zerocarbon-analytics.org/archives/economics/carbon-border-adjustment-mechanisms-require-coordinated-global-action

In 2023, Chinese exports of goods covered by the EU CBAM accounted for more than EUR 14 billion in value, of which steel represented more than 80%[37]. At the same time, Europe relies on coal-fired blast furnaces for 55%-60% of total capacity, with the remaining 40%-45% made up of electric arc furnaces[38], making European steel, on average, less carbon intensive than Chinese-made steel. Moreover, the implementation of EU CBAM would also subject exports to the same carbon price paid within the bloc, which is significantly higher than China's. This combined impact could significantly reduce the competitiveness of Chinese steel exports into the EU, thus making Chinese companies lose market share. In response, Chinese steelmakers would be spurred to lower their product footprint to maintain access to the European market, which would act as another driving force for industrial decarbonisation.

However, the leverage of CBAM should not be overstated. The EU represents only a fraction of China's steel exports; the bulk of it goes to markets in Asia, the Middle East, and South America[39]. Therefore,

Figure 5: Chinese steel exports by destination (million tonnes), 2018-2023. (*Source: Breakwaveadvisors*)



if the carbon price becomes too high for Chinese companies to compete in the European market, they could just redirect the exports to other markets instead of decarbonising their production. According to Chinese industrial stakeholders[40], most companies are adopting a 'wait and see' approach: that is to say, let's wait until CBAM is fully implemented, and look for alternatives in the meantime.

In conclusion, decarbonising China's steel sector is essential for the global effort to reach net zero, yet the industry continues to struggle with overcapacity and high carbon intensity – given by its extensive reliance on coal-fired blast furnaces. While external pressure through instruments such as carbon tariffs could play a role, the main drivers to lower the industry's footprint would remain China's own domestic policies and the country's path to carbon neutralit. In this context, the 15th Five-Year Plan will be crucial in guiding China to peak emissions and setting the country on its post-peak trajectory. The steel sector will remain among the industries that need to decarbonise faster, but the road ahead is still uphill.

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37. Elisabetta Cornago, Aslak Berg, 'Learning from CBAM's transitional phase. Early impacts on trade and climate efforts', Centre for European Reform, December 2024, p5, https://www.cer.eu/publications/archive/policy-brief/2024/learning-cbams-transitional-impacts-trade
38. According to figures provided by Eurofer, the European Steel Industry Association.
39. Breakwave Advisors, 'The big picture: China's steel sector and export outlook', 5 April 2024, https://www.breakwaveadvisors.com/insights/2024/4/5/the-big-picture-chinas-steel-sector-and-export-outlook
40. Conversation with Senior Director at Agora Energy Foundation.

China's overuse of coal is causing negative power prices

To further wind and solar growth, coal must assume its designated role of flexible standby rather than static mainstay, write two economists

During periods of low demand in the first half of 2025, electricity repeatedly hit rock bottom prices on the spot market of Chinese provinces like Zhejiang and Shandong, sometimes even going negative. This was not merely the result of abundant wind and solar power generation. It was also partly because a large proportion of electricity demand had already been met by off-market power-purchase agreements, usually for coal.

In Zhejiang during January's Chinese New Year holiday, prices reached CNY -0.20 (USD -0.03) per kilowatt-hour – the lowest allowed – multiple times. During the Labour Day holiday in May, prices on Shandong's spot market stayed negative for 22 hours in a row.

This is due to a problem with the decarbonisation of China's electricity systems: despite rapid roll-outs of wind and solar power, coal is being used more than it should, rather than reserved as a flexible standby.

China's electricity system is experiencing rocketing demand: between 2022 and 2024, annual growth in demand was between 8% and 10% in many parts of China, particularly in Zhejiang, Hubei and Jiangsu. At the same time, China still has 200 gigawatts (GW) of coal power capacity either under construction or permitted. The country's existing capacity stood at 1,200 GW as of the end of 2024. We think this could reach 1,500 GW, if not more, by 2030.

Government policy documents have repeatedly designated coal power as a supporting and peak-regulation source, rather than a primary provider of baseload. Achieving this new transition role for coal units requires coordinating dispatch principles, market mechanisms and administrative arrangements. This is a major challenge for the decarbonisation of electricity.

Zhejiang: A case study in overusing coal

A National Energy Administration official put Zhejiang's negative January electricity prices down to lower demand and surplus renewable generation.

Figures from energy data provider SP RiXin show demand across Zhejiang fell to 17 GW at midday on 27 January, two days before Chinese New Year. That meant all demand could be met by base-level generation directly ordered by grid dispatchers. Such electricity, mostly coal powered, is not affected by market prices.

Chinese provinces commonly have a 'coal benchmark electricity price', which select power plants awarded 'out-of-market' commitments are permitted to charge, rather than having to compete on the wider market. As a result, some coal power plants are scheduled to run to ensure supplies even if they produce power expensively as they will still make a profit. Meanwhile, other sources of power that would have been competitive – mainly renewables and a few coal power plants – are curtailed or shut out. These out-of-market commitments mean overuse of coal power at the system level.

We believe China should retain the minimum possible number of coal power generator units. This would broaden the opportunity for renewable generators. For example, demand for 17 GW of power could be met by 17 units running at full capacity, or by 34 at half capacity. In the latter case, the generators are already running at the minimum possible level and can't drop down any further, meaning less room for wind or solar power integration. This is overuse of coal at the micro level, namely the generator-unit level.

Also, even at times of low demand, Zhejiang continues to import power from outside the province, 70% of which is coal power. External dispatch arrangements do not respond to electricity prices or demand, with ahead-of-time plans implemented regardless.

Those imports are another example of the excessive use of coal power. Under China's electricity-dispatch systems, each province is responsible for balancing its own supply and demand. When local supply outstrips demand and prices start to fall, perhaps even below zero, there should be no need to use imported electricity, with its associated extra costs. When imports do occur, it doesn't just reflect resource imbalances. It also indicates that at the macro level, China as a whole is still highly reliant on coal power.

How do negative power prices come about?

When a large share of electricity is ordered off-market in advance, there is less demand on the 'day-ahead' markets. This leads to lower – potentially even negative – prices. (The day-ahead markets are part of the spot electricity market, with electricity being purchased for delivery the following day. Buyers and sellers set hourly generation levels and prices through an auction).

Analysing actual market data from the first five months of this year, we found negative prices were experienced almost all day in Zhejiang and Shandong when wind and solar power supplied 20% to 25% of demand. Negative prices also occurred when overall demand dropped to 55% or less of peak levels with wind and solar supplying only 10%, but not all day.

In April 2025, solar power was sold on Shandong's spot markets at an average of CNY 0.02 per kilowatt-hour, far below coal's benchmark price of CNY 0.35-0.45. This is because grid dispatch managers order generation directly, via off-market purchase agreements, rather than via market mechanisms. Such direct dispatch often meets about 50% of all demand, greatly reducing the opportunities for market price-setting, and keeping the marginal payment for renewable power extremely low.

Also, markets are fragmented. Day-ahead markets do not usually allow electricity consumers to bid for power and adjust their power consumption accordingly. The three markets – day-ahead, intraday, and mid- to long-term contracts – work like independent shops, with demand unable to flow between the three. China's mid- and long-term electricity supply contracts are still largely based on physical delivery – the generator must actually produce the electricity and deliver it to the grid to fulfil the contract.

Electricity is a uniform good – once delivered to the grid, power from different sources cannot be distinguished. So, in theory, a generator could fulfil a contract by paying another generator to deliver the same amount of electricity. Requiring physical delivery removes flexibility and hampers optimal allocation of resources.

In electricity markets, the price of power is usually set by the rates of the last power plant needed to meet demand. This 'marginal generator' usually produces the most expensive power because the cheapest generators are used first. Such a setup balances supply and demand for the greatest overall benefit. In a coal-reliant system, prices should in theory fluctuate in line with the costs of fuel for the marginal coal-power generator. But in reality, many provinces have spot prices much lower than that theoretical value, as well as wild fluctuations.

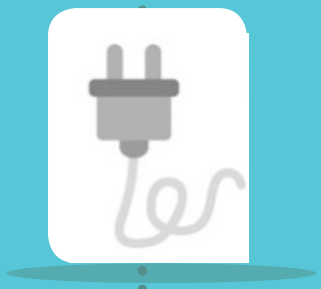
This is because generation from more expensive coal-power plants is prioritised (through off-market commitments), removing the base demand that should be met on the market by low-cost generators. So, lower-cost renewable generators end up becoming, at points, the marginal generator. When demand is ultra low, those low or even negative prices set the price for the market as a whole.

Negative prices in China and abroad

Negative electricity prices also occur in the US and the European Union (EU), but there are significant differences in their cause and frequency when compared to China.

In the EU, electricity exchanges and dispatch authorities are generally independent of each other. The players in the exchanges determine the quantity and location of electricity to be supplied. The dispatch authorities are not involved in this trading process but are responsible for the electricity-balancing market and physical dispatch. Self-dispatch is commonly used: generators themselves determine how much electricity to supply given the prices on offer.

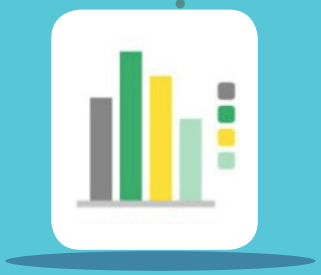
Dispatch results from market trading, rather than government orders. As the ancillary service and energy markets are separate, inefficiencies can result.



For example, if a generator signs a mid- to long-term contract at a price that is higher than the market price at the time of delivery, economics would dictate it stops generating power and simply buys electricity on the market with which to fulfil its obligations. But when power plants opt to generate the power themselves, costs go up for the entire system. This runs contrary to the system-wide goal of minimising costs.

Under the US Independent System Operators arrangement, electricity markets and dispatch are closely linked. Dispatch authorities use an optimised model and bids from market actors to determine a plan for the following day's generation, and adjust that plan in real time. Prices for electricity and ancillary services are co-optimised, with the aim of minimising overall costs.

In comparison, China's provincial spot market trials reveal an imbalance between authorities and responsibilities: dispatch authorities have strong powers, as in the US, but their duties are more akin to those of their EU counterparts: to ensure physical balance. There is no goal of overall optimisation, and generators are not empowered to come up with their own dispatch arrangements.



With the market and dispatch uncoupled, market pricing often fails to reflect supply and demand realities. The low and negative prices seen in China are largely due to market mechanisms being hampered by non-market arrangements, rather than too much renewable energy in the system.

The impact of negative prices

Negative electricity prices prevent wind and solar power from earning their market value, which necessitates external support to sustain renewable-energy investments.

In response, this year the Chinese government announced reforms in how renewables are sold to the grid. Contract for Difference-type mechanisms should ensure income for wind and solar generators.

Many bodies have interpreted these changes as meaning more of a role for market pricing. In reality, the existing, entirely market-based method of determining revenue for renewable generators is going to be replaced with subsidies and taxes, based on expected pricing. It is more a case of creating time for follow-up improvements to market rules, than of implementing actual market reforms. But the new arrangements may reduce the internal impetus for such reforms and mean a return to the traditional model: all short-term pricing depends on long-term costs, and dispatchers decide who generates. The outcomes remain to be seen.

If we are to avoid a rollback of market reforms, we have two options. First, make more use of markets. Use markets in dispatch, increase flow between the different markets, and let market actors respond to price signals, borrowing from the EU's experience. Option two would be an overall optimised dispatch system based on price or cost signals. This would do away with off-market purchase agreements, closely coupling trading and dispatch – as is done in some competitive markets in the US.

Simply put, the current policy provides space for further improvements to market mechanisms and rules, but those reforms are still needed.

The outlook for 2030

China's electricity system could be described as half pulling ahead, half lagging behind. Demand is pulling ahead, with sustained growth. The management lags, however, with higher levels of administrative intervention and centralisation overriding market forces: the pace of investment, the power generation mix, price levels and market access are all under high levels of administrative control.

If China is to eliminate frequent negative prices on the spot market, it needs to prevent the overuse of coal power. Low or negative prices, overuse of coal and lack of flexibility are three aspects of one problem. The generation mix needs to be improved, with operational decisions made in line with market prices or cost signals, to avoid overuse or excessive retention of coal power.

Given the scale of existing and planned coal-power generation, China may have 1,500 GW of coal power by 2030. In that scenario, coal's share of the electricity mix will hold steady at 55% and CO_2 emissions from the power sector will increase slowly, by about 0.2% to 1% a year.

This is a continuation of what we have seen for the past 5 to 10 years. But it does not align with the national goal of achieving peak carbon emissions before 2030. It may, however, be a 'moderate deviation' deemed acceptable by policymakers. The impetus for future electricity-sector reforms may come from changes of international rules, and the increasing priority given to climate issues in domestic politics.

By **Zhang Shuwei** and **Zhang Ji**

Staying cool without overheating the energy system

Rising temperatures and incomes are boosting demand for cooling globally, but equity and affordability matter

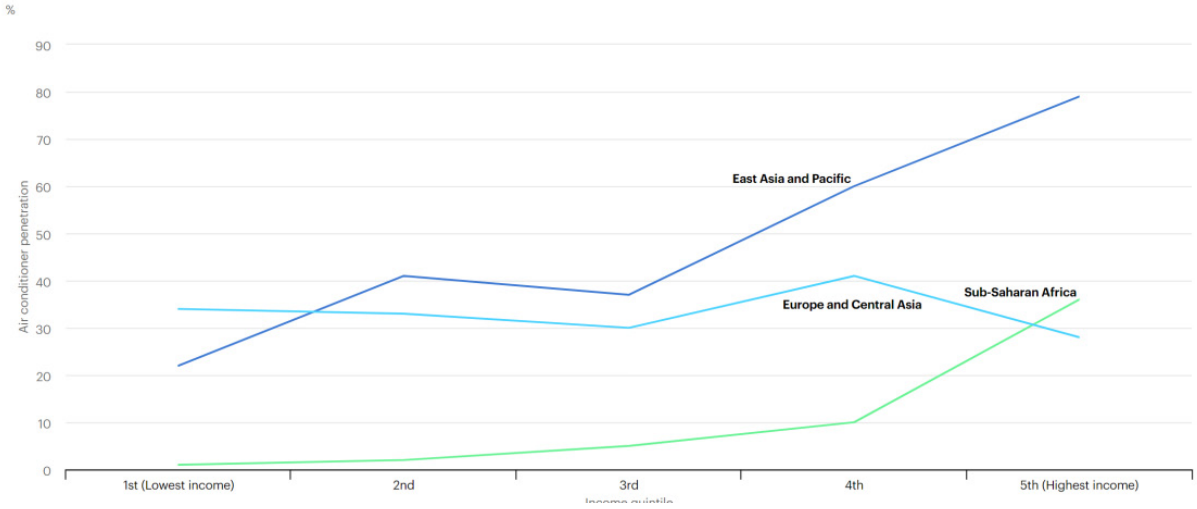
Around the world, demand for cooling is increasing quickly as temperatures, populations and incomes rise. In 2024, global average temperatures reached 1.5 °C above pre-industrial levels for the first time, intensifying the frequency and severity of extreme weather events such as heat waves. At the same time, economic development is reshaping access to air conditioning in many countries – especially in emerging and developing economies, where more than 80% of projected electricity demand for cooling by 2050 is expected to occur.

Currently, about 3.5 billion people live in regions with high temperatures, yet only about 15% of them own an air conditioner. But that is set to change in the years ahead. Across Southeast Asia, for example, the stock of air conditioners is set to increase ninefold between 2020 and 2040 based on today's policy settings. In Indonesia specifically, the share of the population that owns an air conditioning unit is expected to rise from 14% in 2023 to 85% by 2050, driven in large part by an improvement in living standards.

Expanding access to cooling stands to improve the quality of life of millions of people. It would also save lives. According to the World Health Organisation (WHO), almost half a million deaths per year globally are related to heat. While extreme heat is not a new concern in many emerging and developing economies, the challenge is becoming more urgent. Meanwhile, recent heatwaves have pushed temperatures to almost 39 °C in Paris, 37 °C in New York City and 37 °C in Seoul, and last month was the warmest June on record in Western Europe – showing that even traditionally temperate regions are increasingly affected.

While demand for air conditioning is growing rapidly, access to cooling equipment is still highly unequal, especially across income brackets. In a region that covers East Asia and the Pacific, for instance, only about 25% of low-income households own an air conditioning unit, compared with over 75% of the richest households. In sub-Saharan Africa, despite high cooling needs, use of air conditioners outside the wealthiest quintile is extremely limited, in part due to a lack of access to electricity. In contrast, Europe – where total ownership of air conditioning units is relatively low, at 20% – sees more equitable distribution across income levels.

Estimated air conditioner penetration by income quintile in Europe & Central Asia, East Asia and Pacific and sub-Saharan Africa



Increasing cooling demand is testing the grid, but the right technology can offer relief

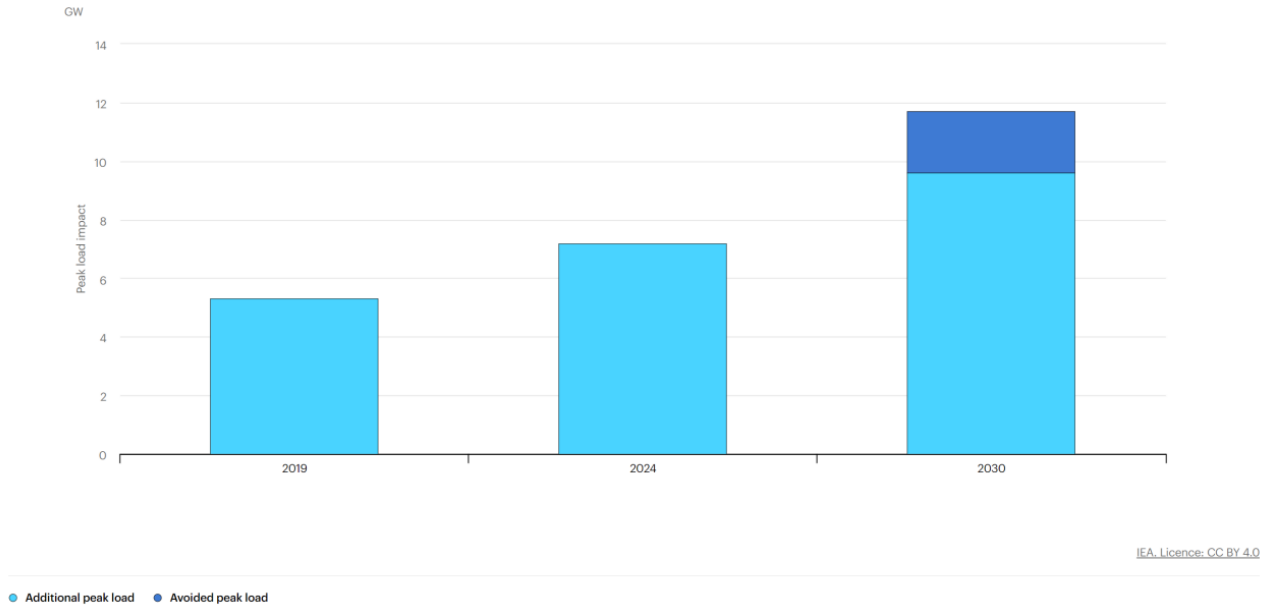
Space cooling is now the fastest growing source of energy demand from the buildings sector, rising by almost 4% annually to 2035 under today's policy settings. Most of this growth is set to occur in emerging and developing economies.

While the increased penetration of air conditioning units is helping households cope with heat, it also brings with it a series of challenges for the energy system – most notably an increase in peak demand, both during the day and in the evening. During the early summer heat waves of 2025, France – where air conditioning ownership is low – recorded an evening electricity peak that was 25% above the off-season average. In New York, where air conditioning ownership is high, it was 90% higher.

These cooling-driven peaks can put electricity affordability and reliability at risk, especially if efficient technologies are not in place to dampen the effects on energy systems.

IEA analysis finds that in India, each 1 °C increase in outdoor temperature in 2024 was associated with a 7 gigawatt (GW) increase in peak electricity demand. This represented a strong increase over the previous five years, and it could further rise to 12 GW per degree in 2030 without further efficiency action. If India were to experience similar heatwaves as in recent years – with temperature anomalies of over 4 °C – the additional peak load would amount to 47 GW, putting substantive pressure on grids and electricity production. However, if all new air conditioners sold in India between now and 2030 were highly efficient, the increase in peak load could be 20% lower.

Additional peak load caused by an outdoor temperature increase of 1°C and avoided peak load due to higher efficiency ACs sales in India, 2019-2030



Boosting energy efficiency makes the benefits of cooling accessible without overstressing power systems or breaking the bank

As households seek effective cooling solutions and policy makers look to address the impacts on electricity grids, improving the efficiency of air conditioning units can serve as a key short-term approach.

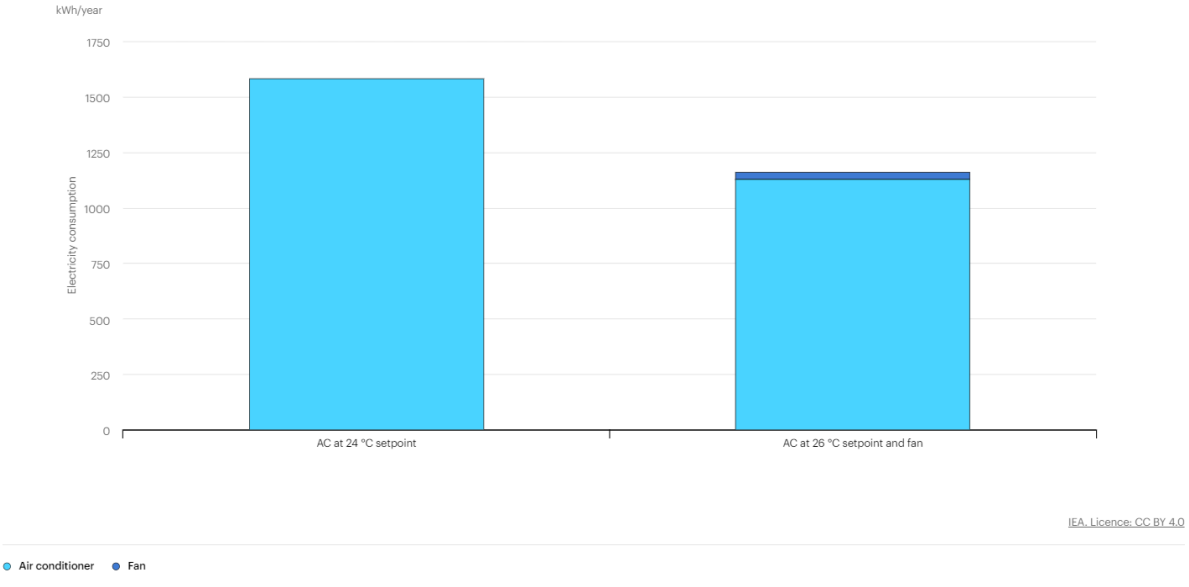
Globally, the average new air conditioner sold is only about half as efficient as the best models available. But more efficient equipment does not have to cost more. IEA analysis across Southeast Asia and Latin America shows that for the same amount of money, consumers can purchase air conditioners with efficiency levels ranging from 3 watts per watt (W/W) to more than 6 W/W. That is twice the level of efficiency for the same upfront cost.

Promoting the purchase of high-efficiency units would not only reduce the strain on electricity systems but also would produce cost savings for consumers. At the IEA's 10th Annual Global Conference on Energy Efficiency, ministers from nearly 50 countries agreed to work collectively towards boosting the uptake of energy-efficient appliances such air conditioners in order to improve the affordability of energy.

Even so, the efficiency of the equipment is only part of the solution. Users can also significantly reduce energy consumption by making the temperature setpoints on their air conditioners slightly higher, or by using fans in conjunction with air conditioning. These options do not require compromises on thermal comfort and can result in much lower electricity costs.

In a study on thermal comfort in Singapore, participants reported feeling equally or more comfortable when air conditioners were set to a higher temperature and used in combination with a fan. This approach uses much less energy: an air conditioner of average efficiency set to 26 °C in a well-insulated building in Singapore consumes about 30% less energy than one set to 24 °C. And adding a fan consumes a negligible amount of additional energy compared with lowering the temperate setpoint by two degrees.

Energy consumption of air conditioners at different temperature setpoints and additional energy demand for fans to reach equal thermal comfort



Sustainable cooling requires a big-picture approach, including urban and building design

Keeping cool entails more than just installing air conditioning. How we design our buildings and plan our cities can significantly impact the magnitude of cooling demand.

At the building level, measures like proper insulation and exterior shading can cut a building's cooling demand by up to 80%, while passive cooling techniques like natural ventilation can offer quick relief, lowering indoor temperatures by up to 9 °C.

As extreme heat becomes more common, rethinking the design of cities is just as important. During a recent heatwave in Paris, for example, nighttime temperatures in an inner-city park were up to 7 °C cooler than in nearby built-up areas. Integrating more green spaces – such as parks and trees – into urban planning can significantly reduce heat island effects and help cities cool down more effectively overnight.

Policy makers must now account for higher cooling demand by adopting a broad, long-term approach that includes both addressing equipment efficiency and integrating cooling considerations into building and urban design.

As highlighted in the IEA's recently updated Energy Efficiency Policy Toolkit, a balanced mix of supportive regulations, information and incentives is key to minimising the negative impacts of rising cooling demand on energy systems around the world.

Policies are key to minimising the impacts of cooling on energy systems

Regulation that supports better urban planning, more ambitious building energy codes and minimum energy performance standards for air conditioners can help ensure that high efficiency becomes the norm, bringing down operating costs for consumers without necessarily increasing purchase prices. While over 80 countries have mandatory building energy codes in place, and more than 100 countries have minimum energy performance standards for air conditioners, the stringency varies widely, and there remains significant room for improvement.

Information can help people make better choices. For instance, energy labels make it easier to choose efficient air conditioners, while guidance on temperature settings supports energy-saving habits and lower energy bills.

Incentives such as grants can also encourage the purchase of energy-efficient air conditioners, fans and other cooling solutions. By directing subsidies towards those most in need and at risk, policy makers can address multiple objectives at once: lowering energy bills, protecting public health and reducing emissions.

Making smart policy choices now can ensure that the benefits of cooling are widely accessible while keeping their energy and environmental impacts in check.

By **Fabian Voswinkel, Doriane Senat, Nives Della Valle, Giulia D'Angiolini, Federico Callioni.**

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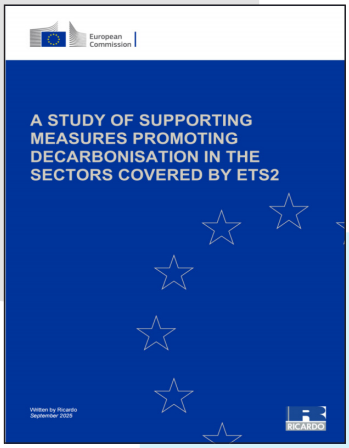

A study of supporting measures promoting decarbonisation in the sectors covered by ETS2

The European Commission has published a study to help Member States prepare for the EU Emissions Trading System for buildings, road transport, and small industry (ETS2), which will take effect in 2027. Prepared by Ricardo AEA Ltd, the report presents 21 case studies of early decarbonisation measures selected for cost-effectiveness and scalability, which could enhance ETS2's impact while supporting a just transition. Measures include tax incentives, grants, soft loans, standards, and information campaigns that aim to reduce upfront costs, accelerate the uptake of electric vehicles and heat pumps, expand charging infrastructure, renovate buildings, and improve industrial efficiency. Three additional measures with strong future potential are also identified. To mitigate higher fuel and heating costs for vulnerable households, micro-firms, and transport users, the EU has created the EUR 86.7 billion Social Climate Fund, financed mainly from ETS2 auction revenues. By showcasing practical initiatives, the study offers Member States timely guidance to design and implement measures and spend ETS2 revenues effectively without overburdening citizens.

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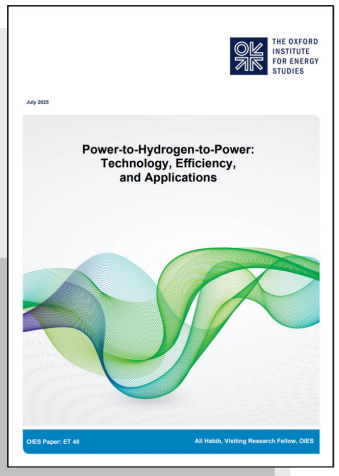

Power-to-Hydrogen-to-Power: Technology, efficiency, and applications

Hydrogen could play a critical role in the power sector, providing flexibility, storage, and a clean fuel source. The Power-to-Power (PtP) process converts surplus renewable electricity into hydrogen, which can either be used on-site or transported to where it is needed. When electricity demand rises, the stored hydrogen can be converted back into power. Each conversion step incurs energy losses, making round-trip efficiency a key consideration.

This paper by Oxford Energy Studies evaluates the efficiency of using renewable energy for hydrogen production and subsequent power generation. It also explores potential PtP applications and compares them with other storage technologies, including batteries and pumped-storage hydro plants. While PtP offers flexibility, grid stability, and support for electricity markets, its value depends on system needs, market conditions, and policy frameworks. The findings highlight the strategic value of hydrogen in building a resilient and decarbonised energy system.

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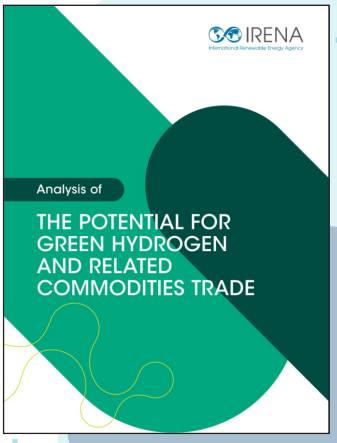

Analysis of the potential for green hydrogen and related commodities trade

Green hydrogen, produced via water electrolysis using renewable electricity, is seen as critical for linking different energy subsectors and supporting decarbonisation. This report, published by the International Renewable Energy Agency (IRENA), examines the techno-economic potential of trading green hydrogen and related commodities—including ammonia, e-methanol, and direct reduced iron (DRI)—by 2050, using a cost-optimisation approach. Trading these commodities can enhance industrial competitiveness in consuming regions by providing access to affordable green inputs from areas with abundant, low-cost resources, while also supporting economic diversification and development in producing regions. Building on IRENA's 2022 analysis, the study incorporates updated market and policy assumptions to explore how global green hydrogen trade can contribute to a secure, low-carbon, and economically efficient energy transition.

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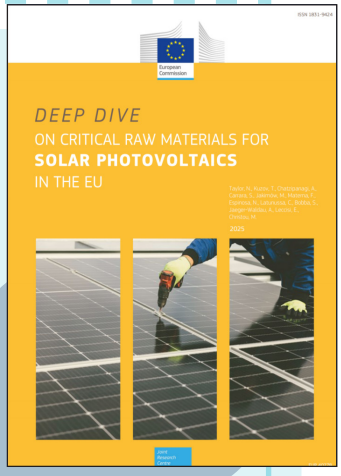
Deep dive on critical raw materials for solar photovoltaics in the EU



The European Union faces significant challenges in scaling up solar photovoltaic (PV) manufacturing, particularly regarding the supply of critical raw materials (CRMs) needed across the PV supply chain. This recent report examines current and projected CRM demand globally and in the EU, focusing on 2030 and 2050, under two scenarios: a baseline (gradual growth with existing technologies) and an innovation scenario (faster adoption of advanced technologies such as silicon-perovskite tandem cells). This study from the Joint Research Centre of the European Commission finds that sector growth will remain heavily dependent on materials such as silicon, silver, and indium, with demand expected to rise sharply. Recycling and circular economy measures can help alleviate supply pressures, but EU companies face challenges in PV waste collection, recycling efficiency, regulatory alignment, and market development for recovered materials. Coordinated research and innovation efforts, guided by the SET Plan and ETIP PV Strategic R&I Agenda, are essential to support a sustainable and resilient EU solar PV industry.

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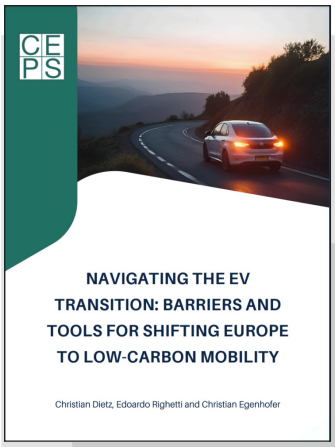

Navigating the EV transition: Barriers and tools for shifting Europe to low-carbon mobility

The European automotive sector is at a turning point, with the uptake of electric vehicles (EVs) now essential if the EU's climate goals are to be met. The shift from internal combustion engine vehicles (ICEVs) to battery electric vehicles (BEVs) is reshaping revenues, cost structures, and supply chains within the sector, and is influencing the competitiveness of the EU's automotive industry. This in-depth analysis prepared by the Centre for European Policy Studies (CEPS) examines the challenges facing the sector, with a focus on light-duty vehicles (passenger cars and vans). The report evaluates the revenue and cost implications of the shift to BEVs, reflecting on persistent supply chain risks, and warning that Europe risks losing a significant share of its industrial value creation unless the domestic EV supply chain is scaled up. The analysis also identifies financial tools to support and accelerate the transition, including targeted support for consumer uptake, innovation, infrastructure, and skills development.

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