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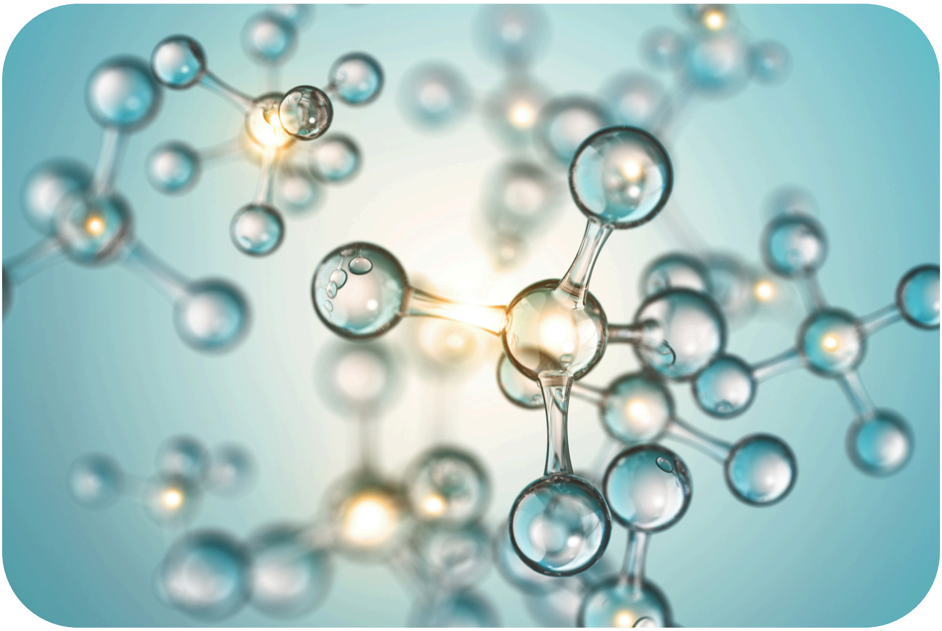
Net-zero Chemical Industry by Policy Design:

Policy Packages in China and the EU, with a Focus on Germany



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Executive Summary

The chemical industry is central to climate objectives in both the EU and China. Its transition is particularly challenging because fossil fuels are used both for energy and as feedstocks. Achieving net zero therefore requires not only decarbonising energy use, but also defossilising the sector's feedstock base. How this transition is managed will have major implications for competitiveness, investment and trade over the coming decades.

Key challenges in the net-zero transition of the chemical industry

In both jurisdictions, the transition is constrained by a combination of shared bottlenecks and country-specific binding constraints.

- **Different fossil baselines, different lock-in risks**: Germany's base chemical industry is anchored in oil- and gas-based feedstocks, with lock-in risks tied to long-lived steam crackers and integrated cluster networks. China combines oil-based petrochemicals with a structurally large and still expanding coal-to-chemicals segment, reflecting its abundant domestic reserves and persistent energy-security concerns. This coal linkage raises the emissions baseline and creates a distinctive lock-in risk.
- **Competitiveness pressures and net-zero investment disincentives**: German chemical industry is largely exposed to global price competition, high operating costs and weak demand can quickly turn cost increases into closure risk and delayed investment. In China, by contrast, the central problem is overcapacity: continued investment despite weak demand is intensifying competition among relatively undifferentiated producers, compressing margins, and pushing excess output into export markets. Under these conditions, net-zero transition pathways that require high upfront capital expenditure while also increasing operating costs are unlikely to attract purely commercial investment unless they are backed by strong policy support, strategic positioning, or credible prospects for premium markets. This matters especially in Germany, where prolonged uncertainty and poor short-term returns increase the risk of postponed investment, maintenance-only spending, asset closures, or capital reallocation to more cost-competitive locations.
- **Energy and circular carbon constraints**: Both countries heavily rely on fossil-based hydrogen and face binding constraints in accessing affordable renewable hydrogen. However, China's strong spatial coupling between renewable hydrogen hubs and coal chemical clusters facilitates their integration. Both struggle with circular carbon limits: waste-derived feedstocks are constrained by collection, sorting, and by competition with mechanical recycling and energy recovery.
- **Cluster interdependence**: Integrated chemical sites are central to the industry in both countries. They deliver high efficiency but they also create cascading risks: disruption or closure in a single major unit can destabilise site-wide balances. Policies must enable coordinated, site level investment rather than isolated project support.

In addition, because direct electrification would increase the chemical industry's dependence on competitively priced grid power, Germany's high industrial electricity prices remain a binding constraint. China has comparatively lower industrial power prices, alongside faster renewable deployment and continued grid investment, giving it a more favourable basis for industrial electrification.

Net-zero chemical transition policies in place and mutual learning

Both Germany/the EU and China have developed broad policy frameworks that steer the chemical industry towards net-zero. A comparative mapping of these frameworks suggests several areas for mutual learning.

- In terms of **strategic direction-setting**, China's policy framework is characterised by strong central coordination. Climate and sustainable development policies, industrial strategy, and policies for infrastructure and renewable energy deployment are closely aligned, providing clearer guidance for net-zero transition pathways and linking compliance expectations to investment signals and infrastructure decisions. In the EU, the ETS can in principle perform a similar directional role. In practice, extensive free allocation for the chemical industry has long weakened incentives to invest in net-zero projects. Carbon pricing also remains focused largely on direct on-site emissions and does not capture embedded carbon across value chains. China's national ETS may expand to chemical industry by 2027. For coal-to-chemicals, prospective ETS coverage could become a material investment signal given its high carbon intensity. In both jurisdictions, the strength of the ETS as a driver of investment depends not only on sectoral coverage, but also on allocation rules, benchmark stringency and the extent to which complementary policies address carbon costs more broadly across value chains.

China's framework also makes preferred technological trajectories more explicit through planning and administrative steering. This contrasts with the stronger emphasis on technology neutrality in German policy discourse.

- In **financial support for low-carbon production**, both China and Germany deploy capital and operating expenditure (CAPEX and OPEX) instruments. On the CAPEX side, China is building a layered support architecture that combines public grants, policy bank concession loans, and the development of transition finance to ease capital access for emissions-intensive industries such as the chemical industry. China's newest subsidy programme prioritises park- and cluster-scale deployment over isolated retrofits. This could inspire German programmes, which remain largely designed around single technologies or sites. The EU Innovation Fund and the emerging Industrial Decarbonisation Bank convert EU ETS auction revenues into competitively allocated support. As China's ETS expands to chemical industry and matures, adopting a similar revenue recycling could be used to build a rule-based funding channel to fund high-CAPEX net-zero transition projects. On OPEX, Germany's CCfD logic is instructive because it targets the operating-risk gap directly and can therefore inspire China to narrow the cost differential for renewable-hydrogen-based chemical routes. Two design features are particularly relevant. First, stringent abatement thresholds tied to measurable abatement can focus support on projects with significant emissions cuts. Second, the two-sided contract structure provides strong early support while limiting windfall gains if market conditions improve, improving fiscal sustainability and policy credibility by automatically adjusting the public contribution over time.

  Electricity cost relief is a key instrument for OPEX support in Germany. In China, by contrast, there is no single nationwide relief mechanism. However, national policies to promote renewable electricity consumption are sometimes translated into local measures that reduce the de-livered cost of renewable power for end users, including industrial consumers. This further strengthens China's advantage in renewable-based industrial electrification.
- **Demand** for green chemicals, such as circular ethylene, remains limited in both jurisdictions, but policy measures to support uptake are beginning to emerge. The EU's minimum recycled-content mandates, such as included in the Packaging and Packaging Waste Regulation (PPWR), provide a vital demand anchor, with calculation and verification methodologies to be set via implementing acts. The EU is also moving to create a second major demand anchor in the automotive sector through the proposed regulation, which would introduce mandatory recycled-plastics targets in new vehicles once formally adopted. China is moving from pollution control to explicit application priorities, with automotive singled out as a key downstream sector. China can learn from EU methodologies for recycled-content accounting. In addition, both are converging on automotive as the next demand anchor for circular polymers and can learn from each other.
- In **securing renewable hydrogen**, both sides are pursuing systematic approaches to affordable renewable hydrogen that offer transferable lessons for other countries. Moreover, in China, the stronger policy emphasis on matching supply with demand may therefore help improve investment signals. Early hydrogen and hydrogen-derivatives projects are most likely to prove viable where they

are co-located with, or closely connected to, established demand in chemical clusters in renewables-rich regions. Since several of these regions also host large coal-chemical bases, such co-location could reduce emissions in parts of the sector, especially where renewable hydrogen substitutes for fossil hydrogen as a feedstock. But this would only partially lower emissions and would not, on its own, resolve the structural carbon intensity of coal-based chemical production.

Transitioning to net-zero in the chemical industry is a shared challenge for Germany/EU and China: emissions must be reduced, the sector must remain investable and globally competitive, and the transition remains socially manageable. In the current context of increasing trade tensions and geopolitical strain, there is a compelling case for structured dialogue and targeted cooperation on transitioning towards net-zero. While such engagement will not eliminate underlying trade frictions, it can reduce misperceptions, support mutual learning and help identify practical pathways towards industrial decarbonisation.

Table of Contents

1. Introduction

The chemical industry is critical to achieving global climate targets. As the industry supplies key inputs for many value chains, its transition will directly affect the competitiveness and environmental impact of downstream sectors, including fertilisers, plastics, construction materials, vehicles, and consumer goods.

The sector's net-zero challenge is distinctive because fossil fuels play a dual role: they are used both as an energy source and as feedstocks.[1] Because each role gives rise to CO_2 emissions, achieving net-zero in the chemical industry requires both decarbonisation and defossilisation.[2]

Decarbonisation requires the use of carbon-free renewable energy and changes in process design to eliminate CO_2-emitting steps in manufacturing, especially those related to energy supply.

Defossilisation refers to the use of non-fossil carbon feedstocks for material production, including biomass, carbon supplied through carbon capture and utilisation (CCU), and carbon recovered from the recycling of carbon-containing waste streams.[3]

Germany and China are central to this transition. Germany, as Europe's largest chemical producer, sets the direction for EU industrial climate policy. China is the world's largest producer and consumer of chemicals and is expanding its capacity. Emissions from both countries pose a significant global net-zero challenge.

Both countries face the same strategic question: how to transition the chemical industry to net-zero while maintaining supply security, investment confidence, and global competitiveness. However, they operate under different structural constraints, such as feedstock mixes, market and capacity dynamics, and energy systems. These factors will determine which policy levers are used and how effective they will be.

This policy brief compares the regulatory frameworks supporting net-zero transition of the chemical industry in Germany/EU and China, focusing on basic chemicals.[4] It reviews policies affecting investment and scale-up of key technologies, demand creation and market development for low-carbon products, and the supporting systems and infrastructure needed for deployment. The analysis highlights opportunities for mutual learning and potential cooperation.

The next sections provide a comparative roadmap for policy makers:

- **Section 2** outlines the core transition challenges.
- **Section 3** maps the current German and Chinese policy landscapes.
- **Section 4** provides a comparative analysis of these approaches and concludes with practical opportunities for mutual learning and strategic international cooperation.

[1] (Wesseling et al., 2017)
[2] (Pan et al., 2024)
[3] (Pan et al., 2024)
[4] (United Nations Statistics Division, n.d.)

2. Key challenges in Germany and China

2.1 Production Routes

Base chemical industry in both Germany and China remains strongly dependent on fossil feedstocks, but with very different mixes.

Germany:

Germany's basic chemicals industry relies primarily on ***oil- and gas-derived feedstocks***. High-value chemicals, including ethylene, propylene, and key aromatics, which are central to downstream polymer and intermediates value chains, are mainly produced through ***naphtha steam cracking at large integrated "Verbund" sites***. While natural gas is less significant as a carbon feedstock compared to crude-oil derivatives, it remains ***essential for the production of hydrogen and synthesis gas*** used in ammonia and other chemical chains. This dependence links certain sector costs directly to gas markets. ***Coal plays only a marginal role*** as a chemical feedstock in Germany.[5]

China:

Crude oil, mainly via naphtha cracking, ***dominates*** the production of key building blocks such as ethylene, propylene, and aromatics.[6] ***Natural gas plays a limited role***, partly because supply is constrained. It is mainly used in selected value chains such as methanol, urea and acetylene. ***Coal is the distinctive feature*** of China's feedstock mix, reflecting abundant domestic reserves, persistent energy-security concerns, and decades of policy support and capital investment that have made China the ***world's largest coal-to-chemicals base***. For example, coal is estimated to account for around 84% of methanol capacity and 78% of ammonia capacity in 2024.[7] This coal-based expansion increases the carbon intensity of chemical production. The concentration of coal-chemical activities in major demonstration zones highlights the scale of the challenge: Yulin, Ordos and Ningdong together recorded a carbon intensity of 2.37 tonnes of CO_2 per USD 1,000 of output in 2023, far above the reported national average.[8] As a result, growing chemical output has become a significant source of additional industrial coal demand,[9] increasing the risk of reinforcing long-term carbon lock-in, and thus ***a key driver for industrial GHG emissions.***

[5] (Scholz et al., 2024b)

[6] (Lu, 2022)
[7] (Zhu, 2025)
[8] (China Council for International Cooperation on Environment and Development, 2025)
[9] (Yang, 2025)

2.2 Industry Landscape and Development

Germany:

Exposure to global competition and margin pressure. Germany's basic chemicals ***compete in globally traded, largely commoditised markets*** and are typically ***price-takers***. Even modest cost increases can therefore translate quickly into lost market share and accelerated rationalisation. These pressures have been compounded by the lasting effects of the Ukraine war: Russia's invasion exposed the sector's dependence on fossil gas and contributed to structurally higher and more volatile energy costs in Europe. Recent evidence suggests that European competitiveness remains structurally weakened by ***low demand*** and uncompetitive energy costs: EU27 chemical ***capacity utilisation is around 75%*** in 2025[10] and European gas prices are around four times US levels.[11] In this environment, ***closures*** have ***risen sharply*** since 2022 while ***investment fell*** over 80 % in 2025.[12,13]

Germany's base chemical industry is also approaching a **narrow reinvestment window latest early 2030s**. Long-lived steam crackers will soon face make-or-break decisions: refurbishment under the incumbent model, conversion towards low-carbon routes, or managed run-down. The risk is that today's business conditions bias firms towards deferral and "maintenance-only" spending, or towards reallocating capital to lower-cost locations.[14]

China:

Expansion-led overcapacity and export spillovers. China's chemical sector has seen ***rapid, sustained capacity expansion*** over the past two decades, especially in basic chemicals. During the 14th Five-Year Plan period, capacity additions in major basic chemicals reportedly exceeded 100 Mt/year, while demand growth lagged.[15] This has led to ***persistently low utilisation rates*** and more ***intense domestic competition***, as producers with ***similar product slates continue to supply low-value, undifferentiated products***, including coal chemicals, which account for a large share of basic chemical output.[16] ***Profitability*** has consequently been ***thin***; some sources cite an industry profit margin of around 2.3% in 2024, consistent with a margin squeeze under oversupply.[17] Crucially, ***the investment cycle has not yet turned***. China's ethylene capacity is expected to keep rising through 2024–2028, adding around 25 Mt per year and accounting for close to half of global net new capacity over the period. The expansion is set to accelerate as a pipeline of mega-projects reaches commissioning in 2026–2028.[18]

Trade patterns show how the expansion has created ***external competitive pressure globally***. These dynamics are increasingly visible in Europe. China is now the ***EU27's largest source of chemical imports***, with its share rising from about 9% (2014) to 18% (2024), amplifying price pressure in externally traded basic chemicals.[19]

Systemic interdependence within industrial clusters. ***German*** chemical production is ***concentrated in highly integrated chemical parks*** ("Verbund" sites), ***with long-lived steam crackers acting as the "heart"***.[20] In ***China***, chemical production is ***similarly organised*** through ***industrial parks***: by August 2025, there were reportedly 729 officially recognised chemical parks, accounting for over 70% of sectoral output.[21]

These clusters combine shared steam and utility systems, by-product hydrogen and intermediates, on-site pipelines, and coordinated maintenance schedules. Integration delivers very high resource efficiency and

[10] (Cefic (European Chemical Industry Council), 2025b)
[11] (INEOS (INspec Ethylene Oxide Specialties), 2025)
[12] (Cefic (European Chemical Industry Council), 2026)
[13] (John, 2026)
[14] (Sievering et al., 2025)
[15] (China Chemical Industry News Weekly, 2025)
[16] (Yang, 2025)
[17] (China Chemical Industry News Weekly, 2025)
[18] (The Oxford Institute for Energy Studies, 2025)
[19] (Cefic (European Chemical Industry Council), n.d.)
[20] (Scholz et al., 2024a)
[21] (China Chemical Economic and Technological Development Centre, 2025)

strong value creation. However, the same technical and commercial interdependencies also increase ***systemic vulnerability***, especially during the current wave of sharp plant closures. Shutting down a single major unit can trigger knock-on disruptions across the site and, in some cases, along connected value chains.[22] For net-zero transition, because plants are linked by shared utilities and interdependent material and energy flows, ***major retrofits need coordinated, sequenced implementation*** across the site rather than stand-alone upgrades.[23]

2.3 Availability of Affordable Energy, Feedstock, and Infrastructure

Germany:

Hydrogen use in Germany is already substantial but remains ***overwhelmingly fossil-based***.[24] ***Chemicals account for most structural hydrogen demand***, making the availability and price of renewable hydrogen key to its net-zero transition.[25] Recent cost assessments estimate that the levelized cost of domestically produced renewable electrolytic (green) hydrogen currently exceeds ~€7.50/kg, and argue that clean hydrogen will only fulfil its role in a cost-effective transition to climate neutrality if costs fall to ~€3.00/kg or less.[26] ***Beyond the high unit cost of renewable hydrogen, the sheer volume of renewable electricity*** required renders full domestic sourcing structurally implausible.

In addition, because the chemical industry relies predominantly on grid rather than self-generated electricity, delivered power prices are an immediate competitiveness constraint. ***Final electricity prices*** for large energy-intensive industrial customers in Germany are significantly higher than those faced by counterparts in the United States, China, and India,[27] raising operating costs directly for electrified processes.

Circular feedstocks face parallel constraints: much of today's waste-derived carbon still flows to established ***mechanical recycling streams or to energy recovery***.[28,29] ***Sorting and quality bottlenecks*** increase pre-treatment and upgrading needs, raising costs and limiting

[22] (Sievering et al., 2025)
[23] (Scholz & Theisen, 2026)
[24] (Dreher & Gast, 2026)
[25] (BMWK, 2023)
[26] (Matthes & Brauer, 2025)
[27] (International Energy Agency, 2025a)
[28] (Federal Environment Agency, 2025a)
[29] (Federal Environment Agency, 2025b)

China:

There is a ***heavy reliance on fossil-based hydrogen.*** In 2024, total hydrogen production reached 36.5 Mt, dominated by coal (20.7 Mt) and natural gas (10.8 Mt), while only 0.32 Mt (~0.9%) came from electrolysis using renewable or grid electricity. Renewable hydrogen remains ***economically and geographically constrained***. North-west and North China have the strongest wind and solar resources and are emerging as the main hubs for renewable hydrogen development.[30] This implies that near-term decarbonisation options for hydrogen-intensive chemical value chains are likely to be uneven across regions. Importantly, ***these regions are also major coal-chemical production bases***, creating a potential pathway to reduce the emissions intensity of coal-to-chemicals by integrating renewable hydrogen.

Circular feedstocks are another bottleneck. China's waste plastics stock exceeds one billion tonnes, with annual additions of more than 60 million tonnes, implying ***substantial recycling potential***.[31] However, treatment is still dominated by ***landfill and incineration*** rather than high-value recycling routes.[32]

On ***carbon management***, China is ***actively deploying CCUS***, with more than 100 projects in operation or development. Wider ***industrial deployment*** will likely depend on scaling ***cluster-based*** approaches. China is actively planning an

[30] (National Energy Administration, 2022)
[31] (China Science Daily, 2025)
[32] (CCTV, 2025)

the availability of large, continuous feedstock flows for chemical recycling.

Carbon dioxide (CO_2) from industrial point sources (CCU) can become an important feedstock in a defossilised chemical industry. This can be achieved through CCU-based Fischer–Tropsch naphtha production or methanol pathways, such as methanol-to-olefins (MTO) and methanol-to-aromatics (MTA). One key constraint is the ***availability of suitable CO_2 pipeline infrastructure connecting sources and industrial users.*** Planning and development of such infrastructure are still ***at an early stage.***

developing CCUS industrial clusters, aiming to integrate capture, transport, utilisation, and storage across whole value chains and to share CO_2 pipeline and storage infrastructure across multiple emitters.[33]

[33] (Burnard, 2026)

3. Policy landscape in Germany and China

For both Germany and China, chemical net-zero transition policies and governance are ***embedded in broader climate strategies and industrial governance.***

Germany:

Germany's industrial decarbonisation pathway is ***anchored in national law but operates within the broader framework of EU climate governance***. The amended Federal Climate Change Act commits Germany to ***climate neutrality by 2045*** and to cut economy-wide emissions by at least 65% by 2030 (vs. 1990), thereby exceeding current EU-level targets. Governance is ***multi-level***: the EU establishes key market rules and regulatory frameworks, particularly through the ***EU ETS*** and s***tate-aid control***. ***Germany translates these into domestic programmes and co-financing schemes***, including first-mover de-risking instruments; and delivery depends on competent authorities, including national agencies and state authorities, for permitting and enabling infrastructure planning.

China:

China's climate strategy is anchored in the ***"dual carbon" targets to peak CO_2 emissions before 2030 and reach carbon neutrality by 2060***, operationalised through ***a top-level "1+N" policy architecture (overarching guidance plus sectoral plans)***. Governance is characteristically ***top-down*** and ***target-driven***: the national government sets targets and priorities and disaggregates targets through a responsibility system that holds provincial governments accountable for delivery. ***State-owned enterprises (SOEs)*** possess substantial financial, technical and organisational capacity, making them ***key actors in advancing low-carbon transformation***. They are also expected to deliver decarbonisation and energy efficiency targets while safeguarding the value of state-owned assets and to serve as lead-by-example demonstrators for the wider industry. For example, Sinopec is leading China's first large-scale CCUS project in Shandong Province, with a planned capacity to capture and store up to 100 million tonnes of CO_2.[34] It has also launched the country's first 10,000-ton photovoltaic renewable hydrogen refining project, advancing the integration of renewable energy into chemical production processes.[35]

The next section maps net-zero transition policies of chemical industries of German/EU and China across four industrial transformation policy dimensions: (i) set direction for net-zero transition; (ii) mainstream low-carbon and circular production at scale; and (iii) accelerate uptake of low carbon and/or circular products, and; (iv) enable the provision of renewable hydrogen.[36]

[34] (National Energy Administration, 2022)
[35] (Tianshan Net, 2024)
[36] The policies can be found in the policy inventories in https://www.eu-china-bridge.eu

3.1 Policies Setting Direction for Chemical Net-Zero Transition

Two distinct architectures of "directionality" policies

Germany:

Multiple national policies are embedded in EU climate and industry governance. At the national level, within the overarching legal framework of the Federal Climate Change Act, Germany's direction of chemical net-zero transition is structured through ***several federal strategic pillars: industrial decarbonisation innovation and CAPEX support, the National Hydrogen Strategy, the Carbon Management Strategy, and the National Bioeconomy Strategy***. The national direction is ***embedded in***, and ***constrained by, EU climate and industrial governance***, in particular the EU ETS, as well as EU regulations (e.g., sectoral directives), and EU state-aid approval and funding programmes. The hydrogen, carbon management and bioeconomy strategies are broadly consistent with corresponding EU-level strategies.

China:

Direction steered through a dense and coordinated policy framework. China's directionality policies combine ***economy-wide and chemical-specific climate and sustainable-development plans, industrial development strategies, and infrastructure and renewable-energy deployment policies***. This directionality is reinforced by ***technology catalogues*** that signal which technologies should be supported and which new projects or production activities should be restricted or prohibited. This directionality shapes what is investable and reduces uncertainty for favoured pathways, but it also risks locking capital into preferred trajectories.

Despite clear differences in governance and policy density, and although both countries have economy-wide climate objectives, ***neither*** Germany nor China sets a ***specific and legally binding climate target for the chemical sector***.

Coal chemicals in China: strategic support alongside tighter controls

China: *Modern coal chemicals*[37] are positioned as ***strategic priorities***, while ***traditional coal-chemical production***[38] is subject to ***expansion controls***. A 2022 national energy policy exempts coal used as a chemical feedstock from enterprise-level energy consumption caps, effectively ***insulating coal-to-chemicals from wider energy control measures***. The National Coal Industry Development Plan also reclassifies coal use in modern chemical production as "***clean coal utilisation***". Since 2023, central authorities also signalled a shift towards ***curbing unregulated expansion of the modern coal-chemical industry*** and tightening scrutiny of new projects, in order to safeguard coal availability for power generation, avoid overstretching local environmental capacity, and address severe product homogeneity and resulting low-value duplication across projects. In parallel, national policy aims to steer this sub-sector away from a past model of "scale expansion" towards "***high-quality development***", with a stronger emphasis on high-end coal-chemical products.

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[37] Modern coal chemicals in China refer to coal-based routes for producing liquid fuels, synthetic natural gas and major petrochemical intermediates, including olefins and ethylene glycol, aromatics, in partial substitution for conventional oil- and gas-based production pathways.
[38] Traditional coal chemicals mainly comprise coke manufacturing, coal-to-ammonia, and coal-to-calcium-carbide pathways.

Technology pathways signalled within current policy mixes

Germany and China are advancing a broadly comparable set of technological pathways for chemical net-zero transition, but the strength of policy signals supporting them differs.

- ***Direct electrification of industrial heat and selected processes.*** Both countries treat direct electrification for low to medium temperature heat as a near-term emission-reduction route. Germany has supported it through ***decarbonisation and energy efficiency funding programs***. In China, heat electrification is framed with not only ***energy efficiency*** but also ***renewable integration*** policies.
- In both countries, ***electrification of the provision of process heat for core chemical processes*** is expected to scale only in later phases of the transition.
- ***Substitution of fossil-based hydrogen with renewable hydrogen.*** Germany and China both frame ***renewable hydrogen as a route to reduce fossil feedstock*** use in parts of the chemical value chain, particularly, ***ammonia production***. In Germany, policy is geared towards ***scaling the supply of renewable hydrogen via domestic electrolysis and structured imports***, while ***accelerating hydrogen transport and storage infrastructure*** so that industrial users can credibly plan and invest in hydrogen-based conversions. Besides the supply side factors, China is now pursuing a ***strong policy push*** for ***hydrogen-based feedstock substitution***, particularly within the ***ammonia*** and ***methanol routes***, which remain largely coal-based. The most recent renewable guidance is especially explicit in promoting the use of renewable electricity beyond the power sector, positioning ***renewable hydrogen and hydrogen-derived molecules as a key outlet for the country's renewable development***. In parallel, China's ***green trade policy*** promotes lower-carbon fuels for international shipping, explicitly supporting green ***methanol*** (alongside other alternatives) and the development of green fuel certification and international mutual recognition.
- ***Bio-based feedstocks.*** Germany's ***bioeconomy strategy and innovation support*** treats bio-based feedstocks as a pillar of the chemicals transition. China has likewise articulated n***ational bioeconomy roadmaps*** and ***action plans*** that explicitly promote the development of bio-manufacturing with near-term targets and included bio-based feedstock as a defossilisation path in ***chemical industrial policies***. In both cases, the policy direction is to ***prioritise non-food applications.***
- ***Circular carbon via recycling as feedstock.*** Both Germany and China treat increased ***mechanical recycling*** and, to varying degrees, c***hemical recycling as routes to expand circular feedstocks*** for polymers and basic chemicals. In China, a ***recent national action plan*** that ***pushes recycled material uptake*** and explicitly ***promotes commercialisation of chemical recycling*** by leading firms. In Germany, the strongest recent demand pull has come via ***EU-level binding targets of recycled content***, which then transmit upstream to polymer and cracker feedstock choices.
- ***Carbon management (CCS/CCU).*** China ***mainstreamed CCUS*** into national economic and industrial planning. Germany ***legally enables CO_2 transport and geological storage*** through its Carbon Management Strategy, and is coupling this with ***public funding to support CCS*** and, where climate-integrity conditions are met, ***CCU applications in hard-to-abate industries.***
- China maintains ***a near-term focus on energy efficiency***. Policies signal energy efficiency gains as the most immediate decarbonisation lever, using ***product-specific efficiency targets*** and the ***phased elimination of inefficient and small-scale capacities***. In the ***coal-chemical*** industry, efficiency is treated as the primary decarbonisation strategy.
- ***Coal-to-chemicals with a combined pathway approach***. Chinese policy signals encourage modern coal chemical complexes, especially in resource-rich regions, ***integrating renewable power, renewable hydrogen*** and ***CCUS***. For example, given the continued dominance of coal-based routes in Chinese ammonia and methanol production, policy signals ***increasingly promote the integration of renewable hydrogen into coal-chemical*** complexes. Recently, China is moving from ***pilots towards early commercial*** operation in coal-to-chemicals projects with such a combination.[39] The ***strong spatial***

[39] (Reuters, 2025)

coupling between coal chemical clusters and renewable hydrogen hubs also enables direct integration pathways.

Beyond the specific technological routes, ***Germany and China both view chemical clusters/parks*** as a lever for net-zero industry, including chemical net-zero transition. In China, policies additionally frame industrial parks as a ***key implementation unit for renewable integration***.

ETS design: mature development in the EU but weak for incentivising chemical defossilisation, while chemical industry not yet included in China's ETS

Germany:

The ***EU ETS*** has been in place since 2005 and already applies to the chemical industry by ***pricing direct (on-site) GHG emissions*** from energy-intensive installations and power generation. This creates an operating cost incentive to cut fossil combustion and pursue low-carbon heat and process options. However, the EU ETS does ***not price Scope 3*** value-chain emissions and therefore is not, by itself, a strong driver of feedstock substitution. In addition, the chemical industry ***benefits from free allocation of EU ETS allowances***. While CBAM will replace free allocation for selected covered goods, most of the chemical sector remains outside CBAM's present scope, which reduces carbon cost exposure. The current policy design is not yet equipped to cover the complex chemical value chains.[40] Furthermore, industry stakeholders argue that the EU ETS emission reduction speed is too fast paced, creating economic strain on the industry.[41]

China:

China's national ETS does ***not yet cover the chemical industry***, but policy signals that coverage is intended to expand to most major industrial emitters ***by 2027***, with chemicals widely seen as a likely candidate for inclusion.[42] The carbon-price effect is likely to be limited in the early phase of coverage. However, it is expected that the price will be low at the very beginning. Nevertheless, for ***coal-to-chemicals***, even prospective ETS inclusion may provide a ***meaningful investment signal*** because of the pathway's very high carbon intensity.

3.2 Policies to Support CAPEX and OPEX for Low Carbon and Circular Chemical Production

Both jurisdictions use broad policy mixes to support net-zero transition, though their instruments differ. In Germany, CAPEX support is provided mainly through nationally administered schemes within the EU state-aid framework and centrally managed EU funds. OPEX support focuses on electricity price compensation and Climate Protection Contracts (CCfDs). In China, CAPEX support is delivered through grants as well as green and transition finance instruments aimed at industrial decarbonisation. OPEX support in China is less consolidated, relying primarily on electricity-pricing reforms and green power market mechanisms. Support for renewable electricity procurement is inconsistent, and tax incentives for circular or recycling activities are more limited in scope.

[40] (Minten et al., 2025)
[41] (Cefic (European Chemical Industry Council), 2025a)
[42] (Xinhua, 2025)

Germany:

Its ***national CAPEX support*** for chemical net-zero transition is built around two pillars: (i) ***EU state-aid-cleared grants*** that de-risk first-of-a-kind (FOAK) assets; and (ii) ***national programme-based CAPEX schemes*** that support decarbonisation and defossilisation technologies, retrofits, and cluster interfaces.

CAPEX grants via EU State aid clearance:

- BASF Ludwigshafen electrolyser (renewable hydrogen replacing fossil hydrogen in chemical production).[43]
- Concrete Chemicals (PtL e-SAF with e-naphtha co-product).[44]

National programmes for CAPEX support:

- ***Federal funding for industry and climate protection (BIK)***, is Germany's main national industrial decarbonisation programme. It subsidises investments to decarbonise production processes, especially, ***electrification and hydrogen-related investments. Carbon management (CCU/CCS)*** is addressed through a dedicated module.
- ***Living labs of the energy transition support industrial-scale demonstration.*** The program is designed to test ***innovative technologies, systemic approaches and business models*** under real operating conditions and to accelerate transfer into practice. Thus, it also addresses ***cluster interfaces***, such as hydrogen supply/use chains into chemical parks, cross-company heat and power integration, while generating monitoring/ verification evidence and operational learning that supports transfer.[45]
- ***Federal funding for energy and resource efficiency in commerce (EEW)*** supports CAPEX for ***incremental improvement*** of energy and resource efficiency and ***renewable process heat***, including selected ***electrification*** measures. However, EEW is predominantly retrofit-oriented, rather than

[43] (European Commission, 2022)
[44] (European Commission, 2024)
[45] (Hauser et al., 2022)

China:

China combines ***central budgetary investment, ultra-long special treasury bonds,*** and ***green and transition finance to mobilise CAPEX*** for chemical net-zero transition.

- Central budgetary investment (***annual programme***): A dedicated subsidy supports ***decarbonisation and circular-economy projects***. The 2025 call prioritises ***energy efficiency*** (with annual savings of at least 10,000 tonnes of coal equivalent, tce), ***coal substitution in coal-to-chemicals,***[51] ***recycling, energy infrastructure for "zero-carbon" industrial parks, green methanol,*** and ***CCUS***. This programme typically covers ***20%*** of total CAPEX as grant.
- In addition, a ***whitelist-like*** annual National Green Technology Demonstration Project List ("the List") is used to ***steer firms*** towards recognised best available technologies (BAT). Projects applying listed BAT are eligible for central budgetary support. The 2024 List includes, ***process optimisation, pollution control, and CCUS***.
- ***"Two-new" package for equipment renewal***: [52] Launched in 2024 and supported by ultra-long special treasury bonds, this package aims to stimulate consumption and promote industrial equipment renewal. For the latter, the government provides grants and subsidised loans to help enterprises, including chemical producers, replace outdated machinery with ***more efficient and technologically advanced equipment***.[53]
- The People's Bank of China (PBoC) launched the ***Carbon Emission Reduction Facility (CERF)*** in 2021. The CERF provides ***local financial institutions*** with ***low-cost funding***, which then on-lend to firms for decarbonisation investment. While early lending focused on clean power supply, PBoC communications indicate that from 2026 eligibility broadens to include ***energy-***

[51] Use renewable electricity and renewable hydrogen in coal-to-chemicals
[52] "Two new" refers large-scale equipment renewal and consumer goods trade-in.
[53] (People's Daily Overseas Edition, 2025)

underwriting FOAK conversions of core chemical assets.

Beyond the national level, the EU deploys a suite of ***centrally managed instruments*** designed to bridge the "valley of death" for energy-intensive industries.

- The ***EU Innovation Fund*** (financed via ***EU ETS revenues***), serves as a primary vehicle for large-scale technology grants. The funded projects include German ***chemical recycling projects***.[46]
- ***Circular Bio-based Europe Joint Undertaking*** (CBE JU): an EU-industry partnership (EU + Bio-based Industries Consortium) funding projects under Horizon Europe to advance circular bio-based industries, including demonstration and FOAK-type ***bio-based*** production plants.[47]
- The ***InvestEU*** program provides ***budgetary guarantees*** to implementing partners, significantly enhancing their risk-bearing capacity to unlock private lending for high-risk industrial transition projects.

CAPEX grants can lower upfront investment barriers, but they do not mitigate the ***operating-cost (OPEX)*** exposure that often determines whether chemical decarbonisation projects proceed. Germany complements CAPEX support with electricity cost relief for energy-intensive, trade-exposed industries such as chemical industry:

- ***ETS indirect-cost compensation*** (Strompreiskompensation, SPK) compensates eligible firms for indirect EU ETS CO_2 costs embedded in electricity prices, explicitly framed as a ***competitiveness and carbon leakage prevention*** measure. SPK is therefore key in determining whether electrification in chemicals is economically attractive.
- ***Discounted industrial electricity price*** is intended as a ***three-year*** measure for 2026-2028, subject to EU State-aid clearance and final implementation. Beneficiaries of such temporary electricity-price relief ***must*** ***intensive industries and industrial parks***. This can be ***layered with the subsidies*** described above.[54,55]
- China is also using ***transition finance*** more explicitly to crowd in capital for low carbon transformation of industries, including chemicals. Transition finance is intended to ***support credible, time-bound decarbonisation in hard-to-abate sectors***, where activities may ***not yet qualify as "fully green", but can align with a defined transition pathway***.[56] At the ***national*** level, the PBoC began work on a ***transition finance framework*** in 2021. In 2024, inter-ministerial guidelines led by the PBoC called for scaling up and standardising transition finance, including clearer sector standards and taxonomies. The PBoC has since issued ***transition finance standards***. A ***chemical industry standard*** is currently under development. Moreover, several ***provinces and cities*** have published ***transition finance*** guidance covering the chemical industry. For example, in Tianjin City, local financial institutions developed the first dedicated guidance for chemical transition finance under PBoC supervision. It covers multiple product categories and prioritises ***energy efficiency, process optimisation*** and ***resource efficiency***. The guidance sets energy efficiency benchmarks for included chemical products. Local loans have already been issued under the framework.[57]

On the ***OPEX*** side, support for industrial electricity prices in China remains limited and fragmented, with pricing and relief measures largely determined at provincial and local level rather than through a single, nationwide relief mechanism. Central directives to increase renewable electricity consumption are sometimes translated into ***local measures that reduce the effective cost of procured renewable power***, through subsidies or by lowering the price premium associated with renewables'

[46] (European Commission, n.d.-b)
[47] (Circular Bio-based Europe Joint Undertaking, n.d.)

[54] (China Energy News, 2026)
[55] (Sina Finance, 2026)
[56] (International Energy Agency, 2025b)
[57] (Sina Finance, 2024)

reinvest at least 50% of the aid in decarbonisation.[48] Furthermore, industry may benefit from ***reduced grid charges***, through the Bandlastprivilegierung for ***highly intensive and constant electricity use***. However, this regime is under review by the federal government.[49]

- Another potential instrument to address OPEX is ***Climate Contracts for Difference (CCfDs, German "Klimaschutzverträge")***, approved by the Commission as two-way contracts with annual payments linked to market prices (ETS allowances and energy inputs). CCfDs ***compensate the incremental annual costs of operating*** a low-carbon process relative to a defined conventional reference over ***15 years***, hedging firms against operating-cost risks, especially ***EU ETS*** price uncertainty and volatility in ***hydrogen*** and ***electricity prices***. Contracts include stringent emissions-reduction requirements, including a requirement to ***eventually reach 90% less emissions*** than a comparable traditional plant. The two-sided design is also fiscally salient: when market conditions make the low-carbon option uneconomic, the state makes variable top-up payments; when conditions swing the other way, beneficiaries return the upside through payback/negative settlements. The first CCfD bidding round awarded two projects in the chemical industry to promote electrification.[50]

environmental attributes (for example, via the way "green" attributes such as certificates or environmental premia are priced and settled in green power transactions).[58] In addition, the government applies ***differentiated electricity tariffs*** to energy-intensive industries to encourage energy efficiency and support industrial upgrading.

Operating costs are also reduced through ***tax preferences***, for example, ***circular-economy tax*** policies that can benefit chemical recycling. However, the current policy emphasis remains centred on conventional circular production pathways with much higher recycling rates than chemical recycling.

[48] (European Commission, 2025)
[49] (Federal Network Agency, 2024a)
[50] (Federal Ministry for Economic Affairs and Energy, 2025)

[58] (Greenpeace, 2025)

3.3 Policies to Drive Demand of Green Chemical Products

Demand-side instruments can establish market credibility for climate-friendly and circular products, before scaling them through lowering transaction costs and reducing risk for buyers and investors. The policy mapping focuses on the ***ethylene from circular carbon feedstock***.

Germany:

Because ethylene is a fungible intermediate that moves through highly interconnected value chains, demand cannot realistically be directed or differentiated at the level of the molecule itself. The ***EU's recycled-content obligations for packaging*** are the ***clearest demand anchor*** capable of pulling cracker-routed circular feedstocks such as pyrolysis oil or depolymerisation outputs into the market, but only if counting and verification rules make the claim bankable. The Commission has therefore used the ***single-use plastics beverage bottle*** methodology as the first operational template for how it counts. It is built around a "***fuel-use excluded***" allocation rule, meaning that material for fuel use or energy recovery is excluded from recycled-content claims, and is intended to provide a model for future sectoral methodologies. It is consistent with the ***waste hierarchy preference to keep carbon in materials*** rather than route it to energy recovery, an approach Germany broadly shares.[59] A second potential demand anchor is the proposed ***end-of-life vehicle (ELV) rules***. In 2025, the Commission ***proposed a staged approach to minimum recycled-plastics content in vehicles***.[60] Vehicles could become the next major non-packaging demand anchor, but only if the final rules make verification workable for original equipment manufacturers (OEMs) and their procurement processes.

Other demand levers are weaker. ***Green Public Procurement (GPP) remains too fragmented*** to provide a reliable demand floor for circular ethylene. While the German stakeholder process on Green Lead Markets initially explored setting standards and thresholds for green ethylene and ammonia, this discussion stalled; unlike the

[59] (Directorate-General for Environment, 2025)
[60] (Council of the European Union, 2025)

China:

From pollution control to demand creation for plastic recyclates.

China's policy approach to address demand of plastic recyclates has focused ***more on pollution control objectives***, such as restrictions on non-degradable plastic bags and disposable tableware, than on developing markets for recycled materials. The 2025 Action Plan for Promoting the Application of Recycled Materials signals a ***turning point*** towards ***explicit uptake expectations***, with an emphasis on the ***automotive sector*** as an early mover. Because automotive parts require higher performance and quality than packaging, this creates a specific demand pull for high-grade chemical recycling outputs over lower-quality mechanical recyclates.

However, China has ***not yet set clear policy guidance on end uses*** for recycled plastics, including whether chemical-recycling outputs should go to fuels or to chemical feedstocks and products.

progress seen in the steel and cement sectors, no formal proposal materialised.[61] Furthermore, earlier drafts of the EU Industrial Accelerator Act included "low-carbon" and "Union origin" criteria for public procurement, specifically targeting chemical-based construction materials, but these provisions were absent from the final proposal.[62]

Eco-modulated Extended Producer Responsibility (EPR) fees at the EU level and in Germany[63] are more concrete, but they ***mainly steer design-for-recycling and recyclability*** improvements, not a durable premium for chemically recycled, mass-balance-attributed content.

3.4 Policies to Secure Access to Affordable Renewable Hydrogen

The upscaling of green chemicals, e.g. green ammonia, highly depends on ensuring stable access to cost-competitive renewable hydrogen. This requires not only an expansion of electrolysis capacity, but also parallel investment in hydrogen transport and storage infrastructure, alongside the coordinated growth of renewable power generation.[64,65]

Germany:

Hybrid renewable hydrogen supply and steel being a priority off-taker

Supply model and definition

Germany's policies to support industrial access to renewable hydrogen are built around a hybrid supply model and sit within the EU's broader, system-wide expansion of the renewable hydrogen economy.

Hybrid supply model: Germany and the EU face different constraints from China. The renewable electricity needed for large-scale H_2-DRI makes fully domestic hydrogen supply unlikely. Policy rests on a hybrid model: ***accelerating domestic electrolysis, while enabling imports*** from countries boasting low-cost, renewable energy-based electricity and hydrogen production, supported by new cross-border infrastructure. This is embedded in EU strategy. REPowerEU sets a 2030 target of producing 10 Mt of

China:

Rapid scale-up with an increasing focus on system building (standards, value-chain integration, and infrastructure and industrial demand)

China has ***rapidly expanded its pipeline of renewable ("green") methanol projects***: by end-2025, public tracking suggests 200+ projects (built, under construction or planned), with ~42 Mt/yr of announced capacity.[74] China also ***dominates the global renewable methanol project pipeline***: As of July 2025, China accounts for 42% of e-methanol projects.[75] On ***green ammonia***, a flagship project with a first phase of ~320 kt/yr is already in operation and a ***first export cargo*** was completed in February 2026, signalling ***progress from project build-out to international offtake***.[76] However, high renewable hydrogen costs remain a central constraint for scaling both green methanol and green ammonia.[77]

[61] (Sach et al., 2024)
[62] (Sach et al., 2024)
[63] Germany mandates eco-modulated participation fees for household ("system-participation") packaging.
[64] (Wang et al., 2025),
[65] (OECD, 2025)

[74] (EnerScen, 2026)
[75] (Gena, 2025)
[76] (Zhong, 2025)
[77] (International Energy Agency, 2026)

of renewable hydrogen in the EU and importing a further 10 Mt. Germany's hydrogen strategy is consistent with this approach, anticipating that imports will meet 50-70% of hydrogen and hydrogen-derivative demand by 2030.[66]

Definition of low carbon hydrogen at the EU level: Renewable hydrogen, or Renewable Fuels of Non-Biological Origin (RFNBOs), and low-carbon hydrogen are ***defined at EU level.*** EU legislation sets detailed and legally binding requirements for renewable hydrogen production and maintains a clear distinction between renewable and low-carbon hydrogen. [67]

Measures to improve availability and affordability

Scale up domestic supply:

- Germany's updated National Hydrogen Strategy doubles the 2030 domestic electrolysis target to at least 10 GW. ***Federal flagship programmes*** aim to expand electrolyser deployment and manufacturing, advance offshore wind-to-hydrogen value chains, and develop hydrogen transport and related infrastructure.[68]
- Germany also operates within the EU framework to support the expansion of the hydrogen production market: the ***European Hydrogen Bank provides a fixed euro-per-kilogram premium to certified RFNBO hydrogen producers*** through auction.

Targeted tools to de-risk import: H_2Global, which employs a ***double-auction*** model to support global trade, and the PtX Development Fund, which provides ***grant-based de-risking*** for industrial-scale PtX infrastructure and value-chain projects in developing and emerging economies.

Infrastructure as a precondition for scale:

- The ***European Hydrogen Backbone (EHB)*** vision is centred on repurposing existing gas assets into a dedicated hydrogen network,

[66] (Federal Ministry for Economic Affairs and Climate Action, 2024)
[67] (Bruch & Knodt, 2024)
[68] (Federal Ministry of Research, Technology and Space, n.d.)

China has ***expanded renewable hydrogen capacity rapidly*** under a ***broad policy framework***. A recent governmental report indicates that, by 2024, China had deployed around 125,000 t/yr of renewable hydrogen capacity, close to half of the global total of about 250,000 t/yr.[78,79,80]

This acceleration is aligned with top-level strategy and policy:

- The ***Hydrogen Energy Industry Medium- and Long-Term Development Plan*** (2021–2035) sets a near-term target of 100,000–200,000 t/yr of renewable hydrogen by 2025 and signals ***a larger role for hydrogen in final energy consumption*** by 2035.
- ***Standard development***: policies aim to reduce regulatory uncertainty through standardisation. More than 30 hydrogen standards were scheduled for development or revision by 2025. The recently issued Clean and Low-Carbon Hydrogen Assessment Standard introduces a lifecycle carbon-footprint accounting framework, strengthening the basis for certification, procurement and future conditional support.[81]

Policy emphasis is also ***shifting from capacity additions to value-chain integration:***

- 2025 ***pilot programmes***: the central government launched pilot programmes to support ***coordinated development across the hydrogen value chain***, including production, storage, transport and end-use, combining national and provincial incentives with preferential lending for selected projects.
- Hydrogen ***transportation***: the West-to-East Hydrogen Pipeline described as the first interprovincial, long-distance, large-scale renewable hydrogen transport project, starts in the renewable-rich western provinces and is intended to reduce spatial mismatches between supply and demand.[82]
- ***Clearer demand-side steering:*** recent policies

[78] (National Energy Administration, 2025)
[79] (Yin, 2025)
[80] (S&P Global Commodity Insights, 2025)
[81] (Guohua investment, 2026)
[82] (China State Council, 2023)

with a 2040 mix of around 60 percent repurposed and 40 percent new pipelines, and on developing import corridors and storage to connect demand centres to lower-cost renewable supply regions.[69]

- ***Germany's Hydrogen Core Network***: in parallel and as a complement, the Commission approved an estimated €3 billion German scheme to support the construction of the Hydrogen Core Network.[70] The national plan foresees 9,040 km of pipelines being brought online in stages through to 2032, around 60 percent of them converted from ***existing gas pipelines***. The national backbone is designed to connect ports, industrial clusters and production sites, and to make imported and domestic hydrogen physically usable for steel decarbonisation.[71] Its ***financing*** is underpinned by ***an innovative intertemporal cost-allocation mechanism***: a €24 billion KfW-backed amortisation account that bridges the gap between high initial investment costs and the capped ramp-up tariff set by the federal government. In the early years, this mechanism prevents excessive network charges for initial users; over time, as network utilisation rises and tariff revenues increase, the account is to be repaid and balanced by 2055.[72]

Important Projects of Common European Interest (IPCEIs) provide an ***EU state-aid framework*** through which member states jointly structure integrated and cross-border value-chain projects and finance them primarily through national public funds. For Germany, IPCEIs have become a ***central de-risking channel*** for both scaling domestic hydrogen supply and building enabling infrastructure (Hy_2Tech and Hy_2Use waves).[73]

give greater priority to low-carbon hydrogen uptake in energy-intensive sectors, including steel and chemicals, with the aim of moving from pilot projects to larger-scale deployment by 2027. In addition, China employs a ***stronger policy push for hydrogen-based feedstock substitution*** particularly in ***ammonia and methanol production*** to replace traditional coal-based routes.

[69] (European Hydrogen Backbone, n.d.)
[70] (Federal Network Agency, 2024b)
[71] (Bundesnetzagentur, 2024)
[72] (Federal Network Agency, 2024b)
[73] [1] (European Commission, n.d.-a)

Demand-pull measures: industry

- At the ***EU*** level ***Renewable Energy Directive (RED) III*** introduces ***binding targets for RFNBO use in industry*** (notably the 2030/2035 milestones).
- At the ***national level,*** the federal hydrogen strategy explicitly identifies ***the basic and petrochemical industries as key offtake*** sectors (alongside steel).

4. Germany and China: Policy Comparison and Mutual Learning

The chemical industry is central to climate objectives in both the EU and China. Its transition is particularly challenging because fossil fuels are used both for energy and as feedstocks. Achieving net zero therefore requires not only decarbonising energy use, but also defossilising the sector's feedstock base. How this transition is managed will have major implications for competitiveness, investment and trade over the coming decades.

The transition is constrained by a mix of shared bottlenecks and country-specific binding constraints:

- **Different fossil baselines, different lock-in risks**: Germany's base chemical industry is anchored in oil- and gas-based feedstocks, with lock-in risks tied to long-lived steam crackers and integrated cluster networks. China combines oil-based petrochemicals with a structurally large and still expanding coal-to-chemicals segment, reflecting its abundant domestic reserves and persistent energy-security concerns. This coal linkage raises the emissions baseline and creates a distinctive lock-in risk.
- **Competitiveness pressures and net-zero investment disincentives**: German chemical industry is largely exposed to global price competition, high operating costs and weak demand can quickly turn cost increases into closure risk and delayed investment. In China, by contrast, the central problem is overcapacity: continued investment despite weak demand is intensifying competition among relatively undifferentiated producers, compressing margins, and pushing excess output into export markets. Under these conditions, net-zero transition pathways that require high upfront capital expenditure while also increasing operating costs are unlikely to attract purely commercial investment unless they are backed by strong policy support, strategic positioning, or credible prospects for premium markets. This matters especially in Germany, where prolonged uncertainty and poor short-term returns increase the risk of postponed investment, maintenance-only spending, asset closures, or capital reallocation to more cost-competitive locations.
- **Energy and circular carbon constraints**: Both countries face binding constraints in accessing affordable renewable hydrogen. However, China's strong spatial coupling between renewable hydrogen hubs and coal chemical clusters facilitates their integration. Both struggle with circular carbon limits: waste-derived feedstocks are constrained by collection, sorting, and by competition with mechanical recycling and energy recovery.
- **Cluster interdependence**: Integrated chemical sites are central to the industry in both countries. They deliver high efficiency but they also create cascading risks: disruption or closure in a single major unit can destabilise site-wide balances. Policies must enable coordinated, site level investment rather than isolated project support.

In addition, because direct electrification would increase the chemical industry's dependence on competitively priced grid power, Germany's high industrial electricity prices remain a binding con-straint. China has comparatively lower industrial power prices, alongside faster renewable deployment and continued grid investment, giving it a more favourable basis for industrial electrification.

These structural factors have shaped policy design and priorities in the two countries.

>>> Set direction for net-zero transition

- Neither Germany nor China sets a specific climate target for the chemical sector.
- Both countries' direction policies converge on a broadly common set of core technology pathways with different extent of signal: electrification, low-carbon hydrogen, circular carbon feedstocks, and carbon management.
- Both view chemical clusters/parks as a lever for net-zero transformation.

CHINA	GERMANY
Direction set through a dense, co-ordinated policy framework.	Policy direction set through multiple national instruments, anchored in EU climate governance.
Coal-to-chemicals remains strategically supported. Coal used as a chemical feedstock is exempted from enterprise energy consumption caps. However, emphasis is shifting from capacity expansion to "high-quality" upgrading, including integration of low-carbon measures such as green hydrogen.	Renewable hydrogen as a chemical feedstock is supported primarily through the national hydrogen strategy.
Clearer signals to scale green ammonia and green methanol based on renewable hydrogen, supported by co-ordination between industrial and renewable-energy policies.	Enabling legal framework for CO_2 transport and storage, complemented by public funding for CCS and, subject to climate-integrity criteria CCU in hard-to-abate applications.
Chemical parks framed as key implementation units for renewable integration and associated infrastructure.	The EU ETS prices direct (on-site) GHG emissions, strengthening incentives to cut fossil combustion and invest in low-carbon energy and process options.
CCUS increasingly mainstreamed, with deployment in coal and petrochemical clusters reinforced through a co-ordinated instrument mix.	
ETS does not yet cover the chemical industry.	

>>> Financial support for low-carbon and circular production

- Both have a broad palette of CAPEX support instruments.

CHINA	GERMANY
CAPEX support: - Blends central budget investment with technology-steering instruments. Support prioritises energy efficiency, but also covers coal substitution in coal-to-chemicals, recycling, energy infrastructure for "zero-carbon" industrial parks, green methanol, and CCUS. - Uses concessional ("soft") loans to back mitigation projects. Lending focuses on energy-efficiency upgrades, with coverage widening to other energy-intensive industries and to industrial parks. - Deploys transition finance to ease capital access for chemical defossilisation, with extensive implementation by provincial and municipal governments. - The instruments also explicitly position industrial parks as the delivery level for defossilisation and the associated shared infrastructure	CAPEX support mainly through EU State-aid-cleared "flagship" grants, national funding programs that support defossilisation technologies, retrofits, and partially cluster interfaces, and EU centrally managed funds (e.g., for bio-based and circular feedstock).
OPEX support: • Local measures that reduce the effective cost of procured renewable power and subsidise the use of green hydrogen in coal chemicals production. • Differentiated electricity pricing to encourage energy efficiency; • Tax incentives that can benefit chemical recycling, but design and coverage need improvement.	OPEX, particularly electricity prices and exposure to the EU ETS, are a key bottleneck for chemical defossilisation in Germany. Support therefore focuses on electricity cost relief and EU-approved state aid CCfDs, which have supported two chemical electrification projects

>>> Accelerate uptake of circular ethylene

CHINA	GERMANY
Until recently, policy was driven mainly by pollution control. It has now shifted towards more explicit uptake expectations and specified applications, particularly in automotive.	EU packaging recycled-content targets are the clearest demand anchor, but counting and verification rules and methodology remain uncertain. Single-use beverage-bottle methodology is contested. Proposed end-of-life vehicle (ELV) targets could make vehicles the next major non-packaging anchor.
Clear guidance on end uses (fuel or materials) is still lacking.	EU waste hierarchy clearly prefers to keep carbon in materials rather than route it to energy recovery.

>>> Enable the provision of low-carbon energy, feedstocks, and enabling infrastructure

CHINA	GERMANY
Green hydrogen access: rapid scale-up with growing emphasis on system-building (standards, value-chain integration, infrastructure, and industrial demand). Policy signals repeatedly prioritise green hydrogen for green ammonia and green methanol.	Green hydrogen access: within the EU framework, a hybrid approach to green hydrogen access-scaling domestic supply while using specialised instruments to de-risk imports and build infrastructure; policy identifies chemicals among priority industrial application sectors.
Renewable electricity: promoting greater industrial renewable-based electrification; Bilateral "green electricity" trading between industrial users and renewable power suppliers is institutionalised, while longer-term contracting is still developing; support for nearby and on-site renewable generation and dedicated connections.	Renewable electricity: securing green electricity mainly through long-term corporate PPAs.

The mapping suggests both China and Germany already deploy a comprehensive mix of instruments to steer chemical net-zero transition. The remaining question is whether the existing policy mix is effective for capital allocation, avoids lock-in, and enables demand at scale. The following section synthesises ***policy gaps*** and outlines ***opportunities for mutual learning and cooperation***.

Directionality

1. **Coordinate directionality through horizontal and vertical governance**. China's policy framework is characterised by ***strong central coordination***. Climate and sustainable development planning, industrial strategy, and policies for infrastructure and renewable energy deployment are mutually reinforcing: together, they provide clearer direction for net-zero transition pathways and align compliance expectations with investment signals and infrastructure decisions. China's top-down governance structure makes national "direction-setting" policies effective: they confer political legitimacy and create the incentive framework through which ***local governments mobilise support instruments*** (including subsidies) for priority objectives such as net-zero transition. The same structure can also reinforce incumbent production models and create lock-in.

   Moreover, China's framework makes directional technology choices more explicit through planning, catalogues, and administrative steering. This contrasts with the stronger emphasis in German discourse on technology neutrality.

2. **Accelerate coal chemicals transition in China, persistent structural carbon risk, with development strategy and renewable hydrogen providing partial remedy**. China's ***modern coal chemical*** industry already exhibits ***prominent high-carbon lock-in and risks China's climate targets***. At the same time, national and regional policies increasingly frame the sector's future in terms of "high-quality development", with greater emphasis on ***higher-value, more diversified and lower-carbon product pathways rather than simple volume expansion***. In coal regions with large coal-chemical clusters and rapidly expanding wind and solar capacity, renewable hydrogen is increasingly prioritised in Chinese policy analysis. This ***co-location*** could help reduce emissions in parts of the sector, particularly where renewable hydrogen is used as a feedstock, although it does not by itself resolve the industry's structural carbon problem.[83,84]

[83] (Guo et al., 2023)
[84] (China Council for International Cooperation on Environment and Development, 2025)

3. **Strengthen the ETS as an investment signal.** While the EU ETS covers direct on-site, it excludes ***product-embedded carbon*** across value chains. In practice, extensive free allocation has long diluted the incentive to reinvest in deep industrial decarbonisation. Credible carbon price requires a continued phase-out of free allocation, especially in CBAM-covered sectors. ***China's national ETS*** may ***expand to chemical industry by 2027.*** For ***coal-to-chemicals***, prospective ETS coverage could become a ***material investment signal*** given its high carbon intensity. In both jurisdictions, the investment effect depends less on formal coverage alone than on allocation design, benchmark stringency and the extent to which complementary policies address the wider carbon embedded in chemical value chains.

Financial support to mainstream low-carbon and circular production

4. **Make CAPEX support cluster-explicit.** Net-zero transition requires integrated utilities and shared infrastructure. China is ***building a layered support architecture that combines public grants, policy bank concession loans, and the development of transition finance*** to ease capital access for emissions-intensive industries such as the chemical industry. China's newest ***subsidy programme prioritises park- and cluster-scale deployment over isolated retrofits.*** This could inspire ***German programmes***, which remain ***largely designed around single technologies or sites. The EU Innovation Fund and the emerging Industrial Decarbonisation Bank convert EU ETS auction revenues*** into competitively allocated support. As China's ETS expands to chemical industry and matures, adopting a similar revenue recycling could be used to build a rule-based funding channel to fund high-CAPEX net-zero transition projects.

5. **De-risk OPEX with innovative contracts and electricity cost relief.** For first-mover, OPEX is often decisive: even with CAPEX grants, projects can stall if electricity and green-hydrogen costs leave them structurally uncompetitive. ***Germany's CCfD logic is instructive*** because it targets the operating-risk gap directly and can therefore inspire China to narrow the cost differential for renewable-hydrogen-based chemical routes. Two design features are particularly relevant. First, ***stringent abatement thresholds*** tied to measurable abatement can focus support on projects with significant emissions cuts. Second, the ***two-sided contract*** structure provides strong early support while limiting windfall gains if market conditions improve, improving fiscal sustainability and policy credibility by automatically adjusting the public contribution over time.

   Electricity cost relief is a key instrument for OPEX support in Germany. In China, by contrast, there is no single nationwide relief mechanism. However, national policies to promote renewable electricity consumption are sometimes translated into ***local measures*** that ***reduce the de-livered cost of renewable power*** for end users, including industrial consumers. This further strengthens ***China's advantage in renewable-based industrial electrification.***

Drive demand for circular ethylene

6. **Minimum recycled content with calculation and verification methodologies.** In the EU, the clearest demand anchor is the PPWR's ***minimum recycled content in plastic packaging, with calculation and verification methodologies*** to be set via implementing acts. The EU is also ***moving to create a second major demand anchor in the automotive sector*** through the proposed regulation, which would introduce mandatory recycled-plastics targets in new vehicles once formally adopted.

   China is ***moving from pollution control to explicit application priorities***, with ***automotive*** singled out as a key downstream sector. China can learn from E***U methodologies for recycled-content accounting***. In addition, **both are converging on automotive** as the next demand anchor for circular polymers and can l**earn from each other**.

Secure affordable renewable hydrogen

7. **A systematic approach to affordable renewable hydrogen.** Although Germany/EU and China are taking different routes to secure affordable renewable hydrogen, both are **applying a systematic approach** to enhance credibility to future hydrogen availability for industries, offers the **transferable lesson for other countries.** Besides, China's ***growing emphasis on coordinating hydrogen supply with demand*** helps to strengthen demand signals for investors. Its early renewable hydrogen derivatives projects are most ***bankable when they are co-located with (or tightly connected to) existing "hard" demand*** (chemical clusters) in strong renewable-rich regions.

Transitioning to net-zero in the chemical industry is a shared challenge for Germany/EU and China: emissions must be reduced, the sector must remain investable and globally competitive, and the transition remains socially manageable. In the current context of increasing trade tensions and geopolitical strain, there is a compelling case for structured dialogue and targeted cooperation on transitioning towards net-zero. While such engagement will not eliminate underlying trade frictions, it can reduce misperceptions, support mutual learning and help identify practical pathways towards industrial decarbonisation.

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