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Efficient Appliances for People & the Planet

Accelerating Appliance Energy Efficiency and Decarbonization in China

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Executive Summary

China has built one of the most comprehensive policy frameworks in the world for improving the energy efficiency of appliances and industrial equipment. Minimum energy performance standards (MEPS), energy labels, green procurement, equipment renewal programs, and local pilots have helped raise product efficiency and supported industrial upgrading. These policies provide a strong foundation for achieving China's 2030 carbon peak and 2060 carbon neutrality goals.

The next decade, however, will require a more ambitious policy approach. Energy-consuming appliances and industrial equipment are estimated to account for about 38% of China's energy-related carbon emissions. The largest sources are industrial motor systems, cooling and refrigeration equipment, and lighting. Improving efficiency in these categories is one of the fastest, most proven, and most cost-effective ways to reduce emissions, lower energy costs, and strengthen energy security.

This report reviews China's national and local policy progress on energy efficiency standards and incentives for appliances and industrial equipment. It also uses CLASP's Mepsy tool to assess technical potential, emissions reductions, and policy impacts. The analysis focuses on industrial systems—including motors, boilers, transformers, pumps, fans, and compressors—as well as cooling and refrigeration, lighting, heat pumps, data centers, and refrigerants.

Key Findings

MEPS are effective, but updates must be accelerated to keep pace with technological advancements.

MEPS have been successful in removing inefficient products from the market and encouraging manufacturers to invest in more advanced technologies. However, several standards have not kept pace with market development or the best available technologies (BAT).

Room air conditioners (RACs) illustrate this gap. China's current RAC MEPS set a minimum annual performance factor (APF) requirement of 4.0, which was world-leading when introduced. However, CLASP's market analysis indicates that the average RAC sold online now exceeds APF 5.0. The current minimum requirement therefore no longer reflects prevailing market performance or the technological frontier.

Similar gaps are emerging in other rapidly evolving product categories. Without timely updates in line with technological and market progress, MEPS lose their ability to remove inefficient products and drive innovation. A more frequent, dynamic revision mechanism that draws on energy label registration data, sales data, product testing, and market surveillance results would help ensure standards remain aligned with progress.

The largest efficiency gains come from shifting from products to systems.

Traditional energy efficiency standards have focused primarily on the performance of individual products. This approach remains essential, but it is no longer sufficient to capture the full energy savings potential available in industrial and commercial applications. Increasingly, the largest opportunities lie at the system level, including equipment sizing, load matching, transmission efficiency, control strategies, operation and maintenance, and digital energy management.

Motor-driven systems are a clear example. Motors power pumps, fans, compressors, conveyors, and many other industrial processes. Improving the efficiency of individual motors continues to deliver energy savings, but the additional gains available from motor upgrades alone are becoming more limited. Improving motor energy efficiency from IE3 to IE4 has an energy-saving potential of approximately 1.5%–2%.

By contrast, optimizing the entire system, including motor-driven equipment, controls, and operating conditions, can unlock substantially greater savings. Compressed air systems exemplify this dynamic. Upgrading the energy efficiency of compressed air systems from Level 5 to Level 4 has an energy-saving potential of approximately 10%. In some applications, system-level improvements can reduce energy use by more than 50%. However, several important standards governing system performance remain voluntary, leaving significant savings unrealized.

Future policy should therefore expand beyond component-level efficiency and place greater emphasis on whole-system performance to capture these larger savings opportunities. Priority areas should include compressed air stations, pumping and ventilation systems, industrial cooling, boiler systems, data centers, and HVAC systems in public buildings due to their large energy consumption and potential for improvement.

Efficient, low global warming potential (GWP) refrigerants are critical for future energy and climate goals.

Cooling and refrigeration will be major drivers of China's future electricity demand as incomes rise, cities expand, and extreme heat becomes more frequent. High-efficiency cooling is therefore essential for climate mitigation and power system reliability.

At the same time, cooling policy must address refrigerants. As China's power grid decarbonizes, direct emissions from refrigerant leakage will account for a larger share of the sector's overall climate impact. A transition from high-GWP refrigerants to ultra-low-GWP alternatives can deliver substantial long-term climate benefits. A more integrated policy framework is needed to address efficiency and refrigerants together. Energy efficiency standards, energy labels, refrigerant management requirements, safety standards, and public procurement policies must be formed into a coherent policy package to promote cooling technologies that are both highly efficient and climate friendly.

Stronger labeling and digital compliance can improve market transparency.

China's energy label system has played a critical role in market transformation, but rapid growth in online sales has created new compliance challenges. Online product listings may omit energy labels, display inaccurate efficiency information, or present labels in locations or formats that are difficult for consumers to notice and understand. Stronger requirements for online energy labeling are therefore needed, supported by digital monitoring and enforcement tools.

Industrial products and systems also require clearer labeling and certification frameworks. Many still lack standardized labels, comparable performance indicators, or transparent disclosure requirements. This makes it difficult for enterprises, procurement officers, and financial institutions to identify high-efficiency options. More robust labeling and certification could improve purchasing decisions, support green finance, and strengthen equipment renewal programs by directing investment toward efficient products and systems.

Carbon footprint and carbon efficiency standards are the next policy frontier.

China is moving from energy consumption control toward a broader carbon control framework. During the 15th Five-Year Plan[1], product carbon footprint standards, carbon labeling, and certification systems are expected to become more important. This creates a major opportunity to link energy efficiency policy with carbon management.

Product carbon footprint standards can support future carbon labels, green procurement, export requirements, and carbon efficiency standards. They can also help manufacturers reduce embedded emissions across supply chains. Priority products should include room air conditioners, refrigerators, heat pumps, motors, pumps, compressors, batteries, photovoltaic equipment, and data center equipment.

[1] https://www.gov.cn/yaowen/liebiao/202603/content_7062633.htm

Efficiency improvements are a cost-effective decarbonization pathway.

The table below summarizes the main energy efficiency assumptions and modeled carbon reduction impacts for the analyzed appliances and equipment. The results show that efficiency improvement remains a major cost-effective decarbonization pathway for China. The largest opportunities are found in motor systems and system-level industrial equipment, followed by RACs, refrigerators, and LED lighting. The comparison between MEPS and BAT scenarios also shows that standards alone are not enough. To capture the full technical potential, China will need faster MEPS updates, stronger market incentives, better compliance, and policies that promote system-level efficiency and low-GWP refrigerants.

TABLE 1 Summary of Modelled Energy-Saving Pathways and Carbon Impacts

Product / equipment	Main energy-saving pathway	Key assumption	Modelled carbon impact
Motor systems	System-level optimization of motors, pumps, fans, compressors, and controls	Global benchmark: 5.5% average system efficiency gain; NZH: up to 14.7%	Cumulative CO_2 reduction by 2040: about 1.30 Gt under Global Benchmark and 3.53 Gt under NZH
Compressed air systems	System performance improvement under GB/T 45785—2025	Current systems can improve by more than 50% when upgraded toward Grade 1 performance	Cumulative CO_2 reduction by 2040: about 0.78 Gt from Grade 4 improvement and 1.44 Gt under Grade 1/BAT
Room air conditioners - efficiency	Higher RAC efficiency through strengthened MEPS and BAT adoption	APF 5.0 MEPS scenario; APF 6.25 BAT scenario	Cumulative CO_2 reduction by 2040: about 0.83 Gt under APF 5.0 and 1.49 Gt under APF 6.25
Room air conditioners - refrigerants	Transition from high-GWP refrigerants to R290	Medium and fast R290 market-penetration scenarios	Cumulative direct CO_2e reduction by 2040: about 0.09 Gt under Medium and 0.37 Gt under Fast transition
Household refrigerators	Implementation of GB 12021.1–2025 and movement toward Grade 1 BAT	Grade 5 MEPS; Grade 1 BAT with TEEI 20%	Cumulative CO_2 reduction by 2040: about 0.29 Gt under MEPS and 0.57 Gt under BAT
LED lighting	MEPS and BAT adoption for indoor LED lighting and road/tunnel LED lighting	MEPS scenario; BAT scenario for indoor and outdoor LED applications	Combined cumulative CO_2 reduction by 2040: about 0.52 Gt under MEPS and 1.04 Gt under BAT

Source: Mepsy analysis conducted by Hu Bo, CLASP China Program, 2025. "Late 2050s" is used for model outputs shown through 2057 in the original charts.

Policy Progress and Challenges

China has made important progress in expanding and strengthening energy efficiency policies. MEPS and energy labels now cover many major household appliances, commercial equipment, and industrial products. The energy label has become a key

policy tool. It supports market transparency, green procurement, consumer incentives, and product verification under appliance trade-in programs.

Recent national policies have broadened the scope of energy efficiency. They increasingly address equipment renewal, industrial retrofits, green manufacturing, carbon footprint management, and low-carbon product certification. National and local policies now place greater emphasis on system-level efficiency, smart controls, high-efficiency equipment, public-sector leadership, and the replacement of outdated equipment.

Local governments have also started to play a stronger role. Some provinces and cities have adopted higher requirements, faster timelines, or targeted programs for cooling systems, public buildings, data centers, industrial equipment, and smart lighting. These local action initiatives provide valuable lessons for future national policy design. But there are also challenges:

- Standards do not always keep pace with technological and market developments. Some MEPS, particularly in rapidly evolving product categories, no longer reflect market-average performance or the best available technologies.
- MEPS coverage remains incomplete. Several renewable energy technologies, industrial systems, and emerging equipment categories are not yet covered by mandatory energy efficiency standards.
- System-level regulation remains limited. Existing policies do not fully capture the substantial savings available from motor-driven systems, compressed air, pumps, fans, HVAC, and industrial cooling.
- Online labeling compliance is insufficient. The growth of e-commerce requires clearer label display rules, stronger verification mechanisms, and digital market surveillance.
- Industrial product labeling is underdeveloped. Many industrial products and systems lack simple and trusted efficiency labels.
- The transition to low-GWP refrigerant faces technical and market barriers. Further progress will require stronger safety standards, expanded servicing capacity, clearer local implementation guidance, and more effective compliance and enforcement tools.
- Successful local pilots are not yet systematically replicated. Although many provinces and cities have generated valuable experience, mechanisms for translating successful pilots into national guidance and wider implementation remain limited.

- Incentives are not always aligned with the highest ambition. Subsidies, procurement, and finance often support average or moderately efficient products, rather than prioritizing best available technologies.

Future Policy Opportunities

China has a strong opportunity to move from a standards and labeling system to a broader energy and carbon performance policy system. This system should support carbon neutrality, energy security, industrial competitiveness, and sustainable trade.

Strengthen and expand MEPS

- Prioritize high-impact categories, including motors, pumps, fans, compressors, RACs, refrigerators, heat pumps, chillers, lighting, data center equipment, and industrial boilers.
- Use a dynamic update cycle to keep MEPS and labels aligned with market progress and best available technologies.
- Ensure future MEPS move the market by removing all obsolete and inefficient products, while using higher energy label grades to pull the market toward BAT.

Prioritize system-level efficiency policy

- Develop mandatory or quasi-mandatory standards for compressed air stations, pump systems, fan systems, industrial cooling, boiler systems, public building HVAC, and data centers.
- Use energy audits, digital monitoring, and performance-based metrics to support compliance.
- Link system-level upgrades with equipment renewal programs, green finance, and local demonstration projects.

Integrate refrigerant policy with efficiency policy

- Add GWP information to labels for cooling and heat pump products.
- Regulate GWP in relevant standards where technically feasible.
- Use procurement, incentives, servicing standards, and technician training to accelerate the uptake of high-efficiency, low-GWP products.

Build product carbon footprint standard and carbon labeling systems

- Develop product category rules and carbon footprint standards for priority appliances and industrial equipment.

- Pilot carbon efficiency indicators for products with large life-cycle emissions.
- Align carbon labels with government procurement, export-oriented standards, and green trade requirements.

Improve incentives and market transformation tools

- Use subsidies and trade-in programs to reward Grade 1, BAT-level, low-GWP, and smart products.
- Raise green procurement thresholds for public institutions and state-owned enterprises.
- Develop financing tools to help small- and medium-sized enterprises (SMEs) to replace inefficient motors, compressors, boilers, transformers, chillers, and pumps.

Strengthen digital compliance and data systems

- Upgrade energy label databases into real-time market monitoring tools.
- Use e-commerce data and product registration data to support standards revision and enforcement.
- Develop digital product passports that include energy performance, refrigerant information, repairability, recycling, and carbon footprint data.

Proposed roadmap

TABLE 2 Proposed Roadmap

Short Term (2026–2028)	Medium Term (2029–2031)	Long Term (2032–2035)
Build the foundation for faster policy revisions	**Scale system-level efficiency and carbon performance policies**	**Establish global leadership in energy and carbon performance standards**
Revise MEPS for priority products.	Adopt system-level standards for compressed air, pumps, fans, HVAC, data centers, and industrial cooling.	Move major product categories toward BAT-based MEPS.
Strengthen requirements for online energy labeling.	Regulate GWP in relevant standards where technically feasible for priority cooling products.	Integrate energy efficiency, carbon footprint, refrigerant impact, smart-grid readiness, and recyclability into advanced labels.

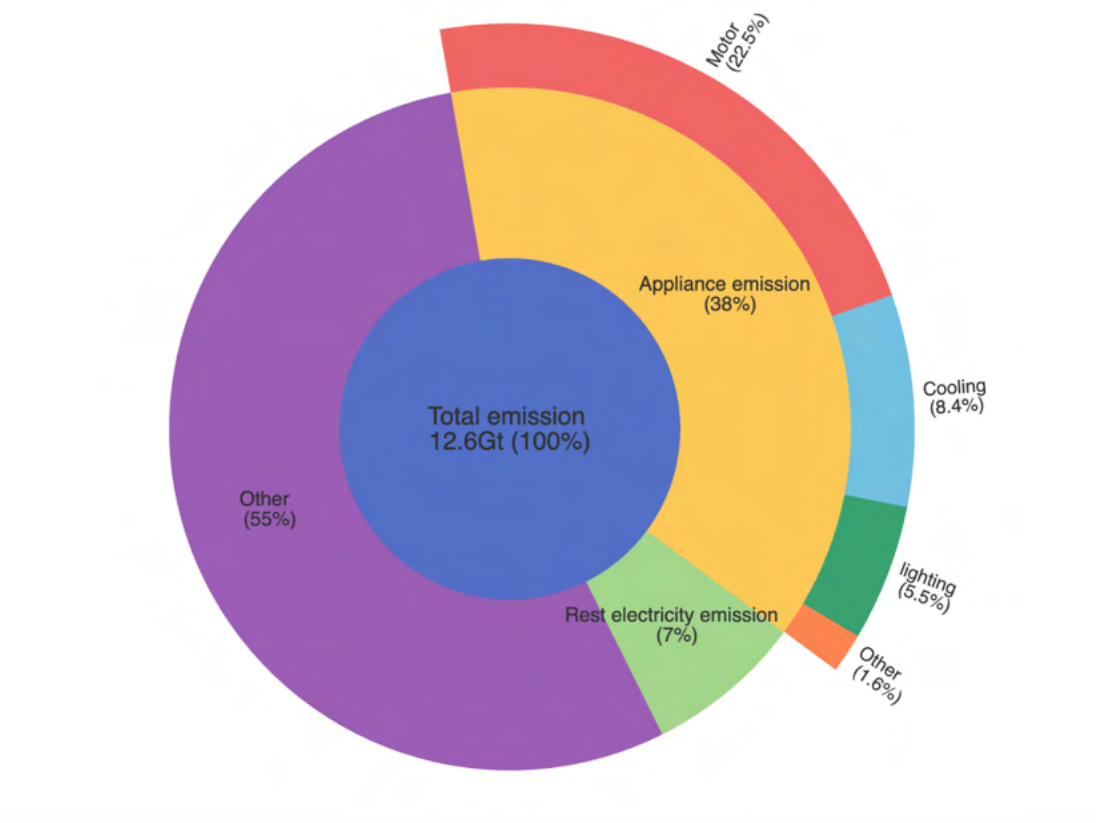
Launch product carbon footprint pilot programs.	Expand carbon labels to major appliances and industrial equipment.	Align Chinese standards with global green trade requirements.
Add GWP information to selected labels.	Link subsidies and green finance to verified energy and carbon performance.	Build a mature digital product passport system.
Convert mature voluntary system standards into stronger requirements.		
Use public procurement and trade-in programs to support Grade 1 and BAT-level products.		

China's Carbon Emissions from the Appliance Sector

China's carbon emissions reached 12.6 gigatons (Gt)[2] in 2023, making it the world's largest emitter, accounting for approximately 33.7% of global emissions. Understanding the sources of these emissions is essential for identifying effective mitigation strategies. Emissions can be assessed by energy source, such as coal, oil, natural gas, and renewables, or by economic sector, including industry, power generation, transport, and buildings.

Energy-consuming appliances and industrial equipment are among the major contributors to China's emissions. In this report, appliances refer to end-use products and equipment that are primarily powered by electricity and used across residential, commercial, and industrial settings. These products provide essential services, but they also account for a large share of electricity demand and associated carbon emissions.

FIGURE 1 Carbon Emissions from Appliances



[2] IEA, *CO_2 Emissions in 2023* (2024), https://www.iea.org/reports/co2-emissions-in-2023.

China's total electricity consumption in 2023 was 9,224 terawatt-hours (TWh).[3] Based on the annual carbon intensity of the power grid,[4] electricity generation was associated with 5.72 Gt of carbon dioxide (CO_2) emissions, equivalent to 45.4% of China's total emissions. This highlights the central role of power-sector decarbonization in China's low-carbon transition.

Appliances and industrial equipment account for a substantial share of this electricity demand. They consume around 75% of industrial electricity[5] and nearly all electricity consumption in non-industrial sectors, including residential and commercial buildings. Based on this allocation, appliances and industrial equipment consumed an estimated 7,705 TWh of electricity in 2023.[6] Applying the average grid emission factor, this corresponds to approximately 4.78 Gt of CO_2 emissions, or roughly 38% of China's total carbon emissions in 2023. This makes appliances and industrial equipment a critical focus for national energy efficiency, industrial, and climate policies.

Appliance-related electricity consumption is highly concentrated in a few categories:

- Industrial motors are the largest electricity consumers within industry. They are widely used in pumps, compressors, conveyors, manufacturing machinery, and other motor-driven systems, and represent about 75% of industrial electricity consumption.
- Cooling and refrigeration equipment are the second major consumers. This category includes room air conditioners, refrigerators, chillers, and cold storage systems used in homes, commercial, and industrial applications. Together, cooling and refrigeration systems accounted for an estimated 18.56% of China's total electricity demand.[7]
- Lighting systems, including LED, fluorescent, and incandescent technologies used in buildings, industrial facilities, and public spaces were responsible for approximately 13% of national electricity consumption.[8]

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[3] NEA, "China's Total Electricity Consumption of 2023," January 2024, https://www.nea.gov.cn/2024-01/18/c_1310760885.htm.
[4] MEE, "China Grid Emission Factor 2022," n.d., https://www.mee.gov.cn/xxgk2018/xxgk/xxgk06/202302/t20230207_1015569.html.
[5] "National Motor Energy Efficiency Improvement Action Plan (2013-2015)," n.d., https://www.gov.cn/zwgk/2013-06/21/content_2431342.htm.
[6] NEA, "China's Total Electricity Consumption of 2024," January 2025, https://www.nea.gov.cn/20250120/4f7f249bac714e7693adecac996d742f/c.html.
[7] China National Institute of Standardization, *SCOPING STUDY ON MITIGATION POTENTIAL OF REFRIGERATION AND AIR CONDITIONING PRODUCTS IN CHINA* (n.d.).
[8] NDRC, n.d., https://www.ndrc.gov.cn/fzggw/jgsj/hzs/sjdt/201612/t20161223_1130556.html.

Combined, industrial motors, cooling and refrigeration, and lighting systems generated an estimated 4.57 Gt of CO_2 emissions in 2023. This represents about 95% of all appliance-related emissions in China.

The concentration of emissions in these three categories points to a clear policy opportunity. Improving the efficiency of high-demand appliances and industrial equipment through stronger standards, advanced technologies, better system design, and improved operating practices can deliver significant emissions reductions. These improvements are also strategically important for supporting China's broader climate objectives, including its commitment to achieve carbon neutrality before 2060.

Key Takeaways

- China emitted 12.6 Gt of CO_2 in 2023, about 33.7% of global emissions, making it the world's largest emitter.
- Appliances and industrial equipment are a major source of emissions. These technologies consumed an estimated 7,705 TWh of electricity and emitted 4.78 Gt of CO_2, accounting for about 38% of China's total emissions in 2023.
- Emissions are highly concentrated in a few categories. Industrial motors, cooling and refrigeration, and lighting together produced 4.57 Gt of CO_2, representing around 95% of appliance-related emissions in China.
- Energy efficiency policies offer significant mitigation potential. Strengthening standards for these key appliance and industrial equipment categories is one of the most effective ways to reduce emissions and is essential for achieving China's carbon neutrality goal before 2060.

China's National Policies on Energy Efficiency and Decarbonization in the Appliance Sector

China's NDC

On 22 September 2020, China announced that it would enhance its nationally determined contribution (NDC), adopt stronger policies and measures, aim to peak carbon dioxide emissions before 2030, and strive to achieve carbon neutrality before 2060.

To support this transition, China has been shifting from an energy consumption control approach to a broader carbon emissions control framework. In August 2024, the General Office of the State Council published the Work Plan for Accelerating the Establishment of a Dual Control System for Carbon Emissions. The plan outlines a new mechanism to shift from managing energy consumption and consumption intensity towards managing carbon emissions and carbon intensity. During the 15th Five-Year Plan period (2026-2030), a dual control system for carbon emissions will be implemented, with a primary focus on emission intensity supplemented by control over total emission amount. The plan also calls for the establishment of a product carbon footprint management system and a product carbon labeling and certification scheme.[9]

In September 2025, China released its updated NDC targets:

- By 2035, the country aims to reduce economy-wide net greenhouse gas emissions by 7%-10% from peak levels, with efforts to achieve even greater reductions.
- The share of non-fossil fuels in total energy consumption is targeted to exceed 30%.
- The combined installed capacity of wind and solar power is set to increase more than six times the 2020 level, with the goal of reaching 3.6 billion kilowatts.[10]

China's "1+N" Policy Framework

China's "1+N" policy framework for achieving carbon peaking and carbon neutrality consists of two core documents:

- Fully, Accurately, and Comprehensively Implementing the New Development Concept and Doing a Good Job in Achieving Carbon Peaking and Carbon Neutrality.[11]
- Action Plan for Carbon Peaking Before 2030.

Together, these policy documents form the "1." The "N" refers to sectoral- and industry-specific implementation plans, as well as supporting and safeguarding measures.

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[9] Work Plan for Accelerating the Establishment of a Dual Control System for Carbon Emissions. https://english.www.gov.cn/policies/latestreleases/202408/02/content_WS66aca35fc6d0868f4e8e9b2f.html?utm_source=copilot.com

[10] 2035 China NDC Report. https://unfccc.int/sites/default/files/2025-11/2035%E5%B9%B4%E4%B8%AD%E5%9B%BD%E5%9B%BD%E5%AE%B6%E8%87%AA%E4%B8%BB%E8%B4%A1%E7%8C%AE%E6%8A%A5%E5%91%8A.pdf

[11] Comprehensively Implementing the New Development Concept and Doing a Good Job in Achieving Carbon Peaking and Carbon Neutrality, https://www.gov.cn/zhengce/2021-10/24/content_5644613.htm

The Action Plan for Carbon Peaking Before 2030 calls for improving energy efficiency in key energy-using equipment. Priority is given to motors, fans, pumps, compressors, transformers, heat exchangers, and industrial boilers, with a comprehensive upgrade of efficiency standards.[12]

The plan requires establishing incentive and regulatory mechanisms that are driven by energy efficiency, promoting advanced and efficient equipment, and accelerating the phase-out of outdated and inefficient products. In line with international best practices, China will strengthen efficiency standards for equipment such as communication, computing, storage, and transmission devices, raising entry thresholds and eliminating backward technologies.

It also encourages green retrofits of existing facilities, including the adoption of high-efficiency cooling, advanced ventilation, waste heat recovery, and intelligent energy management technologies, to raise overall facility efficiency.

China's Sectoral Policies

In China's "1+N" policy framework, the "N" covers detailed carbon-peaking plans for sectors like energy, industry, transport, and urban development. It also includes supporting measures such as technology and energy security, carbon sequestration capacity, financial and pricing policies, standards and measurement systems, and mechanisms for monitoring and evaluation.

TABLE 3 China's Carbon-Peaking Plans by Sector

Sector / year / agencies	Policy contents
Buildings 2022 Ministry of Housing and Urban-Rural Development (MOHURD)	Urban and Rural Construction Carbon Peaking Plan:[13] This plan improves public building energy efficiency. By 2030, key prefecture-level cities and above should complete public building retrofits and achieve overall efficiency gains of more than 20%. Major equipment, including air conditioning, lighting, and elevators, should be upgraded to raise public building mechanical and electrical system efficiency by 10% from 2022 levels.
Boilers 2023 NDRC	Action Plan for Green, Low-Carbon, and High-Quality Development of Boilers:[14] This plan identifies boilers as major energy-consuming equipment, using about 2 billion tons of standard coal annually and contributing roughly 40% of national carbon emissions. Targets and measures: By 2025, raise average operating efficiency of industrial boilers by 5 percentage points and power station boilers by 0.5 percentage points from 2021 levels. By 2030, improve industrial boiler product efficiency by 3 percentage points from 2021 levels and further improve average operating

[12] Action Plan for Carbon Peaking Before 2030. https://www.mee.gov.cn/zcwj/gwywj/202110/t20211026_957879.shtml
[13] Urban and Rural Construction Carbon Peaking Plan, https://www.gov.cn/zhengce/zhengceku/2022-07/13/content_5700752.htm
[14] Action Plan for Green, Low-Carbon, and High-Quality Development of Boilers, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202312/P020231219564149108223.pdf

	efficiency. Accelerate standards for thermal efficiency, system efficiency, testing, carbon accounting, carbon footprint evaluation, special boiler systems, and supercritical CO_2 boilers. Largely phase out coal-fired boilers of 10 tons/hour or below in key regions by 2025.
Cooling 2019; 2023 NDRC	Green and Efficient Cooling Action Plan:[15] By 2030, improve cooling efficiency in large public buildings by 30%; raise overall cooling efficiency by more than 25%; increase the market share of green and efficient cooling products by more than 40%; and save about 400 billion kWh annually. Raise MEPS for major cooling products by more than 15% from 2022 levels, meet or exceed developed country access requirements, and make top efficiency levels world leading. Develop standards for data center cooling, vehicle air conditioners, cold storage, refrigerated trucks, ice makers, and dehumidifiers; phase out 20%-30% of inefficient cooling products; expand energy labels to include top-runner indicators and refrigerant GWP information. Guidelines for the Renewal, Retrofit, and Recycling of Cooling Equipment:[16] China has about 1.15 billion units/sets of cooling equipment in operation. By 2025, high-efficiency products should reach 40% of commercial/industrial cooling equipment and 60% of household cooling equipment in use; newly produced high-efficiency products should reach 55% for commercial/industrial cooling and 80% for household cooling. Expected annual savings: 100 billion kWh, equivalent to 30 million tons of standard coal and 58 million tons of CO_2.
Data centers 2024 NDRC; MIIT	Special Action Plan for Green and Low-Carbon Development of Data Centers:[17] By the end of 2025, improve national data center layout, keep rack utilization at no less than 60%, reduce average power usage effectiveness (PUE) to below 1.5, increase renewable energy use by 10% annually, and improve computing power efficiency and carbon efficiency. By 2030, national average PUE, computing power efficiency, and carbon efficiency should reach international advanced levels, with higher renewable energy use and greater waste heat utilization in newly built large data centers in northern heating regions. Newly built and renovated/expanded data centers must use servers meeting or exceeding energy-saving levels under GB 43630-2023 and the Top Runner evaluation requirements. By the end of 2025, PUE of newly built and expanded large and ultra-large data centers should be within 1.25, and national hub projects should not exceed 1.2.
Heat pumps 2025 NDRC; NEA	Action Plan for Promoting High-Quality Development of the Heat Pump Industry:[18] By 2030, improve the efficiency of key heat pump products by more than 20%. Achieve breakthroughs in large-capacity high-temperature heat pumps, high-efficiency compressors, and new refrigerants. Expand heat pump applications in buildings and installed heat pump capacity. Study energy efficiency evaluation methods for building heating and domestic hot water heat pumps; explore a unified energy label; expand label coverage and consider adding refrigerant GWP information. Air-source heat pumps must meet MEPS requirements while auxiliary electric heating is gradually reduced. Diagnostics and evaluations will be carried out for operating heat pump equipment.
Industry 2022-2024 NDRC; Ministry of Information and Technology (MIIT)	Industrial Carbon Peaking Plan:[19] Raises efficiency requirements for transformers, motors, furnaces, boilers, compressors, fans, and pumps; promotes system-level upgrades. Industrial Equipment Renewal Plan:[20] Accelerates replacement of outdated boilers, motors, transformers, refrigeration and heating compressors, heat exchangers, and pumps; encourages Level 2 efficiency or above.

[15] Green and Efficient Cooling Action Plan, https://zfxxgk.ndrc.gov.cn/web/iteminfo.jsp?id=16199.
[16] Guidelines for the Renewal, Retrofit, and Recycling of Cooling Equipment, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202302/t20230224_1349405.html.
[17] Special Action Plan for Green and Low-Carbon Development of Data Centers, https://www.ndrc.gov.cn/xwdt/tzgg/202407/P020240723625616053849.pdf.
[18] Action Plan for Promoting High-Quality Development of the Heat Pump Industry, https://www.ndrc.gov.cn/xwdt/tzgg/202504/t20250402_1396956.html.
[19] Industrial Carbon Peaking Plan, https://wap.miit.gov.cn/zwgk/zcwj/wjfb/tz/art/2022/art_df5995ad834740f5b29fd31c98534eea.html.
[20] Industrial Equipment Renewal Plan, https://www.miit.gov.cn/jgsj/ghs/wjfb/art/2024/art_9532b8a4a0fa4dfabedde39e0883a338.html.

	Industrial Energy Efficiency Action Plan:[21] Promotes system optimization, advanced controls, high-efficiency centrifugal fans, direct-drive motors, servo drives, efficient boiler systems, and stricter compliance checks. National Energy Saving and Carbon Reduction Plan (2024-2025):[22] By 2025, increase average operating efficiency of industrial boilers by more than 5 percentage points and power station boilers by at least 0.5 percentage points from 2021 levels; raise the share of high-efficiency motors and transformers in use by more than 5 and 10 percentage points, respectively; increase efficient products to 40% of commercial refrigeration, 60% of household refrigeration, and 50% of general lighting equipment.
Lighting 2023 NDRC; MOHURD	Guidelines for the Renewal, Retrofit, and Recycling of Lighting Equipment:[23] More than 10 billion lighting devices are in use across relevant sectors. By 2025, increase the market share of high-efficiency lighting equipment. Among general lighting equipment in operation, raise the share reaching Level 1 or above to 20% and Level 2 or above to 50%. Expected annual savings: 100 billion kWh, equivalent to 30 million tons of standard coal and 58 million tons of CO_2. Urban and Rural Construction Carbon Peaking Plan:[24] By 2030, LED and other high-efficiency lighting products should exceed 80% of lighting use, and more than 30% of cities should have digitalized lighting systems.
Motors 2021-2023 NDRC; MIIT	Guidelines on Motor Renewal and Recycling:[25] China's installed motor capacity reached about 3 billion kW by the end of 2021, consuming 4.5 trillion kWh per year, or around 55% of total electricity use and 75% of industrial electricity. By 2025, the share of in-use high-efficiency motors (Level 2 or above) should rise by more than 5 percentage points from 2021, and the share of newly installed, high-efficiency motors should rise by 15 percentage points. Expected annual savings: 60 billion kWh, equivalent to 18 million tons of standard coal and 35 million tons of CO_2. Motor Efficiency Improvement Plan:[26] Targets annual production of 170 million kW of high-efficiency motors by 2023 and more than 20% of in-use motors meeting high-efficiency standards. Expected annual savings: 49 billion kWh, equivalent to 15 million tons of coal and 28 million tons of CO_2. Action Plan for Green and Low-Carbon Innovation in Power Equipment:[27] Promotes high-power-density permanent magnet motors, synchronous reluctance motors, smart motors, ultra-efficient asynchronous motors, efficient transformers, electric boilers, electric kilns, wider electrification, and higher system-level efficiency. Industrial Energy Efficiency Action:[28] Encourages motor design optimization, efficient cores, lightweight casings, improved control algorithms, energy-saving certification, motor remanufacturing, and user-side efficiency assessments. By 2025, more than 70% of newly installed motors should be high-efficiency models.

[21] Industrial Energy Efficiency Action Plan, https://wap.miit.gov.cn/jgsj/jns/nyjy/art/2022/art_c43d89e0b209438bad7f7baa28606273.html.
[22] National Energy Saving and Carbon Reduction Plan (2024-2025), https://www.mee.gov.cn/zcwj/gwywj/202405/t20240530_1074495.shtml?_esid=4334262.
[23] Guidelines for the Renewal, Retrofit, and Recycling of Lighting Equipment, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202302/t20230224_1349405_ext.html.
[24] Urban and Rural Construction Carbon Peaking Plan, Https://Www.Gov.Cn/Zhengce/Zhengceku/2022-07/13/Content_5700752.Htm
[25] Guidelines on Motor Renewal and Recycling, https://Www.Ndrc.Gov.Cn/Xxgk/Zcfb/Tz/202302/T20230224_1349405_ext.Html.
[26] Motor Efficiency Improvement Plan, Https://Wap.Miit.Gov.Cn/Zwgk/Zcwj/Wjfb/Tz/Art/2021/Art_76228b2294a14e168c94a9a3db77fc40.Html.
[27] Action Plan for Green and Low-Carbon Innovation in Power Equipment, Https://Wap.Miit.Gov.Cn/Zwgk/Zcwj/Wjfb/Tz/Art/2022/Art_4ccbd89465cc4336b88b19a02bbf473b.Html.
[28] Industrial Energy Efficiency Action, https://wap.miit.gov.cn/jgsj/jns/nyjy/art/2022/art_c43d89e0b209438bad7f7baa28606273.html.

Power transformers 2023 NDRC; National Energy Administration (NEA)	Guidelines for the Renewal, Retrofit, and Recycling of Power Transformers:[29] China had about 17 million power transformers in operation in 2023, with total capacity of about 1.1 billion kVA. Transformer losses account for about 40% of transmission and distribution losses. By 2025, the share of in-use, high-efficiency transformers (Level 2 or above) should increase by more than 10 percentage points from 2021, and high-efficiency transformers should account for more than 80% of new additions. Expected annual savings: 16 billion kWh, equivalent to 4.8 million tons of standard coal and 9.3 million tons of CO_2.
Refrigerants 2025 Ministry of Ecology and Environment (MEE)	National Plan for Implementing the Montreal Protocol on Substances that Deplete the Ozone Layer (2025-2030):[30] Prohibits production and use of seven already phased-out controlled substances, except exempted controlled uses and feedstock uses, and gradually reduces hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbon (HFCs) in controlled uses. HCFC phase-down: Based on baseline production of 29,100 tons of ozone-depleting potential (ODP) and consumption of 18,900 tons of ODP, reduce production and consumption by 67.5% and 73.2%, respectively by 2025, and 97.5% by 2030, with 2.5% retained for uses such as refrigeration and air conditioning maintenance. By 1 January 2030, eliminate HCFCs in controlled uses except a small amount for maintenance. In household appliances, reduce HCFC consumption by at least 70% of the industry baseline by 2025 and prohibit production of appliances using HCFC refrigerants from 1 January 2030. In commercial and industrial refrigeration and air conditioning, reduce HCFC consumption by at least 67.5% of the industry baseline by 2025; prohibit production of multi-split air conditioners/heat pumps using HCFCs from 1 January 2027; and prohibit production of all commercial and industrial refrigeration and air conditioning equipment using HCFCs from 1 January 2030. HFC phase-down: Based on baseline production of 1.853 billion tons of CO_2e and consumption of 905 million tons of CO_2e, reduce both production and consumption by 10% by 2029. Prioritize reductions in vehicles, household appliances, and commercial/industrial refrigeration and air conditioning. From 1 July 2029, newly approved M1 vehicle air conditioning systems may not use refrigerants with a GWP above 150. From 1 January 2026, prohibit production of refrigerators and freezers using HFC refrigerants. From 1 January 2029, prohibit production of room air conditioners for domestic sales using refrigerants with a GWP above 750, excluding household multi-split air conditioners/heat pumps. From 1 January 2029, prohibit unitary and ducted air conditioners/heat pumps of 12 kW or below using refrigerants with a GWP above 750, and prohibit production, construction, or expansion of other refrigeration equipment or systems using refrigerants with a GWP above 2500, except equipment operating below -50°C evaporation temperature. Encourage natural refrigerants, demonstration projects, GWP information on energy labels for major cooling products, and regional cooling efficiency standards by climate zone.

In March 2026, the MIIT issued the Implementation Plan for High-Quality Development of Energy-Saving Equipment (2026–2028).[31] The plan calls for accelerating energy efficiency improvements in energy-saving equipment with strong general applicability, high energy consumption, and promising development potential. It emphasizes a shift toward intelligent, green, and integrated development of energy-saving equipment. By 2028, MIIT aims to achieve:

- Continuous improvement in the compatibility and operational efficiency of energy systems in key industries.

[29] Guidelines for the Renewal, Retrofit, and Recycling of Power Transformers, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202302/t20230224_1349405_ext.html.
[30] National Plan for Implementing the Montreal Protocol on Substances that Deplete the Ozone Layer (2025-2030), https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202504/W020250423386357398288.pdf.
[31] Implementation Plan for High-Quality Development of Energy-Saving Equipment (2026–2028), https://www.miit.gov.cn/jgsj/jns/nyjy/art/2026/art_6f9a8208dea648e2be87a260f5665a26.html.

- International leadership in the energy efficiency levels of energy-saving equipment such as motors and transformers.
- Higher market penetration of energy-saving equipment.
- Advanced and applicable system-level solutions for upgrading and retrofitting energy-saving equipment.
- New application scenarios for energy-saving equipment empowered by artificial intelligence.
- Stronger adoption of efficient motor-driven equipment: Newly added energy-saving motors, fans, pumps, and compressors to reach 35% of installations; in-service shares to exceed 15%.
- Improved energy efficiency and system compatibility of transformers in the new energy sector. By 2028, newly-added energy-saving transformers to account for more than 75%; in-service energy-saving transformers to reach 15%.

Key Takeaways

Clear national-level targets: energy efficiency improvement as a key lever for "dual carbon" goals

China has incorporated energy efficiency upgrades of key energy-consuming equipment into its NDC and the "1+N" policy framework as an important pathway to achieve carbon peaking and carbon neutrality. This covers boilers, motors, transformers, refrigeration and air conditioning, lighting, data centers, and heat pumps. The national approach is shifting from energy consumption control toward carbon emission control, accelerating the establishment of a system for both total and intensity-based carbon emission management.

"1+N" policy framework provides systemic institutional support for equipment efficiency upgrades

The "1" consists of top-level design documents and the action plan for carbon peaking before 2030, while the "N" refers to sectoral implementation plans in industry, buildings, energy, and transport. These plans break down efficiency targets into specific equipment, technology pathways, and timelines.

Boilers: largest energy-consuming and carbon-emitting equipment with great reduction potential

China's boilers consume about two billion tons of standard coal annually, accounting for roughly 40% of national carbon emissions. The national target is to raise industrial boiler thermal efficiency by 3 percentage points by 2030 compared with 2021. Efforts include upgrading standards and phasing out outdated capacity, with accelerated development and revision of standards for boiler thermal efficiency, system efficiency, efficiency testing, carbon accounting, carbon footprint assessment, special boiler system efficiency evaluation, and supercritical CO_2 boilers.

Motors and transformers: high electricity consumption and losses

Policies call for innovation in efficient materials, structural design, and intelligent control to accelerate equipment replacement. By 2025, over 80% of newly added transformers and over 70% of newly added motors must be high-efficiency models. Compared with 2021, the share of high-efficiency motors and transformers in operation will increase by more than 5 percentage points and 10 percentage points respectively.

Refrigeration and air conditioning: strengthening efficiency and climate-friendly refrigerant management

By 2030, the efficiency entry level for major cooling products will be raised by more than 15% compared with 2022. Heat pump efficiency labeling coverage will be expanded, and studies will assess adding refrigerant GWP information.

Lighting: strengthening efficiency and digitalized lighting systems

By 2030, the share of LED and other efficient lighting products in cities will exceed 80%, and more than 30% of cities will have digitalized lighting systems.

Data centers: included in key energy-consuming units management

New and expanded large-scale data centers are required to meet stricter PUE indicators (≤1.2 for some hub nodes), while simultaneously improving renewable energy utilization and computing efficiency.

Heat pumps: efficiency improvement and reduced auxiliary heating

By 2030, the efficiency of key heat pump products will increase by more than 20%. Efficiency labeling coverage will be expanded, with studies on adding refrigerant GWP information. Research will be conducted on efficiency evaluation methods for heating and domestic hot water heat pumps. The use of electric auxiliary heating devices will be gradually reduced.

Refrigerants: phased elimination of ozone-depleting and high-GWP substances

China's national plan requires a complete ban on the production and use of seven ozone-depleting substances (CFCs, halons, etc.) except for exempted uses. HCFCs will

be almost entirely phased out by 2030, reduced by more than two-thirds by 2025, and down to 2.5% of baseline by 2030 for essential maintenance. HFCs will be controlled and reduced by CO_2 equivalent, with a 10% reduction by 2029, prioritizing household appliances, automobiles, and commercial/industrial air conditioning. Clear timelines and bans are set, prohibiting HCFC-based appliances and commercial cooling equipment, and gradually restricting high-GWP refrigerants in air conditioners, refrigerators, and vehicle AC systems. By raising efficiency standards, promoting low-GWP or natural refrigerants, and improving efficiency/GWP labeling, China aims to achieve synergistic benefits for ozone protection and climate change mitigation.

China's Appliance Energy Efficiency Policies

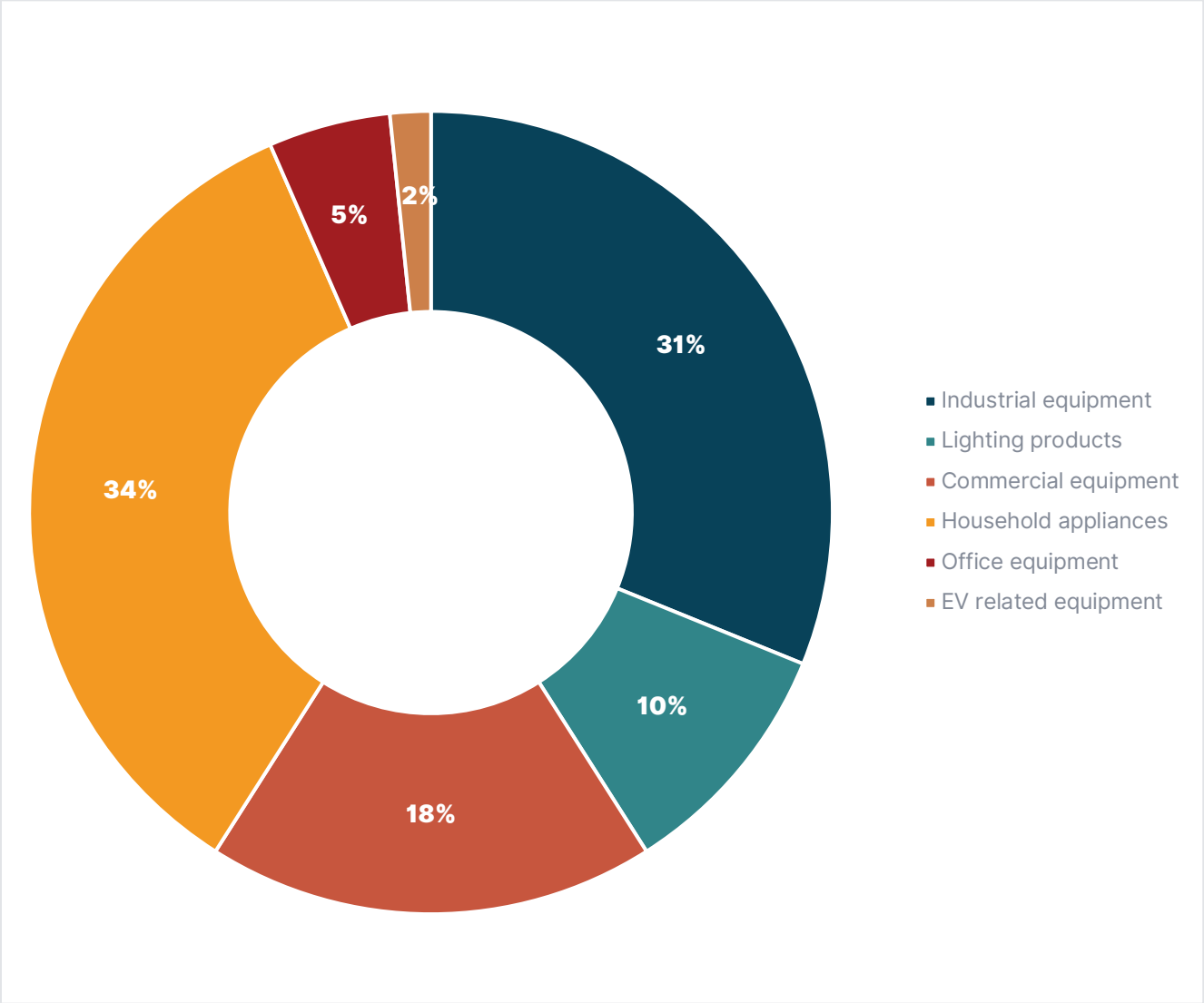
Overview

China has developed a robust regulatory framework for appliance energy efficiency and energy labeling system to support national Dual Carbon Goals. China's energy labeling system has been implemented since 2005. As of June 2026, China has published 61 MEPS,[32] which cover most categories of energy-consuming appliances and machinery available on the market. Among them, 45 categories of energy-consuming products have implemented energy labeling.

These MEPS are systematically organized into six major groups, including industrial equipment, lighting products, commercial equipment, household appliances, office equipment and electronic vehicle (EV) related equipment—as illustrated in Figure 2. By establishing efficiency benchmarks and encouraging the adoption of best available technologies, China's energy efficiency standards and energy label have become a critical policy foundation for accelerating energy-saving innovations and driving decarbonization.[33]

[32] SAMR, n.d., https://std.samr.gov.cn/.
[33] Report on 20 Years of China Energy Labelling Program, 2025, CNIS. https://www.cnis.ac.cn/bydt/kydt/202507/P020250703320906036500.pdf

FIGURE 2 Product Categories Covered by China's MEPS



Source: https://openstd.samr.gov.cn/bzgk/std/index

China's energy labeling system adopts mandatory efficiency grading (Levels 1–3 or 1–5). Level 1 represents the highest efficiency, while Level 3 or Level 5 serves as the minimum threshold for market access. China's energy efficiency standards and labeling are mandatory: products that fail to meet energy efficiency minimum requirements are prohibited from being sold. Subsidy policies favor high-efficiency products, stimulating green transformation and guiding consumers to choose efficient products through financial incentives. China's energy efficiency standard and energy label promote a green transition in the appliance market through the combined forces of policy enforcement, technological innovation, and market incentives.

Policies for Upgrading MEPS and Rescaling China's Energy Labels

In March 2023, the NDRC issued the Notice on Further Strengthening the Updating, Upgrading, and Implementation of Energy-Saving Standards.[34] The notice calls for accelerating the development and revision of a series of energy-saving standards in key areas, enhancing mandatory MEPS for major energy-consuming products and equipment such as motors, fans, pumps, compressors, welding machines, and industrial boilers. The objective is to align China's efficiency indicators with internationally advanced standard levels and continuously improve the energy efficiency of key energy-consuming products and equipment.

In China, mandatory MEPS for key energy-consuming products and equipment are divided into three levels (and five levels in some cases):

- Level 1 benchmarks against the leading domestic or international energy efficiency levels of similar products and equipment, generally representing the top ~5% efficiency level of comparable products.
- Level 2 serves as the basis for energy-saving product certification and for equipment procurement in new, expanded, or renovated projects, generally representing the top ~20% efficiency level of comparable products.
- Level 3 (or Level 5) is the minimum energy efficiency threshold for products and equipment required for market entry. Based on the technical characteristics and current efficiency status of each category, it should, in principle, eliminate about 20% of outdated, inefficient products and equipment.

[34] Notice on Further Strengthening the Updating, Upgrading, and Implementation of Energy-Saving Standards, https://www.samr.gov.cn/zw/zfxxgk/fdzdgknr/bzjss/art/2023/art_bfa57fce9cb24a4d9d1f76cabedc0c59.html.

FIGURE 1 General Principles for Upgrading and Rescaling China's MEPS

In 2024, NDRC issued the Advanced Energy Efficiency Levels, Energy-Saving Levels, and Market Access Levels for Key Energy-Consuming Products and Equipment (2024).[35] For the 43 type categories covered, the mandatory energy efficiency requirements of Level 1, Level 2, and Level 3 (or Level 5) should remain aligned with the current advanced, energy-saving, and market access levels. For major equipment and products that currently do not have energy efficiency standards, the policy also sets advanced values, energy-saving values, and access values to guide future standard development.

For major energy-consuming products and equipment whose energy efficiency levels generally exceed the Level 1 requirements, priority will be given for inclusion in the Catalogue for Guiding Green Industries and the Catalogue for Promoting Green Technologies. Government green procurement policies will be improved, with increased support for the procurement of high-efficiency, energy-saving products that meet policy requirements.

Incentive Policies for Promoting High-Efficiency Appliances

In March 2024, the State Council of China issued the Action Plan for Promoting Large-Scale Equipment Renewal and Consumer Goods Trade-In.[36] Under this plan, individual

[35] Advanced Energy Efficiency Levels, Energy-Saving Levels, and Market Access Levels for Key Energy-Consuming Products and Equipment (2024), https://www.ndrc.gov.cn/xxgk/zcfb/ghxwj/202402/P020240207565694124092.pdf
[36] Action Plan for Promoting Large-Scale Equipment Renewal and Consumer Goods Trade-In, https://www.mofcom.gov.cn/zfxxgk/fdzdgknr/ztfl/ghjh/art/2024/art_b33516d9a9d04f968c7d84c16d950172.html.

consumers who purchase eight categories of household appliances, such as refrigerators, washing machines, televisions, and air conditioners, with energy efficiency or water efficiency of Level 2 or above, will be eligible for trade-in subsidies.

In 2025, NDRC and Ministry of Finance (MoF) expanded the scope of trade-in subsidies to include four additional categories of household appliances: microwave ovens, water purifiers, dishwashers, and rice cookers. For individual consumers purchasing products among the twelve categories of household appliances that meet Level 2, the subsidy rate is 15% of the sales price. For products meeting Level 1, the subsidy rate is 20% of the sales price.

Energy labeling, as a key carrier of energy efficiency information, provides the data foundation for the trade-in policy implementation. The registered data of energy labels supports China's trade-in program by enabling verification of energy efficiency data.

In 2026, the trade-in subsidy program was adjusted to cover six categories of household appliances: refrigerators, washing machines, televisions, air conditioners, computers, and water heaters. Products meeting Level 1 requirements receive a subsidy of 15% of the product's sales price. Each consumer may receive a subsidy for one unit per product category, with the subsidy for each unit capped at 1,500 RMB.

To support the implementation of the Action Plan for Promoting Large-Scale Equipment Renewal and Consumer Goods Trade-In, in 2024, the State Administration for Market Regulation (SAMR) issued the Action Plan for Driving Equipment Renewal and Consumer Goods Trade-In through Standard Enhancement.[37] The plan calls for rapid upgrades to energy consumption and energy efficiency standards.

It emphasizes promptly revising a series of mandatory energy efficiency standards for household appliances and industrial equipment, with a focus on raising standards for key energy-consuming equipment such as EV chargers, boilers, motors, transformers, pumps, chillers, and cold storage facilities. The goal is to enhance energy efficiency requirements up to internationally-advanced levels and strengthen the role of standards in supporting the implementation of the trade-in policies. Targets include completing the development and revision of 294 key national standards in 2024 and 2025, with over 96% alignment between national standards and international standards for consumer goods in key areas. Of these, 113 standards relate to equipment renewal, and 115 standards relate to consumer goods trade-in. SAMR will also carry out domestic and international standards comparison in three fields: household appliances, carbon emissions, and automobiles.

[37] Action Plan for Driving Equipment Renewal and Consumer Goods Trade-In through Standard Enhancement, https://www.samr.gov.cn:7280/zw/zfxxgk/fdzdgknr/bzjss/art/2024/art_0955130c8b7b4716a3a075dd8eb09d0e.html.

According to data released by NDRC in January 2026, more than 360 million people applied for consumer goods trade-in subsidies in 2025. The program has cumulatively resulted in annual energy savings equivalent to over 69 million tons of standard coal and reduced carbon emissions by more than 170 million tons.[38]

The Action Plan for Promoting Large-Scale Equipment Renewal and Consumer Goods Trade-In program significantly accelerated market transformation. CLASP's analysis of more than 4,800 air conditioner models on JD.com shows that over 83% of air conditioner models launched in 2024 and 2025 were rated Level 1. For products launched in 2025 alone, the proportion of Level 1 exceeded 97%. In comparison, only 60% of air conditioners launched between 2020 and 2023 achieved Level 1.[39]

CNIS (China National Institute of Standardization) analysis shows a similar trend for televisions. The proportion of Level 1 models in 2025 reached 64.9%, compared to 23.1% of Level 1 models in 2024.

China's S&L Policies Support the Certification of Energy-saving Products and Government Procurement

China's energy-saving product certification is a voluntary certification system authorized by the Certification and Accreditation Administration of China (CNCA) and implemented by institutions such as the China Quality Certification Center (CQC). It aims to promote energy conservation and emission reduction, encourage green consumption, and support industrial upgrading. Products that pass the certification may carry the energy-saving product label and enjoy policy support, such as priority in government procurement and financial subsidies. The energy-saving product certification is mainly based on energy efficiency standards, with Level 2 requirements in energy efficiency standards generally serving as the requirement for energy-saving products.

China's government procurement policy for energy-saving products requires government agencies and public sectors to give priority to, or in some cases, mandatorily purchase, products that have obtained energy-saving certification when using fiscal funds. The Ministry of Finance and NDRC issue the Catalogue of Energy-

[38] Policy effectiveness of equipment upgrades and consumer goods trade-in programs, http://www.china.com.cn/zhibo/content_118287209.htm.
39 JD, https://www.Jd.com/

Saving Products for Government Procurement,[40] which identifies products that must or should be prioritized for procurement, in order to promote energy conservation.

Currently, the Catalogue of Energy-Saving Products for Government Procurement covers 18 product categories: computer, printing and display equipment, projectors, multifunctional copiers, pumps (centrifugal pumps), refrigeration and air conditioning equipment, motors, transformers, ballasts, household electrical appliances, lighting equipment, television, video equipment, catering and cooking machinery, toilets, faucets, toilet flushing valves, and showers.

The energy-saving standards are based on the latest versions of energy efficiency or water efficiency standards.

- **Mandatory procurement:** For products with strict energy efficiency requirements (such as computers and air conditioners), procurement must be limited to items listed in the catalogue and certified as energy-saving. Currently, computer, laser printers, dot-matrix printers, monitors, refrigeration compressors, air conditioners, data center air conditioners, ballasts, television, video equipment, toilets, and faucets are designated as products for mandatory government procurement.
- **Priority procurement:** For products not subject to mandatory procurement but that meet energy-saving standards, preference is given during evaluation.

China's MEPS for RAC Promotes Green International Trade

By 2025, China had implemented energy labeling for eleven categories of refrigeration products, covering household refrigerators, room air conditioners, packaged air conditioners, chillers (including heat pump units), multi-split air conditioners (heat pump units), remote condensing-unit refrigerated display cabinets, water (ground) source heat pump units, lithium bromide absorption chillers/heaters, self-contained condensing-unit commercial refrigerators, ducted air-conditioning units, and low ambient temperature air-source heat pump (chiller) units.

In 2019, China revised the energy efficiency standard for room air conditioners, and by 2024, 74% of air conditioner models reached Level 1.[41] In April 2025, China launched

[40] Catalogue of Energy-Saving Products for Government Procurement, https://www.ccgp.gov.cn/zcfg/mof/201904/t20190403_11849836.htm.
[41] Report on 20 Years of China Energy Labelling Program. https://www.cnis.ac.cn/bydt/kydt/202507/P020250703320906036500.pdf

another revision to further raise efficiency requirements, with plans to complete the revision by the end of 2026.

To promote green trade of air conditioners, in June 2025, the Ministry of Commerce of China (MOFCOM) issued the voluntary industry standard WM/T 12-2025: Energy Efficiency and Carbon Efficiency Grades for Exported Room Air Conditioners. This standard applies China's energy efficiency testing methods for air conditioners, while integrating the efficiency requirements of target countries or regions, thereby establishing energy efficiency grading requirements and testing methods suitable for international trade.

This standard, using a life-cycle assessment approach, incorporates factors such as product carbon footprint and total output, and on the basis of energy efficiency grading, formulates technical requirements and testing methods for carbon efficiency. This helps improve the green and low-carbon standards for international trade.

The standard stipulates that room air conditioners exported to different countries or regions must comply with local regulations and standards. Energy efficiency is divided into five levels: Green++, Green+, Green, Green-, and Conforming, with Green++ being the highest. Carbon efficiency is also divided into the same five grades, with Green++ being the highest. The requirements are tailored to the standards of target countries and regions.

The standard applies to free-delivery air conditioners with rated cooling capacity ≤ 14,000 watts, using air-cooled condensers and hermetic motor-compressors. It does not apply to portable air conditioners, unitary air conditioners, or multi-connected air conditioners (heat pump units).

The standard took effect on 1 January 2026. At present, the Chinese government, led by the MOFCOM, is actively studying supporting incentive policy measures to promote its implementation.

Key Takeaways

China has established comprehensive mandatory MEPS and energy labeling systems (S&L system).

China's S&L system covers most major energy-consuming products; the system integrates mandatory minimum energy performance standards, energy labels, certification, government procurement, and financial incentives into a coherent policy framework that supports China's Dual Carbon goals.

MEPS and energy labels are evolving from market-entry requirements to a dynamic policy mechanism for continuous efficiency improvement.

Through MEPS revisions and label rescaling, China continuously raises efficiency benchmarks, eliminates inefficient products, and aligns domestic standards with international best practices, creating predictable signals for manufacturers to innovate.

The combination of mandatory standards and financial incentives has significantly accelerated market transformation.

The appliance trade-in program links subsidy levels directly to energy label grades, rapidly increasing the market share of high-efficiency products while delivering substantial energy savings and carbon emission reductions.

China's S&L policies are expanding beyond the domestic market to support green trade and international competitiveness.

By integrating energy efficiency, certification, government procurement, and export-oriented standards, China is using its S&L framework not only to improve domestic energy performance but also to facilitate international trade in high-efficiency room air conditioners.

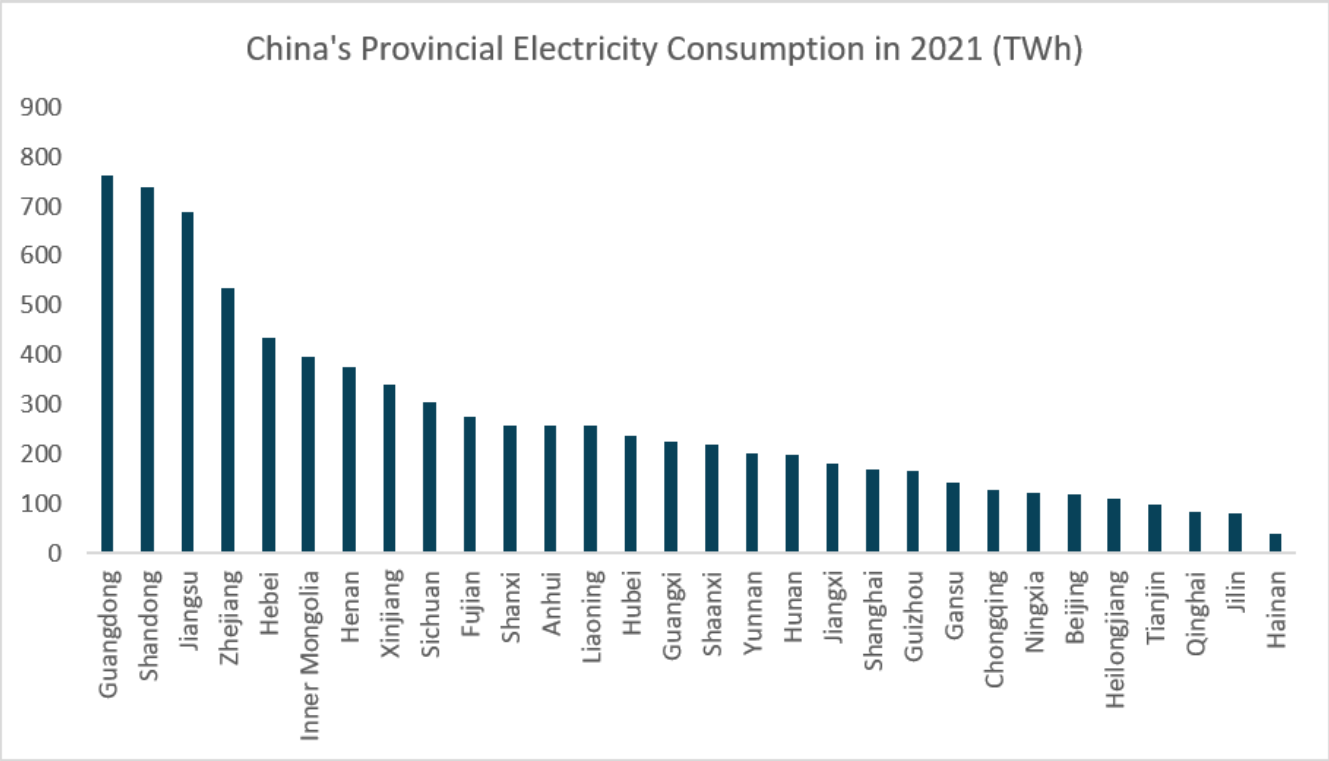
Provincial and Municipal-level Policies on Appliances

Chinese provinces and municipalities develop local energy-saving policies in line with national directives and tailored to their industrial profiles and energy consumption patterns. Local policies prioritize key sectors such as industry, construction, refrigeration, lighting, heat pumps, and data centers. The strength of local initiatives lies in their alignment with regional realities, enabling targeted measures with greater flexibility and stronger enforcement than uniform national policies.

In 2021, China's total electricity consumption reached approximately 8,100 TWh and increased to over 10,000 TWh in 2025.[42] Guangdong, Shandong, Jiangsu and Zhejiang were the top four consuming provinces, together accounting for nearly 33% of national electricity use.[43]

[42] China National Statistical Bureau, 2026
[43] China Energy Statistical Yearbook 2022

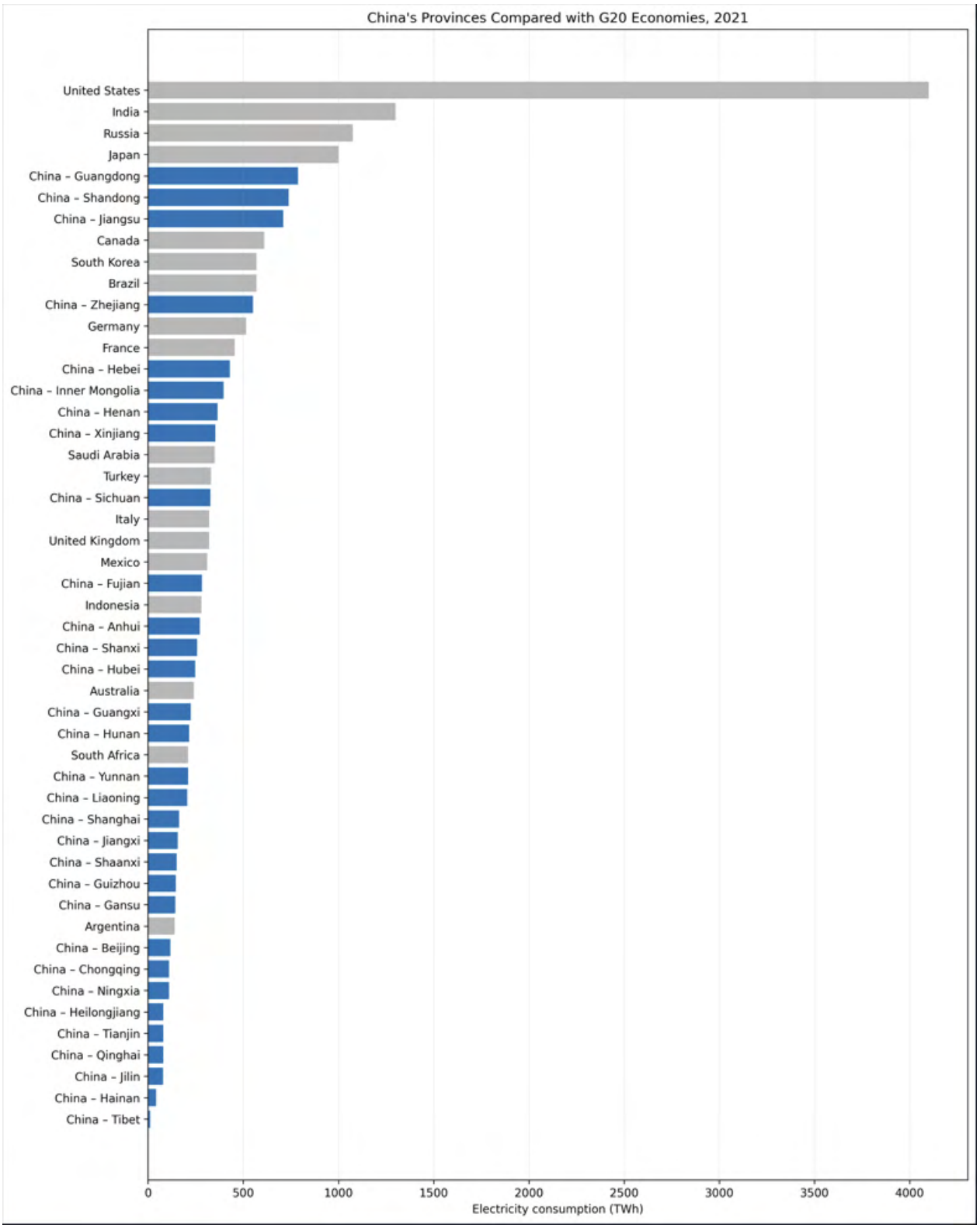
FIGURE 2 China's Provincial and Municipal Electricity Consumption in 2021



Source: China Energy Statistical Yearbook 2022

China's total electricity consumption in 2025 exceeded the combined annual power consumption of four economies, namely the EU-27, India, Russia, and Japan. Separately, China's electricity consumption was more than twice that of the United States for the whole year.

FIGURE 3 China's Provinces Electricity Consumption vs G20 in 2021



Source: IEA, World Energy Statistics & China Energy Statistical Yearbook 2022

Table 4 summarizes energy-saving policies in typical provinces and cities across the fields of industry, construction, refrigeration, lighting, heat pumps, and data centers.

TABLE 2 Typical Provincial and Municipal Policies

Sector / Typical Provinces and Municipalities / Publication Year	Main Policy Contents
Buildings Shanghai 2022	Raises building energy efficiency design requirements and strengthens efficiency requirements for refrigeration products, helping phase out low-efficiency equipment. Improves green government procurement and expands support for innovative, high-efficiency refrigeration products. Encourages engineering tender evaluations to give greater weight to green and energy efficiency indicators.[44]
Data Centers Beijing 2023-2024	Beijing's 2024-2027 plan requires the citywide average data center PUE to fall below 1.35 by 2027 and promotes green retrofits, intelligent computing transformation, and green electricity use.[45] For new, renovated, or expanded data centers, Beijing sets stricter PUE limits based on annual energy consumption: <=1.30 below 10,000 ton of coal equivalent (tce); <=1.25 for 10,000-20,000 tce; <=1.20 for 20,000-30,000 tce; and <=1.15 above 30,000 tce. Beijing's local standard DB11/T 1139-2023, effective April 2024, manages actual operating PUE under energy efficiency limits and applies differential electricity pricing to data centers exceeding the limits.
Heat Pumps Beijing, Hebei, Tianjin 2024	Beijing promotes Level 1 energy-efficient air-source heat pumps for heating and advances building electrification.[46] Hebei promotes electricity substitution through high-temperature heat pumps and large-capacity electric thermal storage boilers, expanding electrified end-use energy equipment.[47] Tianjin prioritizes electric heat-pump heating where conditions allow and encourages demonstrations linked to energy storage and electric heating technologies.[48]
Industrial Jiangsu, Zhejiang, Guangdong 2023-2024	Jiangsu promotes coal-fired boiler upgrades, green lighting, energy-system optimization, and efficiency improvements for key energy-using enterprises; targets internationally advanced energy efficiency in key industries by 2027.[49]

[44] Shanghai building energy efficiency design standards, https://fgw.sh.gov.cn/ys-hqjycs-1.4.2.1/20240319/5fc147305d15436c9e6bc0792b10669d.html.
[45] Beijing Work Plan for Optimizing Existing Data Centers (2024–2027), https://www.beijing.gov.cn/zhengce/zhengcefagui/202411/t20241115_3942264.html.
[46] Implementation Plan for Further Strengthening Energy Conservation of Beijing (2024), https://www.beijing.gov.cn/zhengce/zhengcefagui/202402/t20240202_3554355.html.
[47] Action Plan for Accelerating Technological Transformation and Upgrading of Manufacturing Industry of Hebei Province, https://gxt.hebei.gov.cn/hbgyhxxht/zcfg30/snzc/202504191909089405 2/index.html.
[48] The Special Heating Plan of Tianjin Municipality, https://www.tj.gov.cn/sy/ztzl/ztlbthree/zdlyxxgk/zdxzjc/zdxzjcjg/202411/W020241203294235054016.pdf.
[49] The Implementation Plan for Carbon Peaking in the Industrial Sector and Key Industries of Jiangsu, https://wap.miit.gov.cn/jgsj/jns/dfdt/art/2023/art_a70074bf57c045049440ec1955c97e87.html.

	Jiangsu aims to formulate or revise 100 local, group, and enterprise standards related to energy consumption by 2027.[50] Zhejiang focuses on seven carbon-peaking industries: steel, building materials, petrochemicals, chemicals, papermaking, chemical fibers, and textiles; and regularly updates provincial industrial energy efficiency guidelines.[51] Zhejiang accelerates retrofits of high-energy-consuming equipment systems and promotes efficient boilers, motor systems, transformers, and other major equipment. By 2027, it aims to contribute to 100+ national standards and issue 80+ provincial standards. Guangdong, by 2025 and compared with 2021, raises average operating efficiency of industrial boilers by over 5% and power station boilers by 0.5%; increases in-use high-efficiency motors and transformers by over 5% and 10%, respectively.[52] Guangdong targets high-efficiency products to reach 40% of commercial refrigeration, 60% of household refrigeration, and 50% of general lighting equipment in use; Guangzhou also sets local limit, benchmark, and leading values for key equipment.[53]
Lighting Chongqing, Guangdong 2023-2024	Chongqing requires intelligent control systems for urban road lighting to enable smart monitoring, management, switching, and brightness control.[54] Chongqing, by 2030, expects LED and other high-efficiency lamps to exceed 80% of use, and more than 30% of cities to have digital lighting systems.[55] Guangdong builds smart lighting management and control platforms and pilots Internet of Things (IoT) and big data applications for demand-based lighting management. Guangdong upgrades control platforms and single-lamp controllers, develops smart low-carbon lighting standards and brands, and strengthens urban lighting planning and energy-saving requirements. By 2025, Guangdong targets LED and other high-efficiency lamps to exceed 80% of use, with more than 20% of cities having digital lighting systems.[56]
Refrigeration Guangdong 2023	Guangdong is China's largest cooling-energy province: cooling uses more than 15% of provincial electricity and grows by nearly 20% annually; air conditioning can account for about 60% of summer peak load in large and medium-sized cities. Industrial park cooling loads average about 40% of production electricity use and can approach 60% in some clusters; major cooling products have estimated energy-saving potential of 30-50%. By 2025, the market share of high-efficiency cooling products, including household air conditioners and multi-split units, should rise by 20% from 2020 levels. Large public buildings and industrial parks should improve cooling-system efficiency by 20%; new central air-conditioning systems should achieve annual average energy efficiency ratio (EER) above 5.0, while systems below EER 4.0 should be gradually retrofitted.

[50] The Action Plan for Promoting Large-Scale Equipment Renewal and Consumer Goods Trade-In in Jiangsu Province, https://www.ndrc.gov.cn/xwdt/ztzl/tddgmsbgxhxfpyjhx/dfjy/202406/t20240603_1386664.html
[51] The Implementation Plan for Carbon Peaking in the Industrial Sector of Zhejiang Province, https://wap.miit.gov.cn/jgsj/jns/dfdt/art/2023/art_0bd2ec0fb8cb41bbadfb33b3382da3ae.html.
[52] The 2024–2025 Energy Conservation and Carbon Reduction Action Plan of Guangdong Province, https://www.eesia.cn/upload/files/2024/12/8839520a0eb41761.pdf
[53] Guangzhou Industrial Energy Efficiency Guidelines (2024), https://fgw.gz.gov.cn/tzgg/content/post_9556791.html.
[54] The Administrative Measures for Urban Road Lighting in Chongqing, Https://Www.Cq.Gov.Cn/Zwgk/Zfxxgkml/Szfwj/Zfgz/Zfgz/202109/T20210930_9779795.Html."
[55] Implementation Plan for Carbon Peaking in the Urban and Rural Construction Sector of Chongqing, https://zfcxjw.cq.gov.cn/zwxx_166/gsgg/202301/t20230112_11495514.html.
[56] Lighting Energy Efficiency Improvement Action Plan of Guangdong (2023-2025), https://zfcxjst.gd.gov.cn/cxjs/dtxx/content/post_4209781.html.

	Overall cooling-system efficiency should improve by more than 25%, and digital smart management should reach more than 20% penetration.[57]

Key Takeaways

Industry: Zhejiang, Jiangsu, and Guangdong are major industrial provinces in China. Key general-purpose equipment such as boilers, transformers, motors, pumps, fans, and compressors are priority products for improving industrial energy efficiency. Building on the national plan for industrial equipment efficiency improvement, all three provinces have incorporated into their local industrial development plans the formulation of local and industry standards for industrial equipment efficiency that are stricter than national standards. Guangzhou has already issued a municipal-level Industrial Energy Efficiency Guidelines.

Buildings: Shanghai released its local 14th Five-Year Plan for Green Buildings, which specifies that by 2025, carbon emissions from the building sector should be controlled at around 45 million tons. The plan calls for establishmenting ultra-low energy consumption building standards and demonstration projects, as well as the completion of building energy efficiency retrofits. Shanghai will also improve its building energy efficiency standards, strengthening requirements for the efficiency of cooling equipment in building design standards.

Cooling: Guangdong is China's largest cooling energy consumer, with cooling electricity accounting for more than 15% of total provincial electricity use. Guangdong issued the Green and Efficient Cooling Action Plan (2023–2025), which sets clear requirements for the energy efficiency ratio of air conditioning systems in large public buildings and new projects, efficiency improvement levels, and the penetration rate of intelligent management systems.

Lighting: The national plan aims that by 2030, the share of high-efficiency lighting products such as LEDs in urban areas will exceed 80%, and more than 30% of cities will have built digital lighting systems. Building on this national plan, Chongqing and Guangdong have formulated development plans for urban road lighting, requiring the construction of intelligent urban lighting management systems to enable smart monitoring and management of urban lighting.

Heat Pumps: Beijing encourages the promotion of Level 1 air-source heat pump products for heating and advancing building electrification. Hebei has proposed

[57] Guangdong Green and Efficient Cooling Action Plan (2023–2025), https://www.eesia.cn/upload/files/2023/3/eecf86368ab9cba2.pdf.

electricity substitution using high-temperature heat pumps. Tianjin encourages pilot and demonstration projects for heat pump heating.

Data Centers: The national plan requires that by 2025, the average PUE of newly-built, large and ultra-large data centers nationwide be reduced to below 1.3, and to below 1.25 for national hub nodes. The average PUE of all data centers nationwide should be reduced to below 1.5. Most provinces have followed the national plan in formulating provincial and municipal green data center development schemes. As a national computing hub node, Beijing has not only implemented local standards for data center energy consumption limits, but also set PUE thresholds based on annual electricity consumption, which are stricter than the overall national green data center plan requirements.

Energy Efficiency Improvement Potential and Carbon Emission Impact in China's Appliances

This section summarizes the energy efficiency improvement potential and carbon emission impacts of selected appliances and industrial equipment in China. The purpose is to show why appliances and equipment efficiency should remain a core pillar of China's decarbonization strategy. The analysis focuses on high-impact end uses, including motor systems, compressed-air systems, room air conditioners, refrigerators, and LED lighting. These categories represent a large share of electricity use and offer significant opportunities for cost-effective emission reductions.

Methodology

The analysis applies CLASP's Mepsy methodology. Mepsy is a bottom-up stock accounting model used to assess the energy, emissions, and policy impacts of appliance and equipment efficiency measures. It estimates national appliance stock by combining historical sales, product lifetimes, and retirements. The stock is then multiplied by unit energy consumption to estimate annual electricity demand under different policy scenarios.

Electricity savings are converted into primary energy and carbon emission reductions using country-specific factors. These include transmission and distribution losses,

power plant heat rates, and grid emission factors. The grid emission factor is especially important because China's power system is expected to decarbonize over time. As the grid becomes cleaner, indirect emissions from electricity use will decline, while direct emissions, such as refrigerant leakage from cooling equipment, will become relatively more important.

This section compares a business-as-usual pathway with several policy and technology scenarios. The exact scenario differs by product, but the general logic is consistent:

- **MEPS scenario:** Assumes implementation of strengthened minimum energy performance standards or the new mandatory efficiency threshold.
- **BAT scenario:** Assumes wider adoption of best available technologies, such as Grade 1 products or the highest practical efficiency level available in the market.
- **Global benchmark scenario:** Reflects efficiency improvement levels that could be achieved by aligning with strong international practice and available market technologies.
- **Net Zero Hero scenario:** Presents an accelerated pathway in which appliances and industrial equipment make a stronger contribution to China's 2060 carbon-neutrality goal through faster adoption of high-efficiency technologies and system-level optimization.
- **Refrigerant transition scenarios:** Assesses the direct emission reductions from faster market adoption of ultra-low-GWP refrigerants, especially R290.

Source note: Unless otherwise stated, results are based on Mepsy analysis conducted by Hu Bo, CLASP China Program, 2025, using product-specific assumptions and China power-sector emission factors.

Key Assumptions

The modeling is based on a set of common assumptions across product groups. First, future electricity demand is shaped by appliance stock growth, replacement cycles, and efficiency improvements in new products. Second, policy impacts are calculated by comparing the energy use and emissions of products under a baseline scenario with those under stronger MEPS or BAT scenarios. Third, cumulative emission reductions are calculated over the projected lifetime of effected products. Fourth, for cooling equipment, both indirect emissions from electricity use and direct emissions from refrigerant leakage are considered.

For motor systems, the analysis evaluates efficiency improvement at three levels: component efficiency, motor-driven unit efficiency, and whole-system efficiency. This is important because the largest savings often come from system-level optimization, better matching of motors, loads, controls, and operating conditions. For RACs, the

analysis uses APF 4.0 as the baseline for the current standard, APF 5.0 as an improved MEPS pathway, and APF 6.25 as a high-efficiency or BAT pathway. For refrigerators, the analysis compares the new Grade 5 MEPS level with Grade 1 BAT. For lighting, the analysis compares MEPS impacts with BAT adoption for indoor LED lighting and road and tunnel LED lighting.

Results by Key Appliance and Equipment Category

Motor systems

Motor systems are the largest source of appliance- and equipment-related emissions in China's industrial sector. In 2023, emissions from motor systems reached about 2.83 Gt CO_2. Pumps, fans, and air compressors are the three most important motor-driven applications, together accounting for about 51.1% of industrial electricity-related emissions.

China has established MEPS and efficiency grades for several key types of industrial equipment, including motors, fans, pumps, and air compressors. These standards provide a strong foundation for improving product efficiency. However, the analysis shows that the largest remaining potential lies in system-level optimization. This includes better equipment sizing, variable-speed control, improved transmission efficiency, load matching, and better operation and maintenance.

Mepsy modeling shows that a global benchmark scenario could improve average motor-system efficiency by about 5.5%. Under the more ambitious Net Zero Hero scenario, system efficiency gains could reach 14.7%. When applied to China's projected industrial electricity demand, these gains translate into very large cumulative emission reductions. The result confirms that motor-system efficiency should be treated as a strategic priority for industrial decarbonization, not only as a product efficiency issue.

Compressed air systems

Compressed air systems provide a clear example of why system-level policy is essential. Energy losses occur across the full system, including compressors, dryers, filters, pipes, leakage points, storage, pressure control, and end-use equipment. Improving only the compressor may therefore leave a large share of the saving potential untouched.

China issued GB/T 45785—2025, Evaluation of Energy Performance for Compressed Air Stations, in 2025. The standard establishes a system-level energy performance classification, with Grade 1 representing the best performance and Grade 5, the minimum level. Model results show that moving from current average performance toward Grade 1 could deliver efficiency improvements above 50%. The cumulative

emission reduction potential is also substantial. However, the standard is voluntary. This limits its practical impact unless it is supported by stronger policy tools, such as mandatory requirements for large industrial users, public procurement rules, retrofit incentives, or integration into energy audits and local energy-saving programs.

Room air conditioners and refrigerants

Cooling demand in China continues to rise due to urbanization, income growth, and increasing demand for thermal comfort. Cooling appliances account for an estimated 15% to 18.6% of national electricity consumption. Room air conditioners are the most important residential cooling product and are therefore a key focus for energy efficiency and refrigerant transition policy.

China's current MEPS for common RAC models sets a minimum APF of 4.0. This was once a world-leading requirement. However, CLASP's market monitoring shows that the average RAC sold online now exceeds APF 5.0. A 2025 joint study[58] by CLASP and Beijing University of Civil Engineering and Architecture further found that APF 6.25 is technically feasible, with an estimated product cost increase of about 10% compared with APF 4.0. The results indicate that RAC MEPS can be tightened further and that higher efficiency standards could deliver major lifetime emission reductions.

Refrigerants are also becoming more important. As China's electricity grid decarbonizes, indirect emissions from electricity use will decline. Direct refrigerant emissions will then represent a larger share of lifecycle climate impact. For a typical 3,900 W RAC, estimated direct emissions are about 2,410 kg CO_2e using R410A, 580 kg CO_2e using R32, and about 1 kg CO_2e using R290. The transition from R410A to R32 therefore reduces direct emissions substantially, but the shift from R32 to ultra-low-GWP alternatives such as R290 offers much larger long-term climate benefits.

The modeling compares medium and fast R290 market transformation pathways. The results show that earlier adoption produces much higher cumulative emission reductions. This confirms the need to coordinate RAC efficiency policy with refrigerant policy, safety standards, industry readiness, and consumer awareness.

TABLE 3 Estimated Direct Emissions for Room Air Conditioner Models

Typical 3,900 W RAC	R410A	R32	R290
Direct emissions (kg CO_2e)	2,410	580	1

[58] Technology Options for Doubling the Energy Efficiency of Room Air Conditioners, May 2026. https://www.clasp.ngo/research/all/doubling-energy-efficiency-room-air-conditioners

Source: CLASP calculation using refrigerant charge assumptions and GWP values from IPCC AR5, as summarized in the original section 5 draft.

Household refrigerators

The revised national standard for household refrigerators, GB 12021.1–2025, was issued in 2025. It significantly strengthens the minimum efficiency requirement for common refrigerator-freezers, reducing the Total Energy Efficiency Index (TEEI) threshold from 90% to 40%. This represents a major increase in stringency and creates a new baseline for market transformation.

The standard includes both a Grade 5 MEPS level and a Grade 1 BAT level. The MEPS level will generate significant emission reductions by removing inefficient models from the market. However, the difference between Grade 5 and Grade 1 also highlights a major technology and market challenge. Moving from TEEI 40% to TEEI 20% requires a 100% improvement relative to the new baseline. This is not a minor incremental improvement. It requires major technology upgrades, higher production costs, and stronger market incentives to encourage manufacturers and consumers to move toward top-tier products.

LED lighting

Lighting remains another important source of electricity demand. China has established MEPS for key LED lighting technologies, including indoor LED luminaires, road and tunnel LED lamps, and general LED luminaires. The analysis focuses on indoor LED lighting and road and tunnel lighting because they represent important electricity-saving opportunities.

Indoor LED lighting accounts for about 70% of lighting electricity demand. Road and tunnel LED lighting accounts for a smaller but still important share, estimated at about 4.5% of lighting electricity consumption. MEPS will deliver substantial savings in both categories. However, BAT analysis shows that the full technical potential is much larger. For both indoor and outdoor LED lighting, BAT adoption could roughly double the emission reductions achieved under the MEPS scenario. This suggests that standards should be complemented by green procurement, utility programs, public-sector retrofits, and market incentives for high-efficiency products.

Summary of Energy-Saving and Carbon Emission Impacts

Table 6 summarizes the main energy efficiency assumptions and modeled carbon reduction impacts for the analyzed appliances and equipment. The results show that

efficiency improvement remains a major and cost-effective decarbonization pathway for China. The largest opportunities are found in motor systems and system-level industrial equipment, followed by RACs, refrigerators, and LED lighting. The comparison between MEPS and BAT scenarios also shows that standards alone are not enough. To capture the full technical potential, China will need faster MEPS updates, stronger market incentives, better compliance, and policies that promote system-level efficiency and low-GWP refrigerants.

TABLE 4 Summary of Modelled Energy-Saving Pathways and Carbon Impacts

Product / equipment	Main energy-saving pathway	Key assumption	Modelled carbon impact
Motor systems	System-level optimization of motors, pumps, fans, compressors, and controls	Global benchmark: 5.5% average system efficiency gain; NZH: up to 14.7%	Cumulative CO_2 reduction by 2040: about 1.30 Gt under Global Benchmark and 3.53 Gt under NZH
Compressed air systems	System performance improvement under GB/T 45785—2025	Current systems can improve by more than 50% when upgraded toward Grade 1 performance	Cumulative CO_2 reduction by 2040: about 0.78 Gt from Grade 4 improvement and 1.44 Gt under Grade 1/BAT
Room air conditioners - efficiency	Higher RAC efficiency through strengthened MEPS and BAT adoption	APF 5.0 MEPS scenario; APF 6.25 BAT scenario	Cumulative CO_2 reduction by 2040: about 0.83 Gt under APF 5.0 and 1.49 Gt under APF 6.25
Room air conditioners - refrigerants	Transition from high-GWP refrigerants to R290	Medium and fast R290 market-penetration scenarios	Cumulative direct CO_2e reduction by 2040: about 0.09 Gt under Medium and 0.37 Gt under Fast transition
Household refrigerators	Implementation of GB 12021.1–2025 and movement toward Grade 1 BAT	Grade 5 MEPS; Grade 1 BAT with TEEI 20%	Cumulative CO_2 reduction by 2040: about 0.29 Gt under MEPS and 0.57 Gt under BAT
LED lighting	MEPS and BAT adoption for indoor LED lighting and road/tunnel LED lighting	MEPS scenario; BAT scenario for indoor and outdoor LED applications	Combined cumulative CO_2 reduction by 2040: about 0.52 Gt under MEPS and 1.04 Gt under BAT

Source: Mepsy analysis conducted by Hu Bo, CLASP China Program, 2025. "Late 2050s" is used for model outputs shown through 2057 in the original charts.

Key Takeaways

Energy efficiency standards remain one of the most important policy tools for reducing appliance and equipment emissions in China. Strengthened MEPS can deliver large, measurable, and cost-effective reductions.

System-level efficiency is the next major frontier for industrial equipment. For motors, pumps, fans, compressors, and compressed air systems, system optimization can deliver much larger savings than component-level improvements alone.

Voluntary standards are useful but insufficient for high-impact systems. GB/T 45785—2025 provides a strong technical basis for compressed air systems, but its voluntary status may limit real-world emission reductions.

RAC policy should integrate efficiency and refrigerant transition. Higher APF levels can reduce electricity-related emissions, while low-GWP refrigerants are essential for reducing lifecycle climate impact as the power grid decarbonizes.

BAT adoption can greatly increase long-term benefits. For refrigerators and LED lighting, the BAT scenarios deliver much larger emission reductions than MEPS alone, but they require stronger incentives, procurement policies, and market-pull mechanisms.

China should update MEPS more frequently and use market data to narrow the gap between standards and best available technologies. Faster updates would help ensure that standards continue to guide innovation rather than lag behind market progress.

Policy Implications

The results point to three policy priorities.

1. Tighten MEPS more frequently using real time market data.

China should continue strengthening MEPS for high-impact products, but it should do so more frequently and with stronger use of market monitoring data. Standards should be updated before average market performance moves far beyond the minimum requirement. This is especially important for RACs, refrigerators, and LED lighting, where best available technologies can deliver much higher savings than current minimum requirements.

2. Shift from product-only standards toward system-level regulation.

China should move from product-only standards toward system-level regulation for industrial equipment. Motor systems and compressed air stations show that the greatest savings often depend on how equipment is selected, installed, controlled, and operated. Voluntary system standards should be paired with mandatory requirements for large users, technical guidance for operators, and incentives for system retrofits.

3. Coordinate energy efficiency policy with carbon and refrigerant policy.

For cooling equipment, lifecycle climate performance depends on both electricity use and refrigerant choice. As the power grid becomes cleaner, direct refrigerant emissions will become more prominent. Future standards and labels should therefore consider energy efficiency, refrigerant GWP, and product carbon footprint together.

Conclusion

The results confirm that appliance and industrial equipment efficiency is central to China's decarbonization pathway. The analyzed products can deliver multi-gigaton emission reductions over the coming decades. The greatest potential lies in combining stronger product MEPS with system-level standards, BAT promotion, digital controls, and refrigerant transition. The next step is to accelerate policy updates, expand mandatory system-level requirements, and align efficiency policies with carbon and refrigerant policies. This will help China reduce emissions, improve industrial competitiveness, and support the national goal of carbon neutrality before 2060.

China has already built a strong foundation for appliance and industrial equipment energy efficiency, but the next phase requires higher ambition and stronger implementation. Future policy should move faster, cover more products and systems, and connect energy efficiency with carbon footprint, refrigerant transition, digital compliance, and green manufacturing.

A clear 2026-2035 roadmap can help China capture the full emissions reduction potential of appliances and industrial equipment. It can also reduce energy costs, improve energy security, and support the green transition of Chinese manufacturing. With stronger MEPS, system-level standards, carbon labels, targeted incentives, and local innovation, China can lead the next generation of low-carbon product and equipment policy.

Annex: China's MEPS list

Product Category	Standard Code	Published Year	Products
Commercial equipment	GB 37479-2019	2019	Ducted air conditioners
	GB 19576-2019	2019	Unitary air conditioners
	GB 37485-2019	2019	Submersible mixers of wastewater
	GB 21454-2021	2021	VRF
	GB 40876-2021	2021	Commercial induction cookers
	GB 40879-2021	2021	Data centers
	GB 32030-2022	2022	Submersible motor-pumps
	GB 43630-2023	2023	Tower and rack servers
	GB 26920-2024	2024	Commercial refrigerating appliances
	GB 44015-2024	2024	Cold store(box) and refrigerant compressor condensing unit
	GB 19577-2024	2024	Heat pumps and water chillers
Household appliance	GB 21519-2008	2008	Electrical storage water heaters
	GB 29541-2013	2013	Heat pump water heaters
	GB 30978-2014	2014	Water dispensers
	GB 32049-2015	2015	A.C. electric ventilating fans
	GB 20665-2015	2015	Gas water heater and gas heating and hot water combi-boilers
	GB 35971-2018	2018	Hermetic motor-compressor in room air conditioners
	GB 38448-2025	2019	Smart water closets
	GB 21455-2019	2019	Air conditioners
	GB 24850-2020	2020	TV and set-top boxes
	GB 12021.9-2021	2021	Fan
	GB 17896-2022	2022	Ballasts for gas discharge lamps
	GB 19044-2022	2022	Fluorescent lamps
	GB 21520-2023	2023	Displays
	GB 36893-2024	2024	Air cleaner
	GB 21456-2024	2024	Household and similar kitchen appliances
	GB 38383-2025	2025	Dishwashers
	GB 29539-2025	2025	Range hoods
	GB 26969-2025	2025	Domestic solar water heating systems
	GB 12021.2-2025	2025	Refrigerators
	GB 30720-2025	2025	Gas cooking appliances
	GB 12021.4-2026	2026	Washing machines
Industry equipment	GB 24848-2010	2010	Heater of petroleum industry
	GB 32311-2015	2015	Hydrogen producing systems
	GB 37484-2019	2019	Precipitator
	GB 28736-2019	2019	Welding machines
	GB 38449-2019	2019	Regenerative rolling reheating furnace

	GB 19153-2019	2019	Displacement air compressors
	GB 37483-2019	2019	Rotary aerator in wastewater treatment
	GB 24500-2020	2020	Industrial boilers
	GB 19761-2020	2020	Fan
	GB 18613-2020	2020	Motors
	GB 21518-2022	2022	AC contactors
	GB 30253-2024	2024	Permanent magnet synchronous motors
	GB 30254-2024	2024	Cage three-phase high voltage induction motor
	GB 20052-2024	2024	Power transformers
	GB 19762-2025	2025	Centrifugal pump for fresh water
	GB 20943-2025	2025	Single voltage external AC-DC and AC-AC power supplies
	GB 19762-2025	2025	Centrifugal pumps
	GB 28381-2026	2026	Centrifugal blower
	GB 47834-2026	2026	Crystalline silicon photovoltaic modules and inverters
Lighting product	GB 19573-2004	2004	High-pressure sodium vapor lamps
	GB 31276-2014	2014	Tungsten halogen lamp
	GB 20054-2015	2015	Metal-halide lamps
	GB 38450-2019	2019	LED flat panel luminaires
	GB 37478-2025	2025	LED luminaires for road and tunnel lighting
	GB 30255-2026	2026	LED products for indoor lighting
Office equipment	GB 21521-2014	2014	Copy machines, printers and fax machines
	GB 28380-2025	2025	Microcomputers
	GB 32028-2025	2025	Projectors
Mobile	GB 46519-2025	2025	Electric vehicle power supply equipment

Source: https://openstd.samr.gov.cn/bzgk/std/index

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