

Industrial Heat Pumps in China

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Teaser Report
This document contains selected pages from our full 55-page report. Request access to the complete analysis at ir@twynam.com

Executive Summary

Sector Overview

Industrial heating represents the largest single source of fossil energy demand and carbon emissions in China, accounting for 66% of total energy use and 38% of CO_2 emissions.
Up to half of all process energy is wasted as heat, much of it at usable temperatures between 60°C and 200°C. High-temperature industrial heat pumps (HTHPs) provide a direct electrification pathway to recover and reuse this waste heat, significantly improving energy efficiency and reducing emissions.

Market Opportunity

By 2050, China could deploy approximately 650 GW of industrial heat pumps, potentially unlock **13 EJ of recoverable heat** and avoid around **700 million tonnes of CO_2 annually**.
High-temperature systems below 200 °C can deliver 6.9 EJ of annual energy savings, equivalent to 15% of China's total emissions abatement potential.
Commercial projects already demonstrate payback periods of under two years in the mid-high temperature range.

Investment Themes

Key opportunities arise across the value chain:

- **Upstream:** Advanced refrigerants and high-efficiency compressor manufacturing
- **Midstream:** System integrators enabling modular industrial retrofits
- **Downstream:** Industrial Park decarbonisation and electrified heat EPC models

Technology Landscape

The sector is advancing rapidly in compressor technology, refrigerants, and system integration.

- Screw compressors currently achieve output temperatures up to 150 °C, while centrifugal and oil-free turbo compressors are extending the range to 200 °C and beyond.
- Refrigerants are transitioning from HFCs to low-GWP HFOs such as R1336mzz and R1233zd, as well as natural fluids including ammonia, CO_2, and water.
- Cascade and hybrid compression cycles now exceed 150 °C output, and transcritical CO_2 systems deliver efficient hot water up to 120 °C.

Economics and Deployment

The lifetime cost gap between heat pumps and coal boilers could shrink by two-thirds by 2030 if all currently announced pledges are fully implemented.
China sold approximately 35 GW of heat pumps in 2023, valued above ¥33 billion (US$224 million), driven by industrial and air-to-water systems.
Applications in the mid-high temperature range in industries across textiles, chemicals, and food processing demonstrate energy savings between 30 and 70 percent with **one- to two-year paybacks.**

Sources: CHPA, Industrial Heat Pump Development White Paper 2025; International Energy Agency & Tsinghua University, The Future of Heat Pumps in China, 2024; Hu Bin, Shanghai Jiaotong University, Development and Outlook of High Temperature Industrial Heat Pump, 2024; IEA 2023; China Heat Pump Alliance 2023; ChinaIOL 2023; Twynam's Proprietary Research



The Market Opportunity in Electrifying Industrial Heat

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Deep Dive - Industrial Heat Pumps in China

Industrial Heat: The Core of China's Carbon Challenge

The industrial sector is the largest source of energy demand (66%) and carbon emissions (38%) in China, dominated by inefficient, fossil-based boilers.

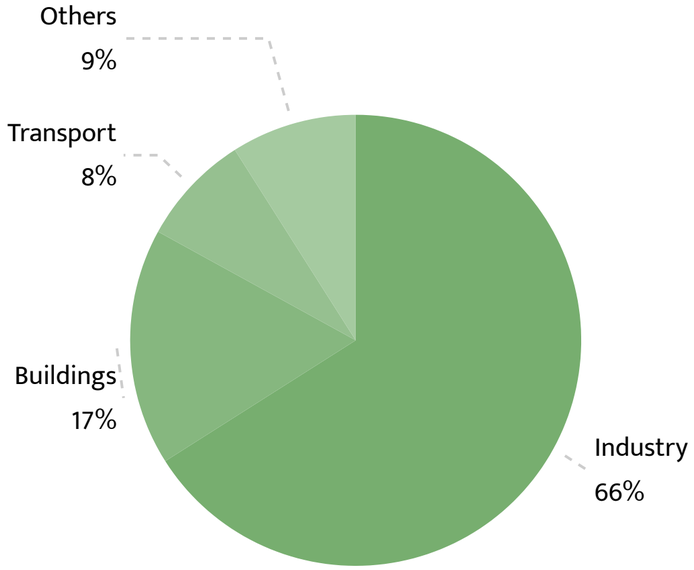


Figure: China Energy Consumption Share

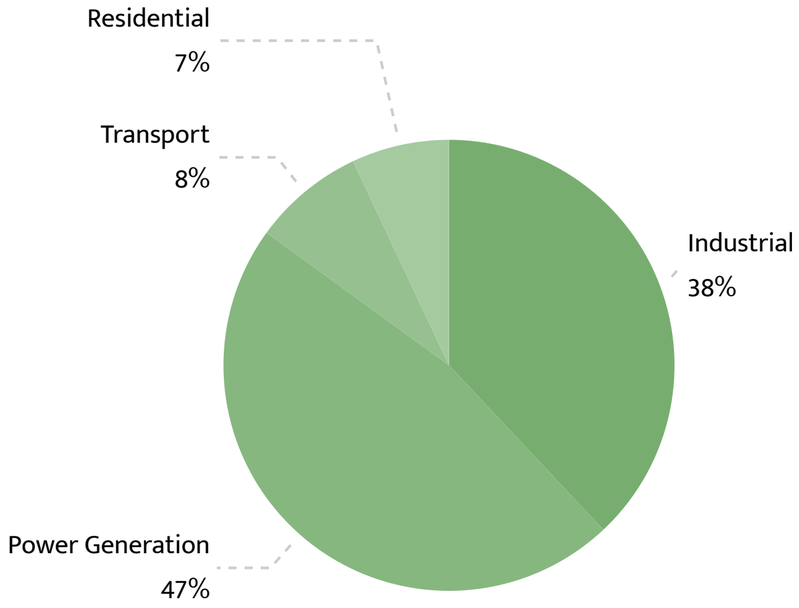
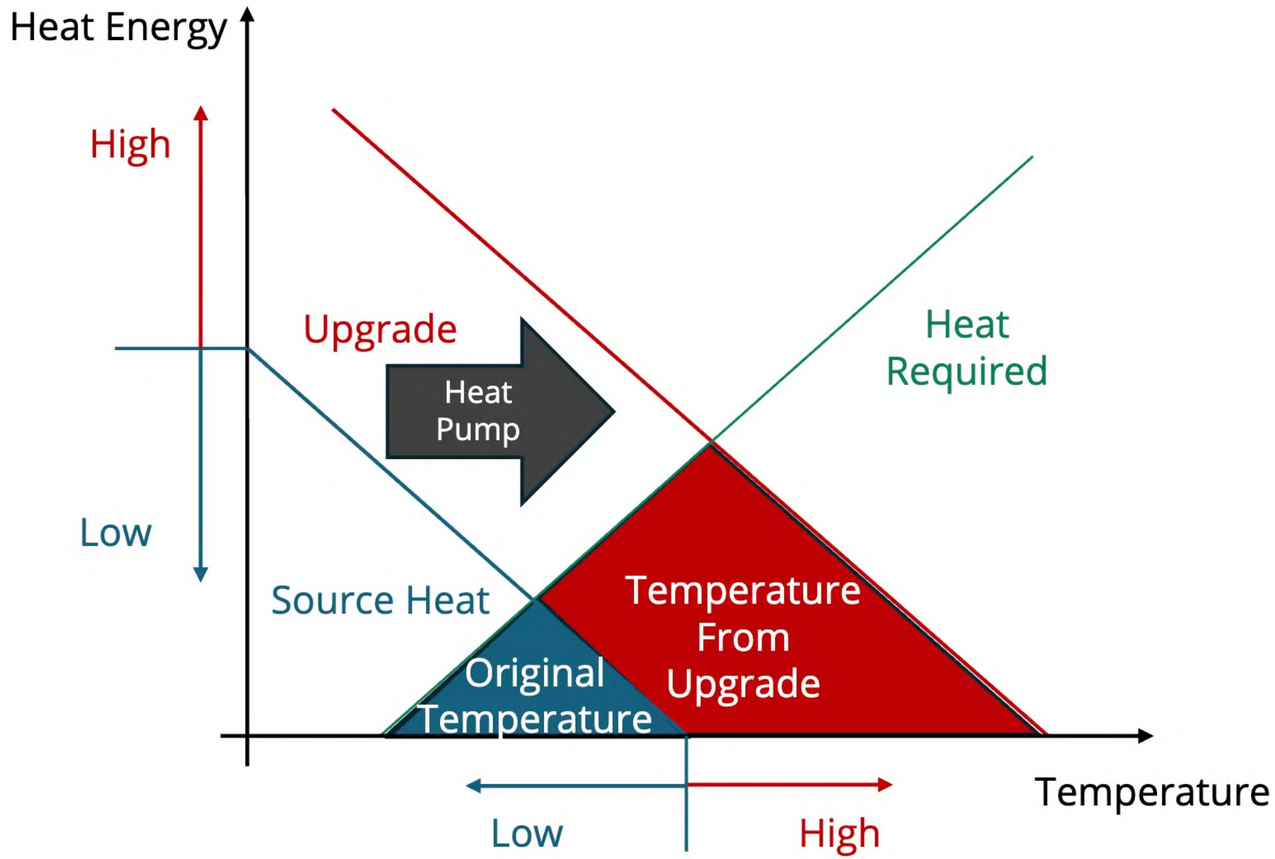


Figure: China CO_2 Emissions Share

Insight: More than 30–50% of this industrial process energy is simply wasted as heat, often at highly usable temperature (60-200 ºC).

Source: Hu Bin, Shanghai Jiaotong University, Development and Outlook of High Temperature Industrial Heat Pump, 2024. CHPA, Industrial Heat Pump Development White Paper 2025.

An Untapped Resource: Recoverable Waste Heat

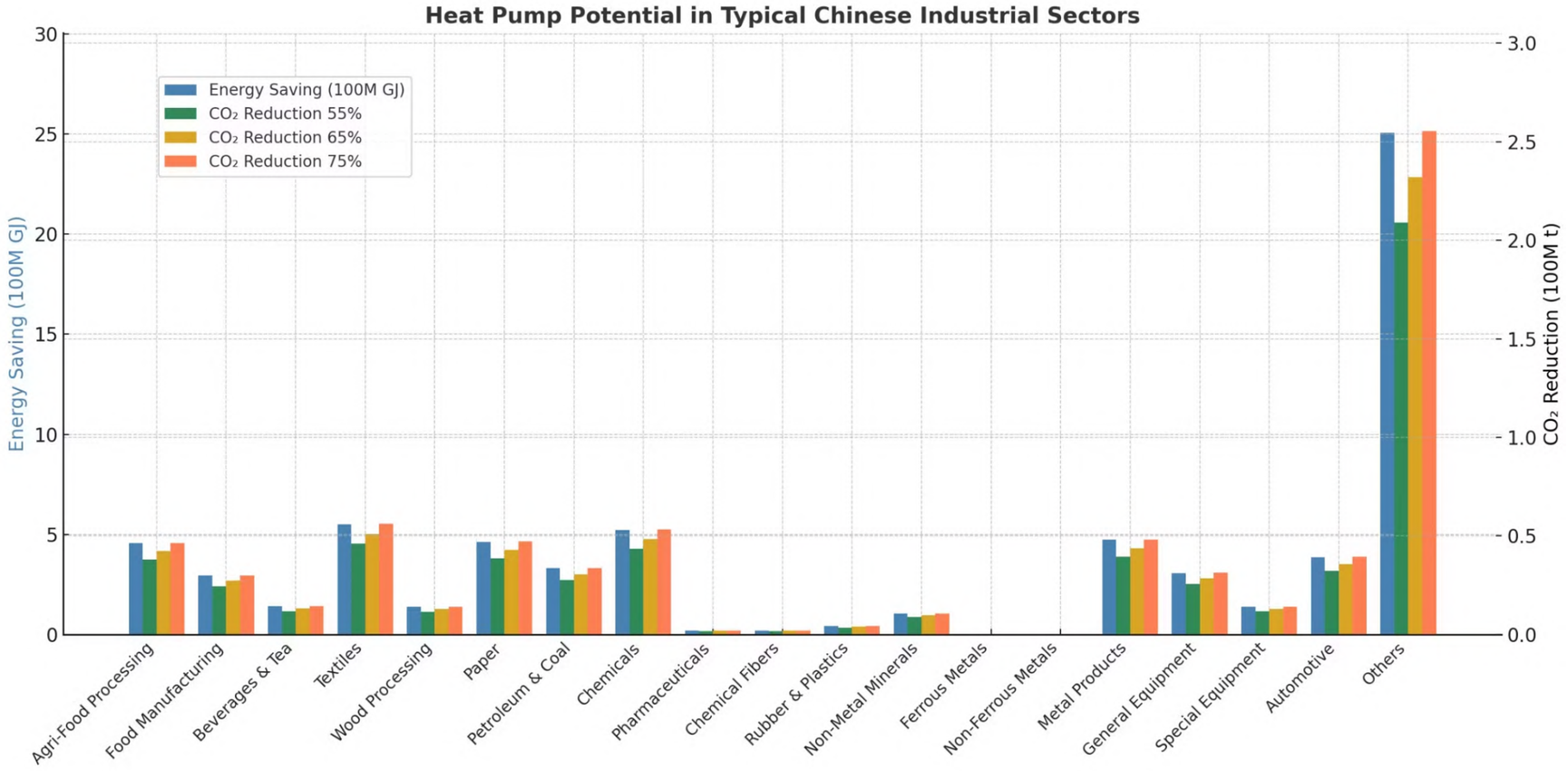


Heat pumps are the key technology to unlock this resource, providing a direct pathway to convert a massive waste stream into valuable process heat.

Note: The 2050 estimate of waste heat suitable for heat pump integration is based on Tsinghua University's calculations. The estimation is based on the availability and economic assessment of waste heat, recoverability, and techno-economic assessments..
Source: International Energy Agency & Tsinghua University, The Future of Heat Pumps in China, 2024. CHPA, Industrial Heat Pump Development White Paper 2025.

Sizing the Market

The potential for HTHPs to displace fossil fuels in China's industrial sector is immense, representing a multi-billion-dollar equipment market and one of the largest single pathways for emissions reduction.



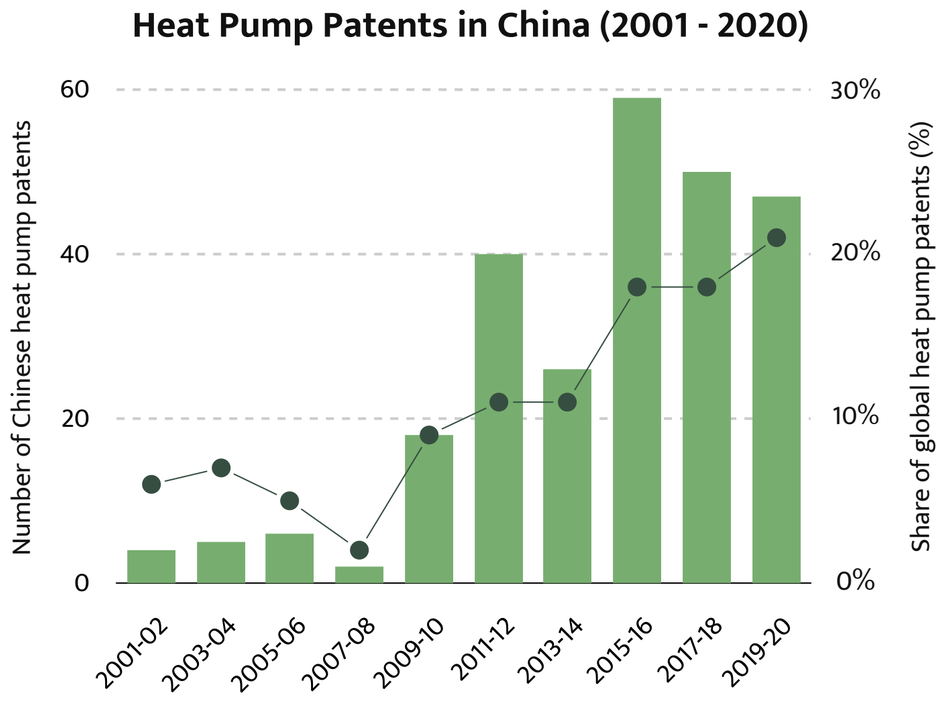
Sources: CHPA, Industrial Heat Pump Development White Paper 2025; Hu Bin, Shanghai Jiaotong University, Development and Outlook of High Temperature IndustrialHeat Pump, 2024.

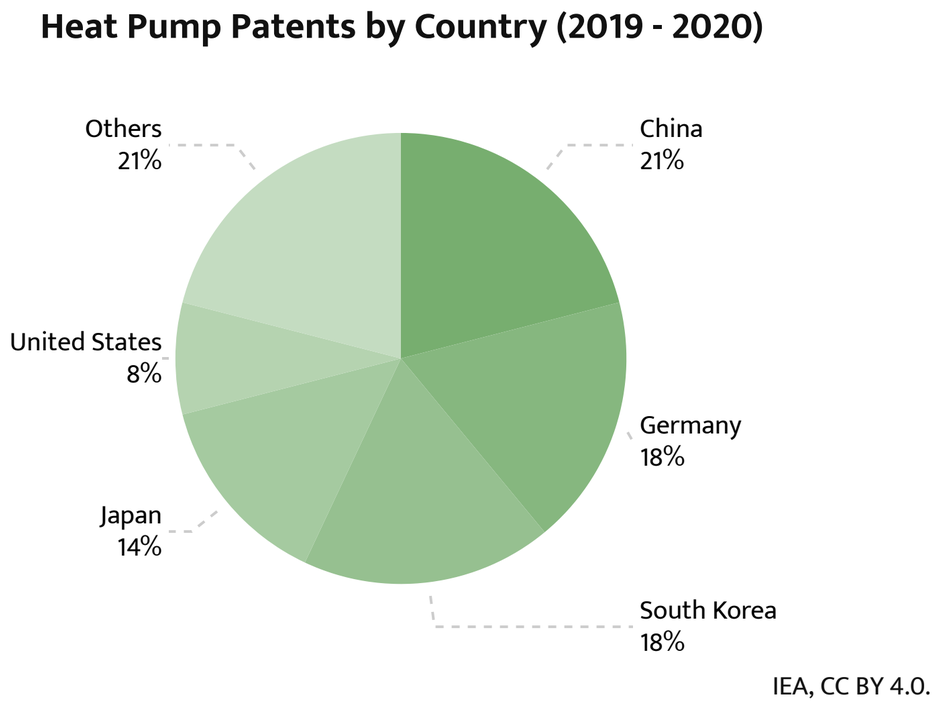
Adoption Readiness in China

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The Competitive Frontier: Closing the Gap in High-Temperature Technology

While Japan and Europe lead in commercial high-temperature compressor technology, China's patent share has surged to over 20%, signalling a clear ambition to achieve technological independence.





Note: Heat pump innovation data are based on the location of patent applicants. If one international patent family has multiple applicants, the share is divided amongthe applicants and their corresponding locations.
Source: International Energy Agency & Tsinghua University, The Future of Heat Pumps in China, 2024.



Appendix C. Market Applications & Case Studies

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Case Study: 1.23-Year Payback in District Heating

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Project Summary

- Hot Water Temp: **80°C**
- Model: **Centrifugal Heat Pump Unit (Waste Heat Source)**
- Heating Capacity: **40 MW**
- Installation Time: **Nov 2022**

Annual cost savings: **¥24.32 million**

Initial Investment: **¥30 million**

Payback period: **1.23 years**

Operating Cost Comparison

Category	Gas Boiler	Heat Pump	Savings
Annual Power Consumption	173,170,732 kWh	27,695,656 kWh	145,475,076 kWh less
Efficiency	95%	COP 6.6 (system eff. 0.9)	—
Electricity Price	¥0.205/kWh	¥0.205/kWh	—
Annual Heating Cost	¥35.5 million	¥5.68 million	¥29.82 million less
Heat Supply Output	—	164,512,195 kW	—
Annual Revenue	¥28.5 million	¥25.08 million (after 12% fee)	Boiler revenue higher by ¥3.42m
Annual Profit / Loss	–¥7.0 million loss	+¥25.08 million gain	Improvement: ¥32.08 million

Source: Hu Bin, Shanghai Jiaotong University, Development and Outlook of High Temperature Industrial Heat Pump, 2024.

Twynam: Investing in Technology with Superior Economics

China's heat pump trajectory reflects a broader truth: the world's largest sources of emissions are now addressable with technologies that clearly outperform legacy systems on cost, efficiency and scalability. Twynam is built to capture this shift.

Why Twynam?

Twynam stands as a strategic investment partner uniquely positioned to capitalise on the global decarbonisation imperative. Our distinct value proposition lies in our profound understanding of the interplay between technological innovation and compelling economics.

Superior Economics

We identify technologies that outperform legacy systems on cost, efficiency, and scalability, ensuring compelling investment returns.

Technological Edge

Our deep understanding of clean technology enables us to pinpoint high-growth opportunities within the transformative shift.

Sustainable Value

We create long-term value by backing solutions that drive industrial decarbonisation and foster cleaner, smarter operations.

We invests where decarbonisation is inevitable, economics are compelling and technology advantage compounds long-term value. We back systems that make industry cleaner, smarter and more profitable.

Get the Full Picture

The complete 55-page report includes:

- Detailed market sizing & case studies
- Technology deep dives & efficiency analysis
- Competitive landscape mapping
- Investment thesis & opportunity mapping

Request access: ir@twynam.com

Available to institutional investors and strategic partners

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