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INNOVATION PRESS

Energy Use

Energy Use 1 (2026):100031

Contents lists available at INNOVATION PRESS

Low-Carbon Transformation for Urban Buildings in China: Insights from the Annual Report on China Building Energy Efficiency 2026

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Received: February 10, 2026; Accepted: March 13, 2026; Published Online: March 25, 2026; https://doi.org/10.59717/ipj.energy-use.2026.100031

Citation: Zhang J., Liu X., Zhang T., et al. (2026). Low-Carbon Transformation for Urban Buildings in China: Insights from the Annual Report on China Building Energy Efficiency 2026. *Energy Use* **2**:100031.

Building construction and operation contribute to over half of global carbon emissions, establishing the built environment as a decisive frontier in the transition to a green, low-carbon future. In March 2026, Building Energy Research Center (BERC) from Tsinghua University will host the public forum of the 22nd Tsinghua Building Energy Efficiency Academic Week in Beijing, during which the *Annual Report on China Building Energy Efficiency 2026 (Urban Buildings)* will be officially released.[1] The report delivers forward-looking insights and actionable guidance to accelerate building energy efficiency and systemic decarbonization.

The *Annual Report on China Building Energy Efficiency* has been published annually for two decades, each focusing on a specific theme (Figure 1A). This landmark series has chronicled and catalyzed the strategic evolution of China's building sector from "energy saving" towards "low carbon" and "zero carbon" goals. As the 20th volume, the 2026 report centers on "urban buildings", systematically addressing the urgent need for low-carbon transformation amid energy restructuring and widespread urban renewal. The report is structured into three parts, establishing a complete framework from macro trends to micro technologies, and from theoretical foundations to practical applications.

BUILDING ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS

The report presents a systematic analysis of energy use and carbon emissions in China's building sector. As shown in Figure 1B, buildings' total operational energy consumption reached 1.25 billion tce in 2024, accounting for approximately 21% of the national total and distributed across northern urban heating, urban residential, public, and rural residential buildings. Notably, China's per capita and per-square-meter building energy consumption remains only one-fifth to one-half of that in developed countries. With urbanization stabilizing, future development is shifting from "quantitative expansion" to "quality enhancement". This transition calls for a parallel move from constructing buildings to high-performance buildings, emphasizing the retrofitting of existing building stocks.

ENERGY-SAVING AND LOW-CARBON CONCEPTS AND KEY TECHNOLOGIES

Building energy efficiency has evolved from a narrow focus on "reducing energy consumption" to the broader objective of "lowering carbon emissions" (Figure 1C). In this progression, "energy efficiency" and "low carbon" are dialectically unified and mutually reinforcing. Deepening energy efficiency requires moving beyond the optimization of individual equipment to implementing "partial-time, partial-space" energy-use modes. Meanwhile, decarbonization demands transforming buildings from passive energy consumers into active, integrated energy nodes capable of "generation, storage, consumption, and regulation" through strategies such as full electrification, photovoltaic (PV) integration, and flexible load management.[2] Centered on the tripartite goal of "passively reducing demand, actively improving efficiency, and flexibly adapting to the grid," the report elaborates six key technologies, including new envelope materials,[3] advanced heat pumps, efficient distribution systems, PV & energy storage integrated direct-current systems of energy-flexible buildings (PEDF)[4] together with flexible electromechanical equipment, AI and big data analytics, and intelligent building control. Collectively, these technologies provide the foundational support for deeply integrating buildings into the new power system and enabling smart, low-carbon operation.

ENGINEERING PRACTICES AND EXPLORATIONS

The vitality of concepts and technologies is ultimately proven in practice. Through diverse scenarios and representative case studies, the report illustrates the implementation of low-carbon principles in China (Figure 1D). It covers five cutting-edge scenarios: zero-carbon islands, zero-carbon airports,[5] zero-carbon parks, low-carbon data centers, and high-density zero-carbon communities. Moreover, the report also highlights twelve exemplary projects spanning various climate zones and building types, providing replicable technical pathways and viable business models.

The release of the *Annual Report on China Building Energy Efficiency 2026 (Urban Buildings)* represents not only a synthesis of annual research, but a strategic guidepost for the industry's journey toward a net-zero future. The report underscores that China's building energy efficiency efforts have entered a new phase characterized by systemic transformation, encompassing conceptual renewal, technological convergence, scenario-based innovation, and robust institutional frameworks.

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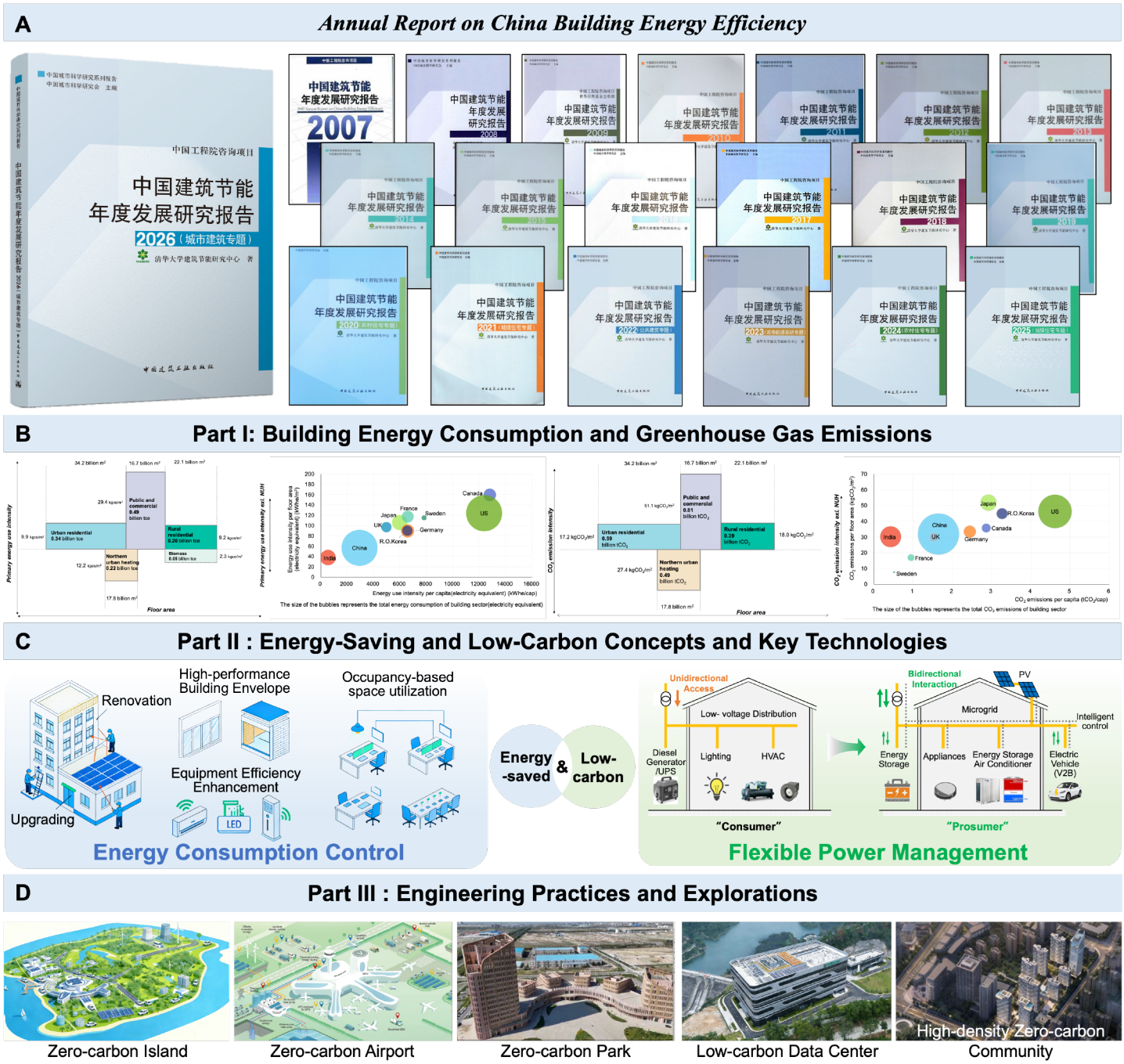

Figure 1. Annual Report on China Building Energy Efficiency 2026 (Urban Buildings) (A) The series of 20 annual volumes. (B) Part I: Building energy consumption and greenhouse gas emissions. (C) Part II: Energy-saving and low-carbon concepts and key technologies. (D) Part III: Engineering practices and explorations.

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FUNDING AND ACKNOWLEDGMENTS

This work was supported by the Chinese Academy of Engineering Project (2023-XBZD-07).

DECLARATION OF INTERESTS

The authors declare no competing interests.