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The PRC's Innovation and Successful Experiences on Building Energy Conservation and Carbon Reduction

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ASIA CLEAN ENERGY FORUM 2025
Empowering the Future: Clean Energy Innovations, Regional Cooperation and Integration, and Financing Solutions

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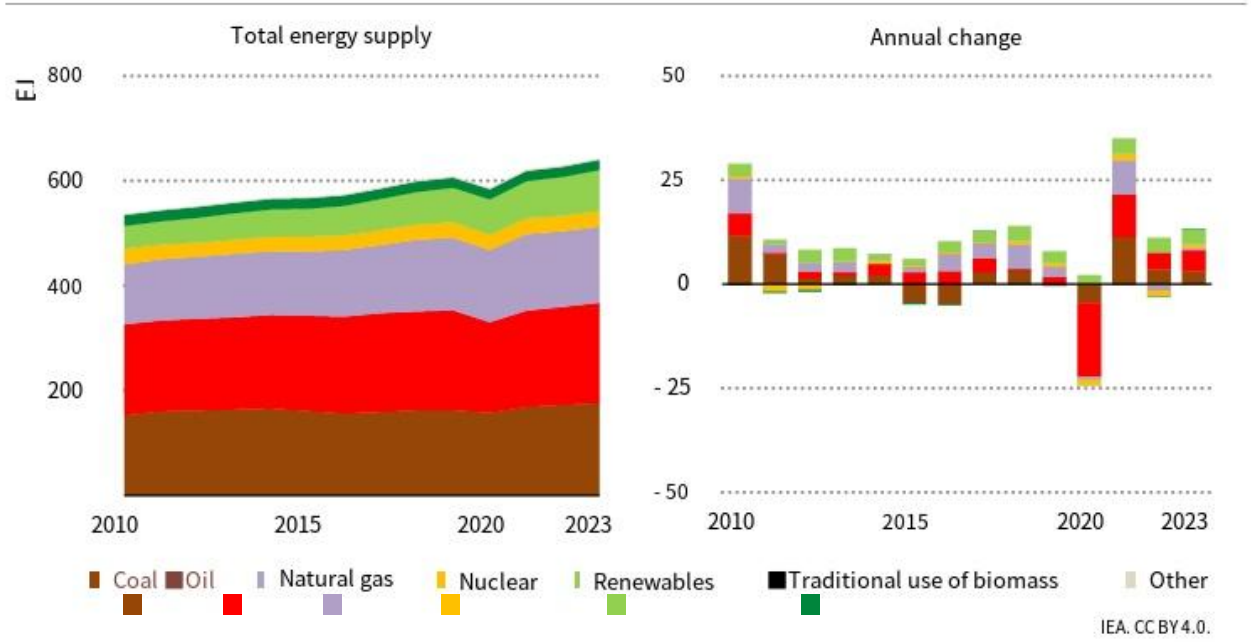
01

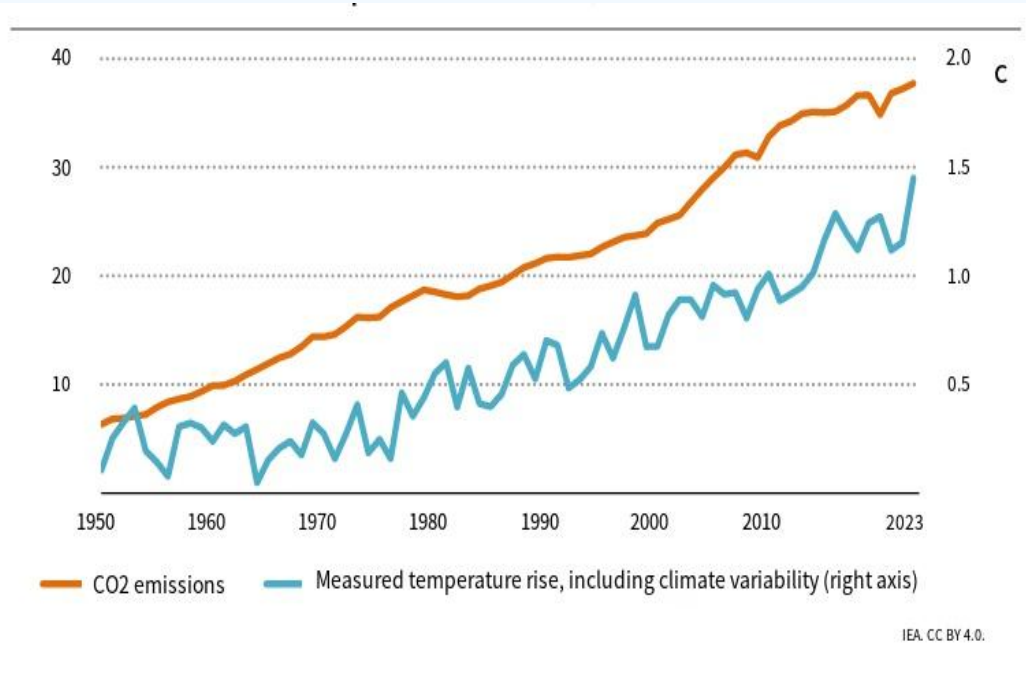
PRC Building Energy Efficiency Policies and Regulations

1.1 Current status of global energy demand and carbon emissions

- According to data from the International Energy Agency (IEA) , global energy consumption increased by 2% in 2023 , of which 2/3 came from fossil fuel.
- Global greenhouse gas emissions increased by 1.9% , of which energy-related carbon dioxide (CO 2) emissions accounted for about 71% , both reaching record highs
- As the world's main source of carbon emissions, energy conservation and carbon reduction in buildings are key to the global response to climate change.



Global energy supply and its annual changes 2010-2023



Global energy-related greenhouse gas emissions from 1950 to 2023

(Data source: IEA2024 World Energy Outlook)

1.2 China's building energy efficiency policy system

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September 22, 2021

The Central Committee of the CPC and the State Council issued the " Opinions on Completely, Accurately and Comprehensively Implementing the New Development Concept and Doing a Good Job in Carbon Peaking and Carbon Neutrality "

October 21, 2021

The General Office of the CPC Central Committee and the General Office of the State Council issued the " Opinions on Promoting Green Development of Urban and Rural Construction "

October 24, 2021

The State Council issued the " Carbon Peak Action Plan before 2030 "

March 1, 2022

The Ministry of Housing and Urban-Rural Development issued the " 14th Five-Year Plan for Building Energy Conservation and Green Building Development "

June 30, 2022

The Ministry of Housing and Urban-Rural Development and the National Development and Reform Commission issued the " Implementation Plan for Carbon Peaking in Urban and Rural Construction "

March 12, 2024

" Work Plan for Accelerating Energy Conservation and Carbon Reduction in the Construction Sector "

May 23, 2024

The State Council issued the "2024-2025 Energy Conservation and Carbon Reduction Action Plan "

July 31, 2024

CPC Central Committee and State Council issued "Opinions on Accelerating the Comprehensive Green Transformation of Economic and Social Development"

1.2 China's building energy efficiency policy system

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☐ Requirements for urban and rural construction and building sector

"Opinions on fully and accurately implementing the new development concept and doing a good job in carbon peak and carbon neutrality"

VII. Improving the quality of green and low-carbon development in urban and rural construction

(17) Promote low-carbon transformation of urban and rural construction and management models.
(18) Vigorously develop energy-saving and low-carbon buildings.
(19) Accelerate the optimization of building energy structure.

Action Plan for Reaching Carbon Peak Before 2030

Key tasks:
(4) Carbon peak action in urban and rural construction.

1. Promote green and low-carbon transformation of urban and rural construction.
2. Accelerate the improvement of building energy efficiency. 3. Accelerate the optimization of building energy structure.

Opinions on Accelerating the Comprehensive Green Transformation of Economic and Social Development

VI. Promote green transformation of urban and rural construction and development

(XII) Promote green planning and construction methods.
(13) Vigorously develop green and low-carbon buildings.
(14) Promote green development of agriculture and rural areas.

Energy Conservation and Carbon Reduction Action Plan 2024-2025

Key tasks:
(7). Building Energy Saving and Carbon Reduction Action

1. Accelerate the transformation of construction methods.
2. Promote the renovation of existing buildings.
3. Strengthen building operation management.

1.3 China's building energy conservation regulations system

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Energy Conservation Law of the PRC

The construction, design, construction and supervision units of construction projects shall comply with the building energy conservation standards. The state encourages the use of new wall materials and other energy-saving building materials and energy-saving equipment in new buildings and energy-saving renovation of existing buildings, and the installation and use of renewable energy utilization systems such as solar energy.

Renewable Energy Law of the PRC

In the design and construction of buildings, necessary conditions are provided for the utilization of solar energy. For existing buildings, residents can install solar energy utilization systems that meet technical specifications and product standards without affecting their quality and safety.

Regulations on Energy Conservation in Civil Buildings

People's governments at all levels should strengthen leadership over energy conservation in civil buildings, actively cultivate the civil building energy conservation service market, improve the civil building energy conservation service system, promote the development and application of civil building energy conservation technologies, and do a good job in publicity and education on civil building energy conservation knowledge.

Regulations on Energy Conservation Management of Civil Buildings

Encourage scientific research and technological development in energy conservation in civil buildings, promote the application of energy-saving buildings, structures, materials, energy-consuming equipment and ancillary facilities and corresponding construction processes, application technologies and management technologies, and promote the development and utilization of renewable energy.

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02

Green and Low-Carbon Buildings Technology and Standards

2.1 China's building energy efficiency standard system

- **PRC has established a standard system covering all types, processes and regions in the field of building energy conservation.**

1980 — The first building energy efficiency standard

August 1 , 1986
" Civil Building Energy Saving Design Standard (Heating Residential Building Part) " JGJ26-86 : Building energy saving officially started, residential building 30% energy saving
1995
" Civil Building Energy Saving Design Standard (Heating Residential Building Part) " JGJ26-95 : 50% energy saving

2000 — Building Energy Saving in Southern Regions

2001
in hot summer and cold winter areas JGJ134
2003
in hot summer and warm winter areas JGJ75

2005 — The first energy-saving standard for public buildings

2005
" Energy Efficient Design Standard for Public Buildings " GB50189-2005
Public buildings are included in the building energy-saving standard system
50% energy saving

2010 — Energy-saving renovation of existing buildings

2010
Standard for Residential Buildings in Rigid and cold regions
JGJ26-2010 65% energy saving

2012
Technical Code for Energy-saving Renovation of Existing Residential Buildings JGJ /T129
Existing buildings are included in the building energy-saving standard system

2015 " Public Building Energy Saving Design Standard " GB50189-2015 Public Building 65% Energy Saving

2018 — 75% energy saving

2018
Energy Efficient Buildings Design Standards for Rigid and Cold Regions JGJ26-2018

2019 — The first leading national standard in the field of building energy conservation

2019
Near Zero Energy Buildings GB/T 51350-2019

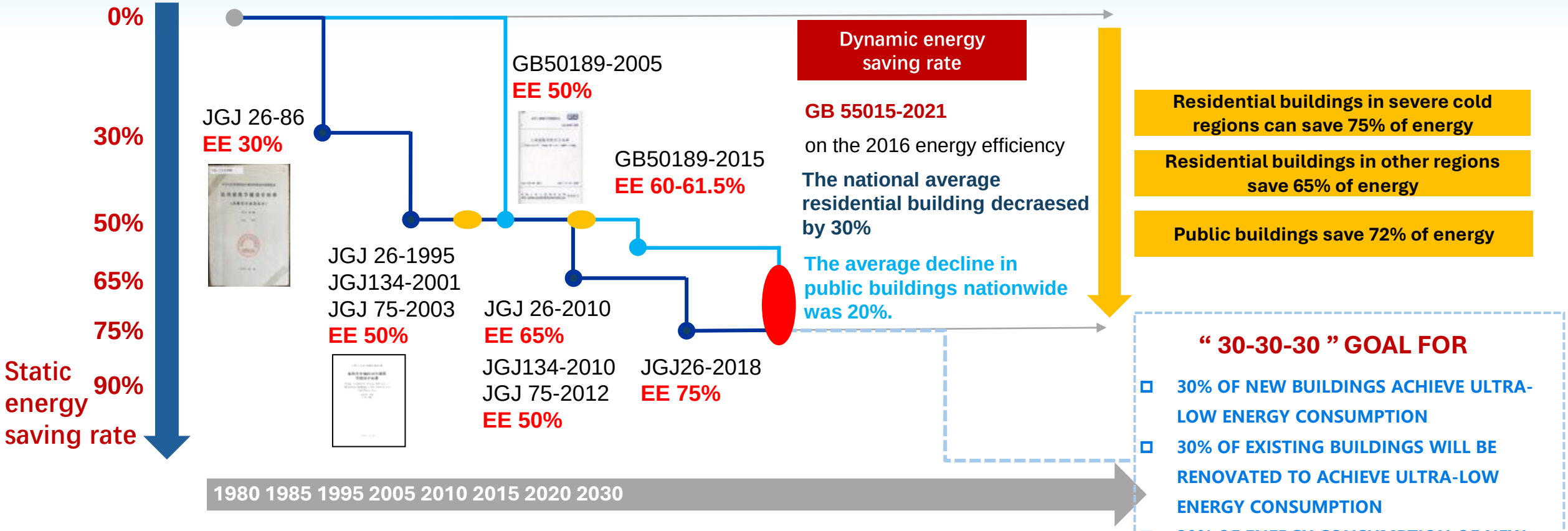
2021 — Full text mandatory standards

2021
General Specification for Energy Efficiency and Renewable Energy Utilization in Buildings GB 55015-2021

2.1 China's building energy efficiency standard system

- After 40 years and four rounds of systematic improvement, China's building energy efficiency standard system is aligned with the international advanced level.
- The future aim is to develop towards the "30-30-30" direction

STATIC BENCHMARK - TYPICAL BUILDING ENERGY CONSUMPTION LEVEL IN



2.2 Green Building Technology Path

Green Building Evaluation Standard GB/T 50378

Five types of evaluation indicators

- Safe and durable
- Healthy and comfortable
- Convenience
- Resource Conservation
- Livable environment

Score

Control items (400 points) + Scoring items (600 points) + Bonus items (100 points)

Total score = (control items + scoring items + bonus items) / 10. **The full score is 110 points .**

Administrative Rules of Green Building Label

Star Rating

Three-star

≥85 points

Two-star

≥70 points

One star

≥60 points

Authorities in Charge

Three-star green building to be certified by Ministry of Housing and Urban-Rural Development

Two- star green building to be certified by Provincial housing and urban-rural development departments

One-star green building to be certified by Municipal and prefecture-level housing and urban-rural development departments

2.3 Technology Paths for Building Energy Saving and Carbon Reduction

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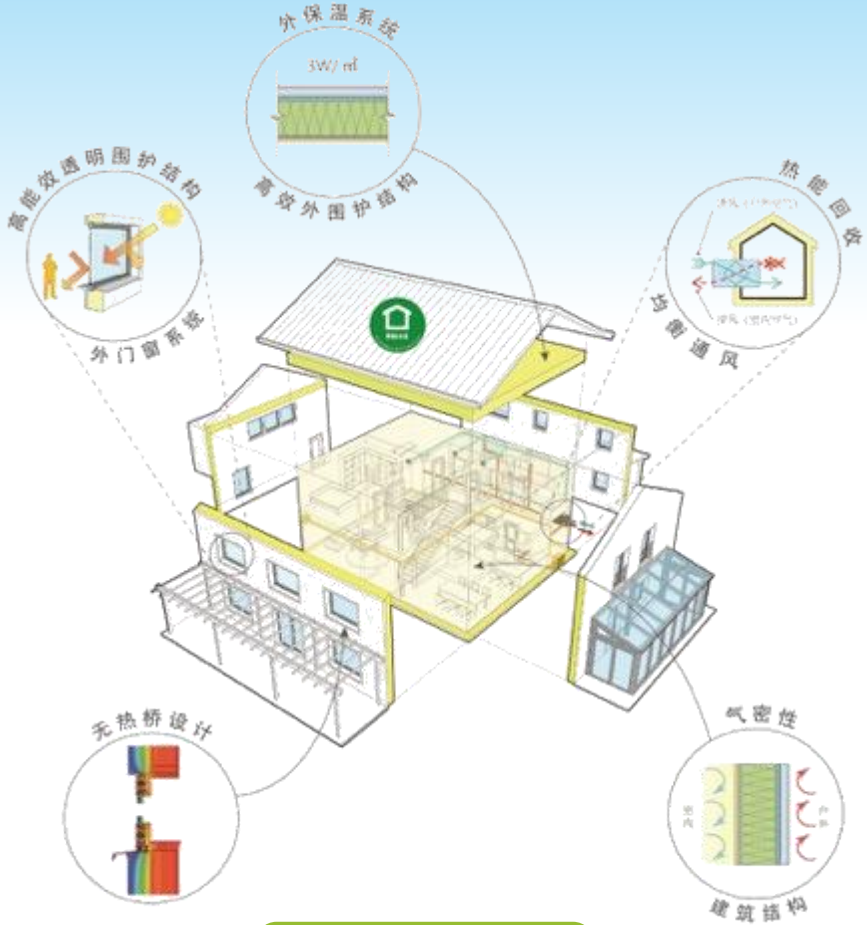
1. Energy Efficient Building Design	2. Energy - saving measures for building	3. Highly Efficient equipment system	4. Renewable energy	5. Energy transition
✓ Optimize building spacial layout; ✓ Optimize building shape design; ✓ Enhance natural ventilation in summer; ✓ Increased sunlight in winter; ✓ Use shape to create sunshade; ✓ Avoid the influence of cold wind; ✓ Reduce heat island effect; ✓ …	✓ High performance insulation system; ✓ High-performance door and window systems; ✓ Effective sunshade design; ✓ Building airtightness design; ✓ Thermal bridge-free structural design; ✓ …	✓ High-efficiency air conditioning system; ✓ Highly efficient heat recovery ventilation system; ✓ Highly efficient machinery room; ✓ Smart lighting system; ✓ Energy-efficient elevators; ✓ …	✓ Optoelectronic systems; ✓ Photothermal system; ✓ Air source; ✓ Shallow soil sources; ✓ Deep soil sources; ✓ Wind energy; ✓ Biomass energy; ✓ Waste incineration; ✓ Residual heat / waste heat; ✓ …	✓ Building electrification; ✓ Multi-energy complementary system; ✓ Energy storage technology; ✓ Light storage direct and flexible technology; ✓ RV coupling technology ; ✓ Green electricity + carbon trading; ✓ …

2.4 Low-carbon / zero-carbon building technology path



Improving building energy efficiency

Operation Carbon	Improving building energy efficiency	Better than	Renewable Energy
	Onsite renewable energy	Better than	Off-site renewable energy
	Renewable Energy	Better than	Carbon offset
Embedded Carbon	Carbon reduction	Better than	Carbon offset

2.5 Technical measures for energy conservation and carbon reduction in buildings in different climate zones

Project		Severely cold areas	Cold Regions	Hot summer and cold winter areas	Hot summer and warm winter areas	Temperate areas
Design principles		Winter insulation requirements must be fully met, and summer heat protection generally need not be considered.	It should meet winter insulation requirements, and in some areas, it should also take summer heat protection into consideration.	Summer heat protection requirements must be met, while winter insulation must be appropriately considered.	Summer heat protection requirements must be fully met, and winter insulation generally need not be considered.	Some areas should consider winter insulation, but generally do not need to consider summer heat protection.
Design Standards		Energy-saving design standard for residential buildings in severe cold and cold regions		Energy-saving design standard for residential buildings in hot summer and cold winter areas	Energy-saving design standard for residential buildings in hot summer and warm winter areas	Energy-saving design standards for residential buildings in temperate regions
Heat transfer coefficient W/(m ^{2}·K)	External Wall	**0.25-0.6**	**0.45-0.7**	**0.8-1.5**	**0.7-2.5**	**0.8-2.0**
	Roofing	**0.2-0.4**	**0.35-0.45**	**0.5-1.0**	**0.4-0.9**	**0.5-1.0**
	External windows	**1.5-2.5**	**1.8-3.1**	**2.3-4.7**	**2.5-6**	**2.5-3.8**
External window shading coefficient		—	**≤0.45**	**Summer ≤ 0.45 Winter ≥ 0.6**	**≤0.9**	**Summer ≤ 0.4 Winter ≥ 0.5**

The climate in China's hot-summer and warm-winter regions is similar to that in parts of Southeast Asia (high temperature, heavy rainfall, and monsoon-dominated) . Therefore, China's experience in energy-saving design of residential buildings **in these regions** can **be replicated to ADB DMCs in East Asia and South Asia** .

2.6 Achievements in building energy conservation and carbon reduction

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By the end of 2023 ,

The total floor area of green building in cities and towns across the country is about 11.463 billion square meters ;

The number of projects that have obtained green building labels has reached more than 25,000 ;

The cumulative floor area of energy-saving buildings has reached approximately 32.68 billion square meters, accounting for 64.5% of the existing urban building area.

In 2023

230 million square meters of existing public and residential buildings have undergone energy efficiency renovation.

Approximately 8.4131 million square meters of ultra-low energy consumption and near-zero energy consumption new buildings started construction

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Typical Cases of Green and Low-carbon Buildings

3 Typical Cases of Green and Low-carbon Buildings

Shenzhen Xiangrui Jinmao Mansion

■ Technology Highlight 1: Energy Saving and Carbon Reduction

High-performance building envelope, efficient air conditioning system, efficient lighting and other measures are adopted to comprehensively reduce the building's carbon emissions. The average annual carbon emission is 39.30 kgCO_2/(m^2·a) .

■ Technology Highlight 2 - Landscape Microclimate

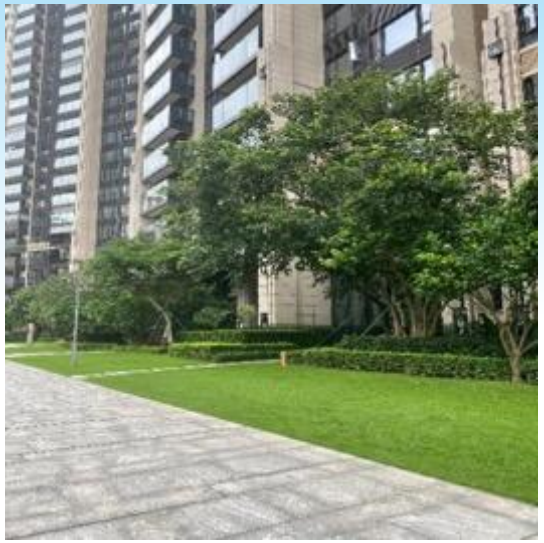
By making full use of landscape microclimate technology and optimizing the design of ventilation, shade and plants, the actual summer perceived temperature is 1~3 ℃ lower than that of surrounding venues , which is conducive to expanding outdoor leisure time.

■ Highlight Technology 3 - Intelligent Operation

The entrances and garages of the residential area are equipped with facial recognition systems, which allow automatic entry into the residential area and buildings, and the intelligent elevator call system allows users to directly reserve the home floor. Lighting, curtains, fresh air, background music, security, door locks, WiFi , etc. can all be remotely monitored and controlled through the mobile phone APP .

The total investment of the project is 300 million yuan , the initial investment cost increased by 12.8444 million yuan to achieve green building , the incremental cost per unit area is 90.66 yuan . The green building can save 6.0876 million yuan in operating expenses per year .

Project picture



Fall protection buffer zone with landscape

Basement lighting well

Sunken Courtyard

3 Typical Cases of Green and Low-Carbon Buildings

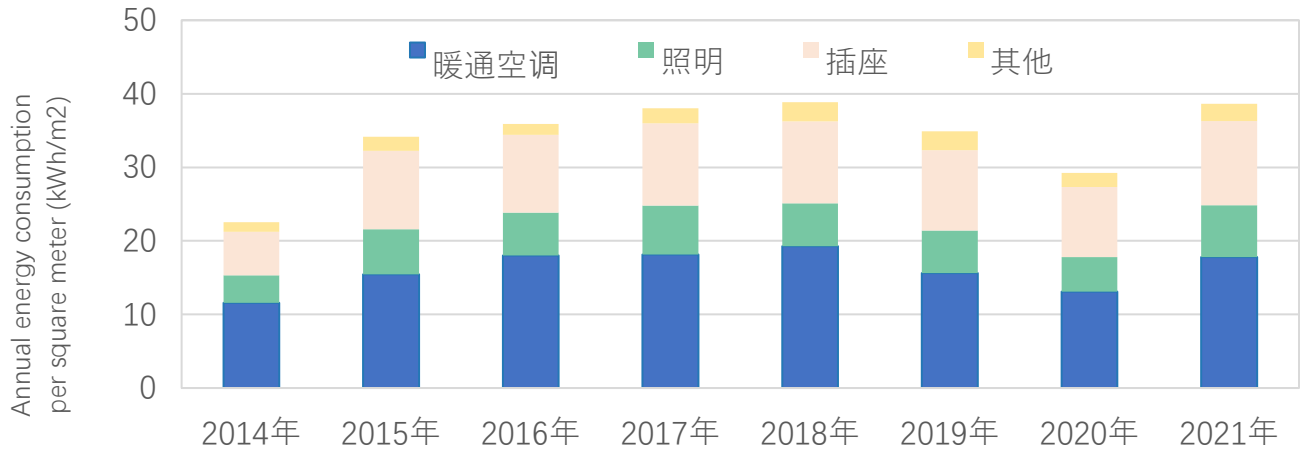
Nearly Zero Energy Demonstration Building of China Academy of Building Research

- 4 floors above ground and a construction area of 4025 ^{m2}. It was put into use on July 11 , 2014 and is mainly used for office and meeting.
- Adhering to the principle of " passive priority, active optimization, economy and practicality " , we focus on taking measures in terms of building design, envelope structure, energy system, renewable energy utilization, efficient lighting, energy management and building automation, indoor air quality, and mechanical and electrical system debugging.

2015~ 2021

- **Average annual power consumption 143,773.1 kWh**
- **Electricity consumption per unit building area 35.7 kWh/(m^2·a)**
- The HVAC system consumes 16.8 kWh/(m^2·a) , accounting for 48% of the total energy consumption.
- The lighting system consumes 5.9 kWh/(m^2·a) , accounting for 17% of the total energy consumption.
- The socket system consumes 10.79 kWh/(m^2·a) , accounting for 30% of the total energy consumption
- Other power systems consume 2.26 kWh/(m^2·a) , accounting for 5% of the total energy consumption

- Annual energy saving: approx. 330,100 kWh



Historical data of electricity consumption

3 Typical Cases of Green and Low-carbon Buildings

Xiong'an High-speed Railway Station

- Construction in 2020
- Design Institute: China Architecture Design & Research Group Co., Ltd.
- Total construction area: 475,000 m^2 Green building star rating: three stars
- Photovoltaic area: 35,000 m^2

- 35,000㎡ photovoltaic system installed on the roof
- 5.8 million kWh of clean electricity provided to Xiongan High-speed Railway Station every year , accounting for 12.7% of total annual electricity consumption
- Reduce coal consumption by 1,800 tons and reduce carbon dioxide emissions by 4,500 tons

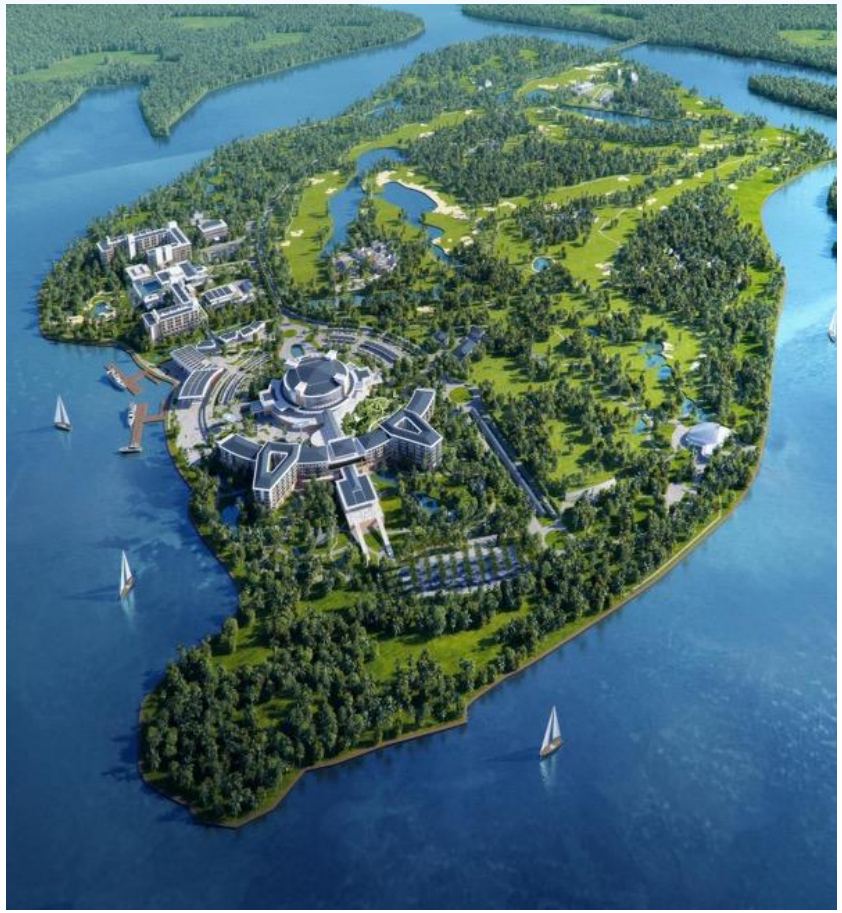
4 Typical Cases of Green and Low-carbon Buildings

Bo'ao Near-Zero Carbon Demonstration Zone

"Region of near-zero carbon, resource recycling, natural environment, and smart operation"

4 major construction concepts,

8 types of low-carbon technology integration



Concept	Eight categories	18 implementation projects
environment nature	1. Garden landscape Ecological transformation	Project 01 : Dongyu Island Ecological Coastline Reconstruction and Restoration Project
		Project 02 : Ecological restoration and function improvement project of forest land on the island
		Project 03 : Yuanyang Avenue Landscape Improvement and Function Improvement Project
area Zero Carbon	2. Green transformation of buildings	Project 04 : Boao Forum for Asia Conference Center and Hotel Renovation Project
		Project 05 : Dongyu Island Hotel Renovation Project
		Project 06 : News Center Renovation Project
	3. Utilization of renewable energy	Project 07 : Integrated construction project of distributed photovoltaic systems for buildings and structures
		Project 08 : Agricultural and photovoltaic complementary organic fruit and vegetable supply base project
	4. New power system	Project 18 : Dongyu Island Zero-Carbon New Power System Demonstration Project
	5. Greening of transportation	Project 09 : Green transportation site construction project on the island
		Project 10 : Off-island green transportation transfer station construction project
		Project 11 : Transportation supporting facilities and equipment construction project
resource cycle	6. Solid waste resource treatment	Project 12 : Waste collection and transportation facility renovation project
		Project 13 : Material recycling and processing facility construction project
	7. Water recycling	Project 14 : High-quality water supply improvement project
		Project 15 : Outdoor rainwater utilization and sponge transformation project
wisdom operations	8. Intelligent operation	Project 16 : CIM+ Visualized Zero Carbon Management System
		Project 17 : Carbon Monitoring Terminal Equipment Construction Project

4 Typical Cases of Green and Low-carbon Buildings

Building Renovation Projects

Two Five-star conference hotels, one media center

Project Features

- ✓ Demonstration of Zero-Carbon/Low-Carbon Retrofit Technologies for Existing Buildings in Hot Summer and Warm Winter Areas
- ✓ Application Scheme for High-Efficiency Chiller Room Retrofit in Buildings within an Extremely Short Construction Period (3 Months)
- ✓ Demonstration of Full Electrification Application in Five-Star Hotel Buildings

Main technical measures

- ✓ Natural ventilation and natural lighting
- ✓ Improved thermal insulation performance of roofs and curtain walls
- ✓ Sunshade, green plant system shading
- ✓ High-efficiency refrigeration room
- ✓ Air source heat pump for domestic hot water
- ✓ Efficient lighting + intelligent lighting control
- ✓ Roof, ground, sunshade
- ✓ Fully electric cooking

End result after renovation

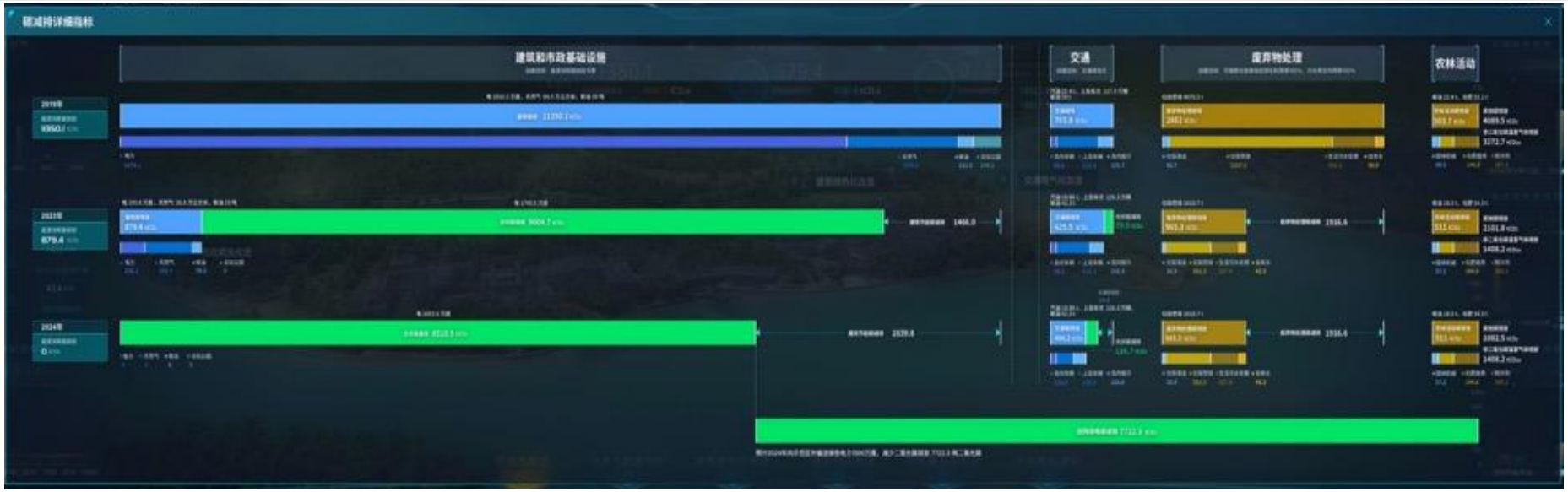
- ✓ After the renovation, the carbon emissions of the two hotels decreased by 28%, and those of the news center dropped by 100%.
- ✓ The hotel buildings have reached the low-carbon building standard, while the media center has achieved the zero-carbon building level.
- ✓ The entire island has achieved 100% electrification of building energy use.

4 Typical Cases of Green and Low-carbon Buildings

On March 18, 2024, the Bo'ao Near-Zero Carbon Demonstration Zone officially entered its operational phase.

	Electricity (excluding PV) 10,000 kWh	Gas 10,000 m^3	Diesel fuel ton	PV power generation (on the island + outside the island) 10,000 kWh	Net carbon emissions tCO_2
2019	1910	65	39	0	11350
2024	1653	0	0	3154	0
Decline	Down 13%	100% decrease	100% decrease	-	100% decrease

31.54 million kWh of PV power , of which 16.54 million kWh was supplied to the island and 15 million kWh was transmitted to the municipal power grid.



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After over 40 years of development in building energy conservation in the PRC, we have gained a wealth of experience and lessons. We are willing to share them with the world and work together to promote global ecological civilization.

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Thank you!

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