Innovative solutions for low carbon cities:
Case Study of Nearly Zero Energy Building
——Xingye Renewable Energy Industry Park R&D Building

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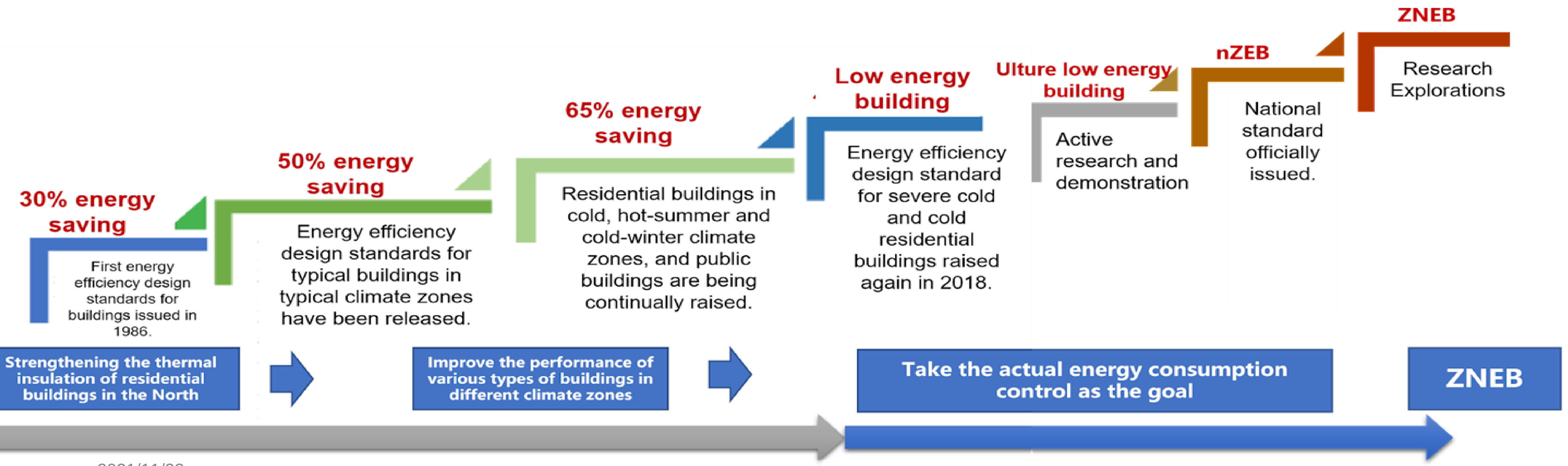
Content

Background

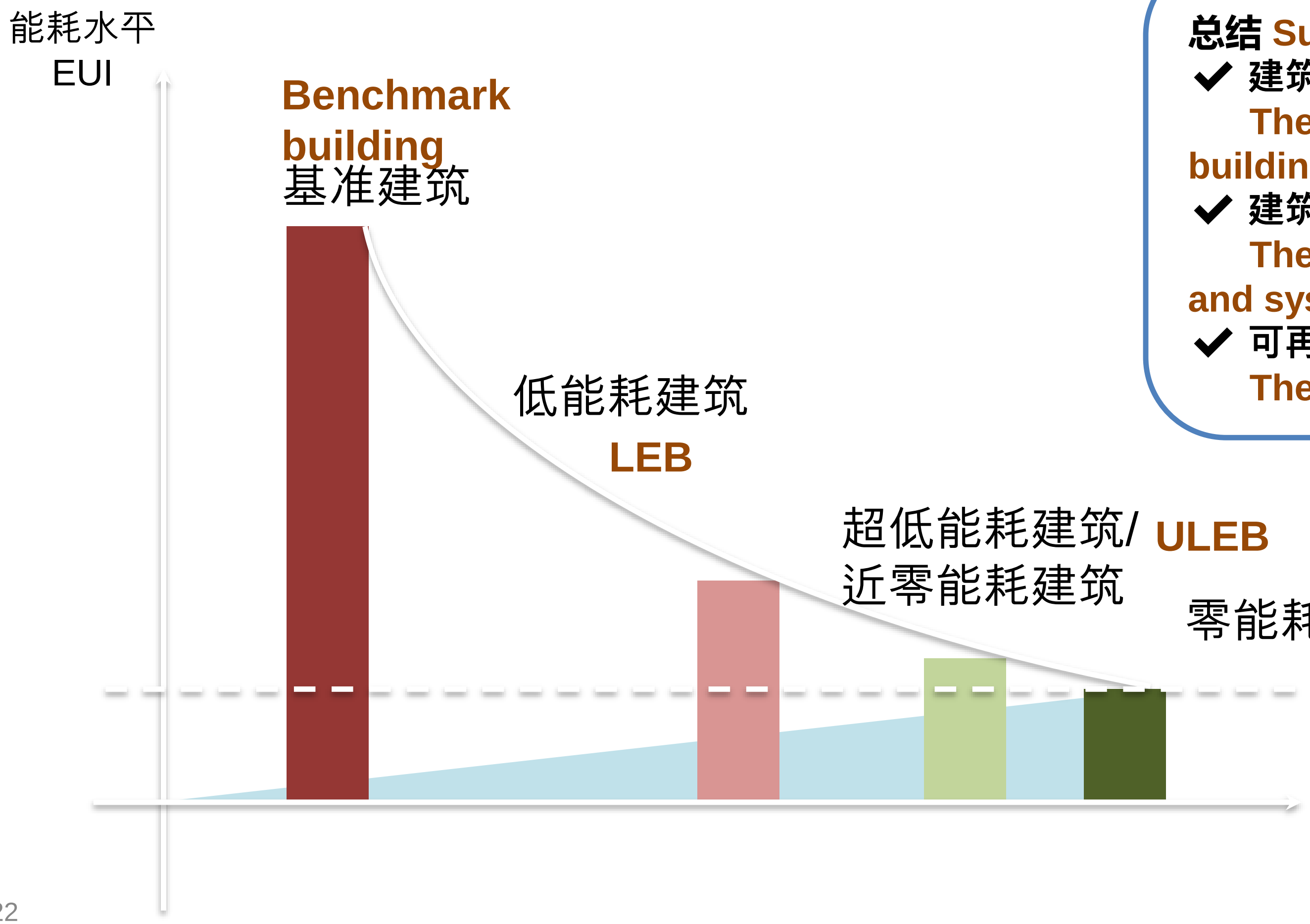
History of China's building energy efficiency development

- Substantial improvement in the energy efficiency of buildings through a "three-step process".
- Gradually shift to a dual control of energy intensity and total energy consumption in buildings that is guided by actual operational results.
- Progressively exploring high-performance, low-emission buildings such as ultra-low energy buildings, nearly zero energy buildings and net zero energy buildings.



Background

China: Towards zero energy buildings



由可再生能源系统产能抵消剩余能耗(电和热)

Residual energy consumption (electricity and heat) offset by renewable energy system

总结 Summary：

- ✔ **建筑围护结构的性能提高的极限**
  The limit of the performance improvement of the building envelop
- ✔ **建筑能源设备与系统的效率提高的极限**
  The limit of efficiency in building energy equipment and systems
- ✔ **可再生能源贡献的极限**
  The limit of the contribution of renewable energy

Overview

Zhuhai Xingye New Energy Industrial Park R&D Building

- **Project Location**: Zhuhai, China
- **Investment and construction unit**: Zhuhai Xingye Energy Conservation Technology Co.
- **Completion date**: April 2018
- **Climate zone**: Hot summer and warm winter climate zone
- **Building area**: 23546.08 ㎡ (17 storeys)
- **Building function**: R&D, office, exhibition
- **Design energy intensity**: 50kWh/(㎡·a)

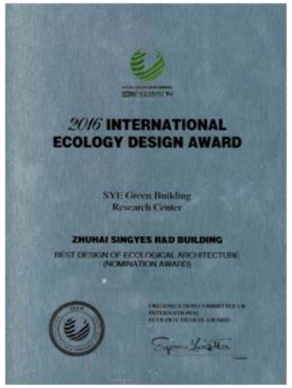
- **Demonstration project of the Sino-US Clean Energy Joint Research Centre(CERC)**
- **Research and build a nearly energy building for hot summer and warm winter areas**
- **Carry out integrated demonstration to become the first zero energy building in Zhuhai and even in hot summer and warm winter areas.**
- **The level of operational energy consumption is about 1/4 of that of similar buildings in hot summer and warm winter regions.**

Awards Received

China Three-star Green Building Label

2018 China Better Green Building

Consturuction 21



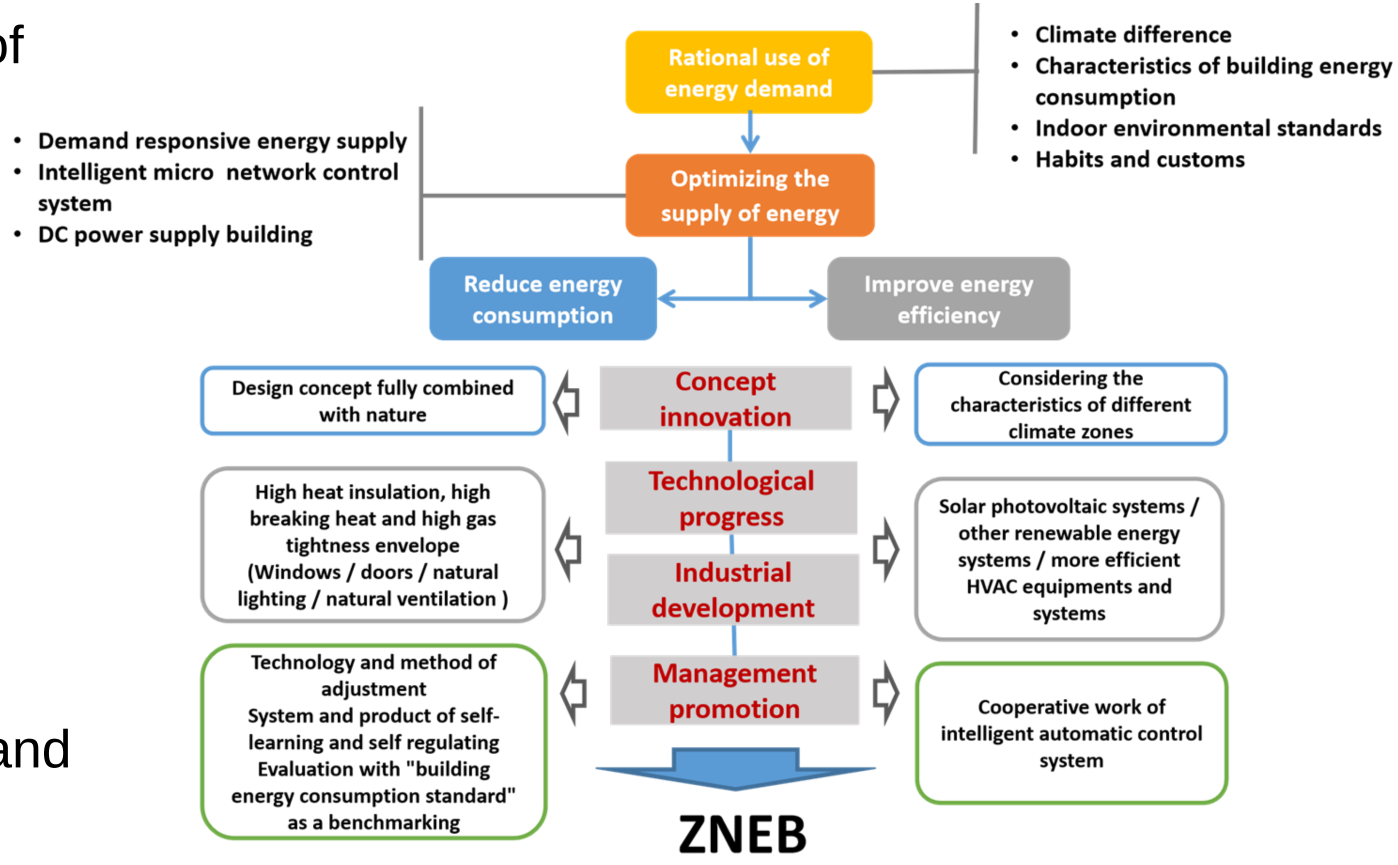
2018 International Ecology Design Awards

LEED PLatinum Certification

G20 International Energy Efficiency Dual Innovation Award

Technical routes

- Hot summer and warm winter climate zones **with high summer temperatures and humidity**, mainly addressing the issue of summer air conditioning supply.
- The technical route **uses passive technologies as a priority and further optimizes the energy system to meet energy demand through active technologies.**
- Research into the integrated use of technology by combining two passive technologies: "ventilation and shading" and two active technologies: "personalised intelligent control and renewable energy use



Technical routes

Building Design

- Natural Ventilation;
- Basement Natural Lighting;

Building Envelope & Building Equipment

- High Performance Glass, double glaze LOW-E;
- Heat Recycling System;
- CO_2 Control System;
- Rain Water Recycling;
- Energy-Feedback Elevator;

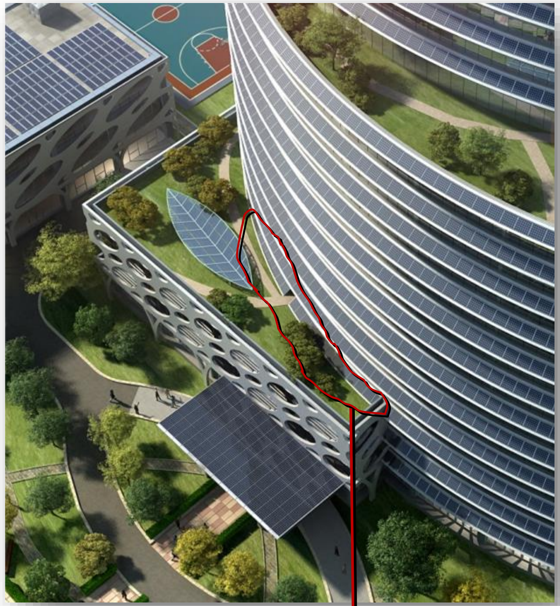
Renewable Energy/Distributed Generation

- PV (238.56kw) & Solar Thermal (800L/d) integration;

Whole Building

- Commissioning, start from design phase, integrated in all building procedures.
- Building Energy Management;

Integrated solar building design



Flat plate collectors	31 pieces

Region	Installed PV power (kW)	Annual module surface irradiance Wh/m²	Electricity generation (kWh)
Rooftop power stations	78.75	1335.1	73903
Ventilation and shading louvres	8.505	504.01	3013
Light roofs	3.465	1018.9	2482
Curtain walls	130.37	7443.4	68448
Podium canopies	17.472	1034.4	12704
Total	238.56	11335.9	161001

BIPV	Supply over 10% of the building's electricity
Solar water heating Water	Water supply to building bathing facilities

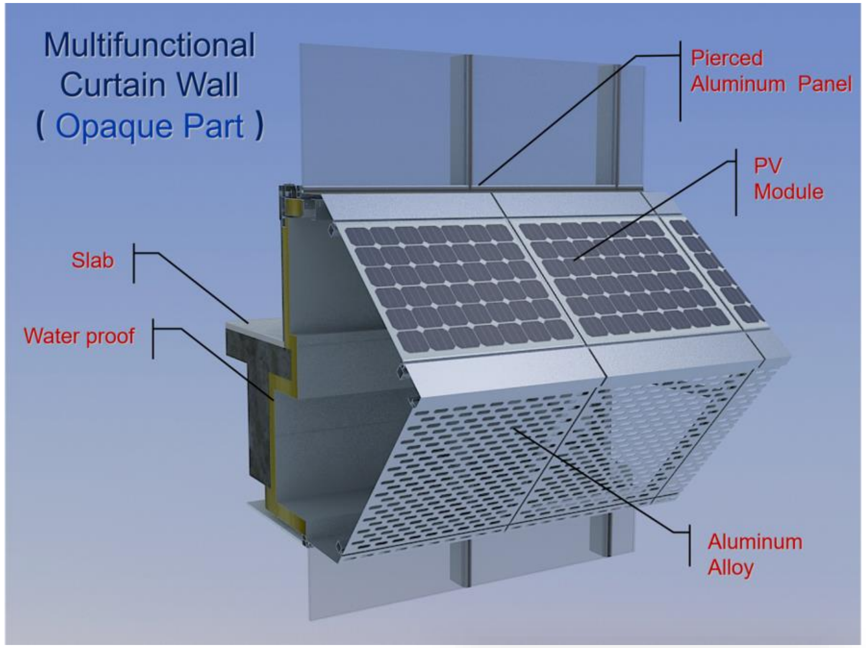
Innovative Technologies

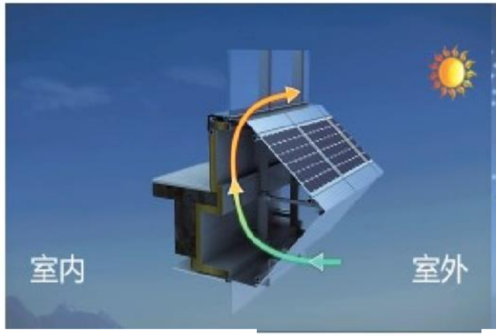
Develop a seasonally controllable multi-functional photovoltaic curtain wall integrating ventilation, shading and power generation.

- Effective opening strategy for rotatable ventilators
  Approximately 30% more energy efficient than ordinary fresh air systems

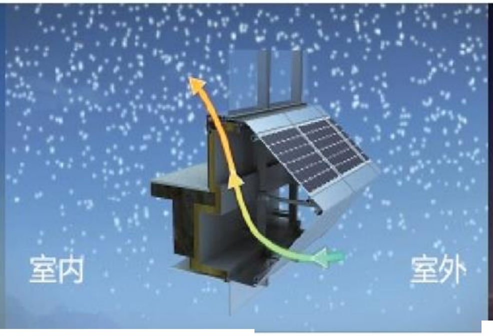
- Increased efficiency of photovoltaic modules for power generation
  16.5°C lower average PV module surface temperature

- Reduced indoor air conditioning load
  5% reduction in air conditioning power consumption

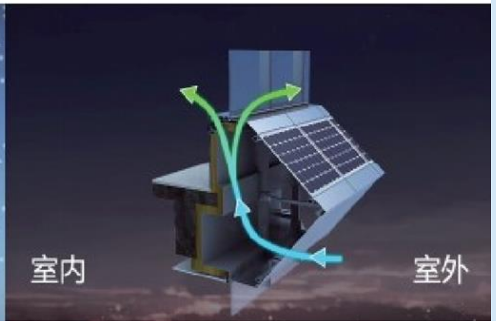




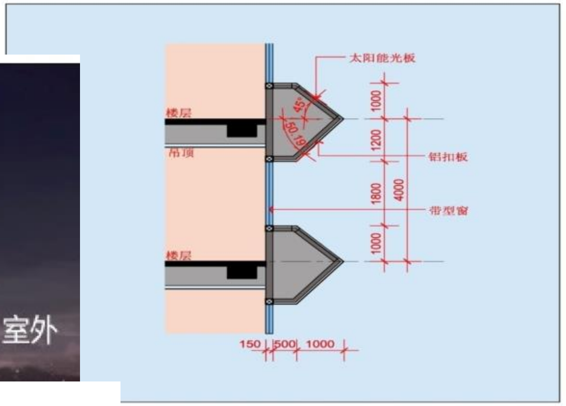
summer



winter



Spring, autumn and transitional season evenings

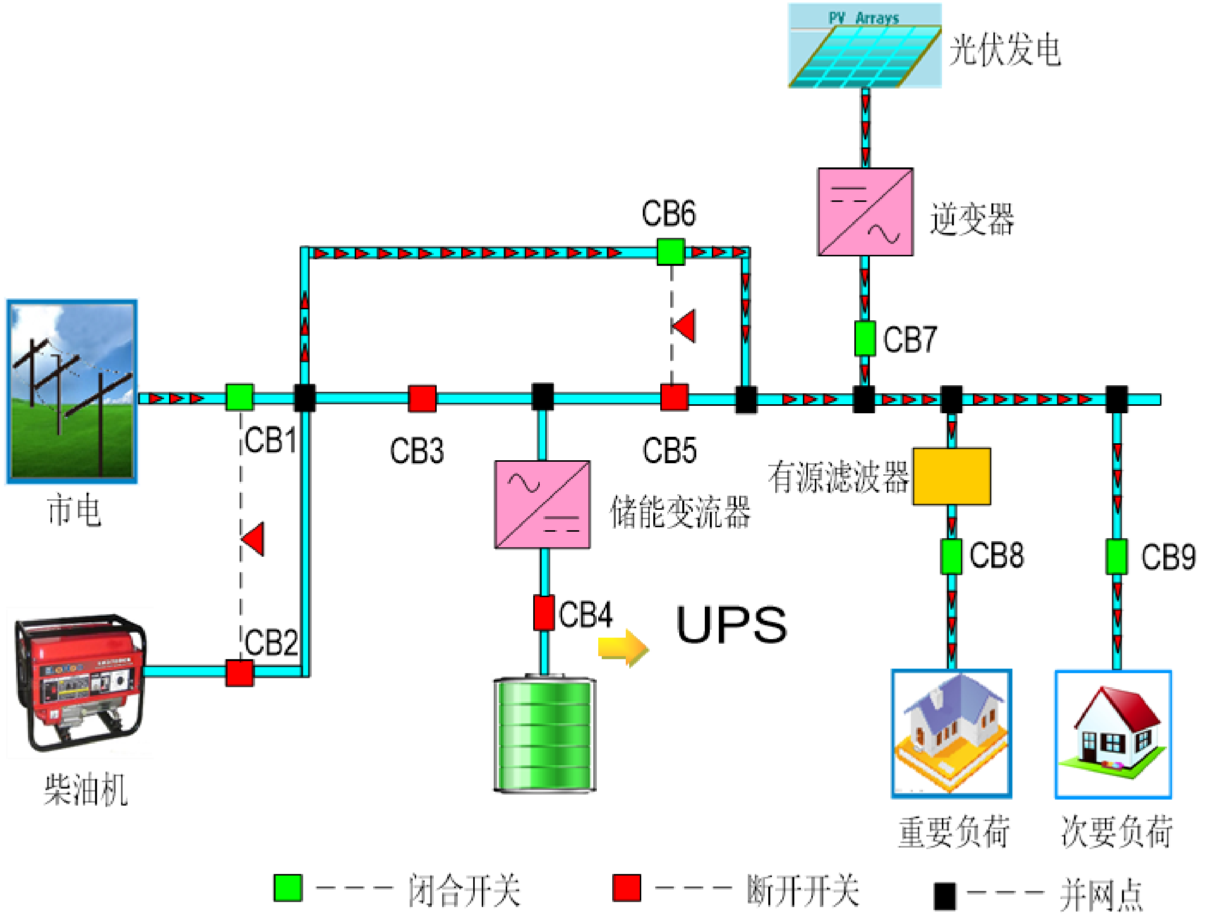


Innovative Technologies

Developed a smart microgrid system based on never losing power to critical loads in public buildings.

- providing solutions for building power security, stability and efficient integrated energy use.

- Seamless switching between multiple power sources such as photovoltaic power generation, energy storage and utility power, ensuring safe power supply to important loads and expanding the application area and reliability of photovoltaic microgrid systems



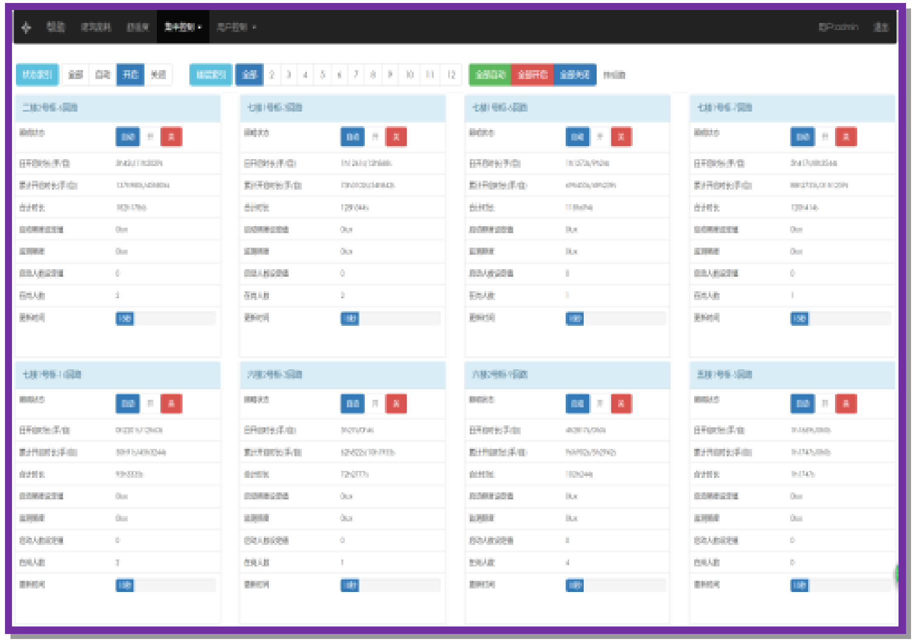
Innovative Technologies

An office building energy management system has been established to enable continuous commissioning of building systems and operational management optimisation through data collection and feedback from users.

Innovative Technologies

Intelligent building control models based on behavioural energy efficiency in office buildings to meet the individual needs of occupants for environmental service quality

- Study of "self-learning" of equipment start/stop thresholds.
- Personalised comfort enhancement.
- Research on control strategies for building energy monitoring systems based on human behaviour perception technology.
- Research and development of energy consumption monitoring platform.



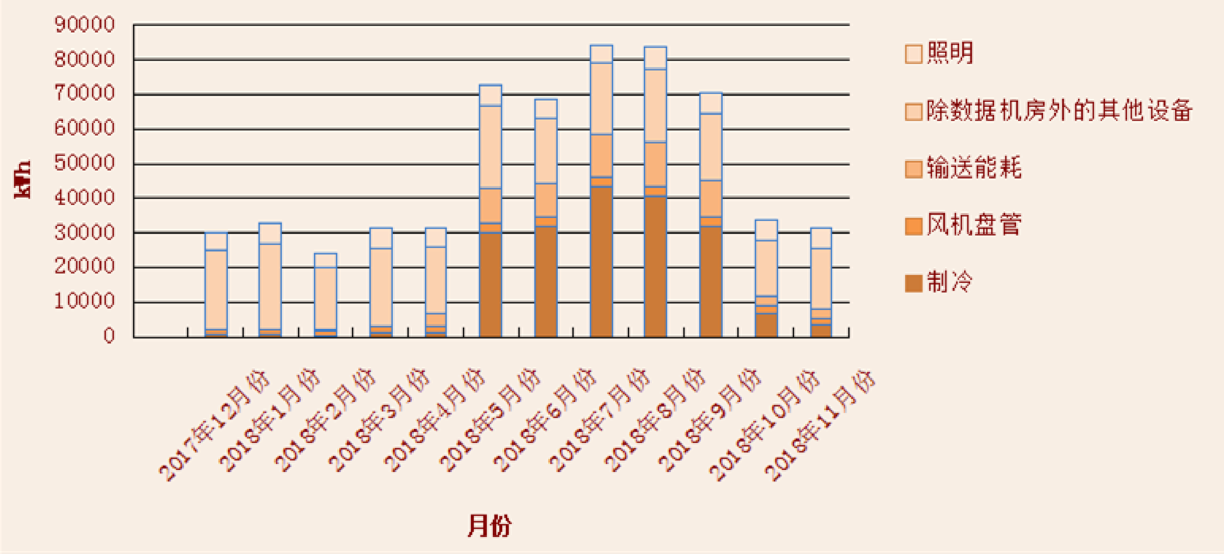
Operational Results

2017.12-2018.11

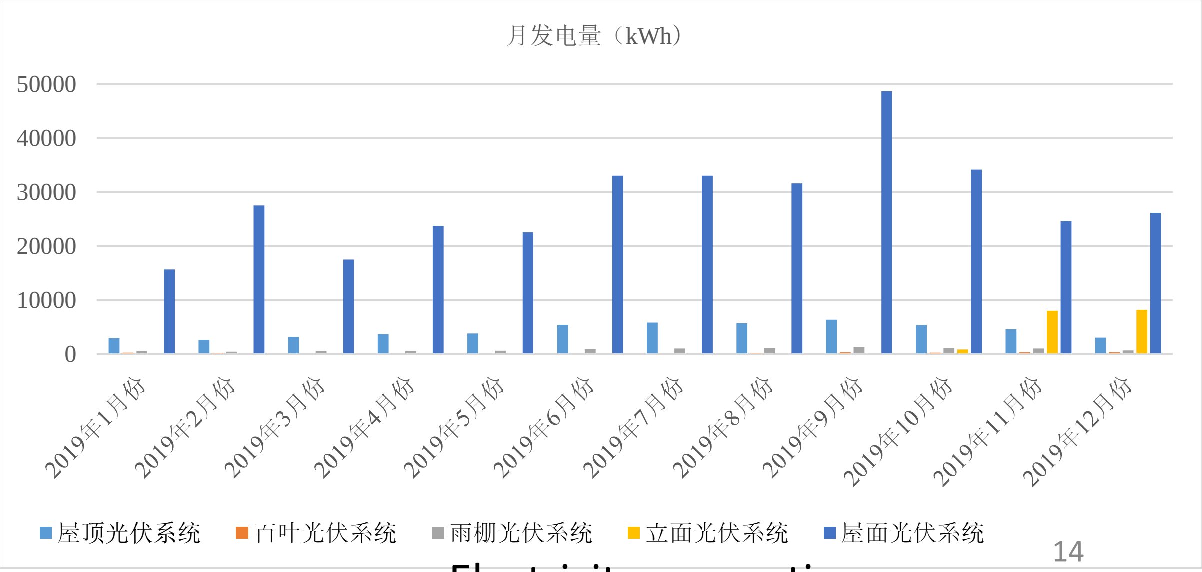
- the net electricity energy intensity and carbon emission intensity are **23.85kWh/m^2** and **11.93kg CO_2/m^2** respectively, which is only 24% of the average of the public data on energy consumption of large public buildings in Guangdong Province, achieving the goal of a near-zero energy consumption building.

- The project saves approximately **312,200 kWh** of electricity and **2,689 tonnes** of non-traditional water annually.

- An overall increase in project investment of 8 million yuan, with an incremental cost of 362 yuan per unit area, expected to be recovered in **5.32 years**.



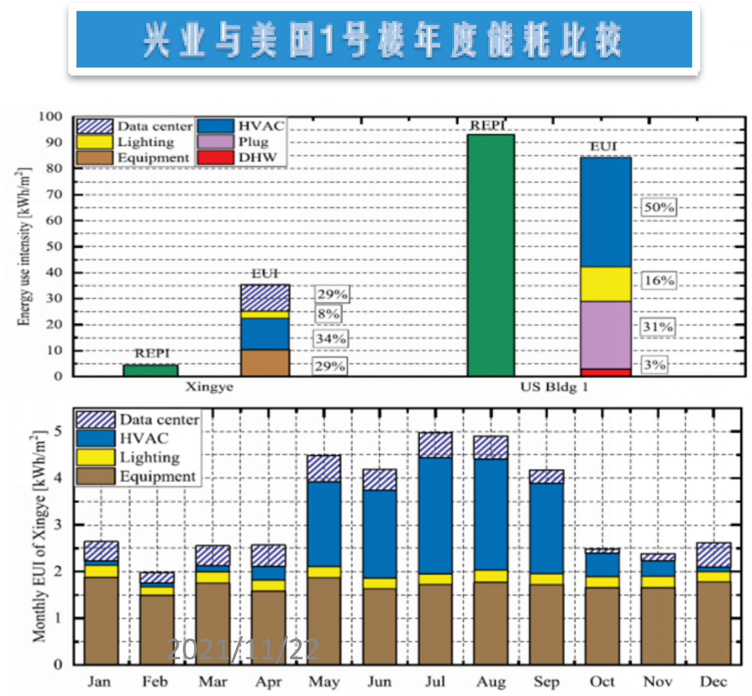
Energy use



Electricity generation

Operational Results

- Lawrence Berkeley National Laboratory, National University of Singapore, Shenzhen Institute of Building Research Ltd, Guangzhou University and Tianjin University collected **34** zero-energy building projects in the same climate zone around the world.
- *The energy efficiency level of Zhuhai Xingye New Energy Industrial Park R&D building is the best through analysis and comparison.*



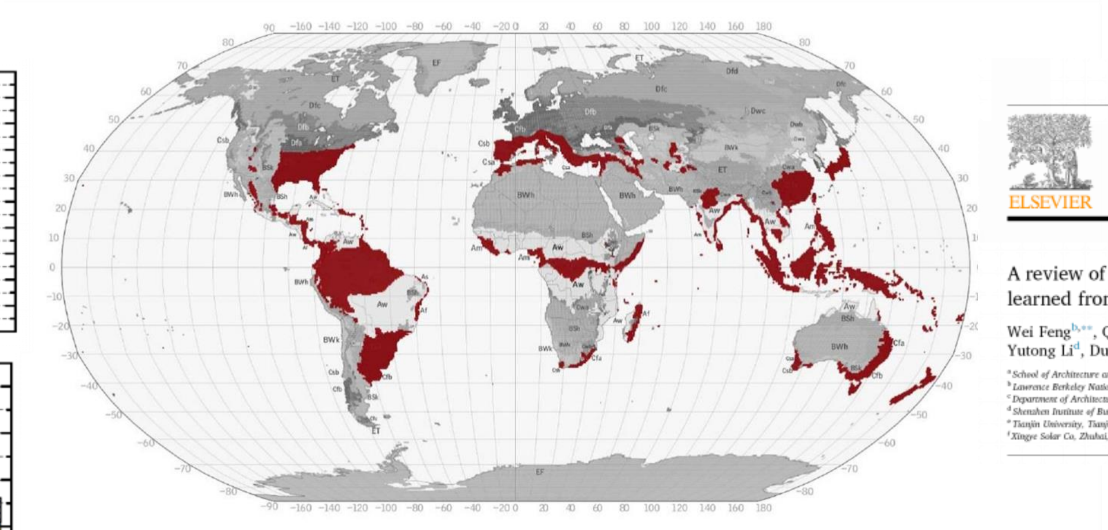
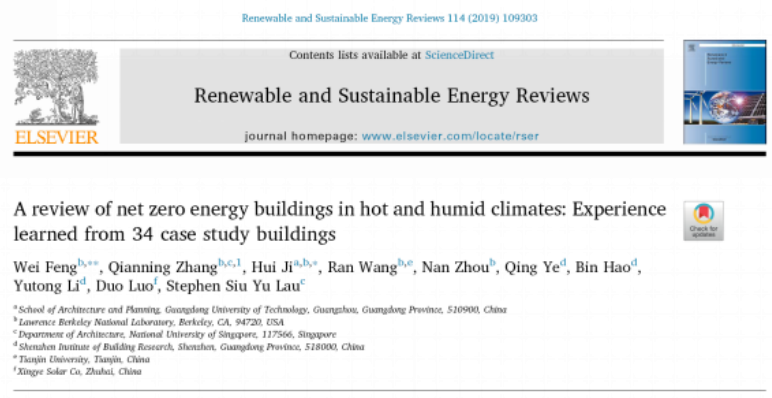


Fig. 1. Hot and humid climate regions in the world.



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A review of net zero energy buildings in hot and humid climates: Experience learned from 34 case study buildings

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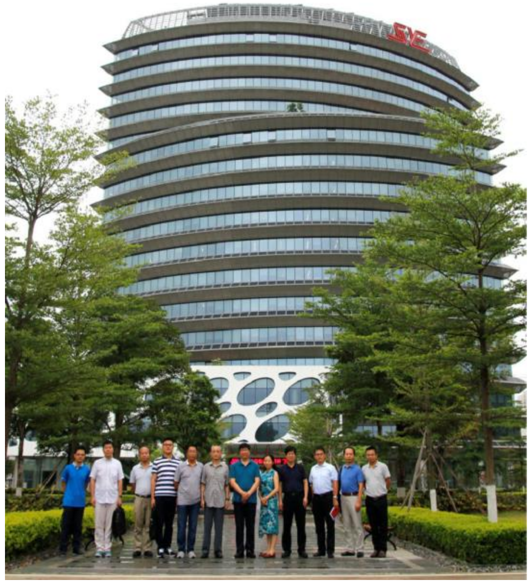
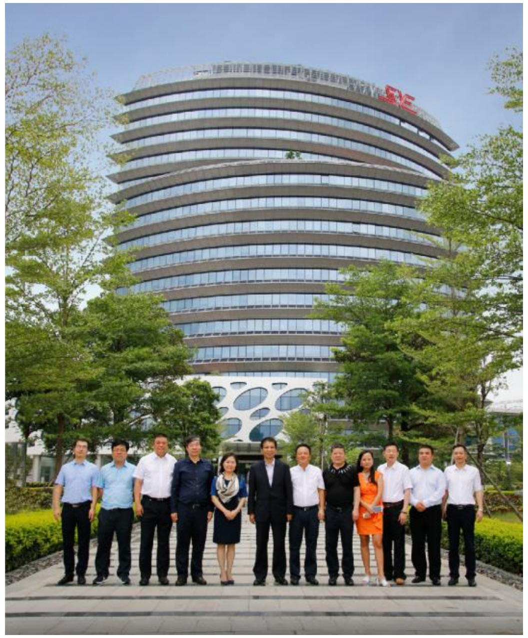
Comprehensive Benefits

Tens of thousands of people visit for study tours





How to Replicate and Promote

Barriers to the application of innovative technologies：

1. Insufficient conceptual understanding. There is a misunderstanding or insufficient understanding of the application of high performance envelope technology, solar photovoltaic utilisation and intelligent micro-grid control, building adaptation and other innovative technology.

2. High incremental costs.

3. Lack of professional talents. There is a shortage of talents engaged in design, construction, testing, supervision and management related to high performance buildings such as near-zero energy buildings, and industry practitioners lack systematic and extensive education, training and qualification.

How to Replicate and Promote

How the experience can be replicated ?

1. Encourage incentive policies. For example, policies such as granting financial incentives, volume ratio bonuses, and upward fluctuations in selling prices should be supported.

2. Research technical standards. Accelerate the research and development of relevant design, construction and acceptance standards, guidelines and drawing sets to provide technical support for the rapid promotion of near-zero energy buildings.

3. Build demonstration projects. By buildinging demonstration projects in other cities, we will accelerate the application of innovative technologies to achieve replication.

4. Strengthen the training of professional and technical talents. Strengthen the capacity building of relevant professional and technical talents through technical training.

How to Replicate and Promote

延安创智中心
Chuangzhi Center, Yanan

贵阳建工大厦
Jiangong Building, Guiyang

Nearly 300,000 m^2 rolled out in similar climatic zones

珠海派诺研发中心 Painuo R&D Building, Zhuhai

珠海钰海行政办公楼 Yuhai Office Building, Zhuhai

大同能源博物馆
Museum, Datong

Thank you！