中国建研院 环境能源研究院
Institute of Building Environment and Energy

The Development of Heat Pump Technology in China

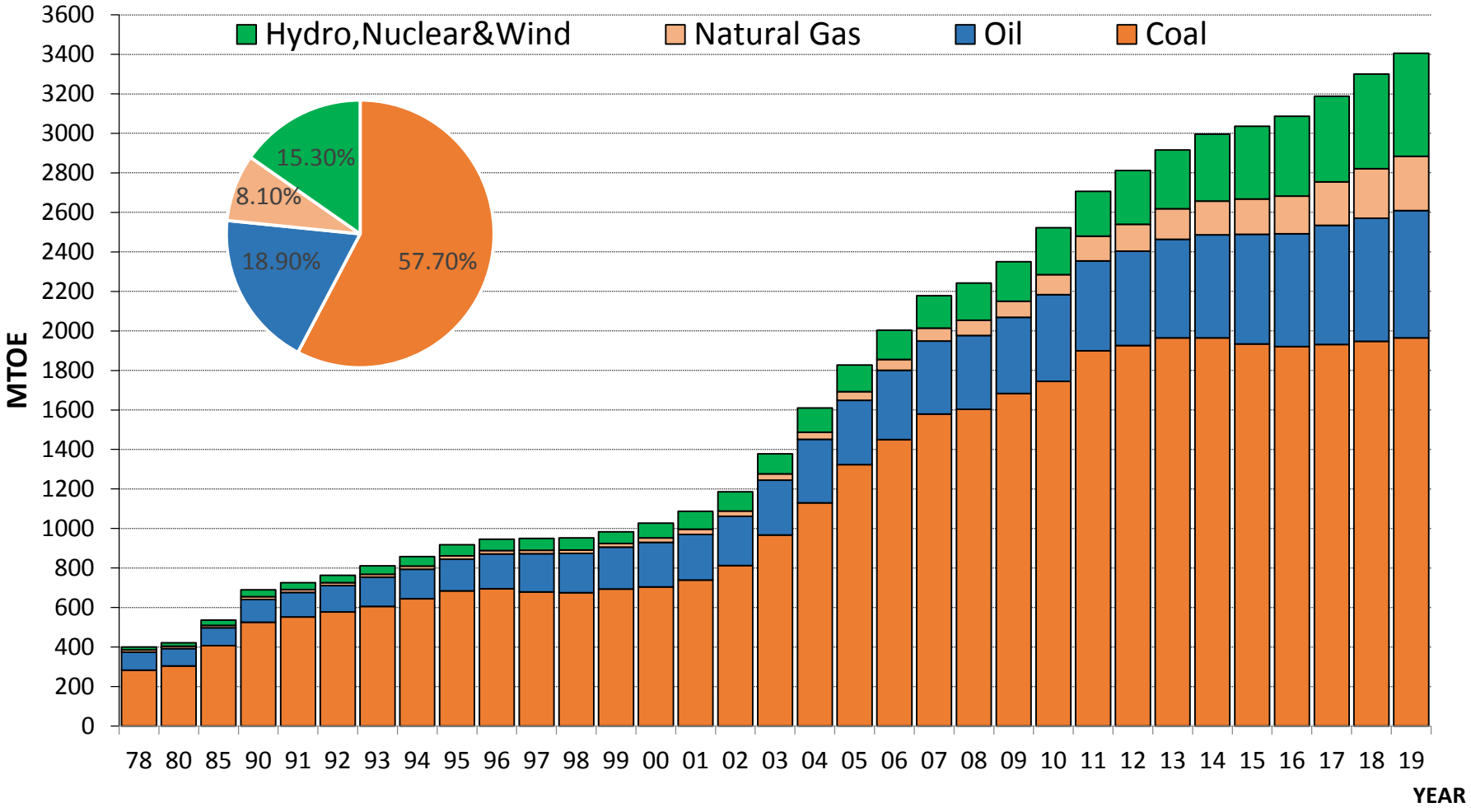
Yang Lingyan & Xu Wei

China Academy of Building Research

yly8111@163.com +86-15901118986

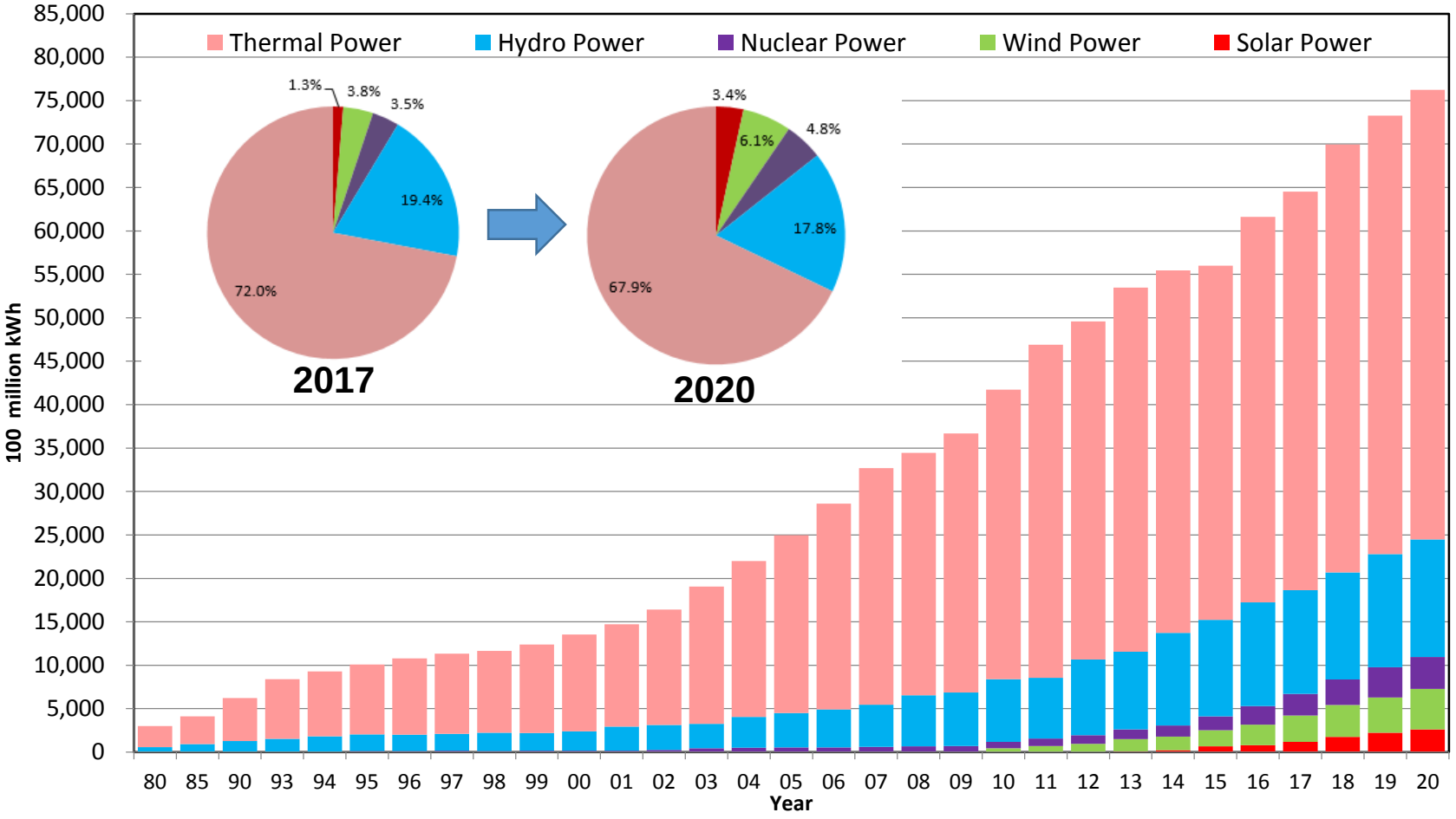
Content

1. Energy and Building



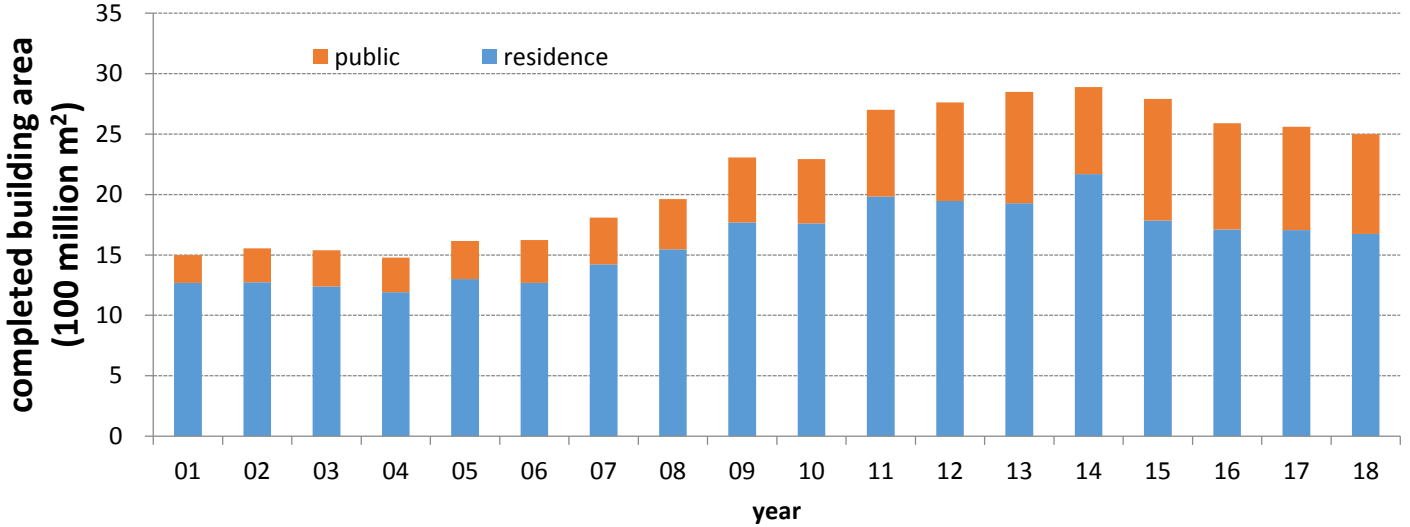
Total energy consumption and composition

1. Energy and Building

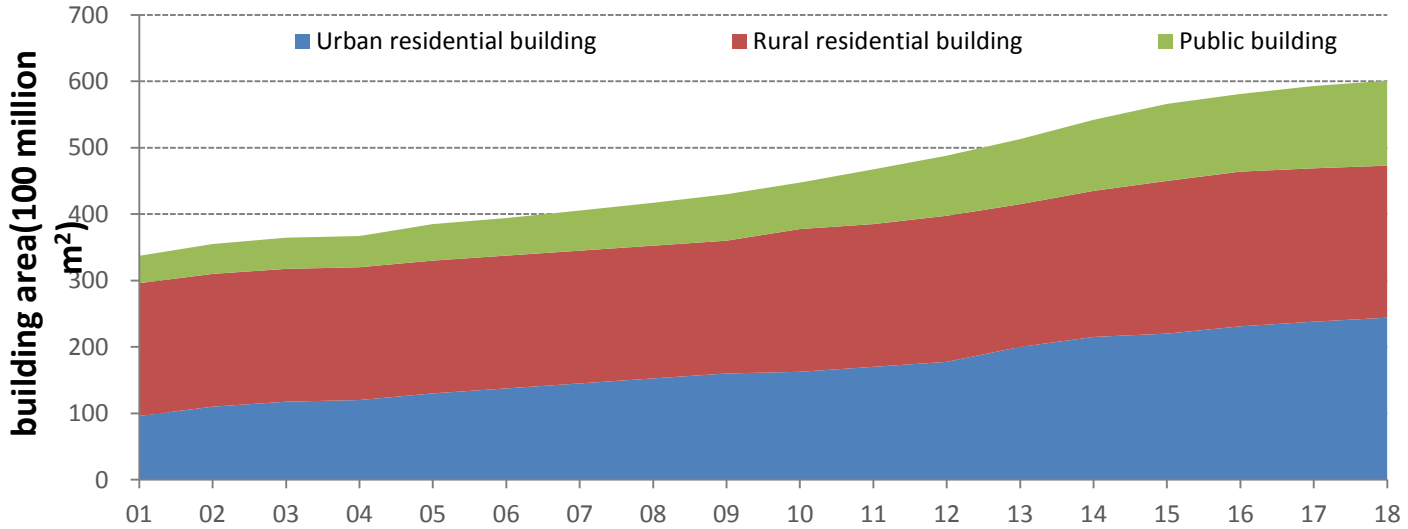


Total Electric Power Generation by energy source

1. Energy and Building

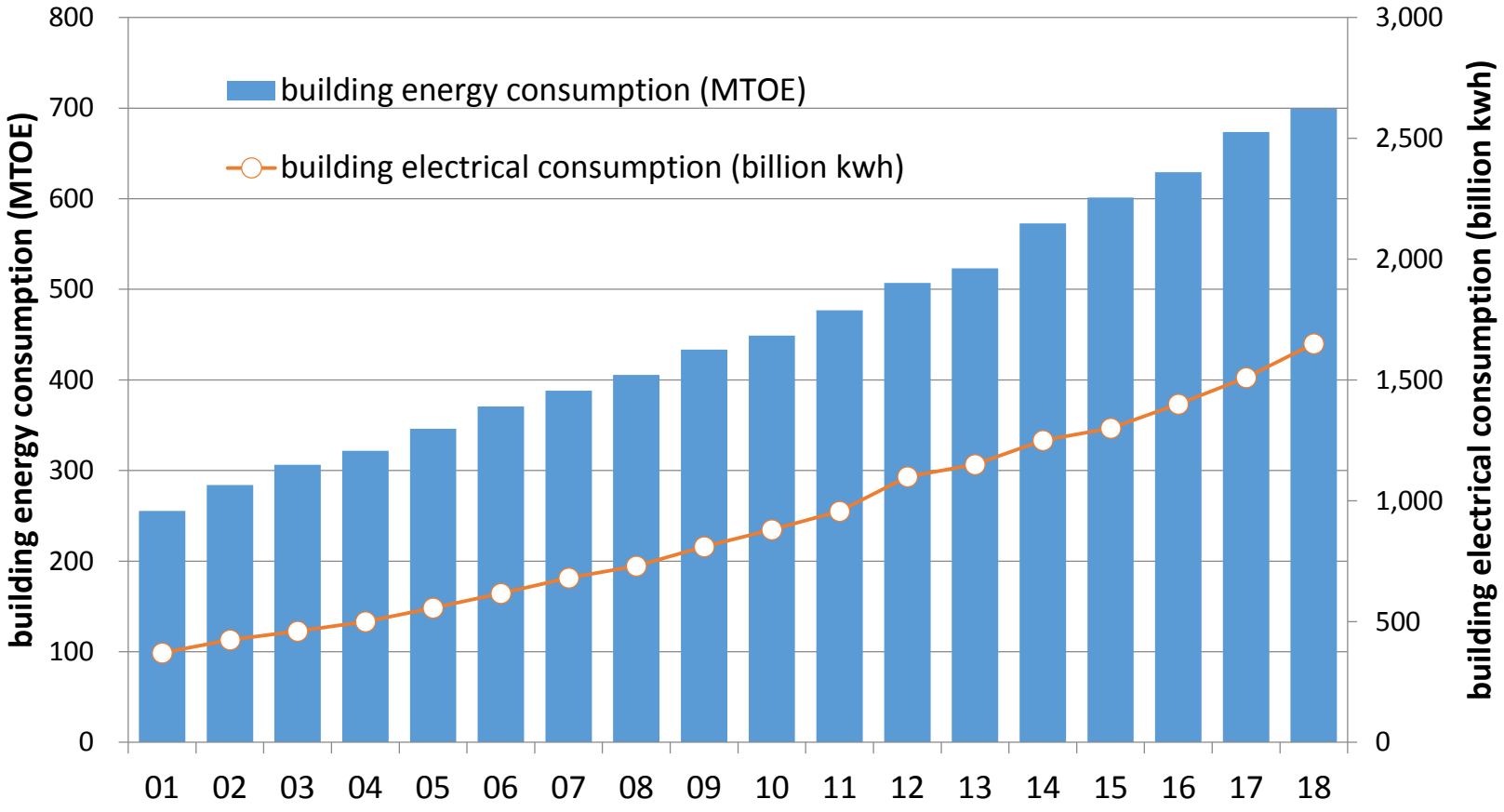


Completed Area of Civil Buildings in China



The total building area in China

1. Energy and Building



- energy consumption : 700 MTOE; Electrical consumption :1650 billion kWh；

Building energy consumption in China

2. Policy

Carbon emission

- The Work Plan for Controlling Greenhouse Gas Emissions in the "13th Five-Year Plan

By 2020, the carbon dioxide emissions per unit of GDP will fall by 18% compared with 2015.

- Reach the peak in carbon emissions by 2030

The carbon intensity per unit of GDP will fall by 60% to 65% compared with 2005.

- National Carbon Emissions Trading Management Measures

It will promote the construction of China's carbon emission trading market.

- Action plan for reaching the peak of carbon emissions by 2030

2. Policy

Clean heating

2013

Policy introduced:

"Beijing Clean Air Action Plan 2013-2017".

2014

Subsidy policy

The Beijing government promotes the subsidy policy of "coal to electricity" and "coal to gas"

2017

Policy upgrade

Financial support from the Chinese government for the pilot project of clean heating in winter in northern China. " 26+2"

2018

Expand the scale

National special funds support 12 new cities.

2021

Continue to push forward and expand to severe cold areas.

20 new pilot cities were added, and the scope of the pilot cities was expanded to severe cold areas. The total number of clean heating pilot cities reached 63.

2. Policy

Object of planning

According to the National Development and Reform Commission, the Energy Bureau and other 10 ministries and commissions jointly issued the "Northern District Winter Clean Heating Plan (2017-2021)".

The overall goal:

clean heating rate of **50%** in 2019; clean heating rate of **70%** in 2021, replacing **150 million tons of coal**.

Advance the goal:

Choose clean heating technology according to local conditions

Improve energy security

Reduce energy consumption

2. Policy

ASHP

◆Guidance on Promoting Electric Power Substitution

The NDRC issued to promote Air Source Heat Pump Heating to replace Coal-fired Heating

◆Work programe on air pollution prevention and control in Beijing, Tianjin, Hebei and surrounding areas in 2017

The MEP issued, the ASHP should be the main heating system for new residential buildings, and coal-fired boilers should not be built in it.

Relevant financial subsidies for ASHP projects:

- Beijing: 24,000 yuan/household.
- Tianjin: 29,000 yuan/household.
- Shanxi:27,400 yuan/household.
- Hebei: 7,400 yuan/household .
- Shandong: 8,000 yuan/household.

2. Policy

GSHP

◆13th Five-Year Plan for GSHP Energy Development and Utilization

The NDRC issued to complete GSHP energy heating development target of **700 million square meters**.

◆Accelerating the Development and Utilization of Shallow Geothermal Energy to Promote Coal-Reducing Substitution in the North Heating Area

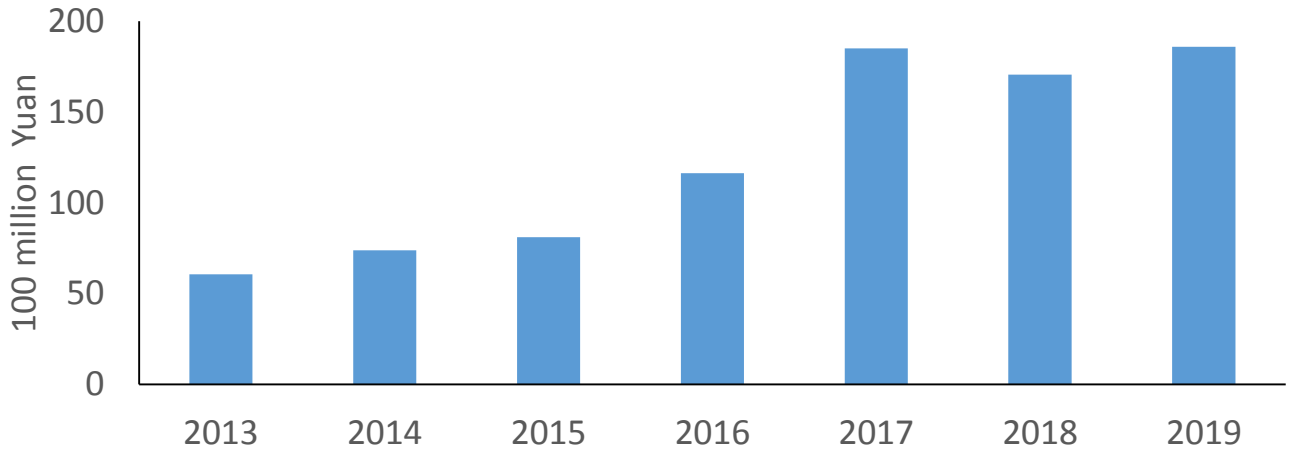
The State issued to accelerate the application of GSHP, especially in rural area.

Relevant financial subsidies for GSHP projects:

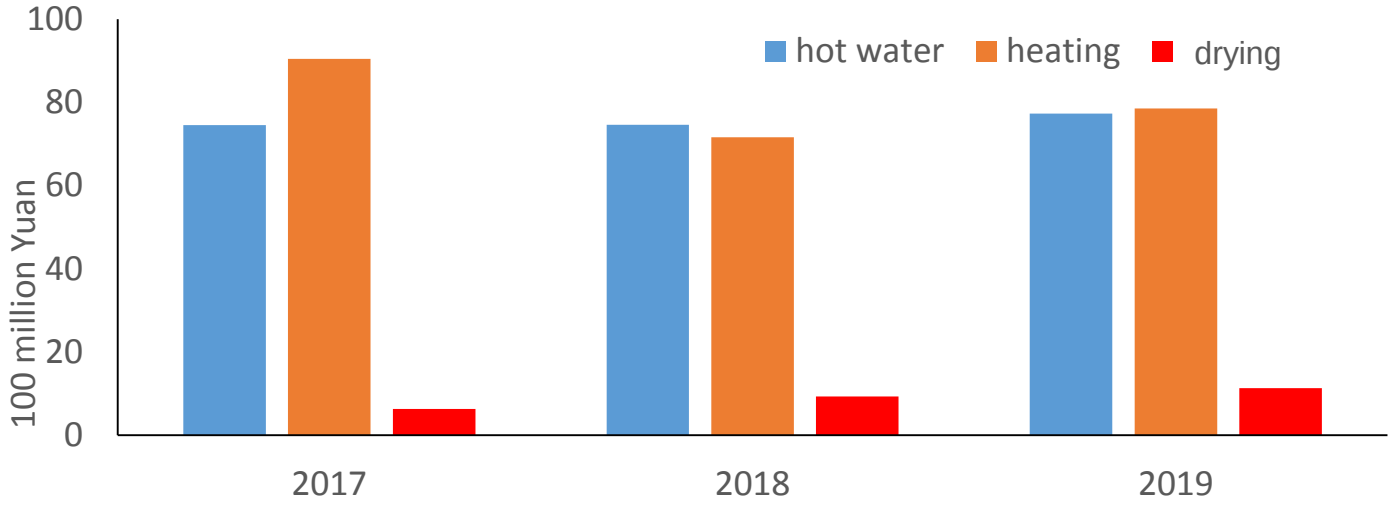
- Beijing: 30% of the initial investment in compensation engineering.
- Jilin: 60 yuan/㎡ in accordance with the energy supply area.
- Chongqing: 30-40 yuan/ ㎡ in accordance with the energy supply area.
- Nanjing: Compensation for energy supply area is 35-70 yuan/ ㎡.

3. Market

ASHP



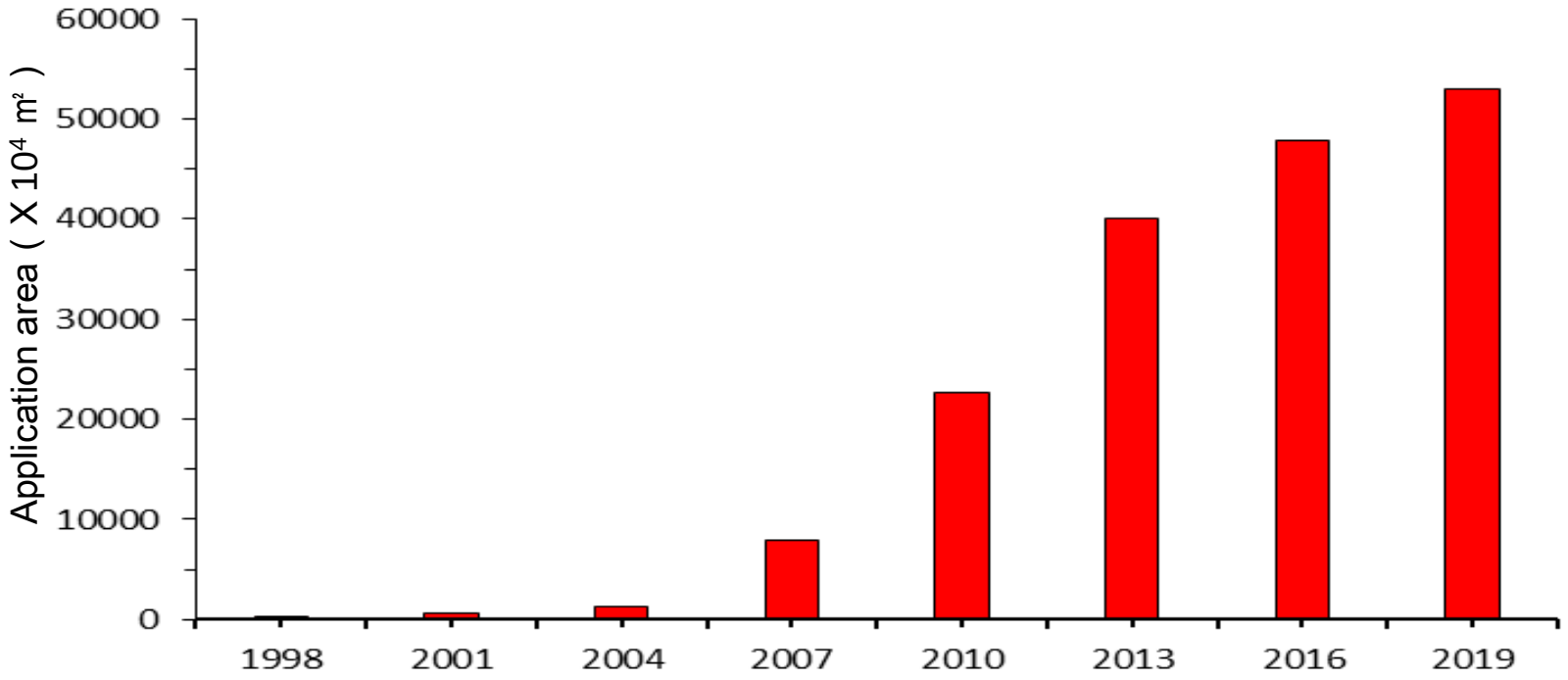
ASHP sales from 2013-2019



Sales of different types of products

3. Market

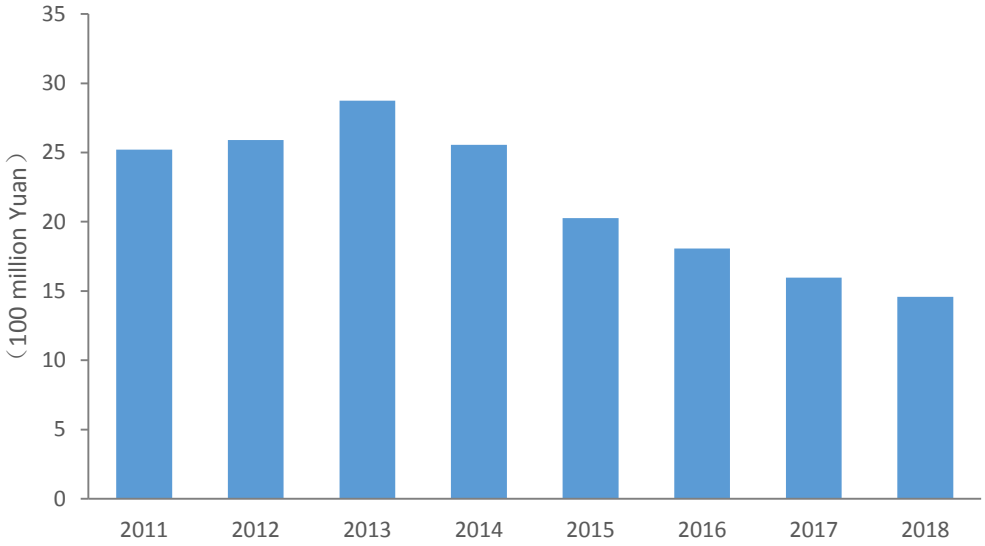
GSHP



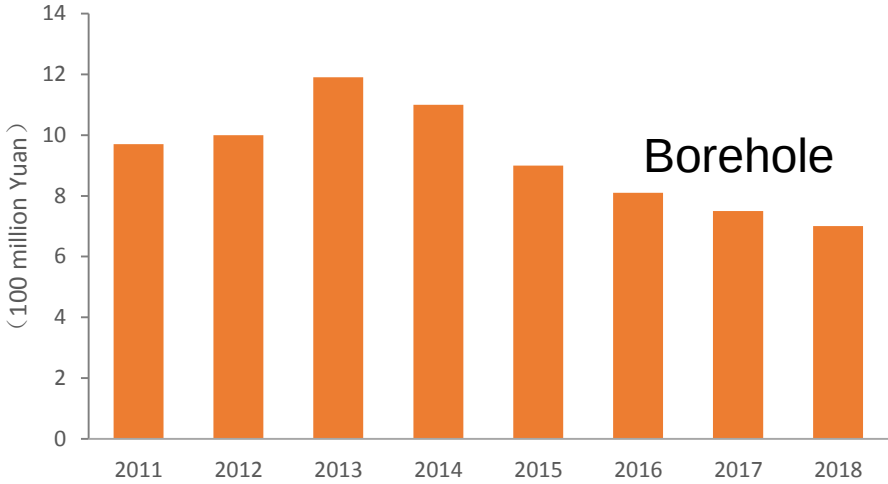
Application Area of Ground Source Heat Pump

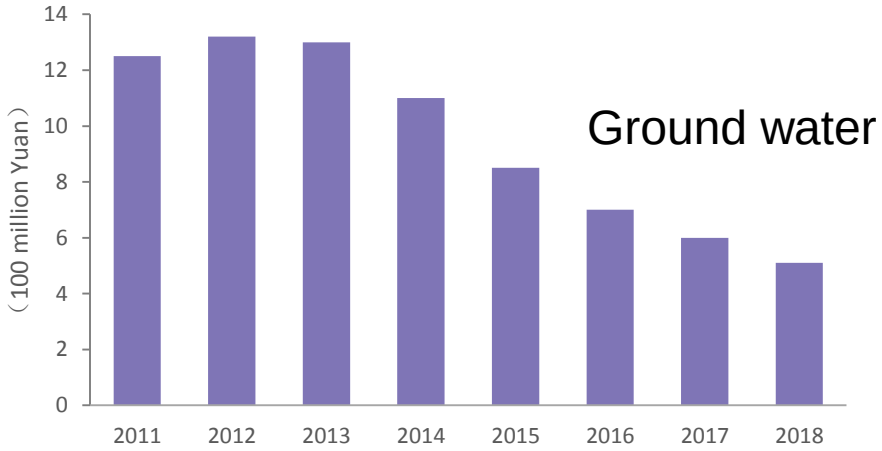
3. Market

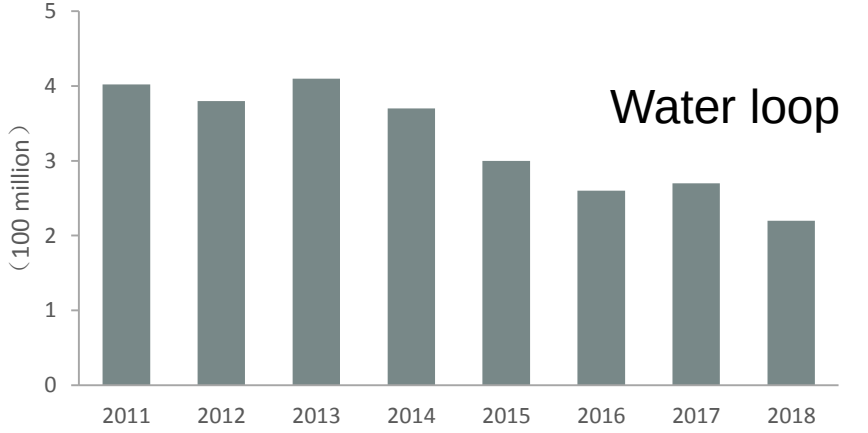
GSHP



Sales of GSHP units







4. R&D strategy

National Key R&D Plan for the 13th Five-Year Plan

"Technical System and Key Technologies Development of Near Zero Energy Consumption Building" led by China Academy of Building Research

The goal of this project is to study and establish a near zero-energy building technical indicator system for different regions of China. These include research into the application of renewable energy and energy storage technologies in near-zero energy buildings, with a focus on developing high-efficiency heat pump products and technologies.

4. R&D strategy

National Key R&D Plan for the 13th Five-Year Plan

"New Technology of Heating and Air Conditioning Using Renewable Energy in Tibetan, Northwest and Plateau Areas"

led by China Academy of Building Research

This project mainly studies solar energy heating in Tibet, air source heat pump heating in Sichuan and Tibet, and evaporative cooling technology in hot and dry western regions.

4. R&D strategy

National Key R&D Plan for the 13th Five-Year Plan

"Development and demonstration of low-grade residual energy recovery technology and heat pump equipment" led by Shanghai Jiao Tong University

The project aims to develop compressed high-efficiency heat pump for industrial waste heat, high-efficiency absorption heat pump and chemical heat pump for upgrading the grade of low-temperature heat energy. The overall technical scheme of network utilization of low-temperature residual energy is put forward to realize the effective utilization of medium-low-temperature heat energy.

4. R&D strategy

National Key R&D Plan for the 13th Five-Year Plan

"Solutions and corresponding systems for building heating and air conditioning in the Yangtze River Basin" led by Chongqing University

The project aims to improve the living environment of the Yangtze River basin in China, and to develop winter and summer shared heat pump products and high-efficiency cold and heat source equipment systems.

4. R&D strategy

Expand the application of heat pump

Improve the performance

Improving application applicability --
low temperature performance of ASHP, high temperature heat pump

Increasing renewable energy –
medium and deep geothermal heat pump

Meet the needs of diversified development --
composite integrated high efficiency heat pump technology products

4. R&D strategy

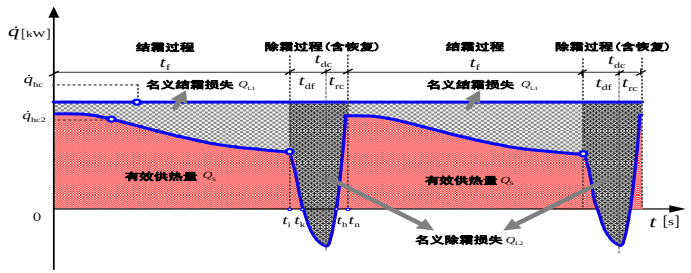
Research on improving low temperature heating performance of ASHP

Suitable compressor technology :
it can operate normally when the lowest ambient temperature is -25 ℃ or even - 30 ℃

Suitable heat pump control technology :
reduce the attenuation of heat supply at low ambient temperature

Effective defrosting Technology:
find the best defrosting control point, reduce energy consumption, improve comfort

Antifreeze technical measures:
improve heat pump efficiency and reliability at low ambient temperature



4. R&D strategy

Research on the heating of high temperature heat pump

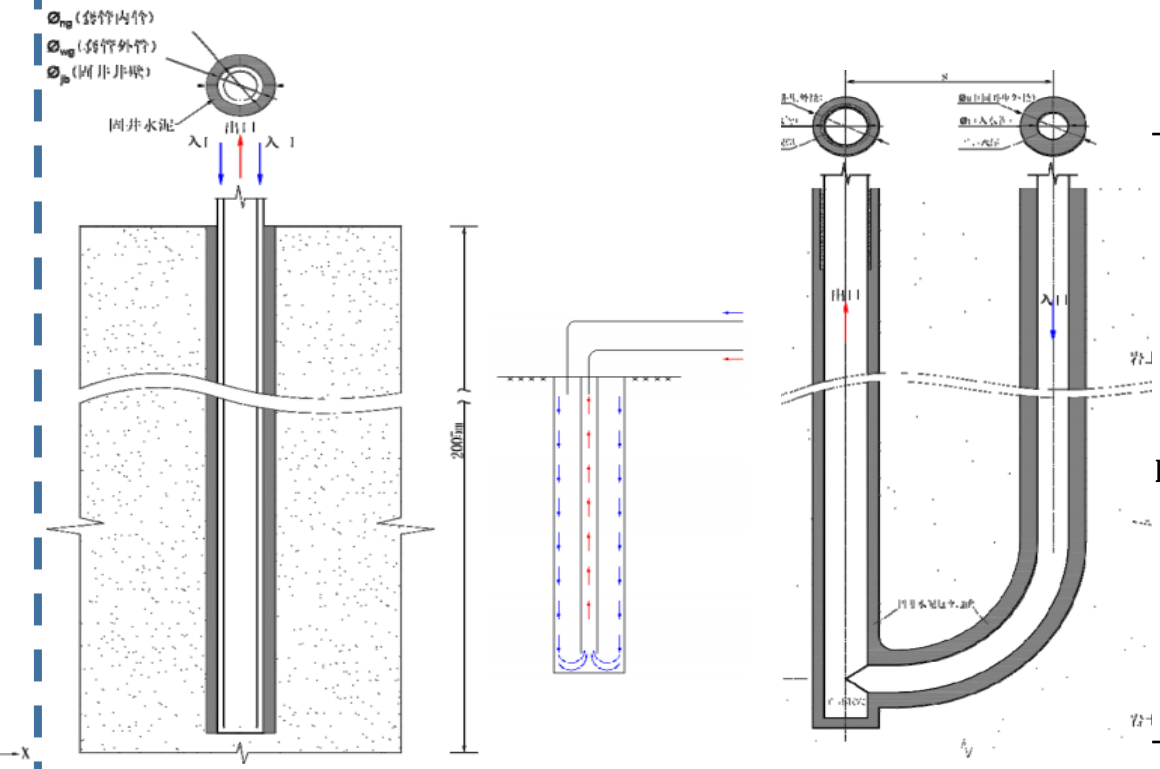
Increase heating temperature:
Improve the heating temperature range of high temperature heat pump to 100-200 ℃, so that it has greater industrial application prospects.

Research the working medium and components:
Meet the high temperature cycle and high temperature and high pressure working conditions, safety and economy.

Best application strategy:
Optimize the application scenarios of high temperature heat pump, respond to the process heat demand, and select the optimal application method.

4. R&D strategy

Medium-deep geothermal heat pump technology



Casing pipe

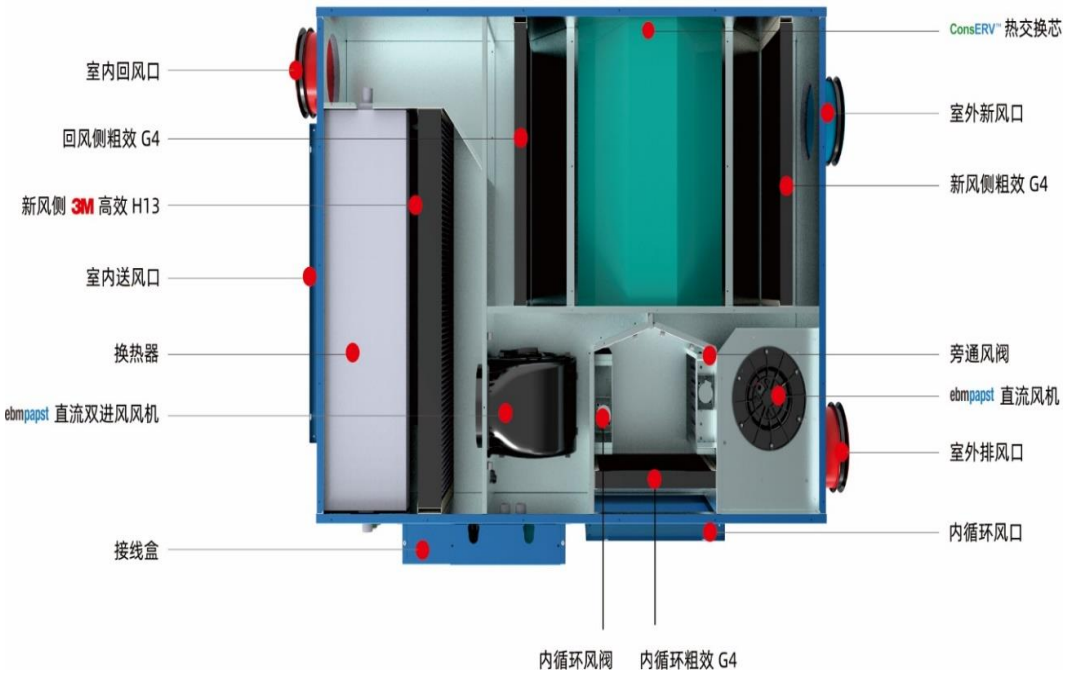
U type pipe

Number	Project A	Project B	Project C	Project D
Building area ㎡	20600	43500	56000	37800
Occupancy rate %	29	43	68	20
Heating area ㎡	6000	18700	38000	7560
Heat pump installed power kW	1040	1986	2600	2160
Number of heating holes	2	3	5	3
COP of system	3.91	3.28	3.61	3.35

The application area of medium-deep geothermal heat pump in China has exceeded 10 million square meters.

4. R&D strategy

Integrated heat pump product development



Product features:

- It has the characteristics of fresh air purification, fresh air heat recovery, cooling and heating, and flexible adjustment.
- It is highly integrated, convenient for household installation and property rights division, and can realize personalized settings to meet the needs of different indoor environments.

It provides an integrated energy environment solution for low energy consumption buildings.

5. Summary

1. China has become the largest heat pump producer and the largest application market in the world.
2. Heat pump heating will play a more important role in achieving China's carbon emission reduction and carbon neutralization goals.
3. Heat pump technology will be more widely used, and the heat pump industry will be more advanced.

中國建築科學研究院
China Academy of Building Research

谢 谢
THANKS