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

Solar Heating and Cooling in China

He Tao

Professor, China Academy of Building Research

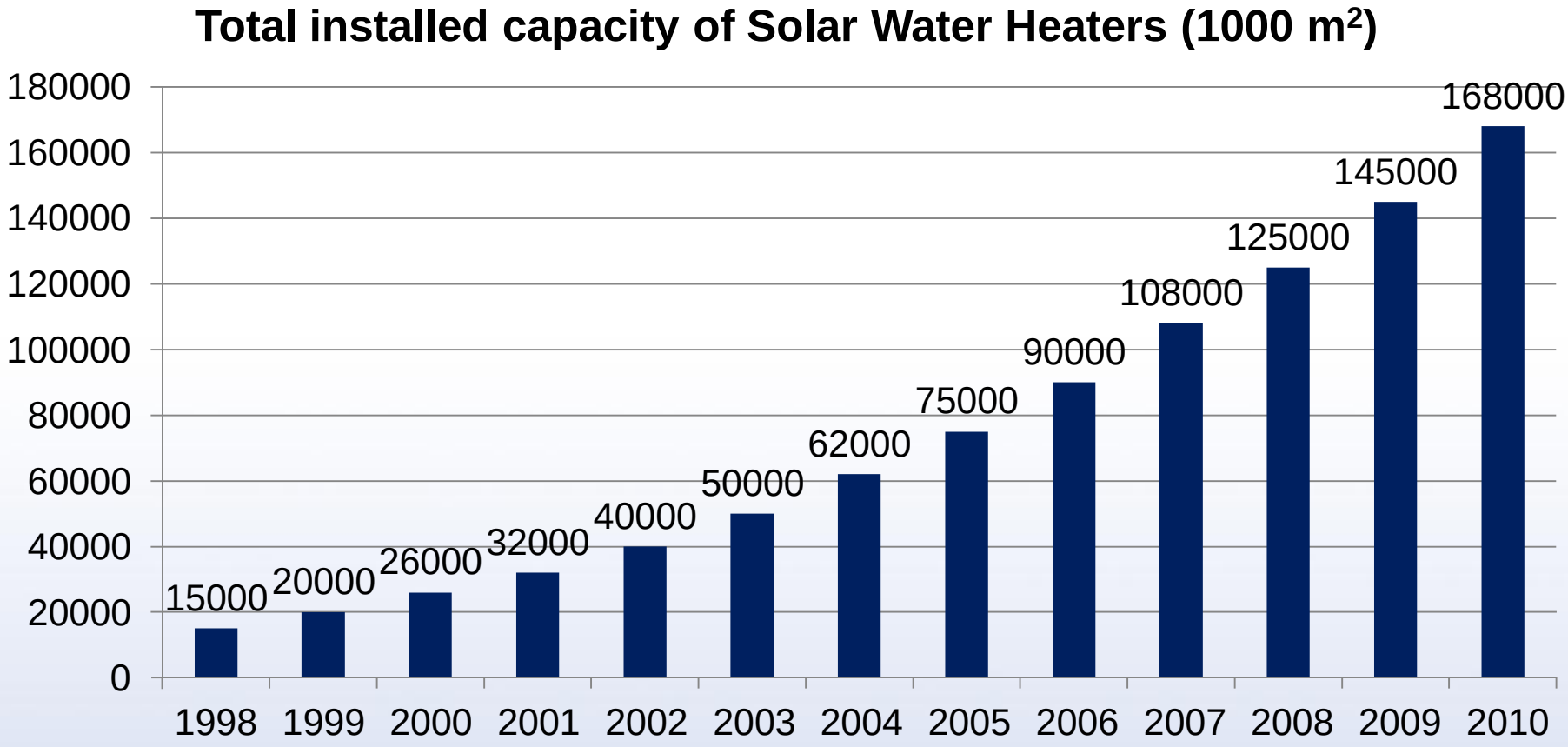
Vice Director of China National Solar Thermal Testing Center, Beijing

iac@vip.sina.com

Contents

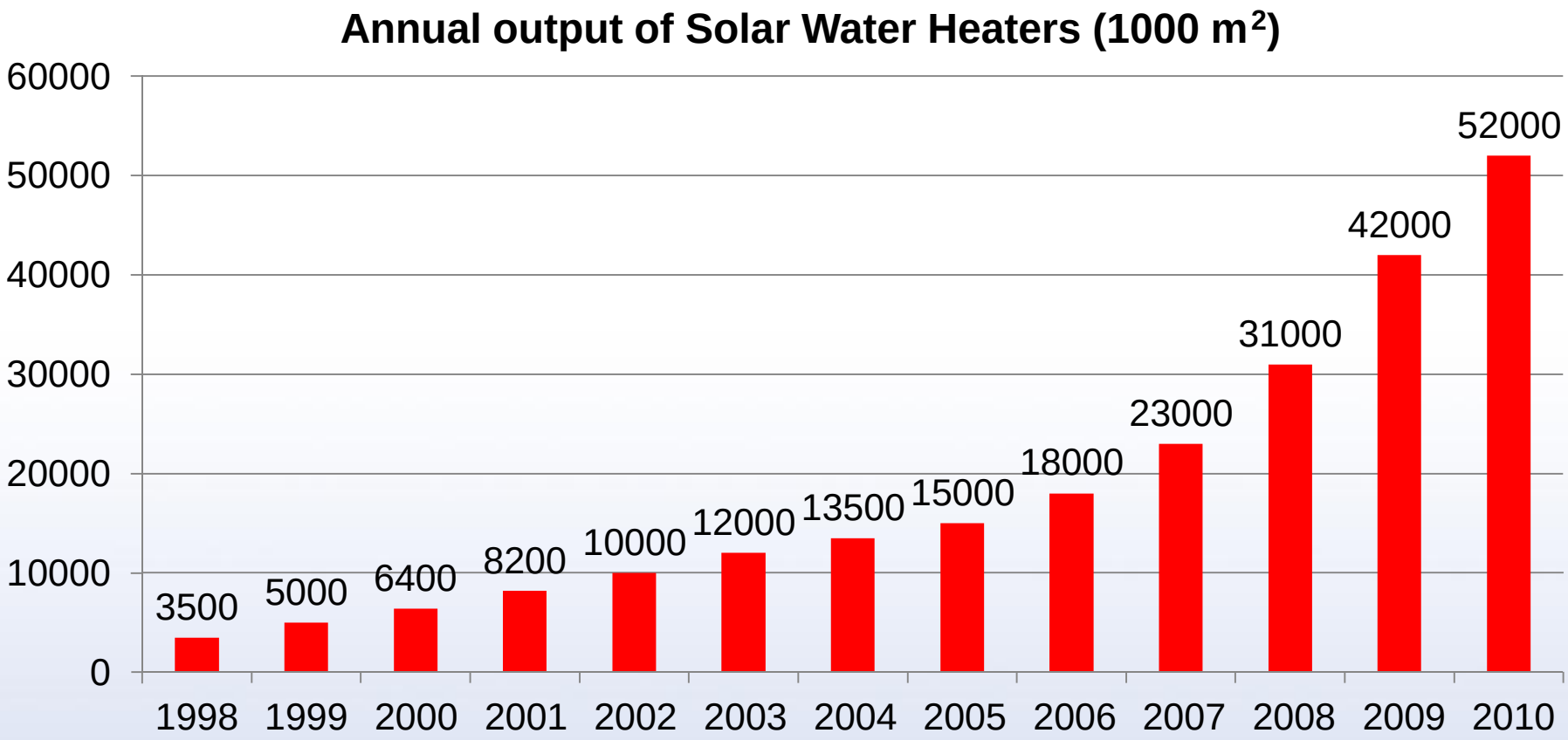
- Overview
- Policies
- Industry
- Research and Development
- Standard, Testing and Certification
- Conclusion

Overview



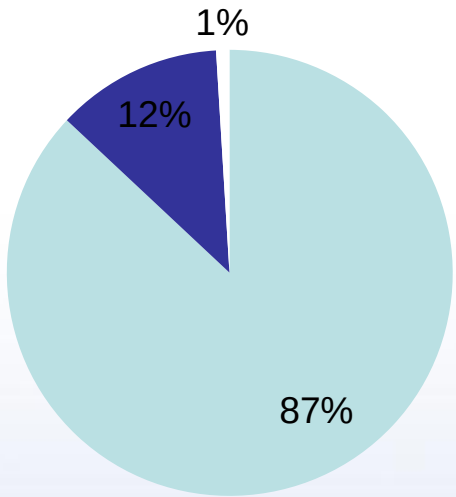
There are 168,000,000 m^2 solar water heaters being used in China by the end of 2010. The average annual growth rate is 80%.

Overview



In 2010, China's annual output of solar water heaters reached 52,000,000 m^2, 15 times of 1998's.

Overview



The main products in China are vacuum tube compact solar water heaters, which have high heat gain and low price. A typical SWH's heat gain under the daily irradiation 17 MJ/m^2 is more than 7.5 MJ/m^2, the price of it is about 3,000 to 5,000 yuan (300-500 euro).

中國建築科學研究院

Solar Resource areas of China

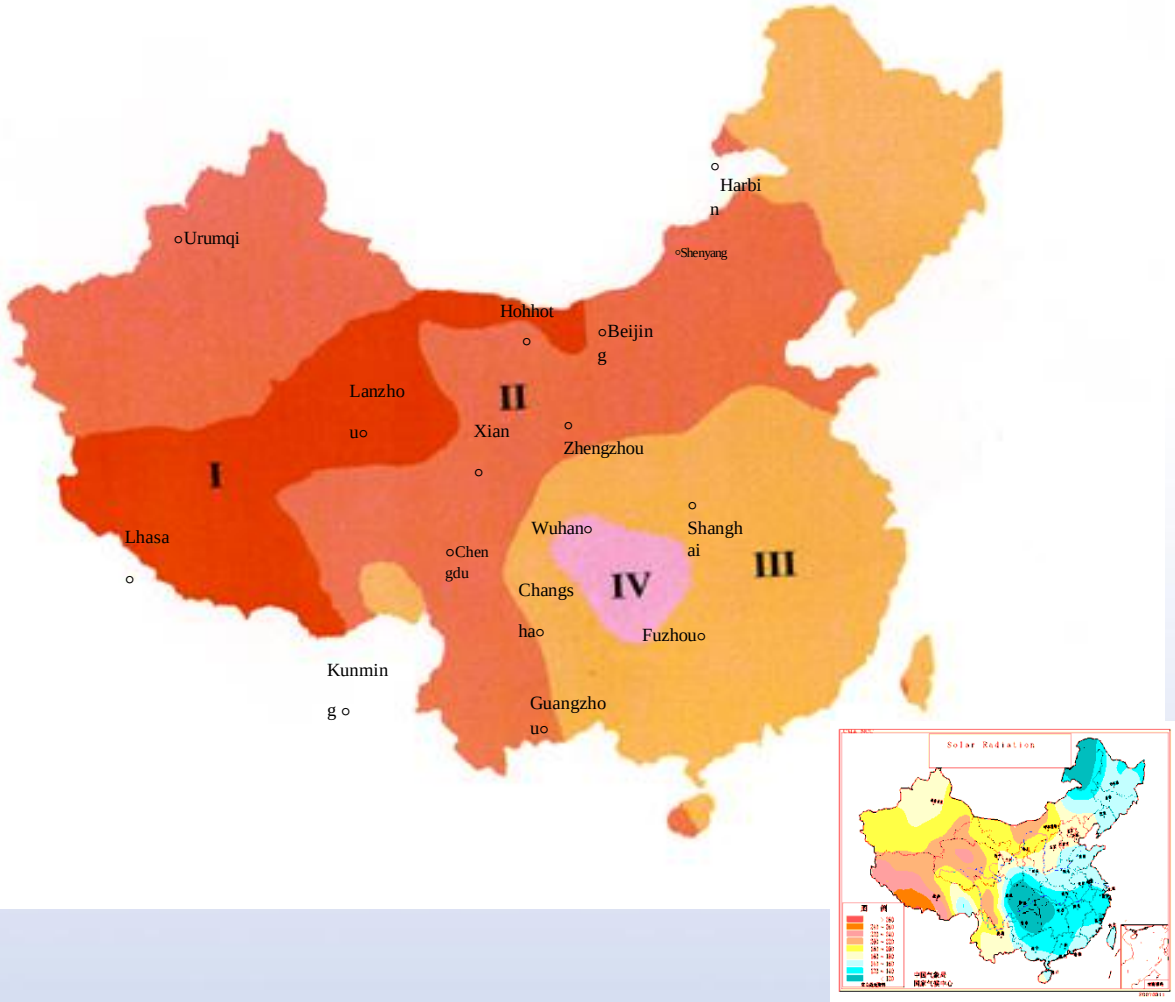
Four solar resource areas：

I, very rich area, Global irradiation >6700 MJ/(m2·a)

II, rich area, 5400-6700 MJ/(m2·a)

III, normal area, 4200 to 5700 MJ/(m2·a)

IV, poor area, less than 4200 MJ/(m2·a) .



Overview
Solar Space Heating Systems in China

- After 2000, solar pace heating start developing and it is important transition duration from demonstration projects to application on large-scale during 2005 to 2010 in China.
- There are about 100 solar pace heating systems operating or being under construction.

Ø Solar space heating system in office building in Tsinghua Solar Co. Ltd with low temperature floor radiation system

Ø Solar space heating system in residential buildings for peasants in some villages of rural areas in Beijing

Ø Solar space heating system of Lhasa railway station in Tibet

Ø Solar space heating system with seasonal heat storage for thermal consumer substation in inner Mongolia

Residential buildings in Pingu county of Beijing, The system is similar with solar combisystem

Large solar heating system

A solar space heating system with seasonal heat storage in inner Mongolia Autonomous Region of north China, which was installed about 5000 m2 evacuated tube collectors and 5000 m3 underground water storage pools and is still under construction.

Solar Thermal for Industrial Process

Usage: Hot water supply in printing and dyeing process, Dali CO. LTD, Zhejiang.

Collector area: 13000 m2 ,

Daily hot water output (20~60℃): 1300 T

Annual Steam saved: 36000 T

Price of Steam: 130 yuan/T

Money saved: 4,680,000 yuan

Initial investment:14,000,000 yuan

Payback time: 3 year

Solar air collectors for grain desiccation, warehouse in Kuming


A solar preheating system for the printing and dyeing process in Chang shu Jinhong Printing and dyeing Co. LTD, Jiangsu province. Total global solar tube collectors area is 7460 m^2. This system can produce over 500 T hot water at 50 ℃, was installed by SUNRAIN Co. LTD.

Solar Cooling system

There are no more than 10 solar cooling systems running in China

Heat pipe Collector area: 850 m2 ,
Cooling capacity : 360 kW
Building area: more than 3000 m2
Sanyo absorption chiller
Solar fraction (cooling+heating): 70%
SUNPU LTD Co., Beijing.

Flat plate Collector area: 552.9 m2 ,
Cooling capacity : 528 kW
Building area: more than 5000 m2
2 Sanyo absorption chillers
Solar cooling fraction : 29%
Qingdao Olympic Sailing Center

Policies for Solar Heating and Cooling

- **National strategy**

Ø In 2006, the National People's Congress promulgated the Law of Renewable Energy of the People's Republic of China. The government will strongly support technological progress and the development of the industry of solar water heating system.

- **National action aims**

Ø 15% of the total energy consumption of China will be supplied by renewable energy by 2020.

Ø Installed areas of solar collectors should be 300 millions m2 by 2020.

Policies for Solar Heating and Cooling

- **National subsidy policies for the peasants**

Ø The peasants in countryside can get subsidy to buy SWH, the ratio is 13 % of the total cost of SWH in 2009 and 2010.

- **Demonstration projects supported by central and local government**

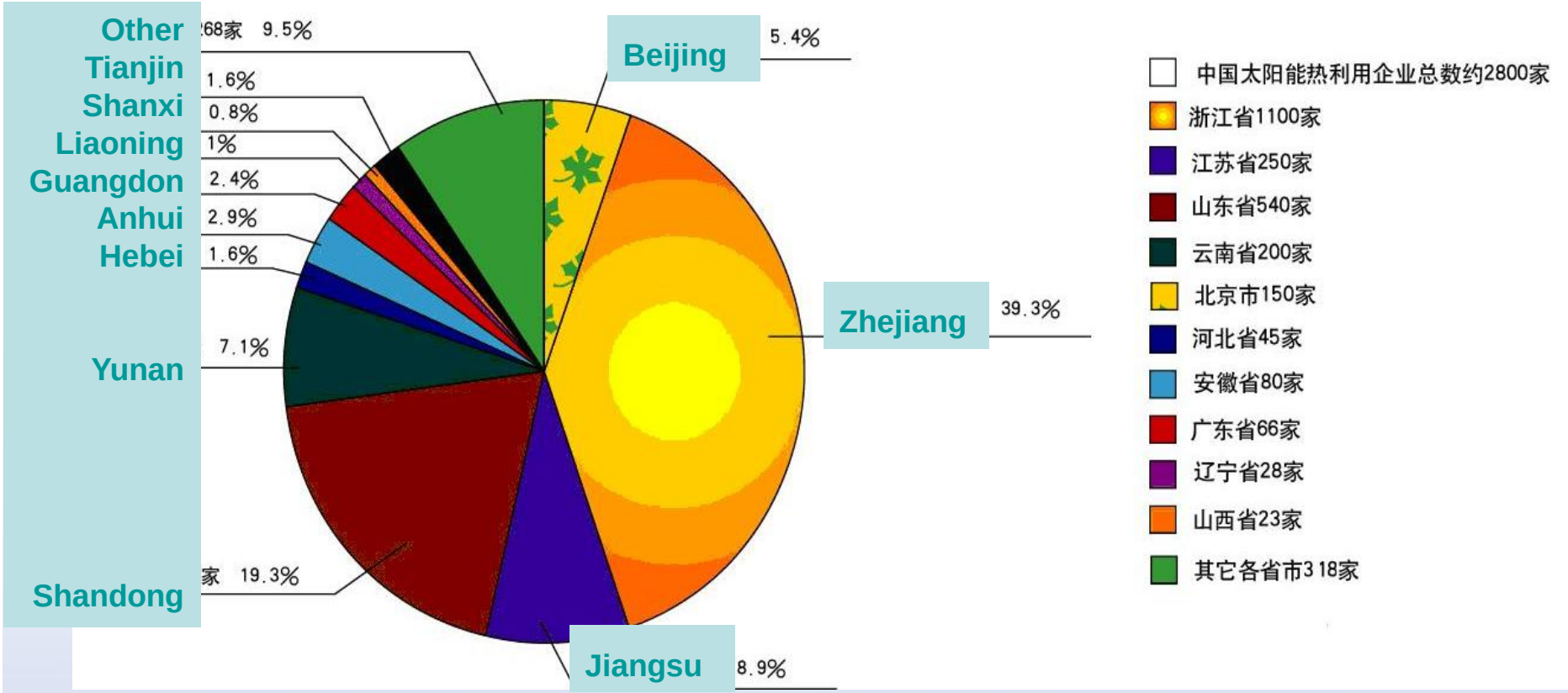
Ø From 2006 to 2008, there were 359 projects getting the financial support from central Government, 41% of them are solar heating projects and can get about 50 to 100 yuan/m^2 (building area) for a project using solar water heating system or solar heating combisystem.

Policies for Solar Heating and Cooling

- **Demonstration Cities supported by central Government**
  - In 2009, the Ministry of Finance and the Ministry of Construction decided to support renewable energy building demonstration cities.
  - Each city can get 50 million to 80 million RMB Yuan of subsidy.
- **Favorable local policies promoting the development of regional market**
  - Over 20 provinces,autonomous regions and over 80 cities have issued compulsory and favorable policies for installing solar water heating systems.
  - Some provinces such as Shandong and Beijing will give subsidy to this installing.

Industry

I There are about 2,800 manufacturers of solar thermal in China



Standard, Testing and Certification

- Under the support by UNDP, China has established a testing and certification system for solar water heating systems

Ø There are three national testing centers (In Beijing, Wuhan and Kunming)

Ø Three kinds of certification

ü General certification—Golden sun

ü Environment certification—Ten ring

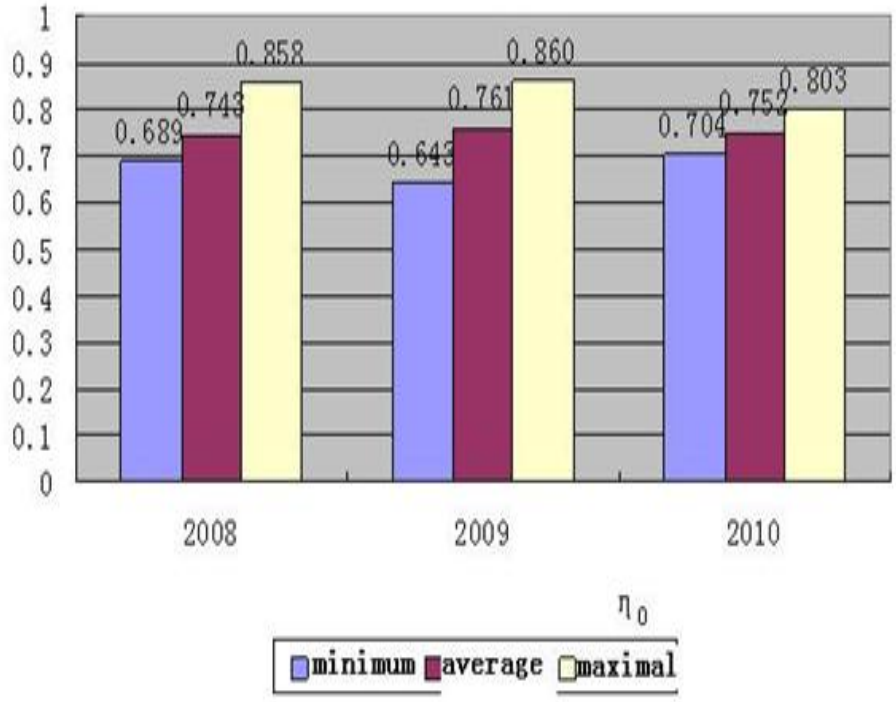
ü Building certification—CABR

Standard, Testing and Certification

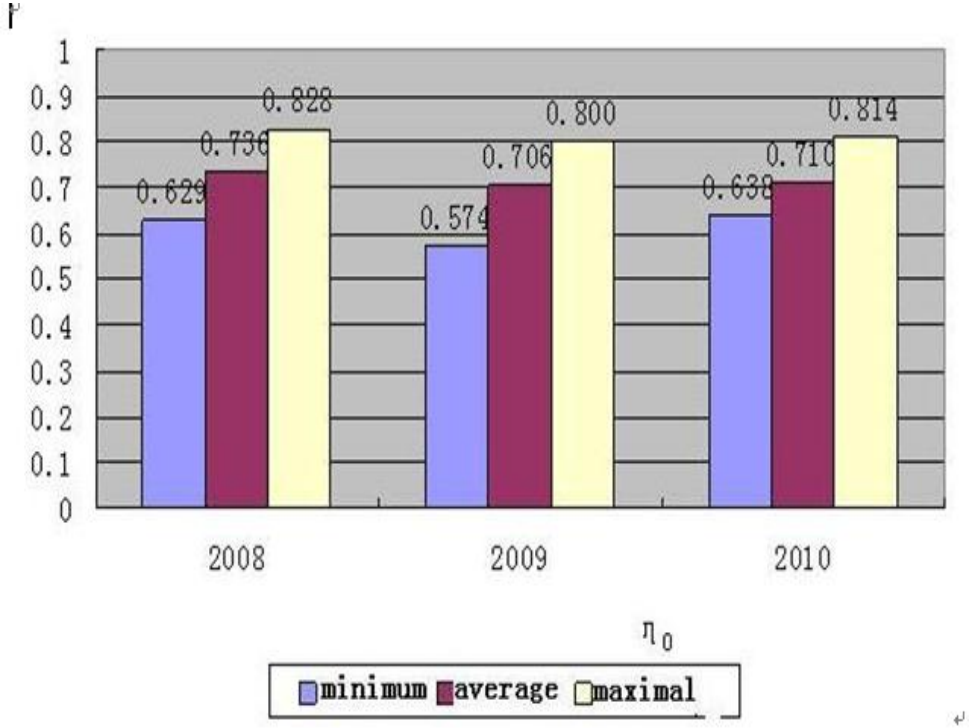
Average performance of solar collectors according to testing data

p Intercept of instantaneous efficiency

- **Flat plate collectors**



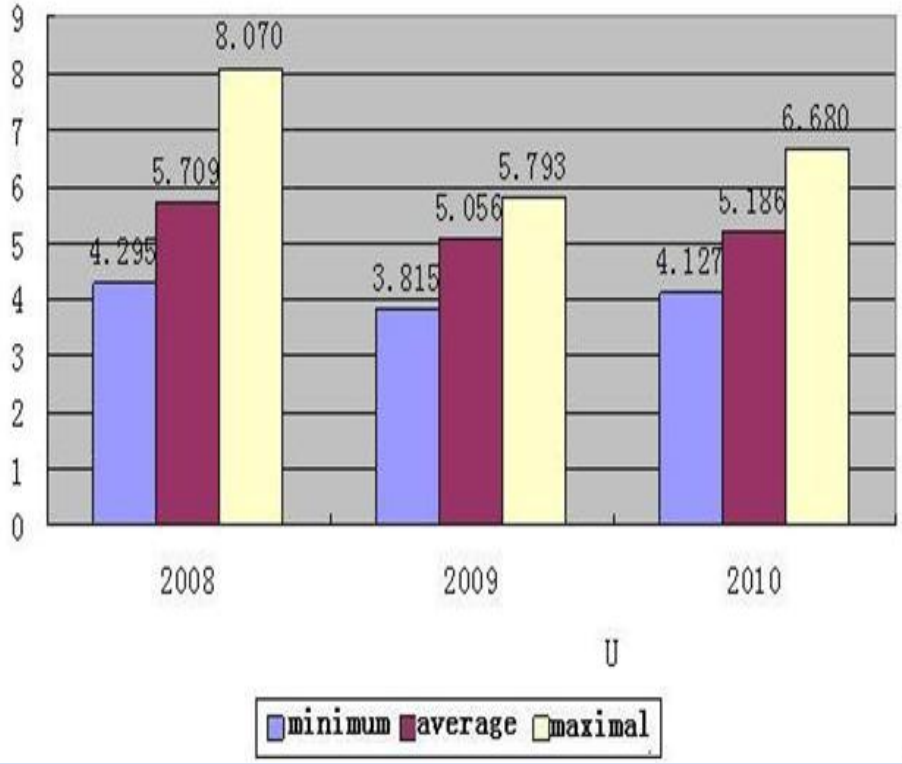
Evacuated tube collectors



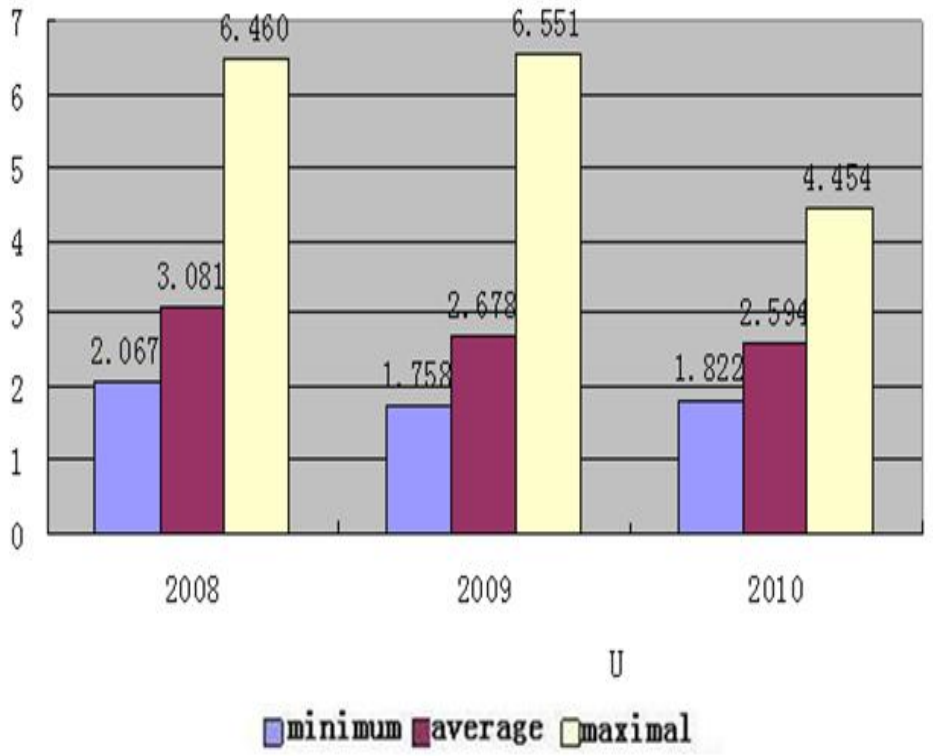
Average performance of solar collectors according to testing data

p Heat loss coefficient W / m² ℃

- **Flat plate collectors**

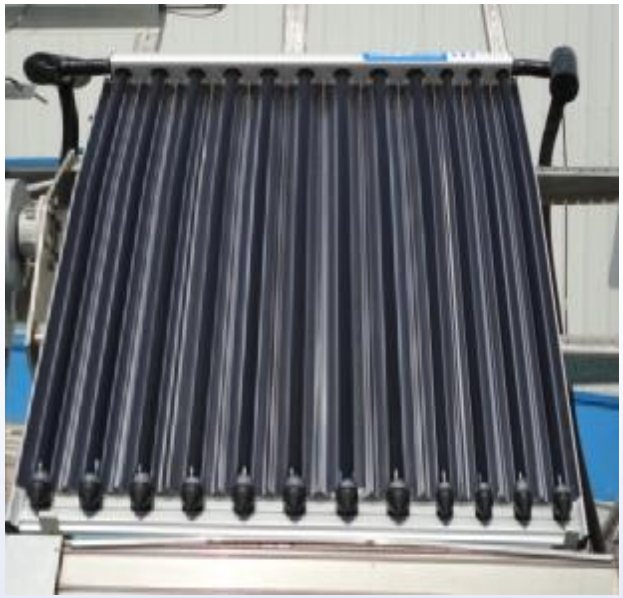


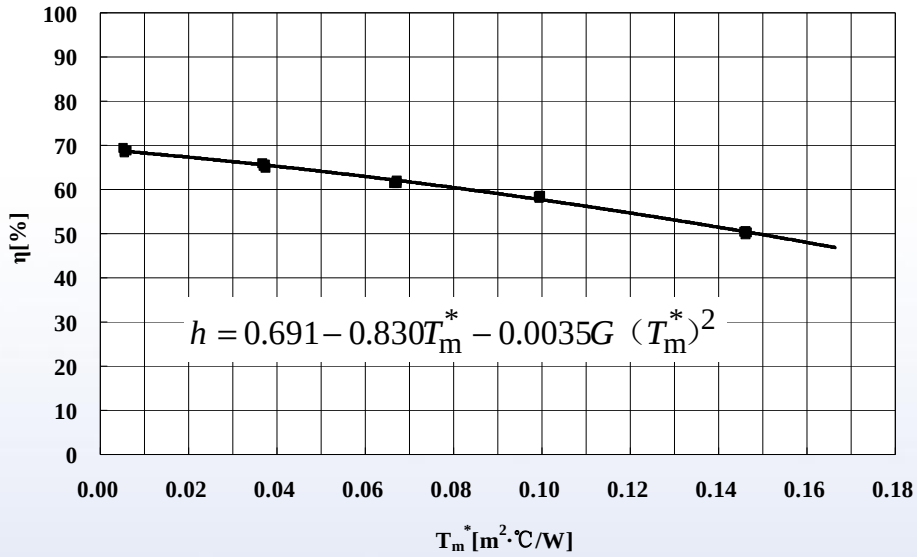
Evacuated tube collectors



Research and Development

p Developing for solar collector with high efficiency





- **Average working temperature is 150℃，Tm*= 0.13（m2·℃）/ W，η=0.522；Tm*= 0.15（m2·℃）/ W，η=0.488.**

Research and Development

- R & D of the receiver tubes for parabolic trough solar power system
- R & D of selective coating for flat plat collector
- R & D of large scale solar heating combisystems
- R & D of Solar Thermal for Industrial Process

	Sealed type	Size	Temperature tolerance	Absorptance/Emittance @ 400℃	Transmittance	Price €
Linuo	non-matched welding	70/125mm 4060mm	450℃	≥0.94 ≤0.14	≥0.93	800-900

Conclusion

- Solar space heating systems will be developed faster in the near future in China.
- Solar cooling is still in the demonstration stage, but solar collector with high efficiency can promote the developing of solar cooling in China.
- In west areas, government should give some financial support to build solar space heating systems. But in east areas maybe solar space heating systems can be built through market and government's promoting policies.
- Solar space heating will be the next great opportunity for China's solar industry. To develop the high performance solar collector at low ambient temperature will seize this chance successfully.

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

谢 谢
THANKS