Present Status of Solar Thermal Utilization in China

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1. Solar Thermal Industry in China

- China has abundant solar energy resources with an average annual irradiation of more than 5,860 MJ/m^2.
- Regions with annual sunshine over 2,200 hours for more than 2/3 of total geographic area of China.

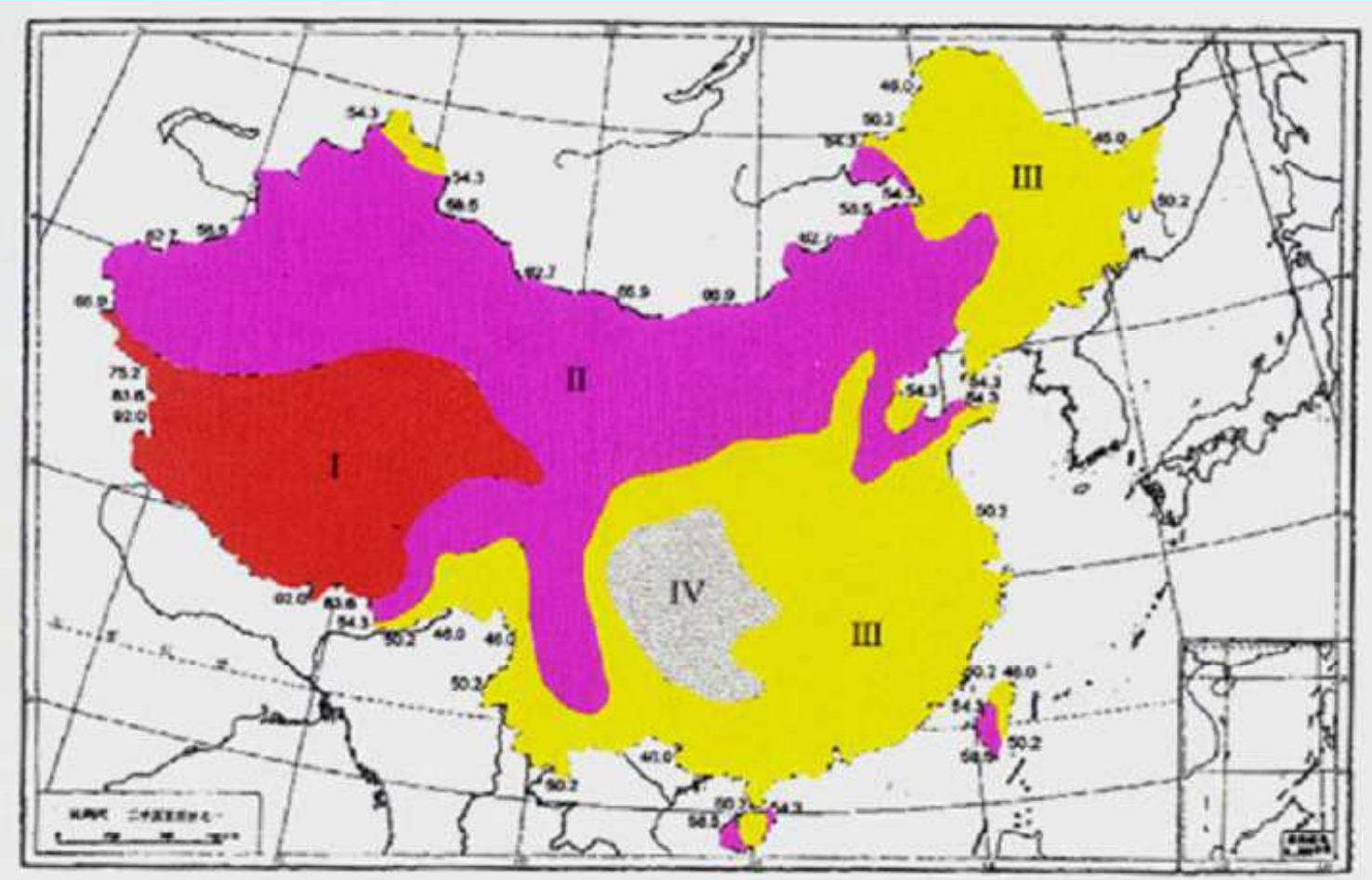
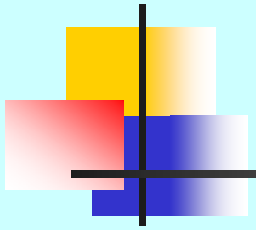


图1　中国太阳能资源分布带[100 MJ/ (m^2 a)]

Class	Solar irradiation [MJ/ /(m^2a)]	Sunshine hours(h)
I	>6700	3200—3300
II	5400—6700	3000—3200
III	4200—5400	1400—3000
IV	<4200	1000—1400



- Since 1980s, the Chinese Government has carried out a plan to strengthen the R&D and application of solar water heaters (SWH) in China.
- With awareness of energy conservation, environment protection and climate change rising, China gives more priority to the development of the solar thermal industry.

- The State Law of Renewable Energy was issued in 28 Feb 2005, and has been implemented since 1 Jan 2006.
- Implementation of the State Law tremendously facilitates the development of solar thermal industry and application in China.

- At present, there are more than 2,800 manufacturers of SWH throughout the country.
- The Chinese SWH market is developing with an annual increasing rate of about 25%.

Annual Production and Accumulated Installation of Solar Collectors in China （1999 – 2009）

Year	Annual production （Million m^2 ）	Increasing rate (%)	Accumulated installation （Million m^2）
1999	5	—	20
2000	6.4	28	26
2001	8.2	28	32
2002	10	22	40
2003	12	20	50
2004	13.5	12.5	62
2005	15	11.1	75
2006	18	20	90
2007	23	30	108
2008	31	32.5	125
2009	42	35.5	145

- In 2009, the annual production of solar collectors reached 42 million m^2 .
- By the end of 2009, the accumulated installation of solar collectors reached 145 million m^2 .
- At present, China becomes the largest annual production and accumulated installation of SWH in the world.

Total Capacity of SWH in the World（in 2007）

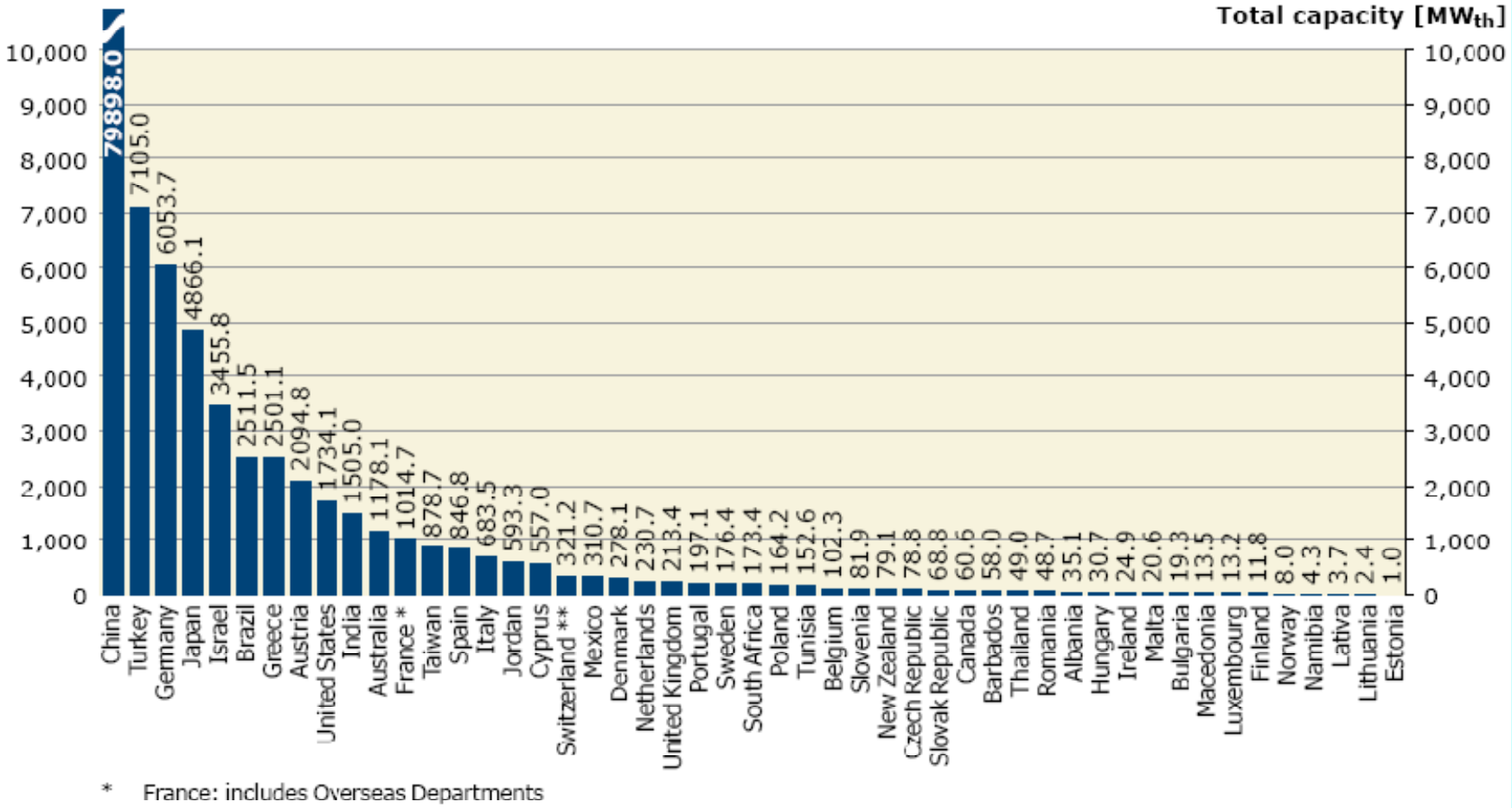


Figure 5: Total capacity of glazed flat-plate and evacuated tube collectors in operation at the end of 2007

Total Capacity of SWH per 1000 Inhabitants (in 2007)

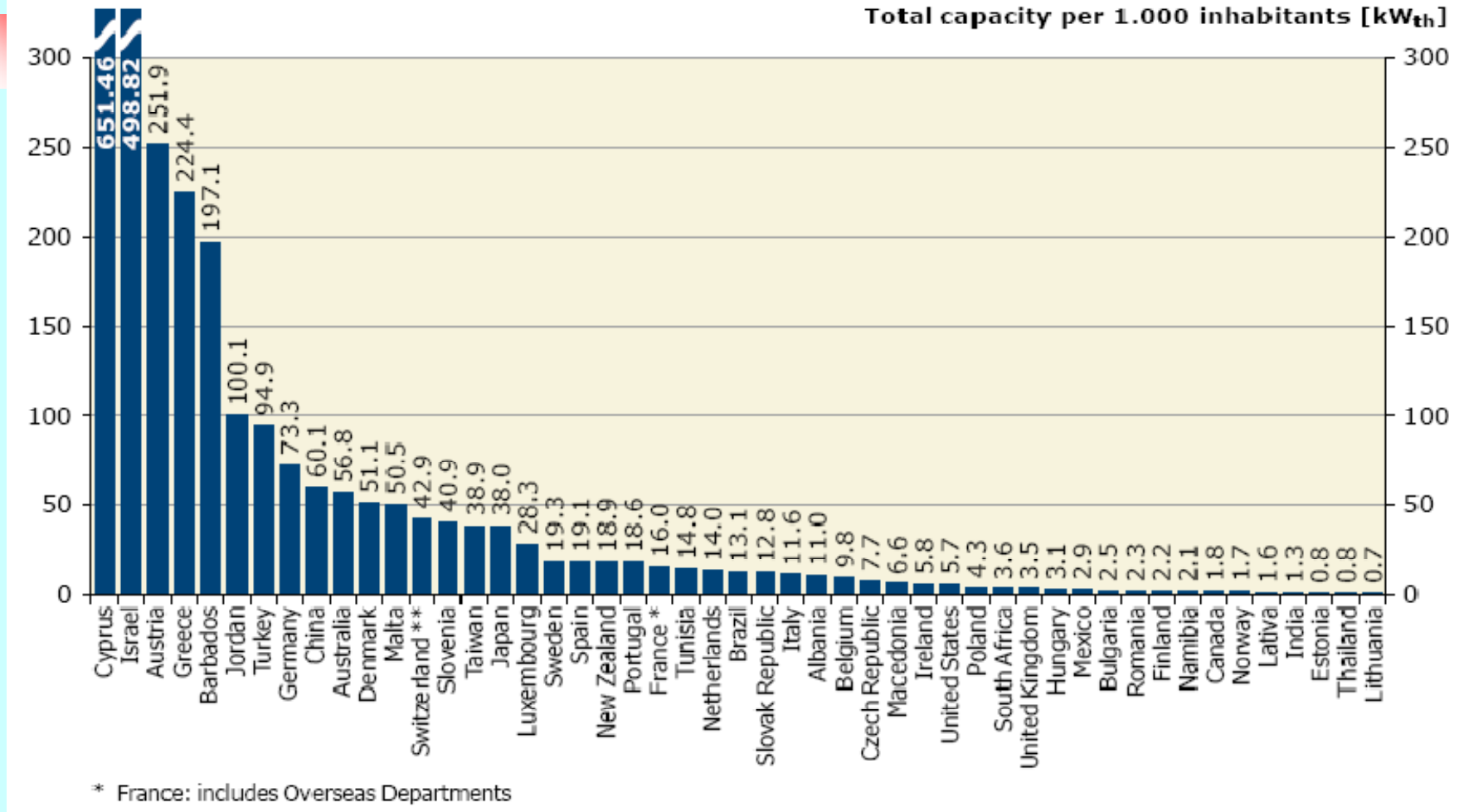


Figure 6: Total capacity of glazed flat-plate and evacuated tube collectors in operation at the end of 2007 in kW_{th} per 1,000 inhabitants

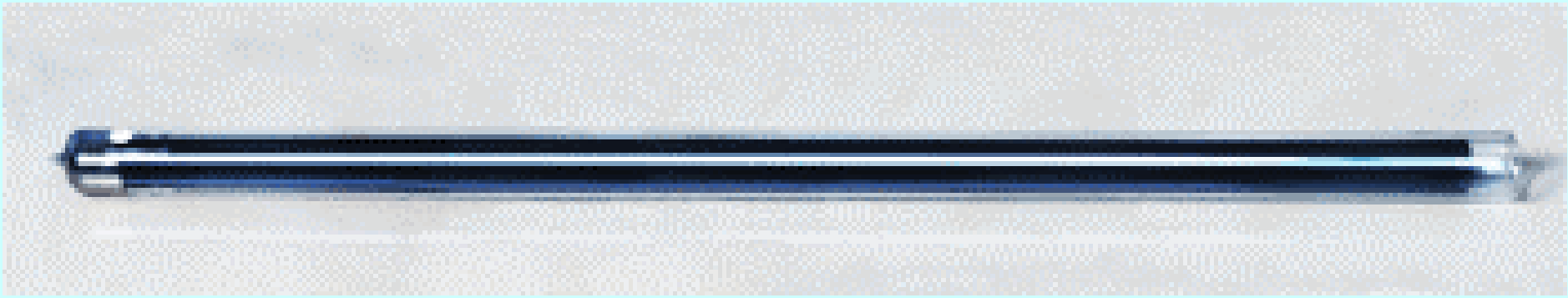
Main SWH Markets in China

Main Components of SWH in China

Flat plate collector

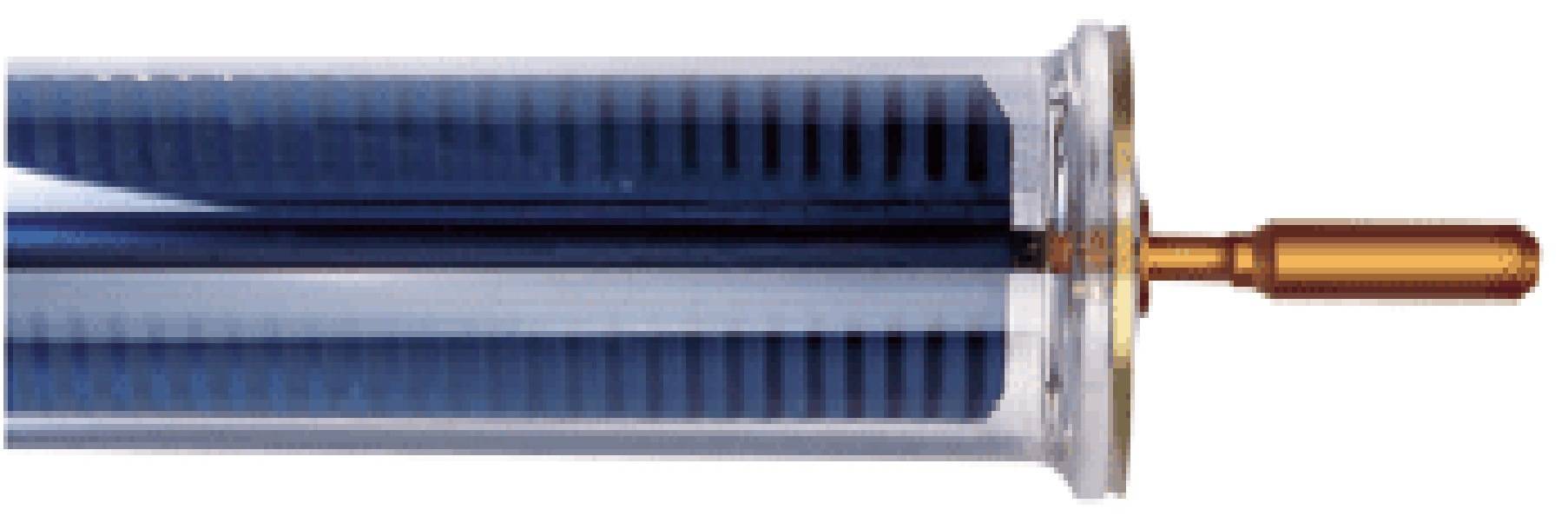
Evacuated tube collector

All-glass evacuated tube



Evacuated tube collector

Heat-pipe evacuated tube



2. Solar Thermal Applications in China

2.1 Solar Water Heating

Flat plate SWH

All-glass evacuated tube SWH

Forced circulation system

Flat plate SWH system completed by BSERI

Forced circulation system

All-glass evacuated tube SWH system completed by BSERI

Forced circulation system

Heat pipe evacuated tube SWH system completed by BSERI

UDC

中华人民共和国国家标准 GB

P GB 50364—2005

民用建筑太阳能热水系统应用技术规范

Technical code for solar water heating system in civil buildings

2005—12—05 发布 2006—01—01 实施

中 华 人 民 共 和 国 建 设 部

中华人民共和国国家质量监督检验检疫总局 联合发布

Demonstration projects (1)

Guest House, Lijiang, Yunnan Province

Demonstration projects (2)

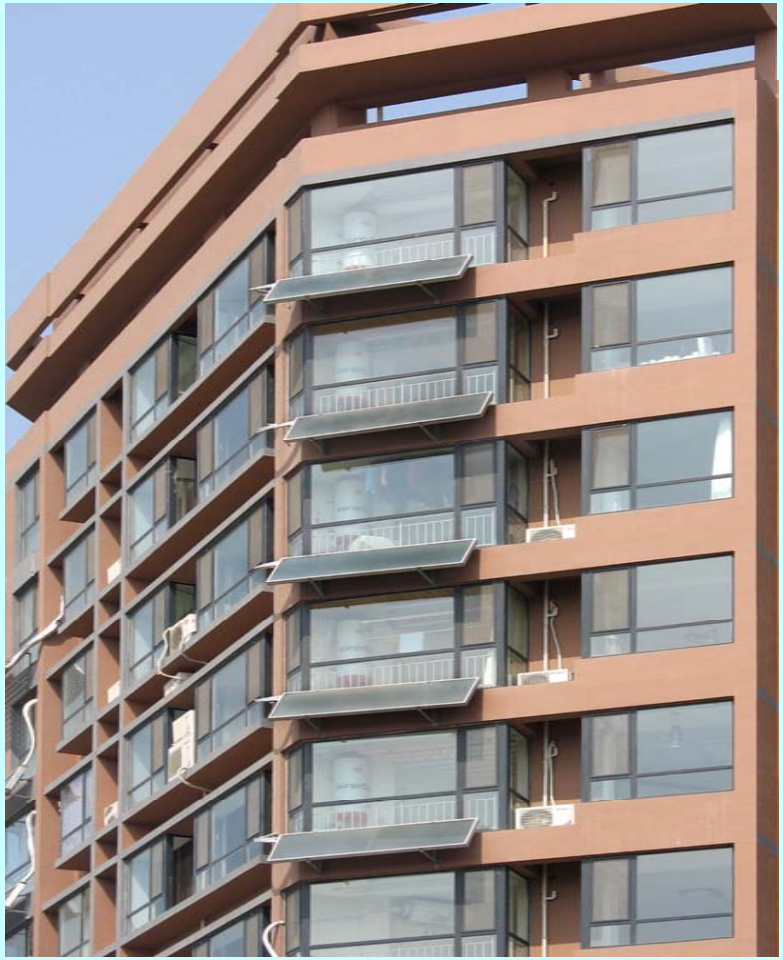
Townhouse, Hangzhou, Zhejiang Province

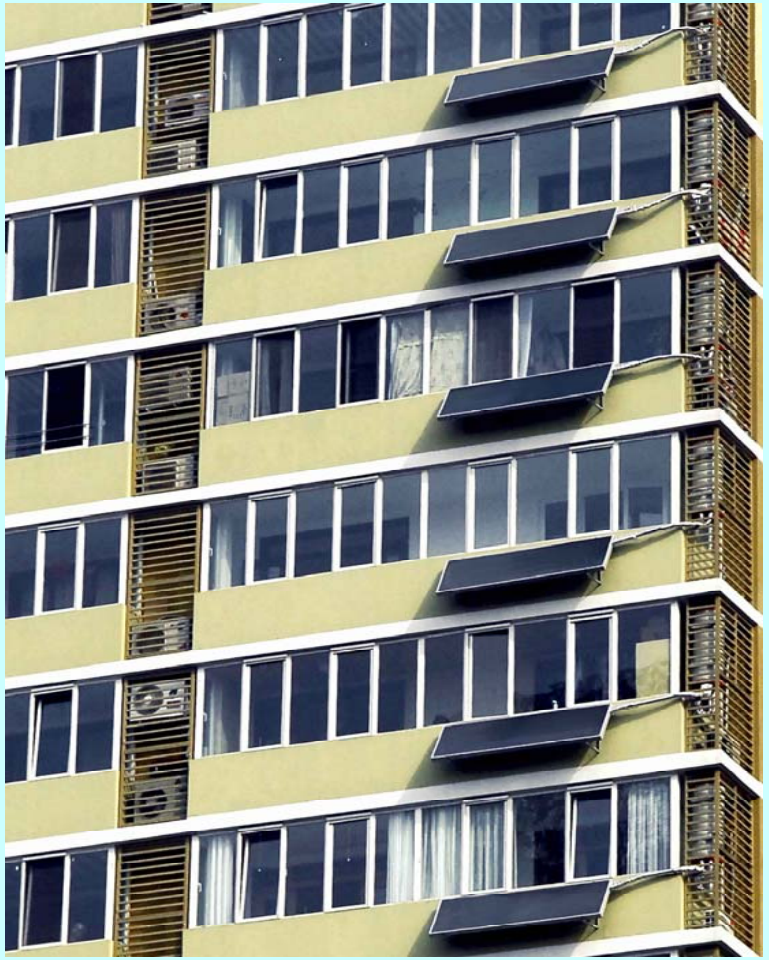
Demonstration projects (3) completed by Sunpu

Apartment, Nanning, Guangxi Province

Demonstration projects (4) completed by BSERI

Apartment, individual systems, Hebei Province





Demonstration projects (5)

Apartment, collective-individual system
Guangdong Province

2.2 Solar Space Heating

UDC

中华人民共和国国家标准 GB

P GB 50495—2009

太阳能供热采暖工程技术规范

Technical code for solar heating system

2009—03—19 发布 2009—08—01 实施

中华人民共和国住房和城乡建设部
中华人民共和国国家质量监督检验检疫总局 联合发布

Solar space heating systems (1) completed by BSERI

Village, Pinggu District, Beijing

Solar space heating systems (2)

Village, Pinggu District, Beijing

Solar space heating systems (3)

Village, Mentougou District, Beijing

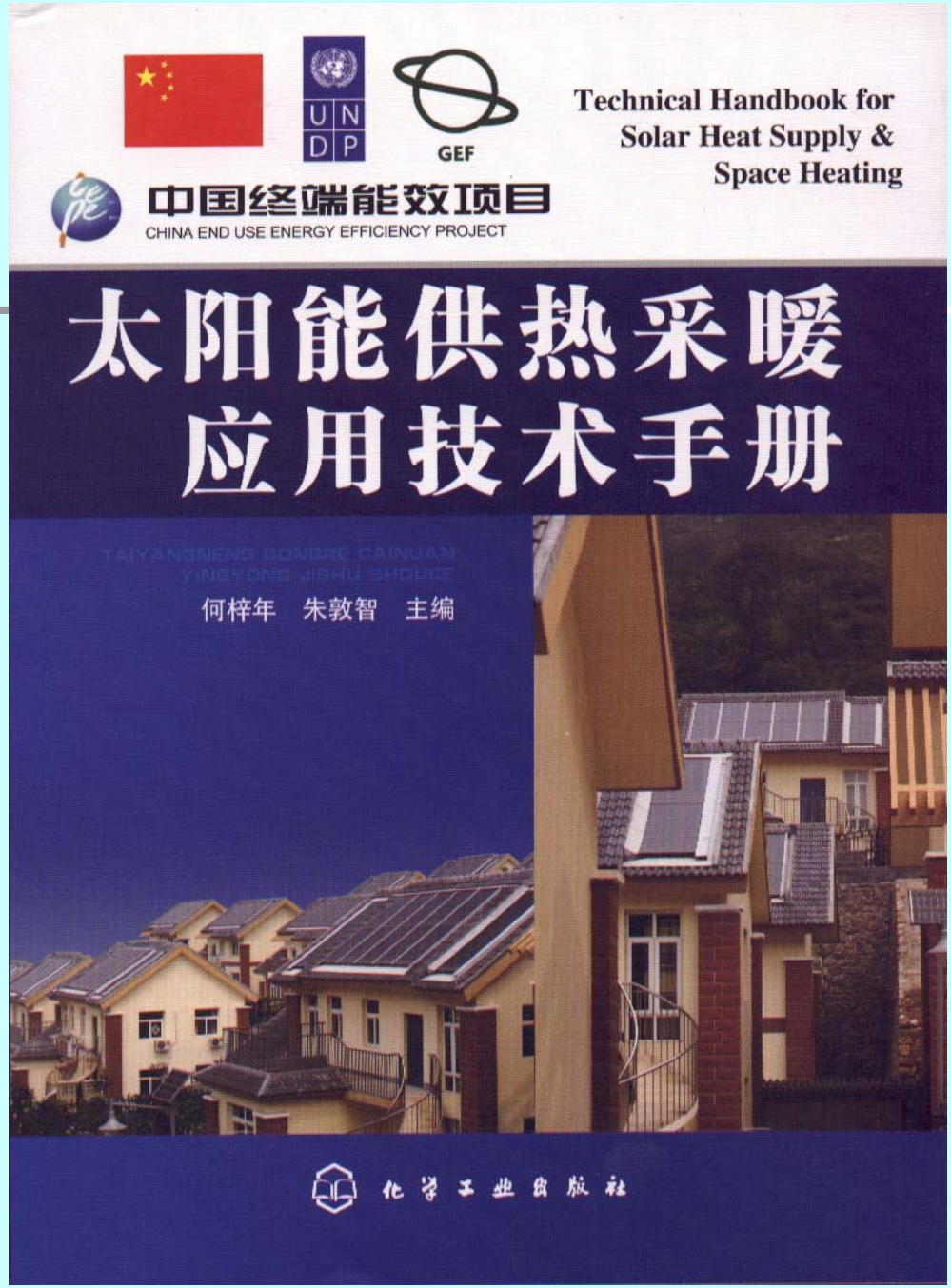
Solar space heating systems (4)

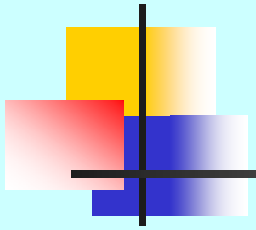
Apartment, Xining, Qinghai Province

Solar space heating systems (5) completed by BSERI

Hotel, Shuanghu, Tibet

Technical Handbook for Solar Heat Supply & Space Heating was edited by He, Zinian and Zhu, Dunzhi





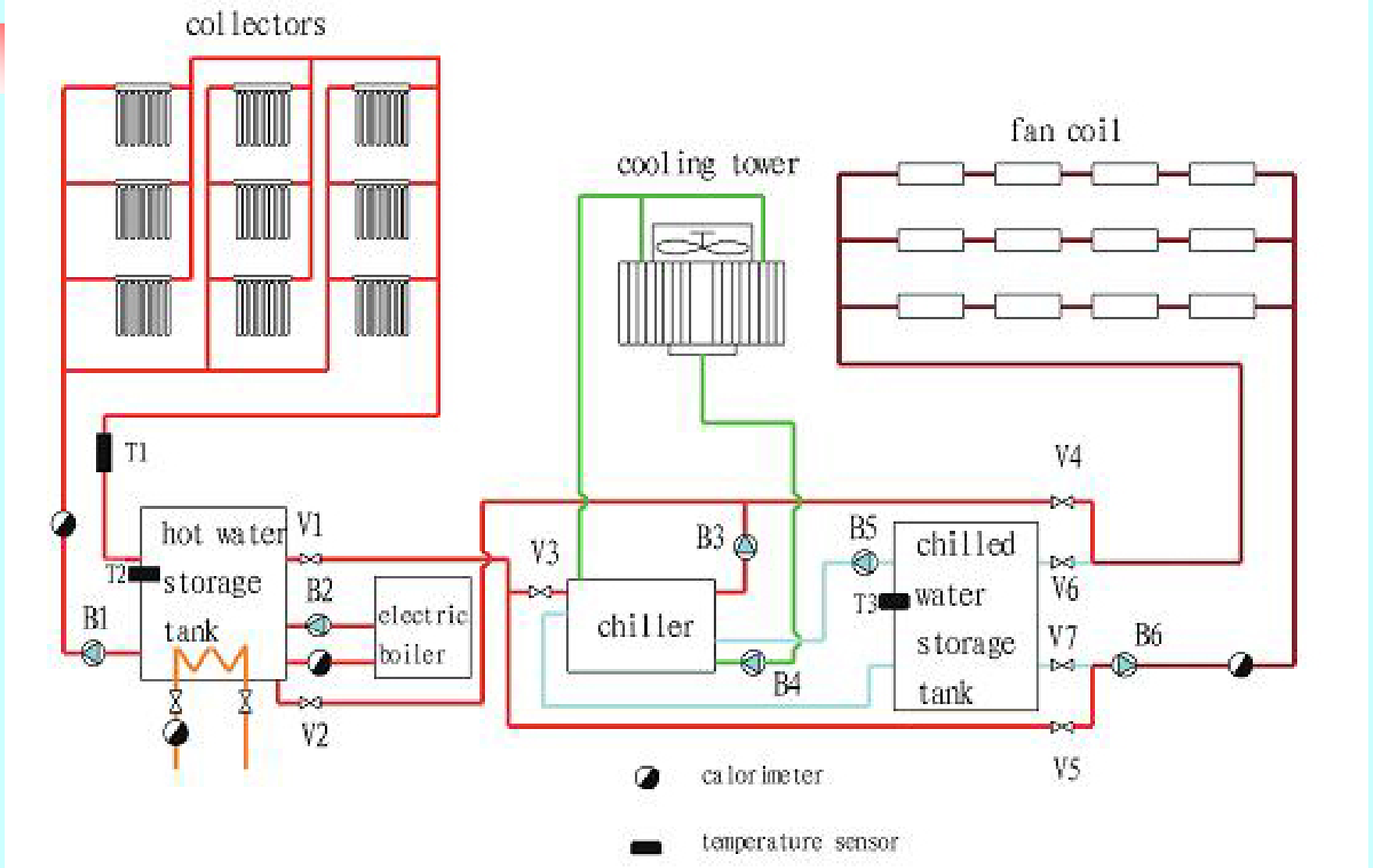
2.3 Solar Air-conditioning

Solar air-conditioning relies on the fact that the largest cooling demand in summer is just matched with the strongest sunshine in summer.

Solar air-conditioning systems can be classified into:

- Solar absorption AC system
- Solar adsorption AC system
- Solar desiccant AC system

Layout of solar absorption AC system



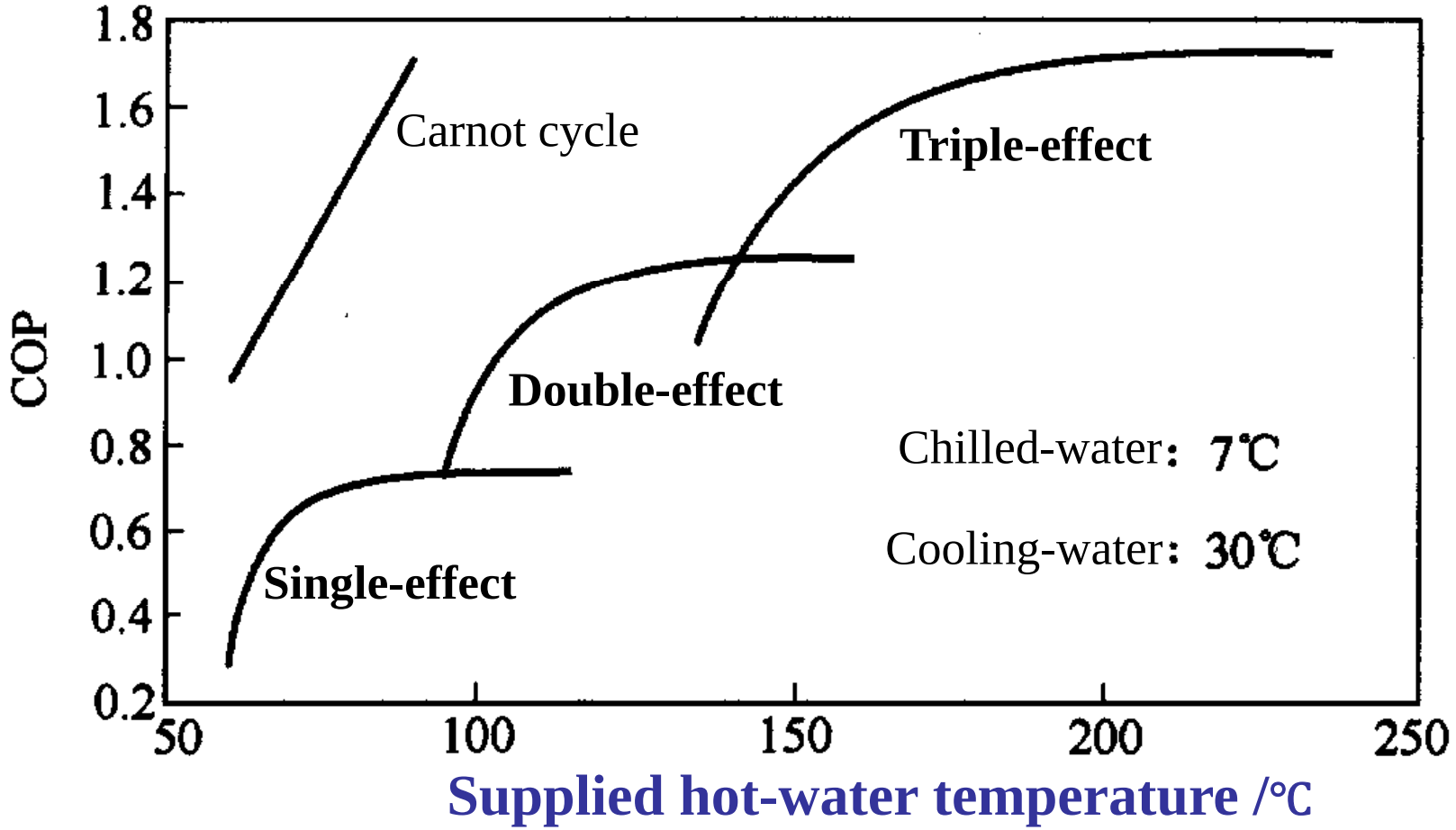
Solar air-conditioning system (1) completed by BSERI

100kW, Exhibition hall, Rushan, Shandong Province

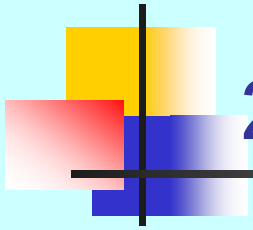
Solar air-conditioning system (2) completed by BSERI

360kW, Office building, Beijing

Improvement of AC System Performance



Middle-temperature collector is under development by Sunda



2.4 Solar Industrial Process Heating

Characteristics of solar industrial process heating systems:

- Higher heating temperature
- Reliable system operation
- Integration with manufacturing process
- Acceptable pay-back period

Potential industrial sectors & processes for solar thermal uses

Industrial sector	Process	Temp. range（℃）
Food & beverage industry	drying	30～90
	heat treatment	40～60
	washing	40～80
	pasteurizing	80～110
	boiling	95～105
	sterilizing	140～150
Textile industry	washing	40～80
	bleaching	60～100
	dyeing	100～160
Chemical industry	raw petroleum heating	70～80
	boiling	95～105
	distilling	110～300
	various chemical processes	120～180
Transportation	vehicle washing	70～80
	cement maintenance	70～90
	asphalt heating	160～180

Solar raw petroleum heating system completed by BSERI

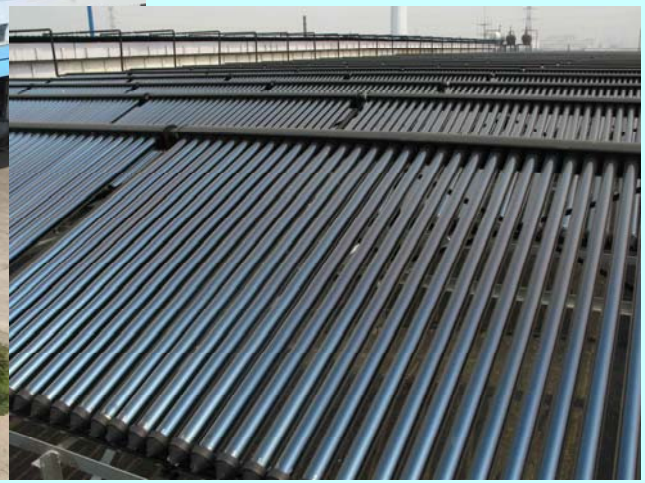
Liaohe Oil Field, Liaoning Province

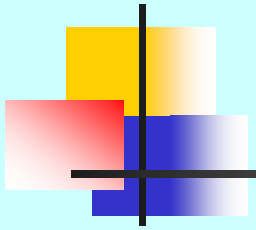
Solar electroplating process heating system completed by BSERI

Coin Manufacturing Factory, Shanghai

Solar dyeing process heating system

Printing & Dyeing Mill, Jiangsu Province





2.5 Passive Solar Houses

- Passive solar house is a house with solar space heating by only adopting some measures to the building itself but without any additional mechanical equipment.
- There are three types of passive solar houses:
  - Attached sunspace
  - Heat collection (storage) wall—Trombe Wall
  - Direct gain

- Passive solar houses are mainly built in Northwest, North and Northeast of China.
- According to statistics, by the end of 2008, there are passive solar houses over the country

  -Total construction area: 15,000,000 m^2

Passive solar houses with attached sunspace

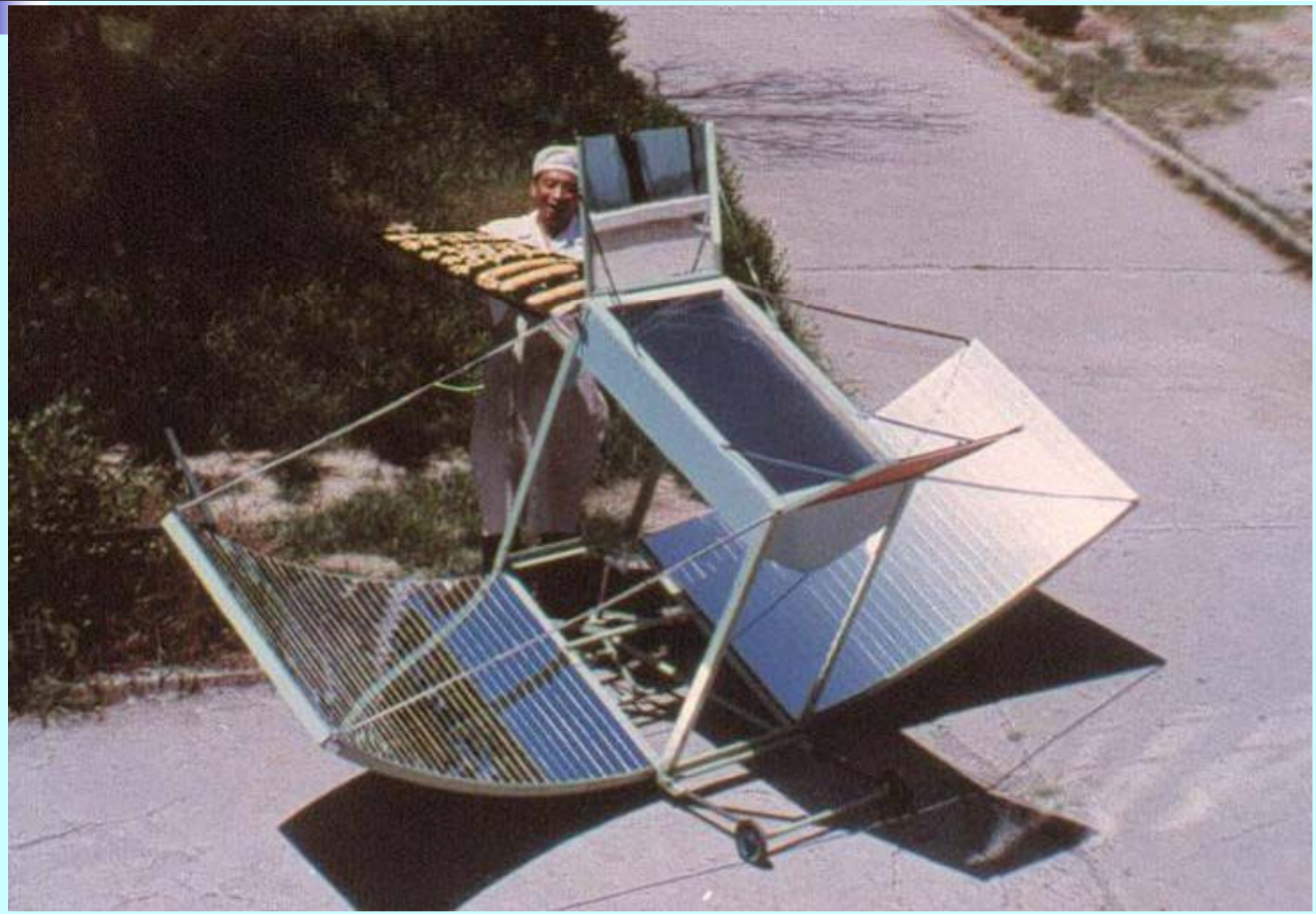
Passive solar houses with Trombe Wall

Passive solar houses with direct gain

2.6 Solar Cookers

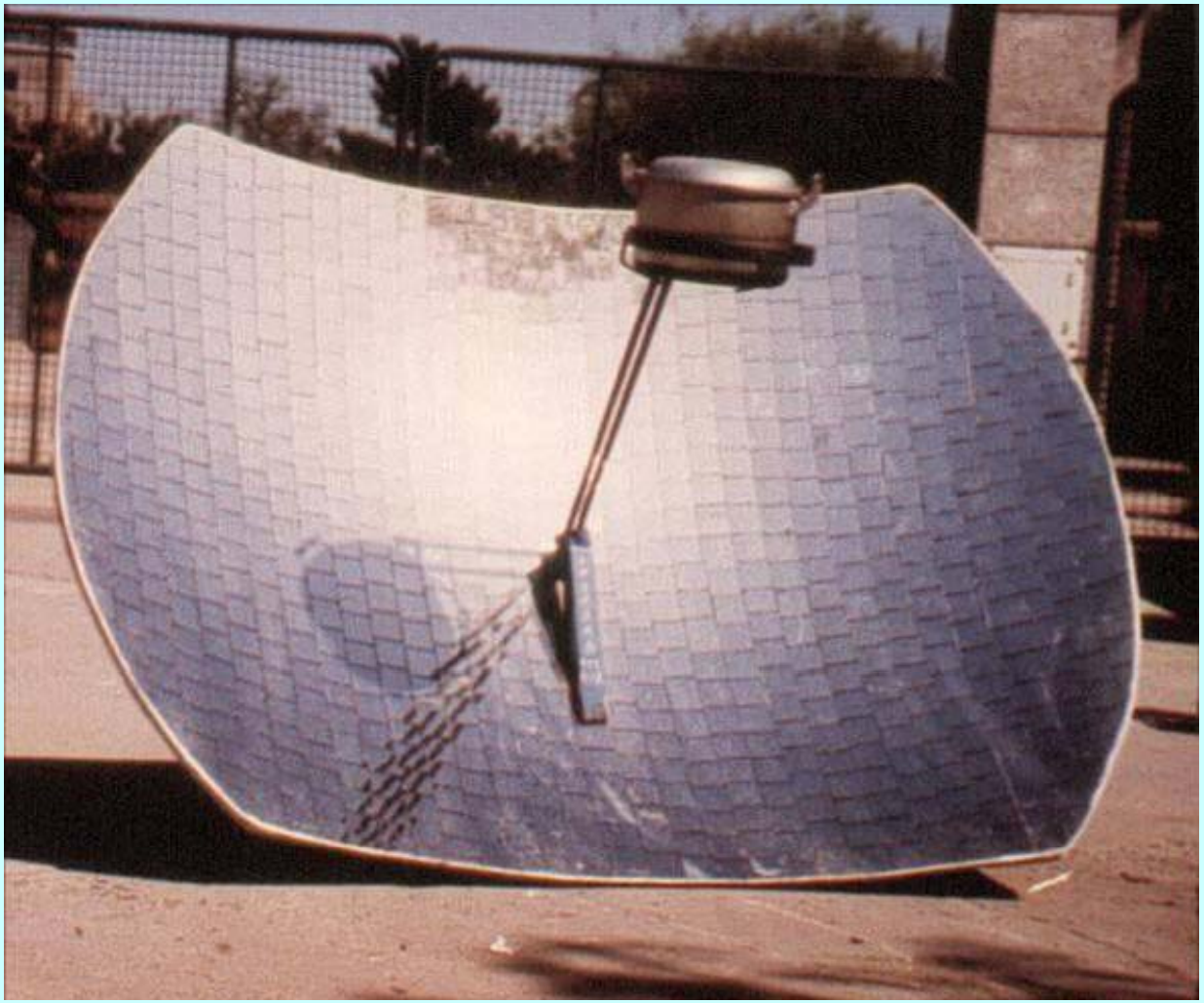
- Solar cooker is a device by which the cooking can be done using solar energy.
- There are mainly two types of solar cookers:
  - Box solar cooker
  - Concentrating solar cooker
- By the end of 2008, there are more than 2,960,000 sets of solar cookers used in rural households over the country.

Box solar cooker with cylindrical reflectors



Concentrating solar cooker with spherical cast reflector

Concentrating solar cooker with oblate concrete reflector



Concentrating solar cooker with parabolic glass fiber reinforced plastic reflector

Concentrating solar cooker with foldable reflector

Thank you for attention !