

China's Energy Future

WANG R.Z.

Institute of Refrigeration & Cryogenics
Engineering Research Center of Solar Energy, MOE China
Shanghai Jiao Tong University

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OUTLINE

- Energy Challenges in China
- Current Status of Renewable Energy
- Important Energy Research Areas in Future 10 Years
- Conclusions

Part I

Energy Challenges in China

Drought in China

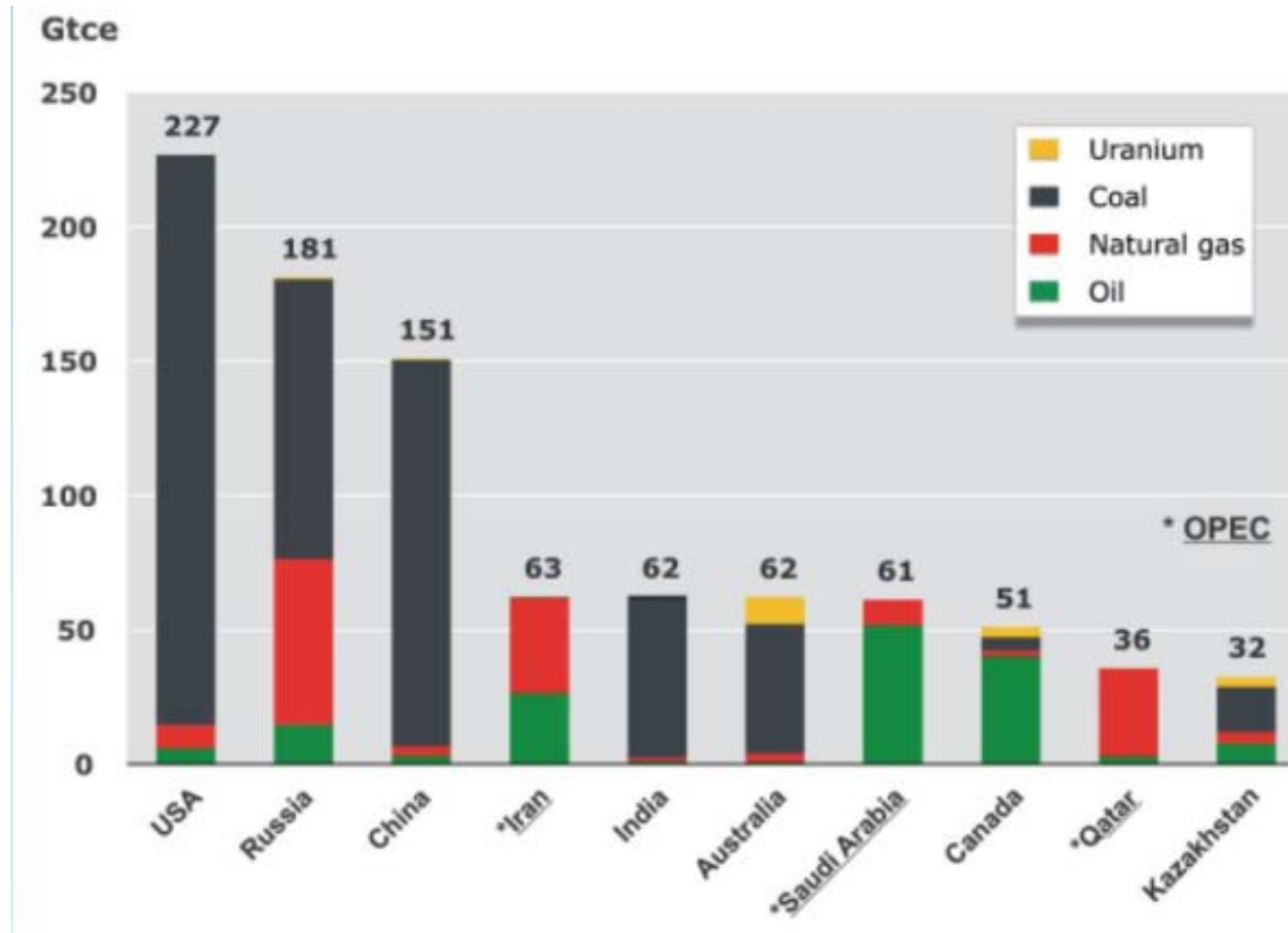


Climate change in China

China's current energy situation

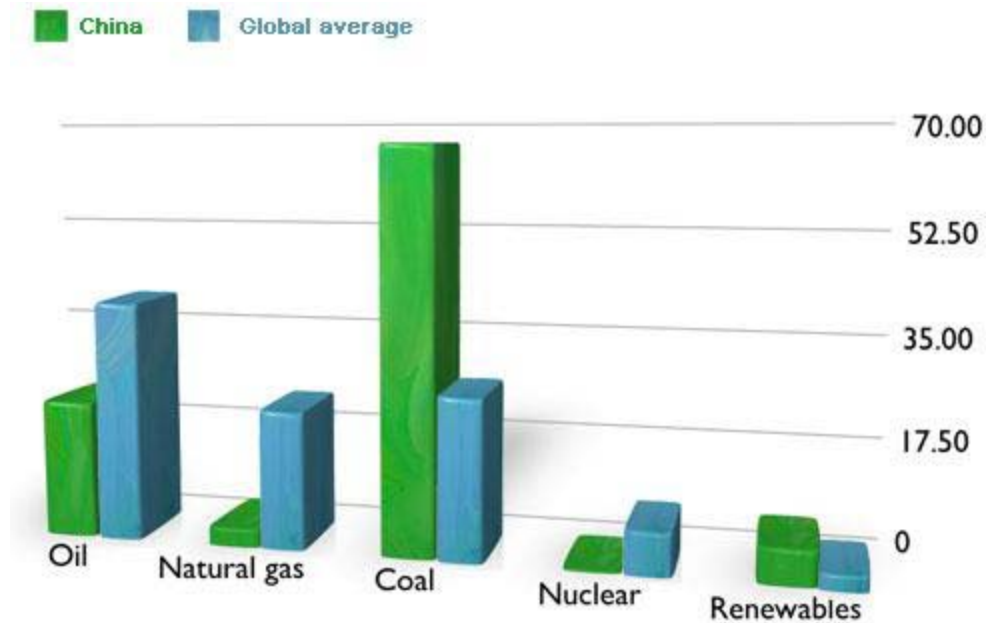
- 2010 China's annual energy consumption totaled 3.25 billion tons of coal equivalent, up 5.9 % from a year earlier.
- Coal accounts for around 70 % of China's energy mix, 30 % higher than the world average level.
- China is presently constructing 28.71 GW of nuclear power capacity, the most in the world.
- 2010, its share of non-fossil fuels in primary energy consumption is approximately 8 %, including both renewable energy and nuclear energy

Top 10 most abundant energy reserves

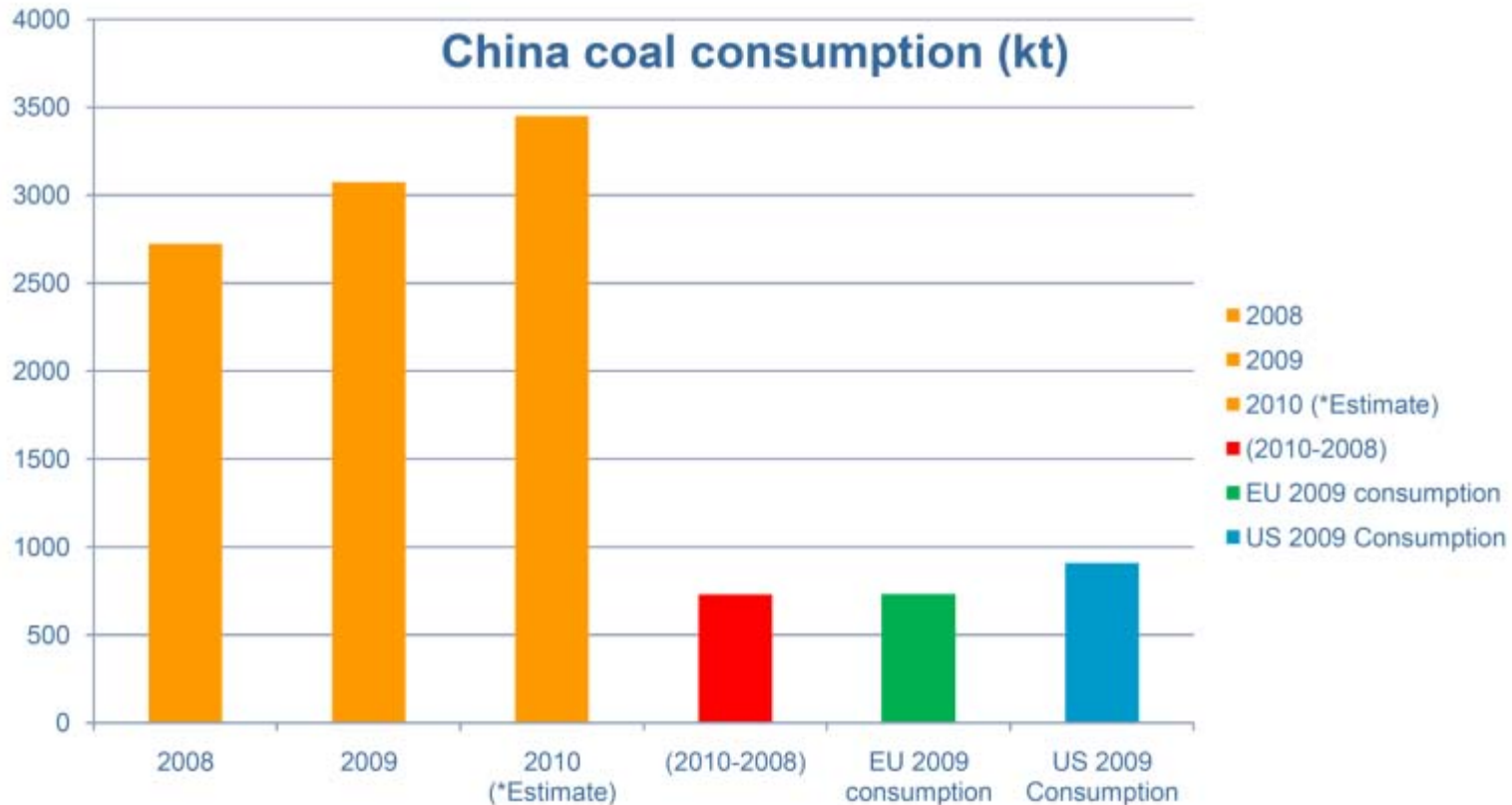


China's energy sources compared with global energy sources in 2008

Energy sources	China	Global average
Oil	23.2	39.9
Natural gas	3.4	23.1
Coal	67	27
Nuclear	0.4	7.3
Renewable	6	2.7

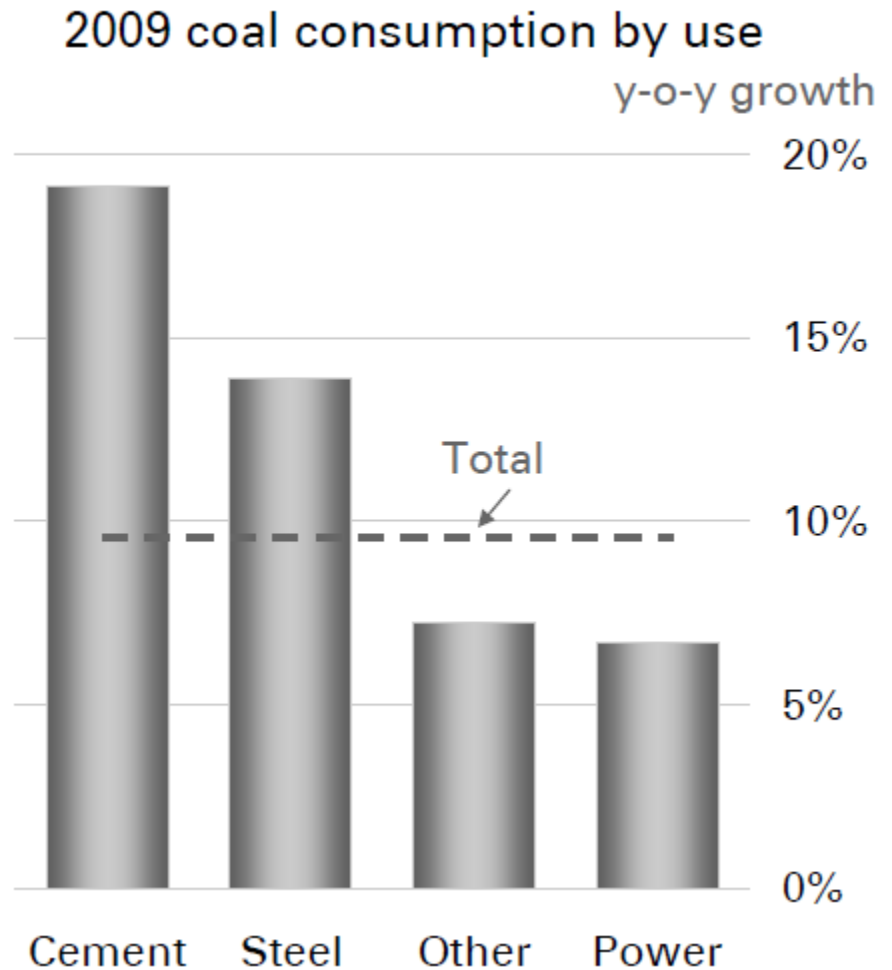
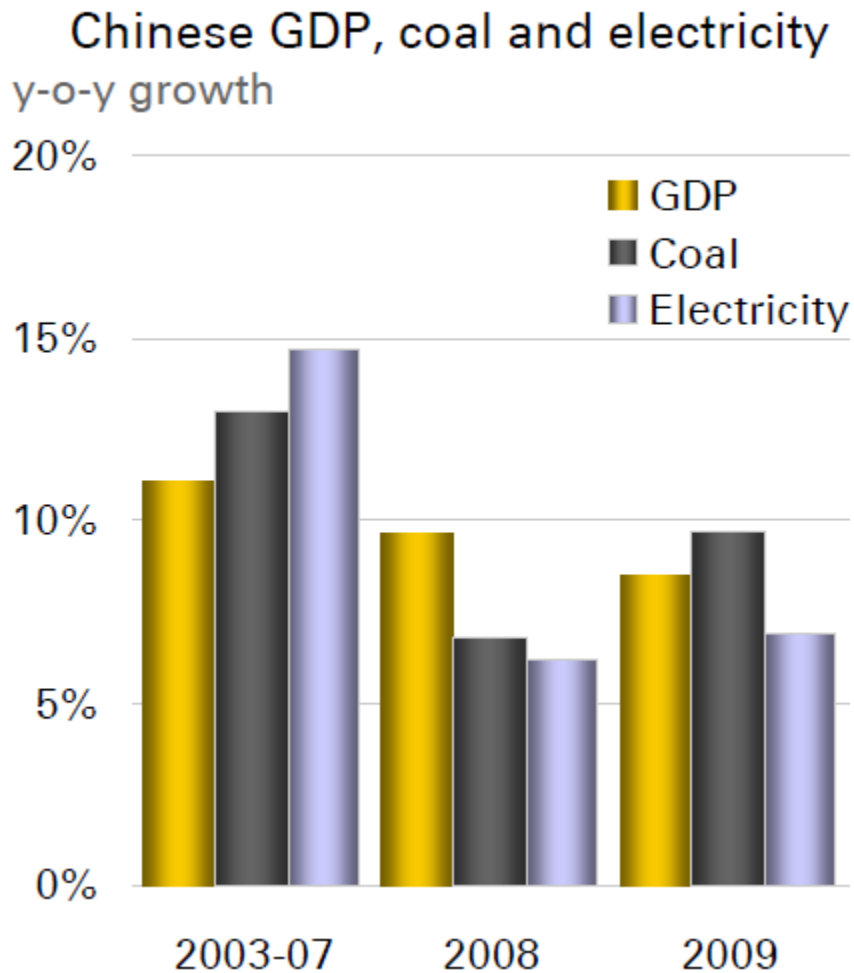


Global coal trends



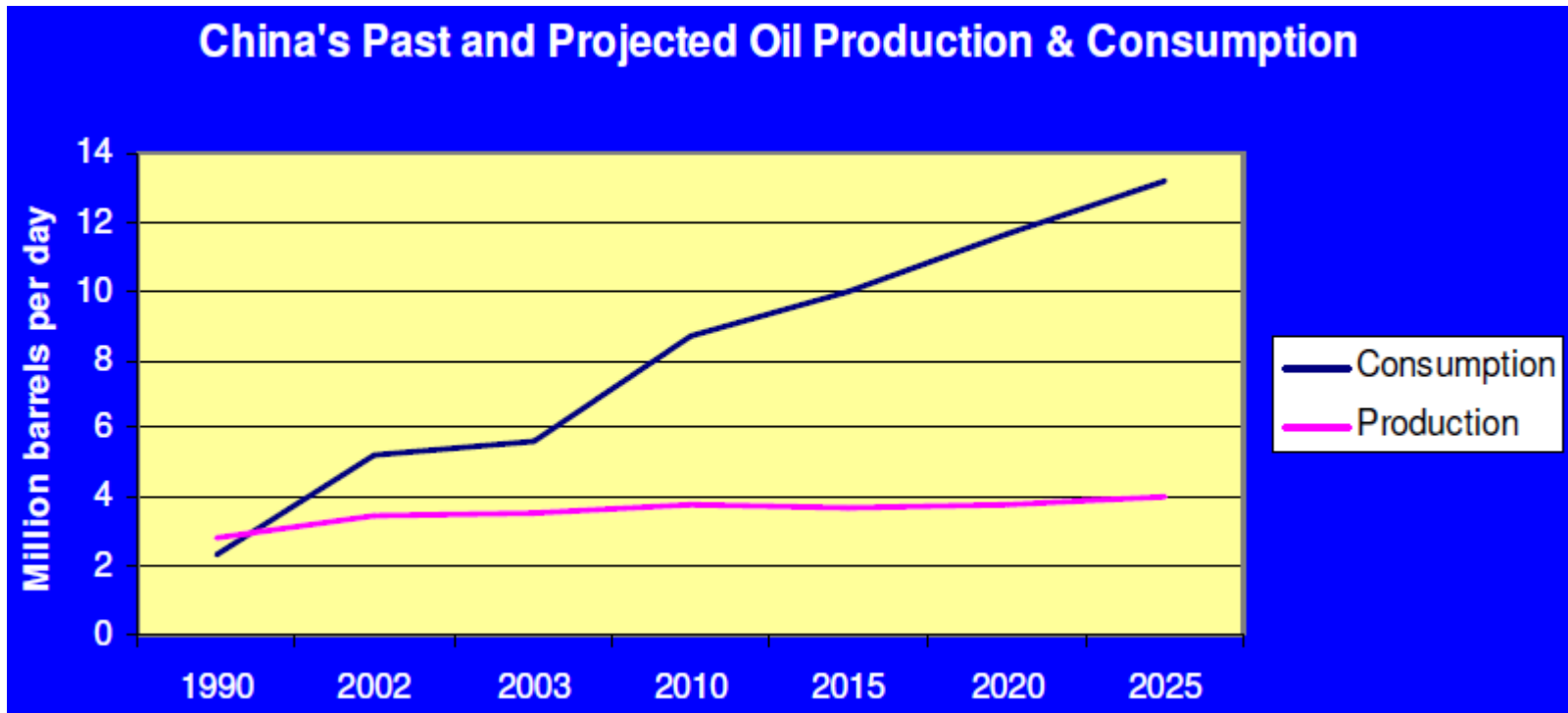
- China's incremental demand of the last two years is equal to TOTAL EU coal use and not far off TOTAL US 2009 consumption

Coal consumption growth in China



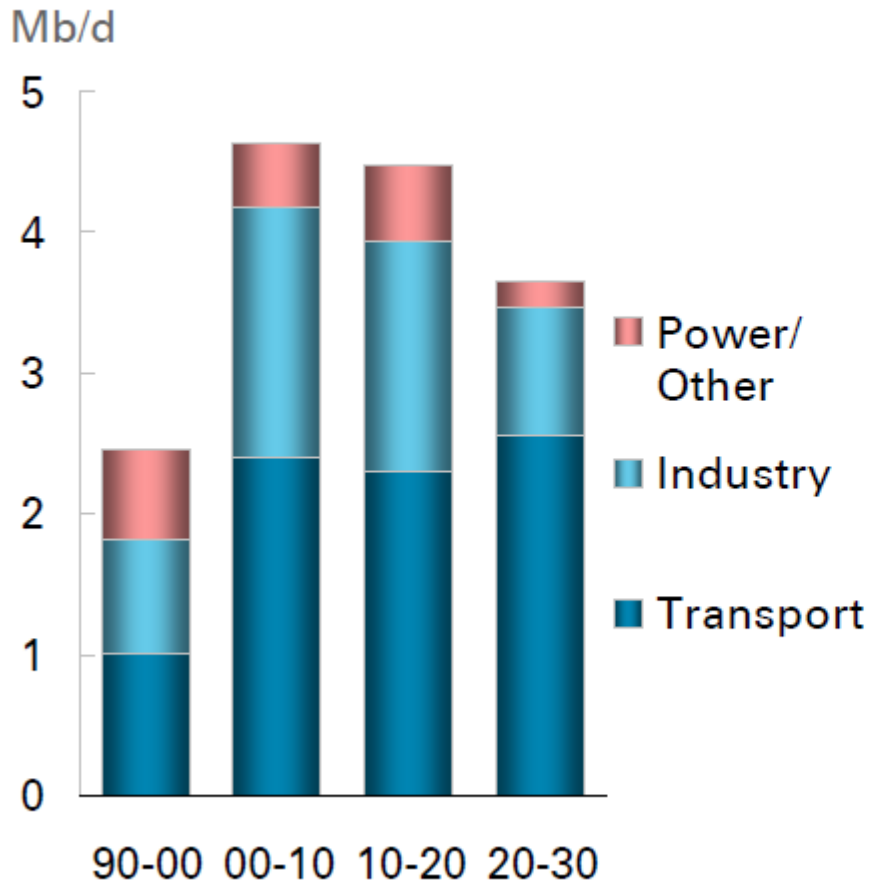
China's dependence on overseas oil hit 55.2 %

- Bigger than that of the US
- 2010, 58% of China's oil imports come from Middle East region. By 2015, the share of Middle East oil will stand on 70%.

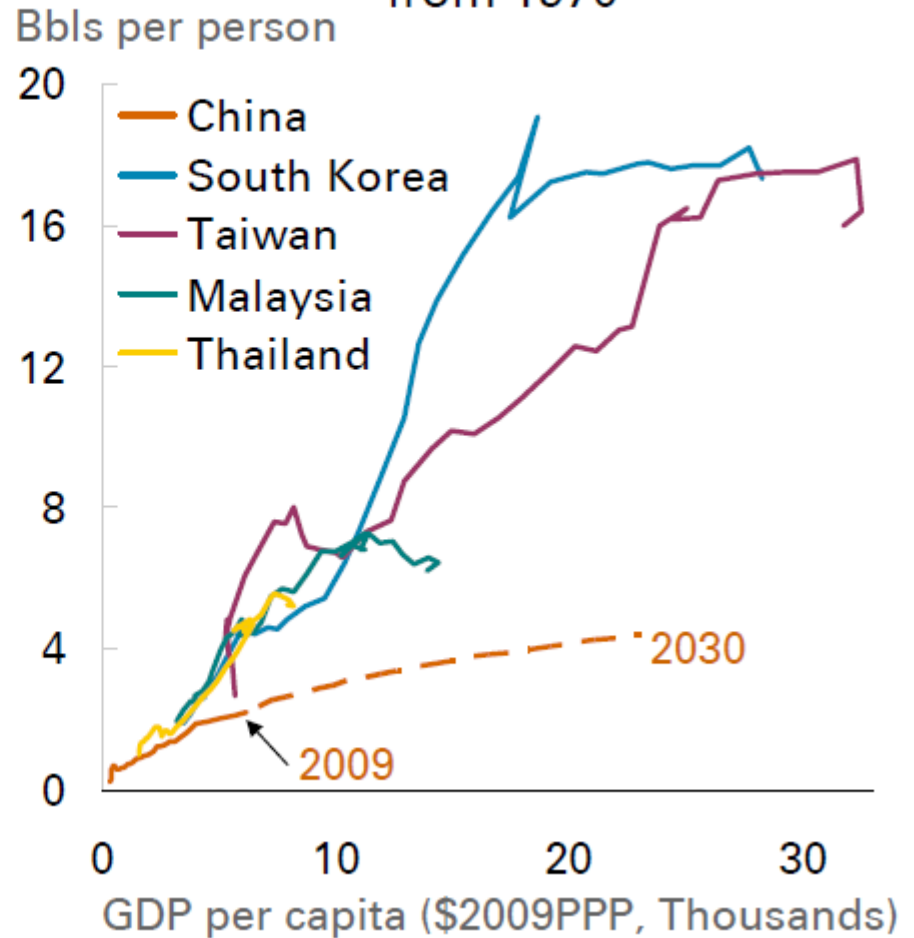


China remains a key component of oil consumption growth

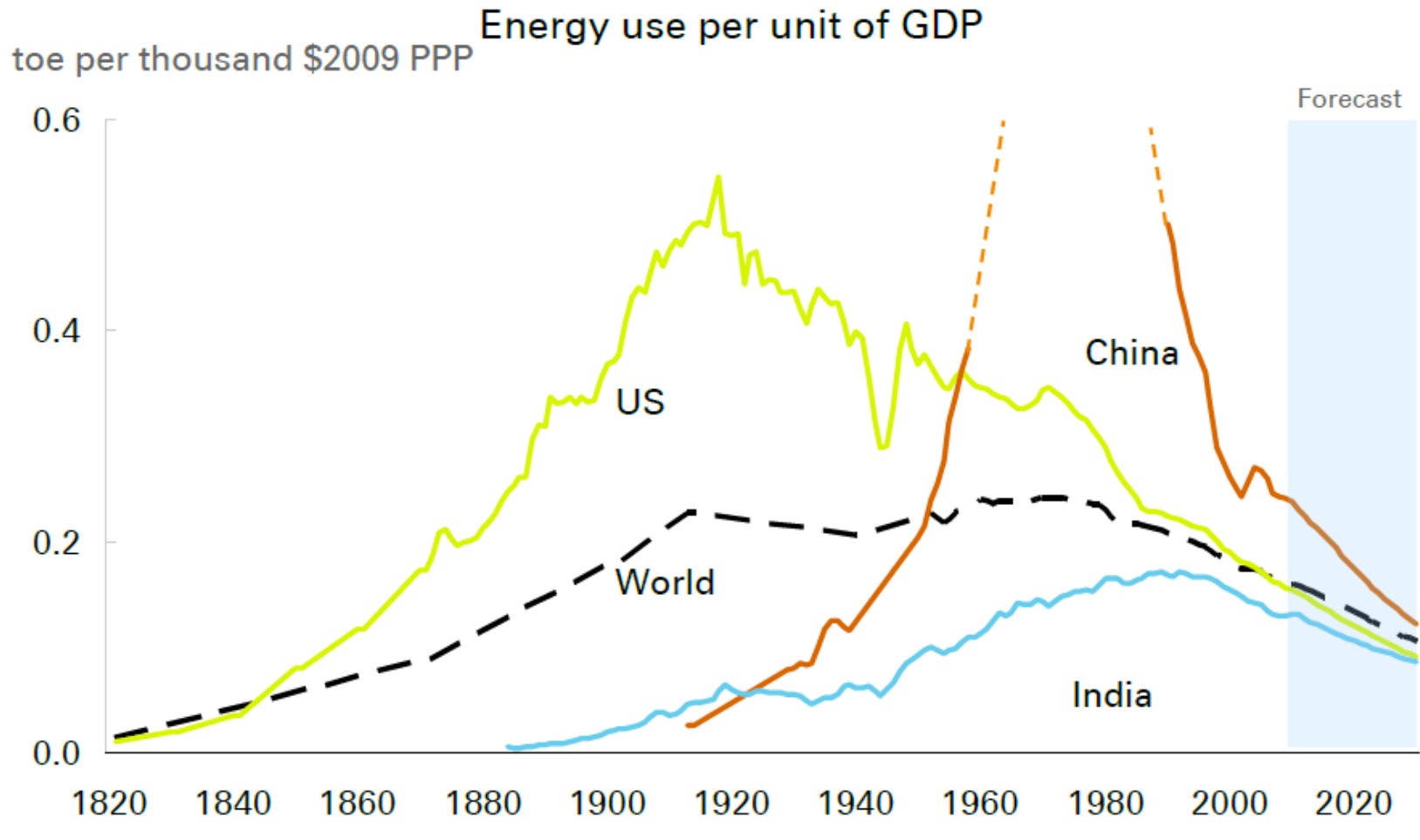
China's liquids demand growth



Liquids demand per capita from 1970



Historical trends and patterns of development



Energy Target in China

- In 2009, the State Council announced that China will commit to reduce CO₂ emissions per unit of GDP by 40 - 45 % of 2005 levels by 2020
- China aims to increase the proportion of non-fossil fuels in overall primary energy use to 11.4 % by 2015, 15 % by 2020, including both renewable energy and nuclear energy
- By 2015, China's natural gas consumption may reach 260 billion m³ . By 2020, use of natural gas in China is forecasted to increase to 8-10% of the energy mix, from 3% in 2008.
- Coal will meet 63 percent of the nation's energy needs by 2015, down from 70 % last year.

5 trillion Yuan (\$738 billion) into alternative energy over the next decade

Energy Laws in China

- The **Renewable Energy Law** enforced in 2006
- The **Energy Saving Law** issued in 2008



- **Energy Saving and Emission Reduction** are the key issues in China

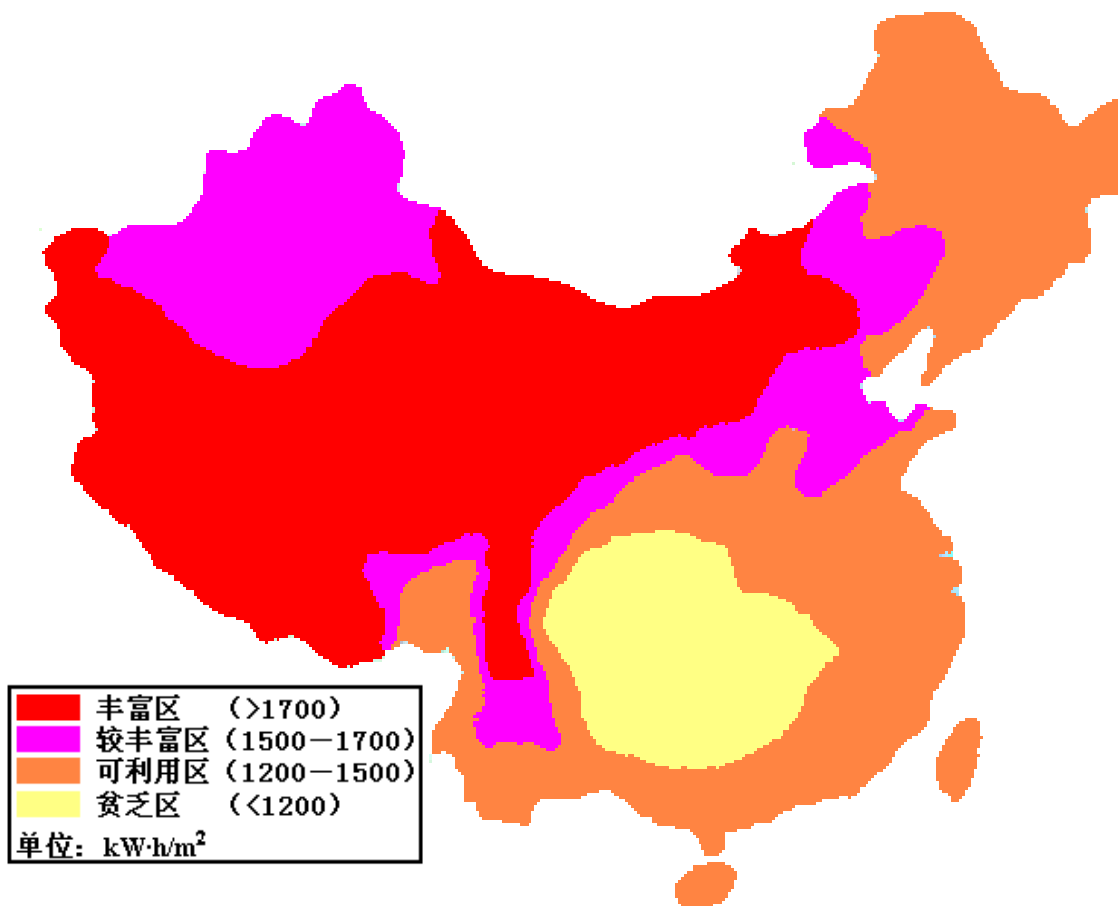


Part II

Renewable Energy in China

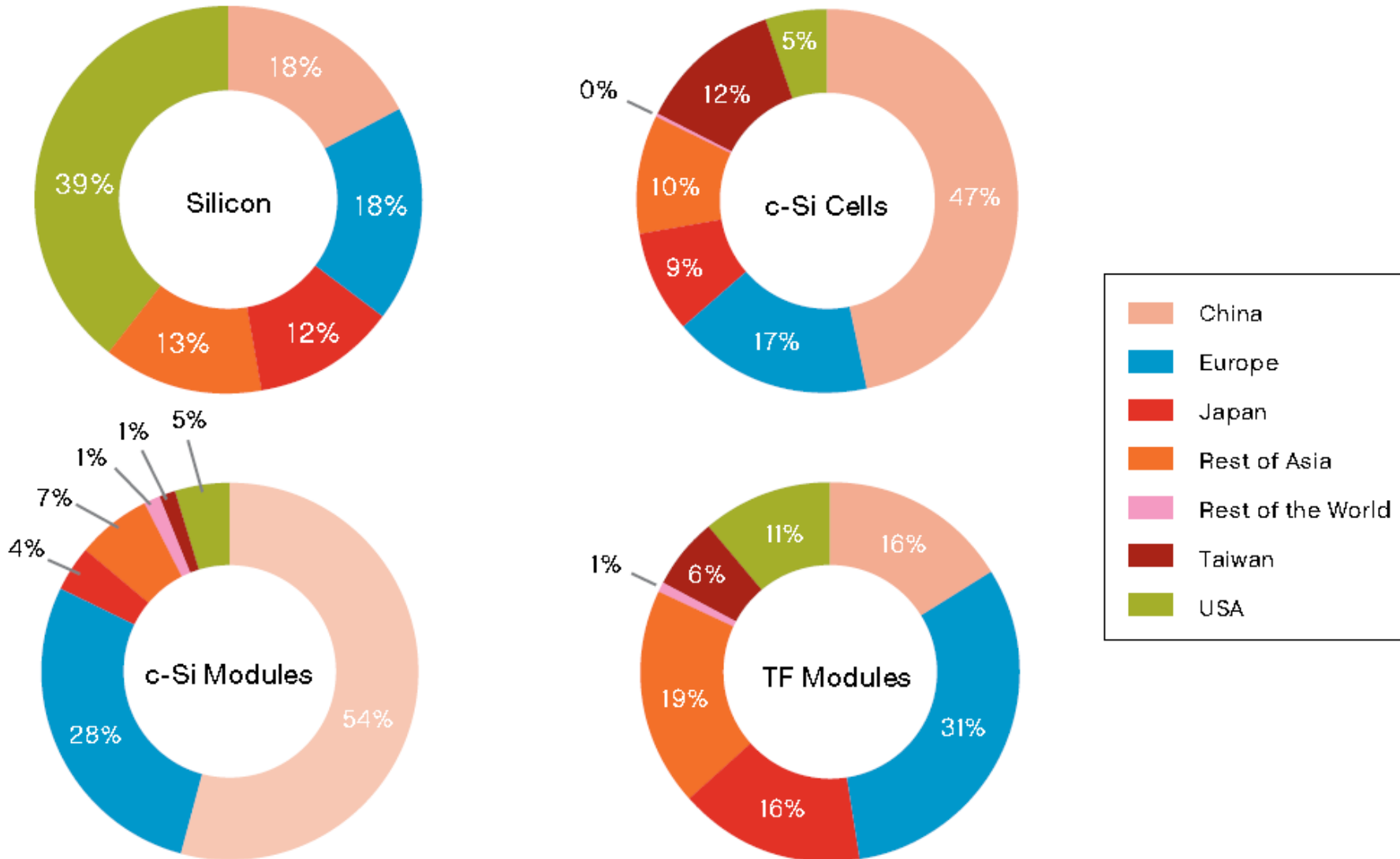
Solar Source in China

	Area	Radiation intensity
I	Rich area	≥ 6700 MJ/ (m ² a)
II	Somehow Rich	5400—6700 MJ/ (m ² a)
III	Can be used	4200—5400 MJ/ (m ² a)
IV	Lack of Source	< 4200 MJ/ (m ² a)

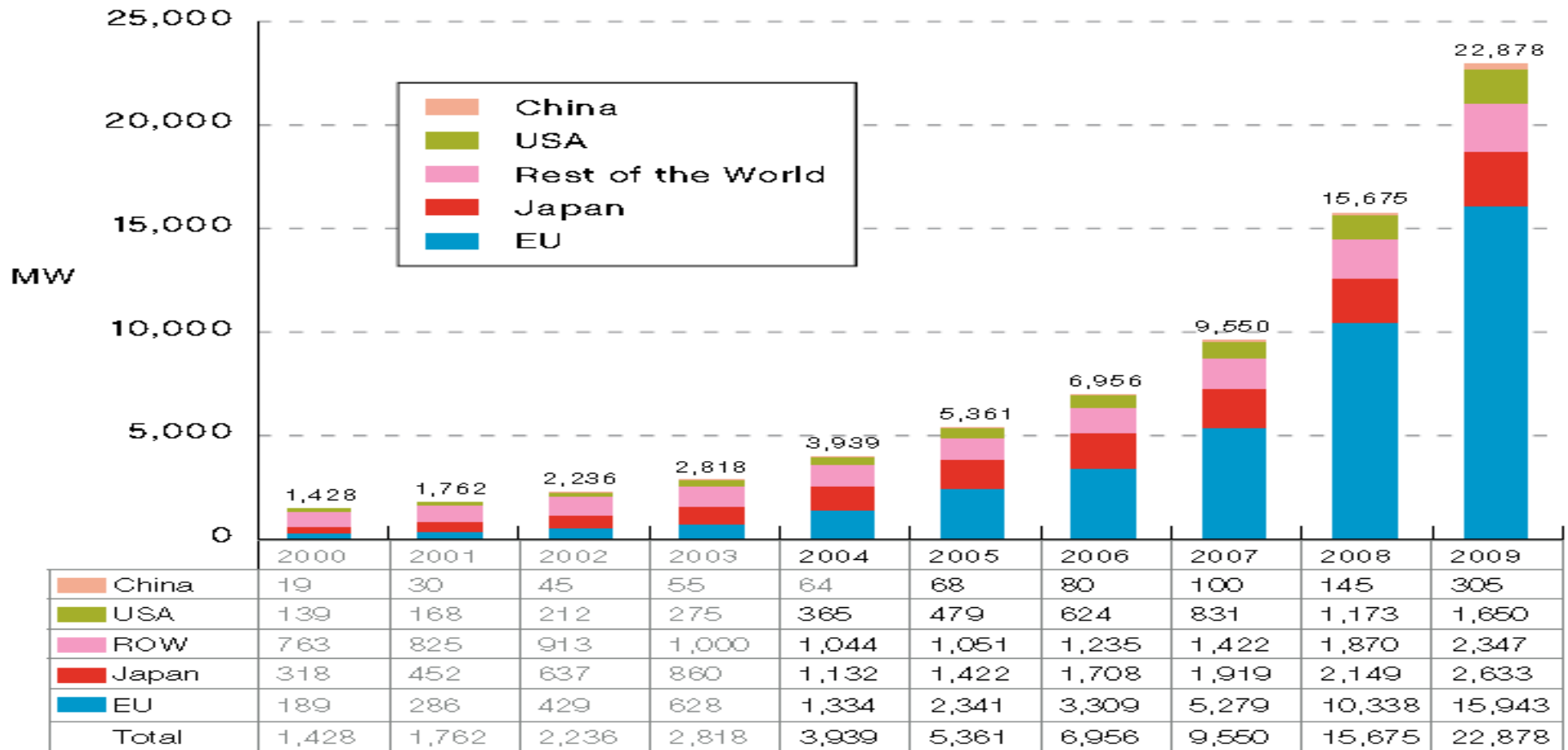


2/3 Land over 2200 sunshine hours per year;
annual sun radiation intensity 5000 MJ/m² ~
170kg standard coal

World solar PV Production in 2009



Market of Solar PV in China



Solar Thermal



Prof. Yin ZQ
Tsinghua Univ.



Huang Ming
Himing Solar Co.

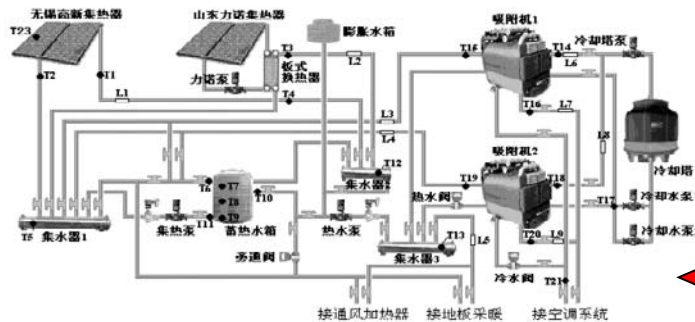


Four steps of solar thermal development



1. Solar water heating

2. Solar heating for building



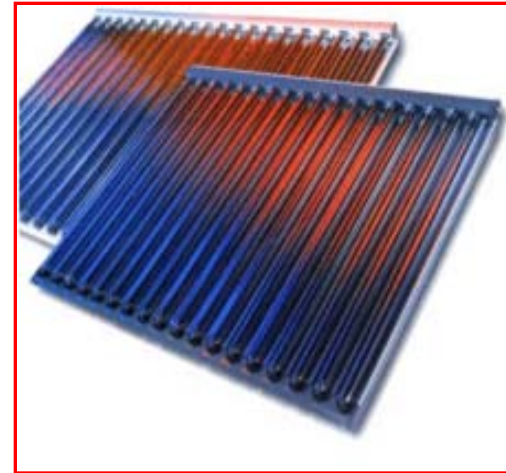
4. Solar integrated hybrid energy system

3. Solar air conditioning

Solar Collector



Heat pipe type



U tube evacuated tube

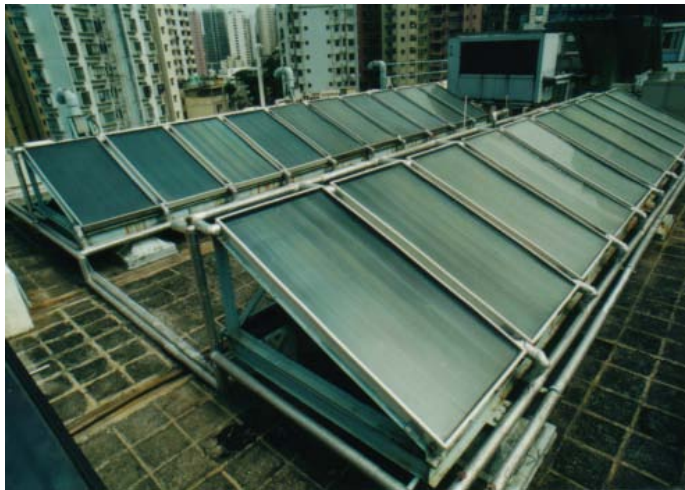
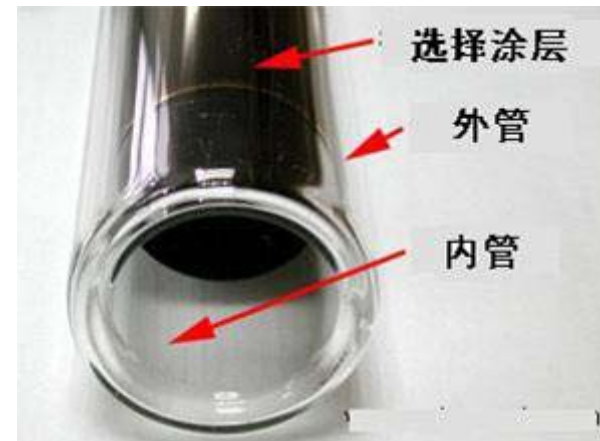


Plate type



All glass evacuated tube

Solar Thermal in China

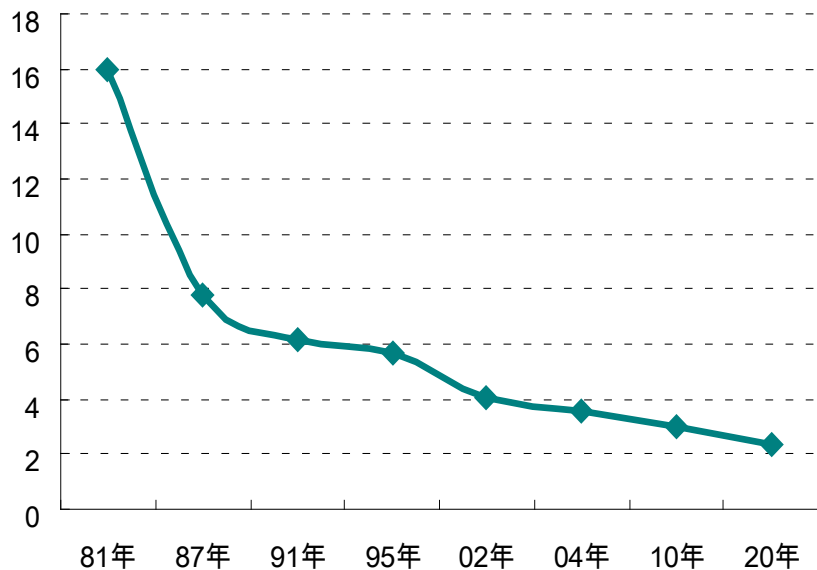
- 2005- total in use 80Mm², Annual production 15 Mm², a complete Production chain in China, 80% solar thermal uses in the world;
- 2010- total in use 150 Mm², 2 times of 2005;
- 2020- total in use 300 to 500 Mm², co₂ reduction 60 MTce per year;
- Solar Thermal integrated on building

Wind Turbine Electricity

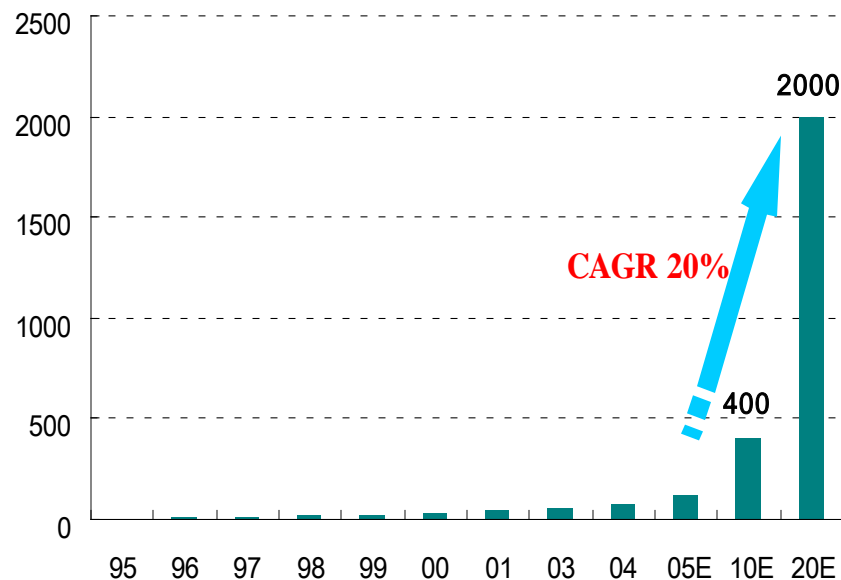


Wind turbine , a substantial Market

风力发电成本不断下降 (单位: 欧分/千瓦时)



风电装机容量走势 (单位: 万千瓦)

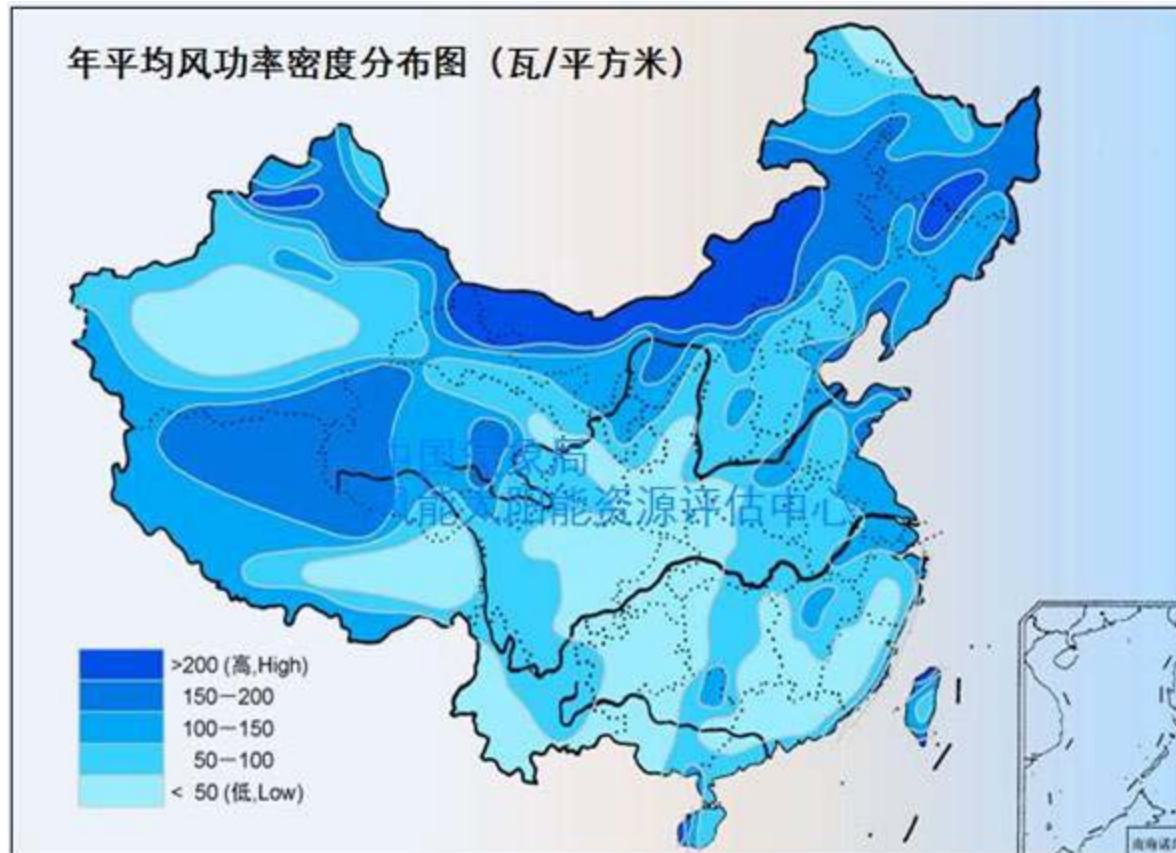


The most accepted renewable energy, cost reduction obviously

Annual increase at least 20% in this ten years

Wind energy Source in China

- Land source
250 Million kW
- Offshore 750
Million kW
- 1000 Million
kW in total
source



Wind power development in China-scheduled

2003 : 567 MW

2004 : 700 MW

2005 : 1260 MW

**60 wind field, mainly
750kW or less per unit.**

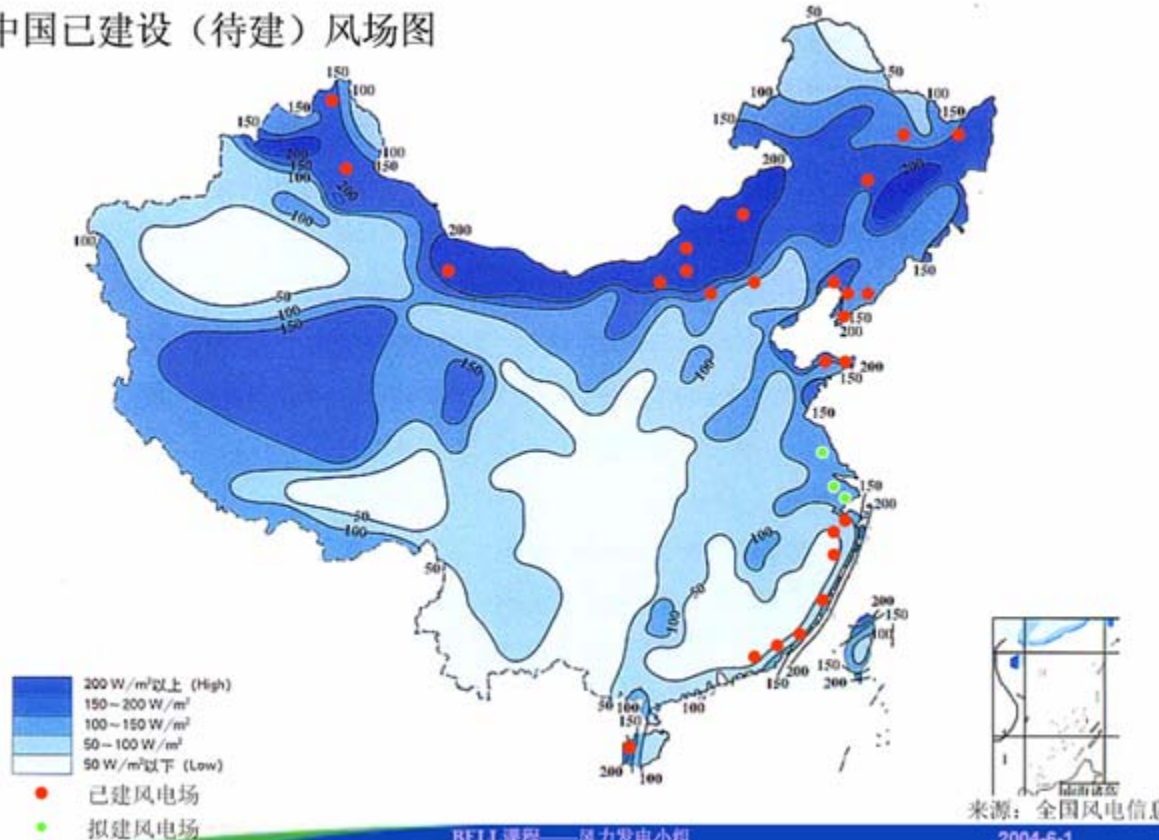
2010: 5000 MW

2020: 30000MW

**But in 2008 6246MW has
reached**

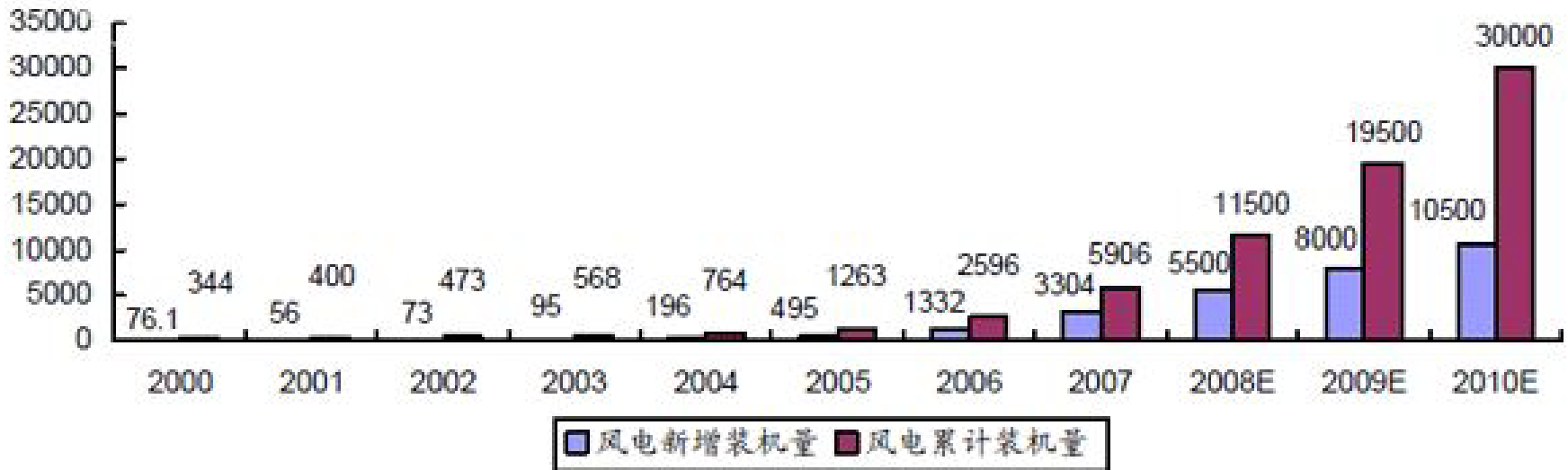
2009 say over production

中国已建设（待建）风场图



More wind farm to be developed

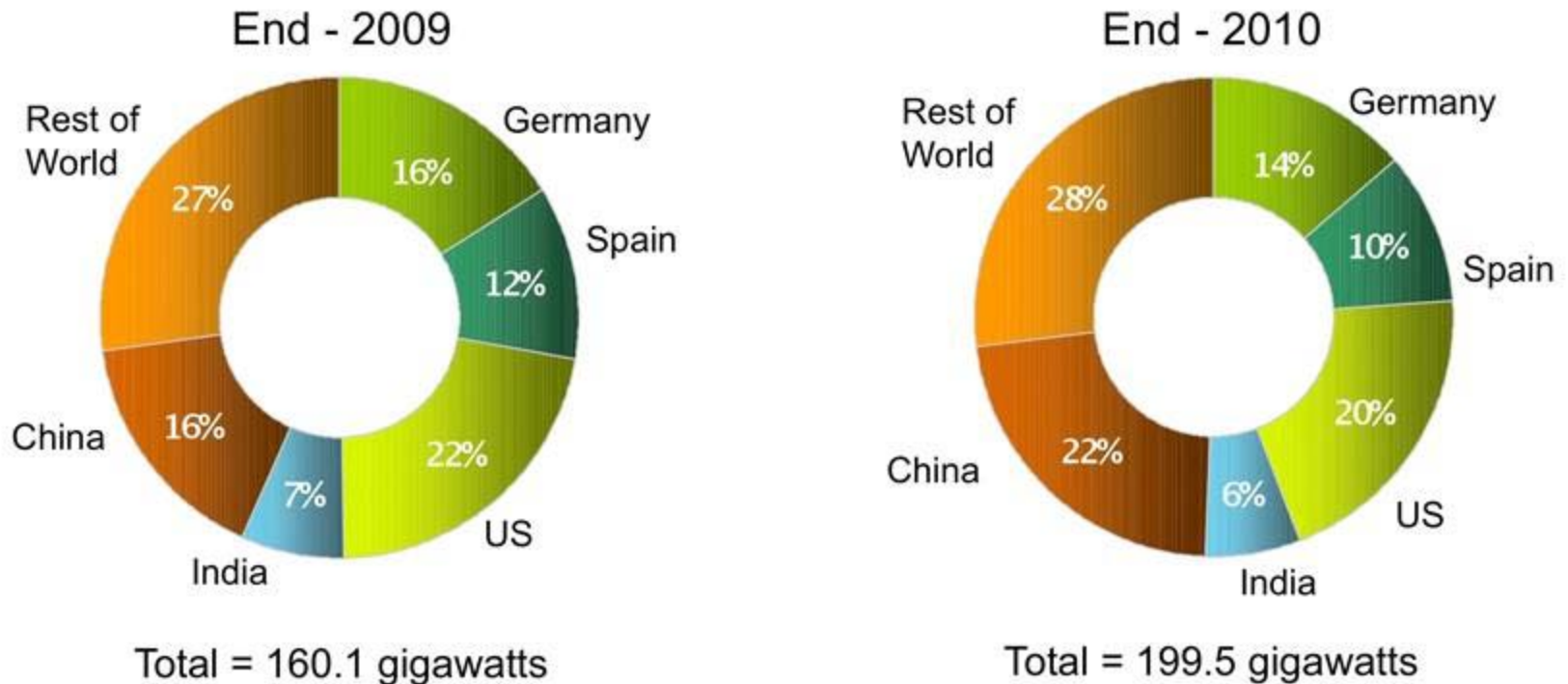
China Wind Energy Development



中国风能协会：2010年中国风电新增装机量和累计装机量及预测
Unit: MW Far bigger than estimated

China takes the leader in wind energy

By 2010, China's installed wind power capacity exceeded 44 GW, the world's largest.



Installed Wind Generation Capacity

Wind power generating capacity grew by 24.6% in 2010, with capacity increasing by a record 39.4 GW to reach 200 GW by the end of 2010.

100MW wind turbine energy in Shanghai started to generate electricity in March 2010



Shanghai East sea bridge side wind farm

距离岸线8-13千米，平均水深10米，总装机容量102兆瓦；年发电量可达2.6亿千瓦时；每年减排二氧化碳20万吨。200 thousand ton CO2 reduction per year!



3MW 32 wind turbines

Part III

Key R&D Fields in Energy Science and Technologies in Future 10 Years

Energy conservation and energy efficiency improvement

- Energy saving in energy intensive sectors
 - optimization of energy use in petrochemical industry, development of petrochemical processes with high potentials in energy conservation, application of information technologies in the petrochemical sector for energy saving, application of ultra-supercritical coal-fired power generation technology, and integrated gasification combined cycle (IGCC) technology.
- Industrial energy conservation and pollution control
- Energy efficiency in buildings Transportation, appliances and lighting
- Distributed energy systems

Clean coal and liquid fuel

- **Clean coal technology**
 - mechanism of formation of pollutants from coal combustion and pollution control technologies, efficient and clean utilization of coal
- **Clean conversion and utilization of liquid fuel**
 - Efficient and clean use of heavy oil and non-conventional oil resources, clean and super-clean vehicle fuel production,
- **Clean petrochemical and energy conversion,**
 - basic science supporting the integral development of petrochemical oil processing. Other areas are: power saving and clean fuel conversion, direct efficient conversion of methane, conversion of natural gas into high quality chemicals and liquid fuels.
- **Power saving and clean fuel conversion**

Alternative energy

- Solar

- large-scale solar thermal energy conversion and utilization, solar thermal energy industry application, high temperature heat storage processes and materials, materials for use in high temperature systems
- Solar photovoltaic materials, devices, system characteristics and operation optimization. New concepts and new mechanisms for improving the energy conversion efficiency of solar cells

- Wind

- simulation of wind farms with the characteristics of the complex topography in different areas of China, wind turbine blade and optimized aerodynamic design, optimal control of large wind turbines, the key offshore wind turbine technologies.

- biomass

- nuclear

- renewable energy storage

Electricity generation, distribution, storage and utilization

- Large-scale renewable energy and electricity distribution
- Smart grid
- Ultra high voltage power transmission, high voltage power equipment
- Electrical energy storage system
- Power electronic devices and systems
- Efficient use and saving of electric power
- Electrical transport and delivery systems
- Superconductor power technology

GHG control and low- or non-carbon energy system

- Emission reduction in energy power systems
 - Independent control of power systems and GHG. Integrated cascade utilization of chemical energy and directional migration of carbon components for GHG control, greenhouse gases control based on the combined reaction and separation process.
- Low- or non-carbon energy systems technology, chemical and industrial
 - Emission control technologies on coal and coal-based product consumption and application, reuse of waste coal product, absorption, adsorption, and membrane separation processes for CO₂ capture.
- Low-carbon eco-industrial system
 - Cleaner production alternative technologies, ecological recycling of carbon resources, bio-carbon sequestration sciences and technologies, integration technology on low-carbon cycle system, decision-making and support tool for carbon recycling eco-industrial system.

Conclusions

- China is facing big challenge in providing energy to support its economy development and living standard improvement
- Non-fossil fuels have increased significantly and will continue developing in future 10 years
- 5 key R&D fields for future 10 years
 - Energy conservation and energy efficiency improvement
 - Clean coal and liquid fuel
 - Alternative energy
 - Electricity generation, distribution, storage and utilization
 - GHG control and low- or non-carbon energy system

SJTU Projects in the next 5 years approved by M.O.S.T. China

- Nuclear
- Coal gasifying power generation with CO₂ capture (Prof. Zhang ZX)
- Smart Grid with offshore wind energy (Prof. CAI X.)
- Solar Thermal for use in Industries (Prof Wang R.Z., Dai Y.J.)
-
- Building energy saving and etc..

Thank You!