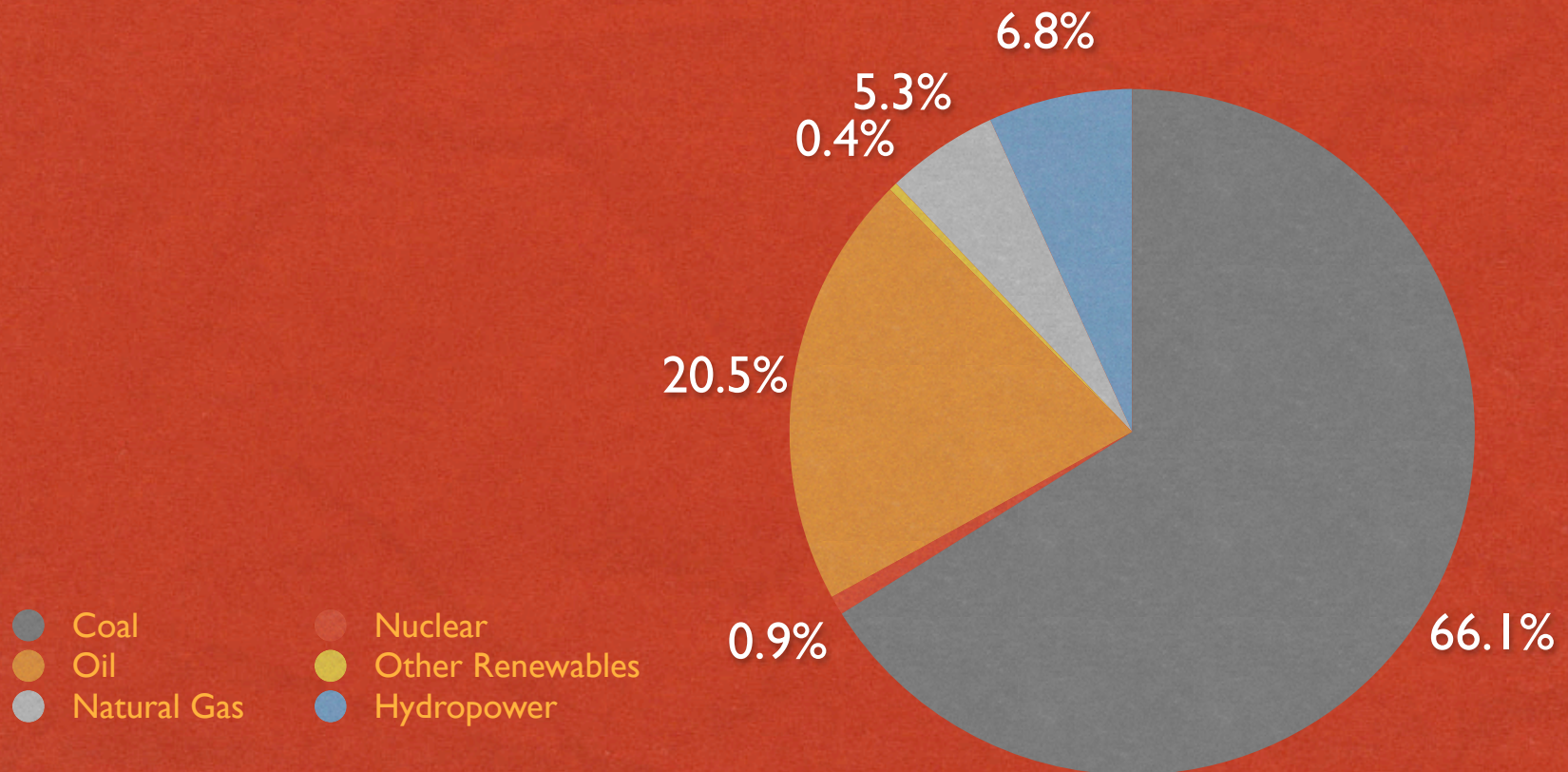


CHINA'S RENEWABLE ENERGY
INDUSTRY
中国可再生能源行业

Louis B. Schwartz
China Strategies, LLC
www.chinastrategiesllc.com

COMPOSITION OF ENERGY IN CHINA IN 2010

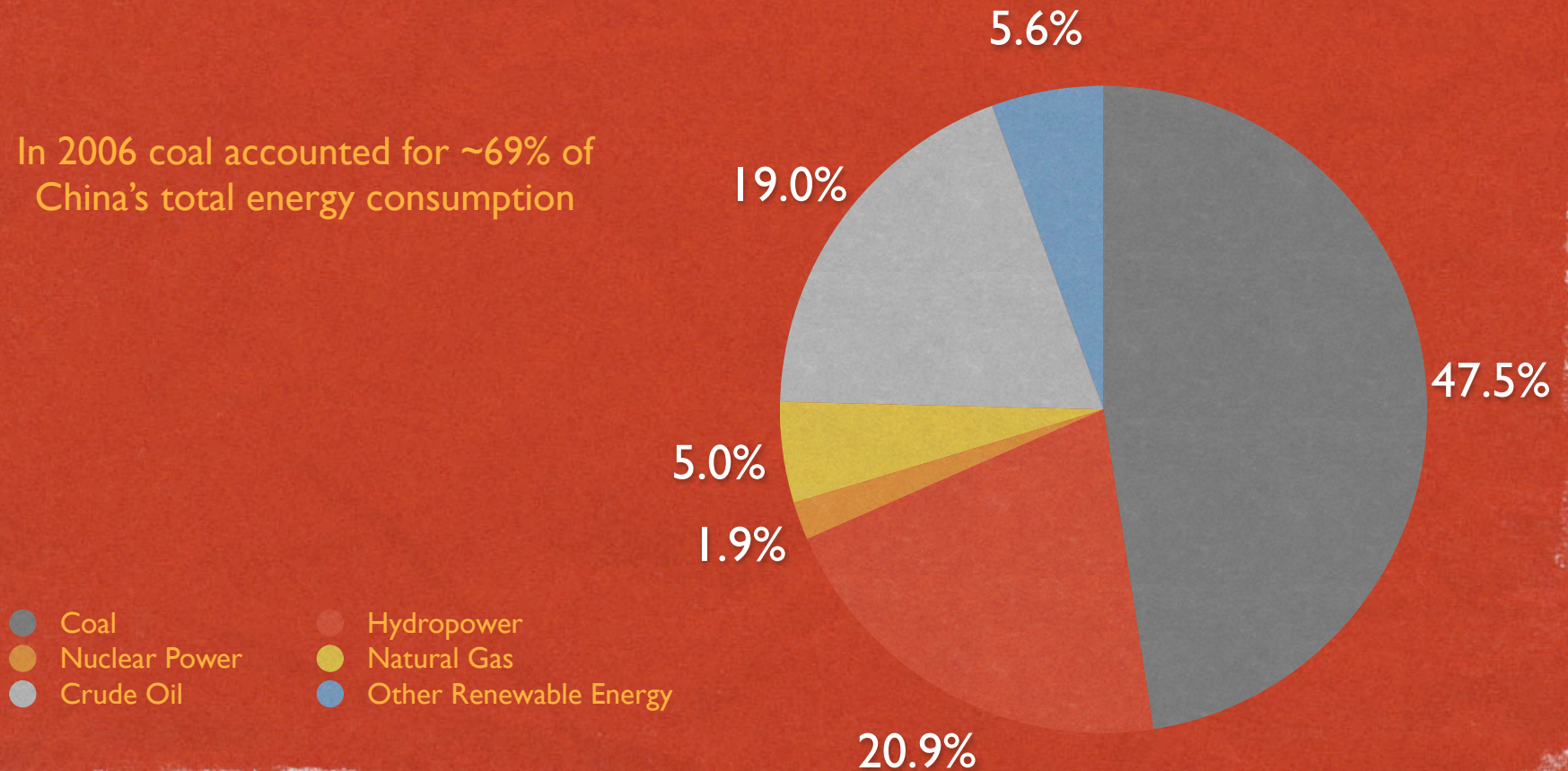
Projected Sources of Energy in China (%) in 2010



COMPOSITION OF ENERGY IN CHINA IN 2050

Projected Sources of China's Energy as of 2050 (% of total)

In 2006 coal accounted for ~69% of
China's total energy consumption

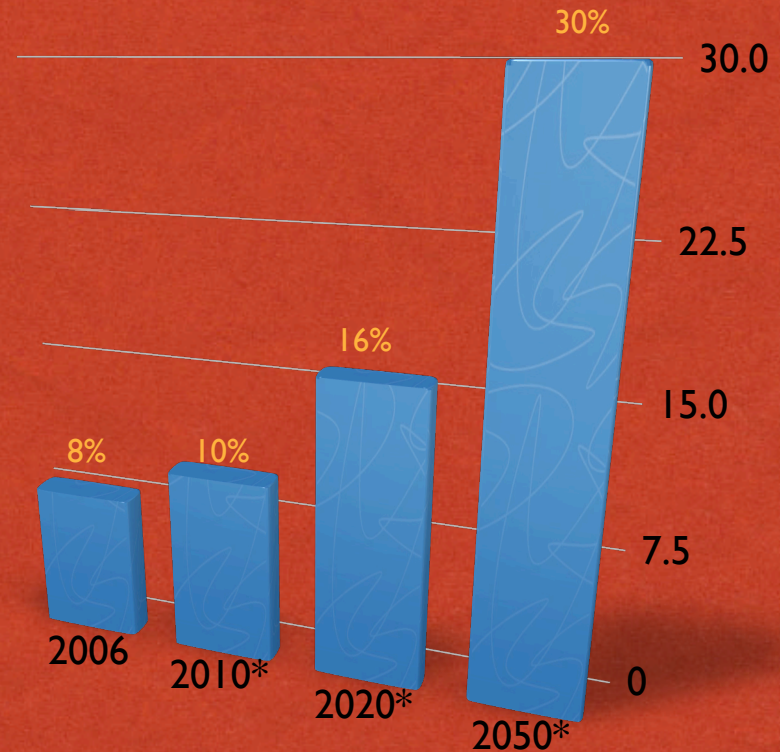


GROWTH OF CHINA'S RENEWABLE ENERGY

By 2020 there will be 300,000 MW of hydropower, 30,000 MW of wind power, 30,000 MW of bio-mass, 1800 MW of solar power, 300 million sq. meters coverage of solar hot water heaters, 20 million tpy of bio-fuels and 44 billion sq. meters of methane gas.

source: Mid to Long Term Development Plan for Renewable Energy

■ Growth in Renewables as a Percentage of Total Energy Requirements



*projected

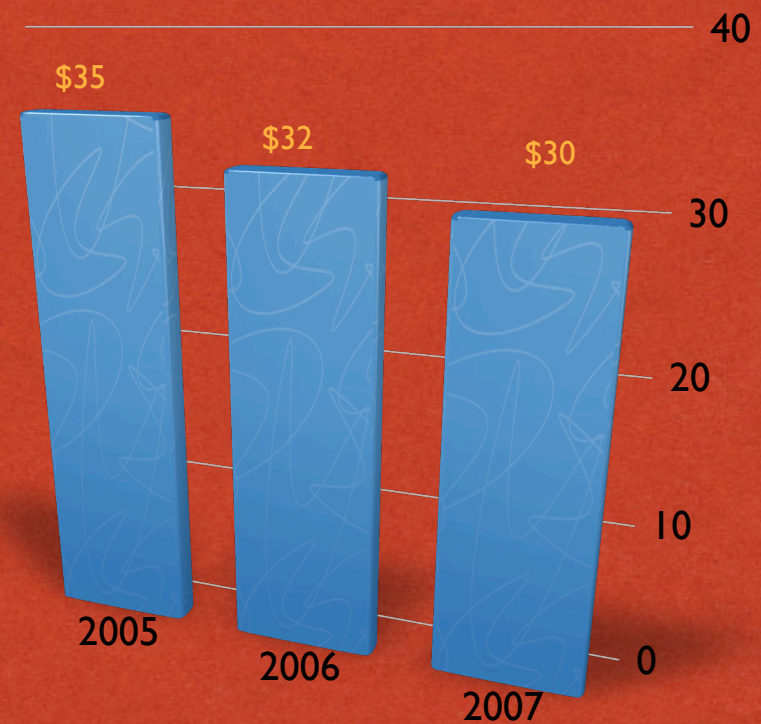
CHINA'S SOLAR INDUSTRY

China is one of the three largest producers of solar cells in the world, yet 90% of what Chinese solar cell manufacturers produce is exported and China may only have 1800 MW of solar power installed by 2020.

CHINA'S SOLAR INDUSTRY

As of year end 2006 there were ~200 Chinese solar module manufacturers

Declining Prices for Solar Modules (\$/watt)



CHINA'S SOLAR INDUSTRY

Chinese Solar Stocks Shine on Wall Street

Name	Symbol	Market Cap. (as of 1/25/08)
Suntech	STP	\$8.0 billion
Trina Solar	TSL	\$1.05 billion
Yingli Solar	YGE	\$2.9 billion
China Sunergy	CSUN	\$2.4 billion
LDK	LDK	\$4.2 billion
JA Solar	JASO	\$9.1 billion
Solarfun	SOLF	\$4.6 billion
CSI Solar	CSIQ	\$509.2 M

CHINA'S SOLAR INDUSTRY

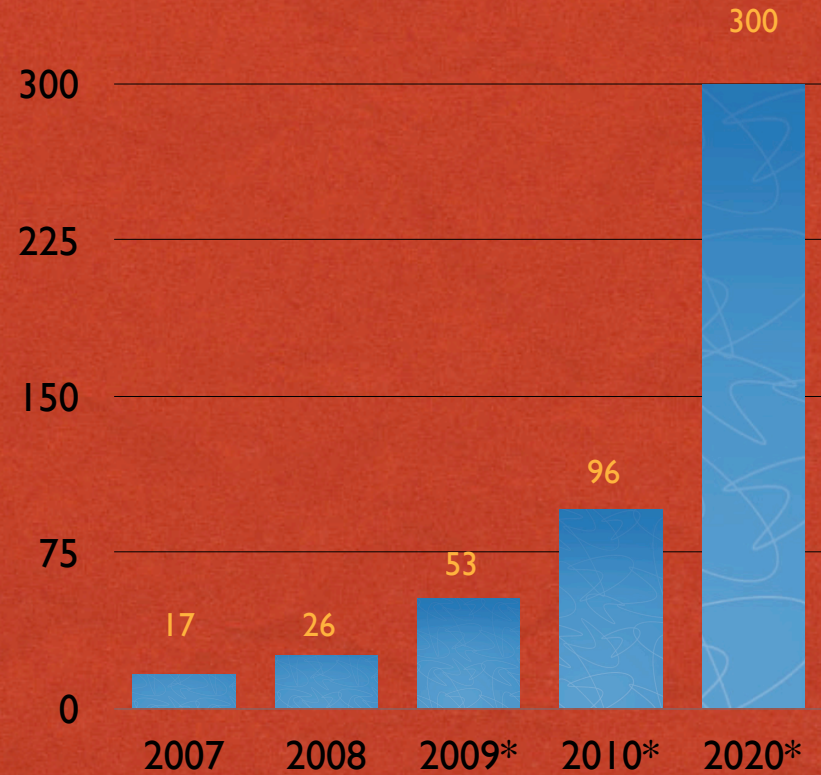
■ Installation of Solar Hot Water Heaters (millions of square meters)

Sales of solar hot water heaters are 10x that of Europe with systems in ~35 million Chinese households.

In 2007 Shandong Province established a \$300 million fund to subsidize the installation of solar hot water heaters in hotels, schools and other buildings; Rizhao, Shandong has the largest adoption rate of solar hot water heaters: 99%.

Chinese solar hot water heater companies earned ~\$2.6 billion in 2006; by 2010 the market for solar hot water heaters is projected to be \$8.2 billion/year.

Nanjing recently joined Jinan, Yantai, Guangzhou and Wuxi in requiring the installation of solar hot water systems in new construction and renovations of building less than 12 stories tall and under.



*projected

CHINA'S WIND POWER INDUSTRY

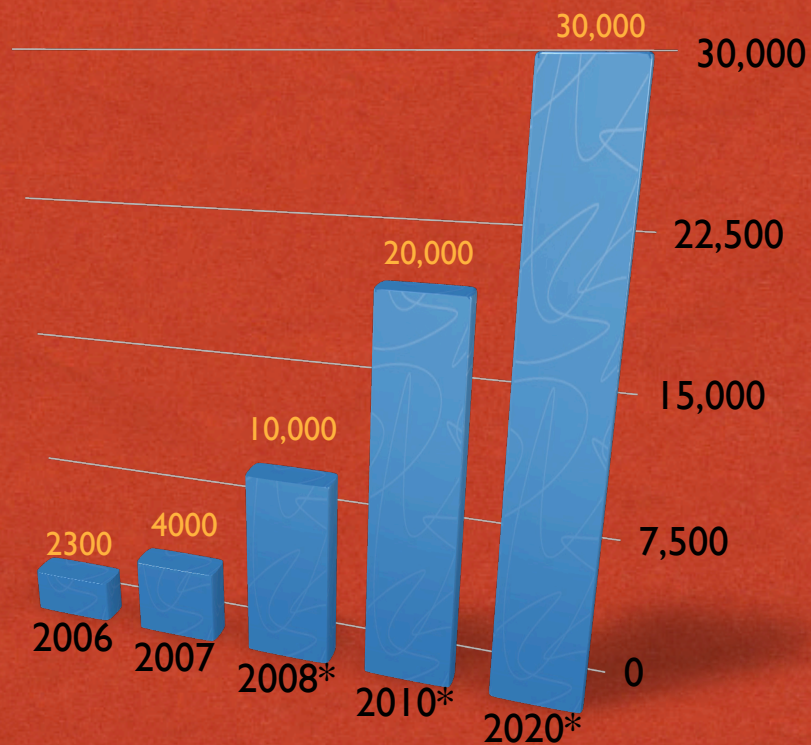
China has an estimated 1 million MW of wind resources, including 250,000 MW of land-based wind resources.

Between 2006-2020 China will spend ~\$28 billion U.S.D. on wind power capacity development

Wind power in China will grow at a rate of 300%/year, second only to the rate of growth in the U.S.

By early 2008 China's wind power capacity will exceed 5000 MW, an amount originally expected to be accomplished in 2010

■ Installed Capacity of Wind Power (in MW)



*projected

CHINA'S WIND POWER INDUSTRY

In the next five years, eastern China's coastal regions, Northwest China, Northeast China and eastern China cumulatively will build 30 or more 100 MW class wind projects and will create three 1000 MW 'bases' in Jiangsu, Hebei and Inner Mongolia.

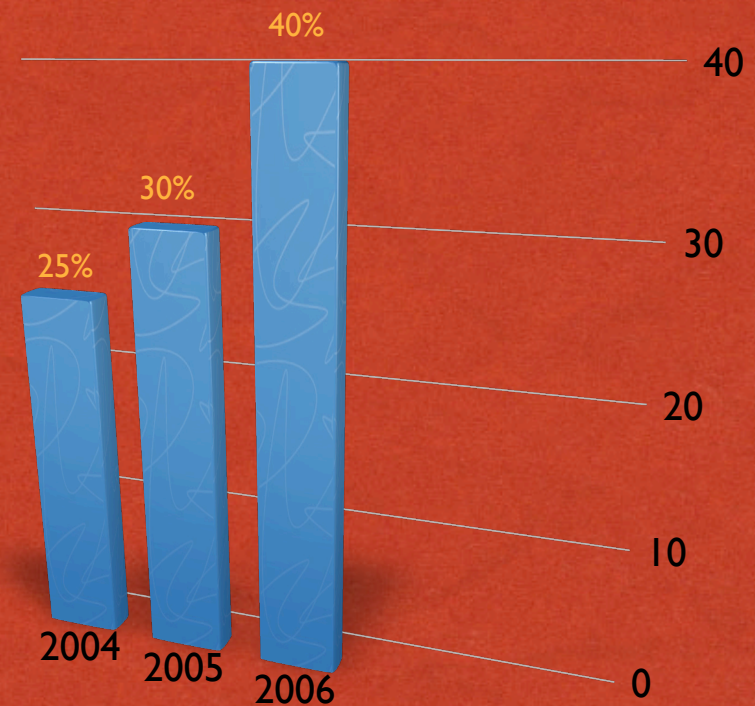
Some are estimating that China's installed base of wind power might reach 500,000 MW by 2050.

CHINA'S WIND POWER INDUSTRY

■ Growth of Indigenous Manufacturing Capabilities (% Supplied from Domestic Sources)

Chinese companies have the capability to produce 600Kw and 750Kw wind turbines while foreign manufacturers can produce 1 MW to 2.5 MW wind turbines.

By 2010-2015 the Chinese wind power industry will have reached international standards.



CHINA'S GEOTHERMAL INDUSTRY

As of 2004 China's total installed capacity to produce power from geo-thermal resources was 28.8 MW. Estimated total potential geo-thermal power generating capacity is 5800 MW.

The richest discovered geo-thermal resources are in the Hengduan Mountain range in the Yunnan Province and Tibet border region. In Tibet the Yangbajing magma geo-thermal power plant has been operating for nearly 30 years. The installed capacity of the Yangbajing magma geo-thermal power plant is 25.18 MW.

Glitnir Bank of Iceland and Sinopec will jointly develop a 300 square kilometer basin near Xian, Shaanxi Province, which has geothermal resources (hot water) equivalent to 720 million MT of coal equivalents.

CHINA'S GEOTHERMAL INDUSTRY

It is estimated that geothermal resources throughout China at a depth of 2000 meters or less are equivalent to 250 billion MT of coal.

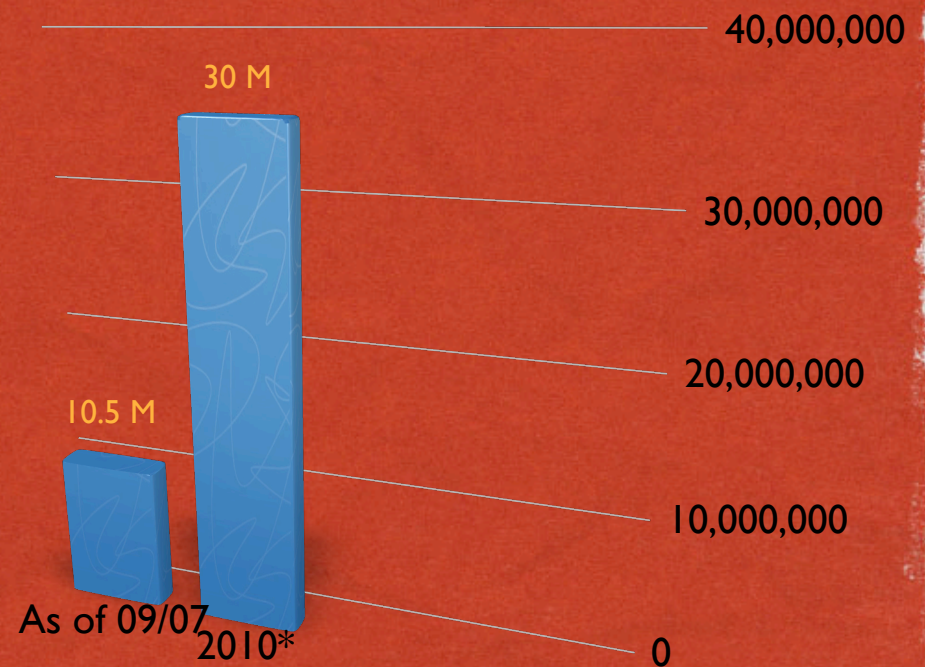
There are an estimated 2500-4000 existing direct geo-thermal sites which have a total installed capacity of 2282MW

Direct uses of geo-thermal resources include heat pumps (~35%); bathing (~26%); heating (~22%); greenhouses (~8%); aquaculture (~4%) and industrial (~3%).

CHINA'S GEOTHERMAL INDUSTRY

■ Coverage area of shallow geothermal heat pumps (in square meters)

China's market for geothermal heat pumps already exceeds 100 million Yuan (~\$14 billion) and is growing at a rate of 20%/year.



* Projected

CHINA'S BIO-ENERGY INDUSTRY: ETHANOL

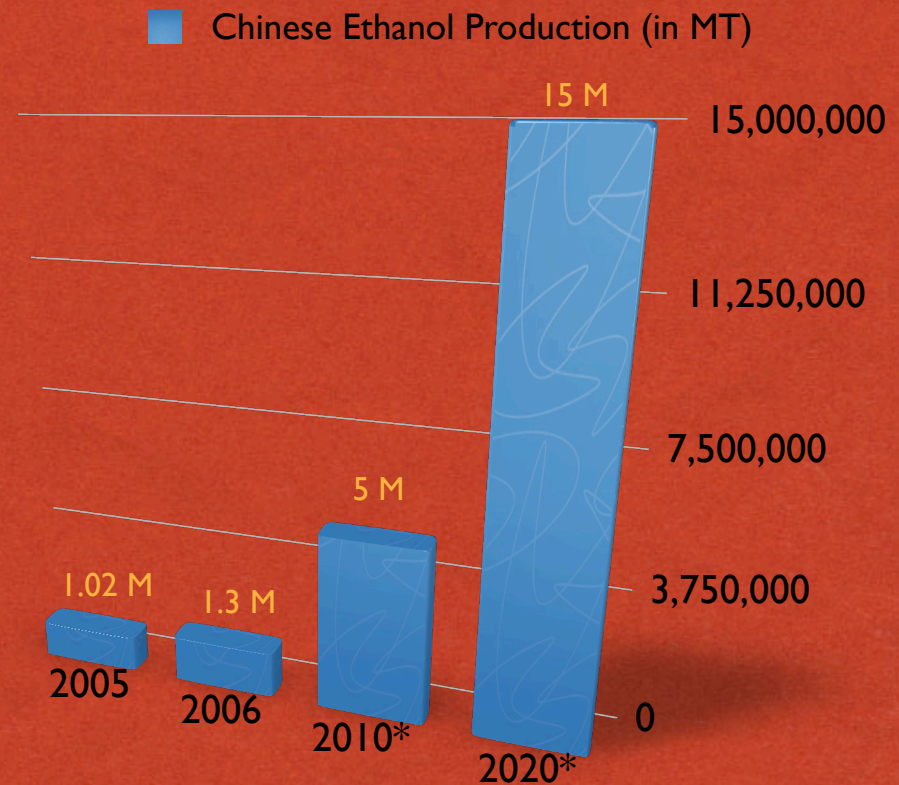
In 2010 fuel ethanol will account for more than 80% of all bio-fuel output.

In 2006 ~4.75 million MT of corn were used to produce ~1.3 million MT of fuel ethanol.

In 2006 Beijing placed a moratorium on the creation of new grain ethanol businesses.

Beijing has provided a subsidy for ethanol production. To discourage the further development of the grain ethanol industry the subsidy has declined from 1883 Yuan/MT in 2005 to 1373 Yuan/MT in 2008; after 2008 the subsidy will be eliminated.

Non-grain fuel ethanol production is expected to reach 2 million tpy by 2010

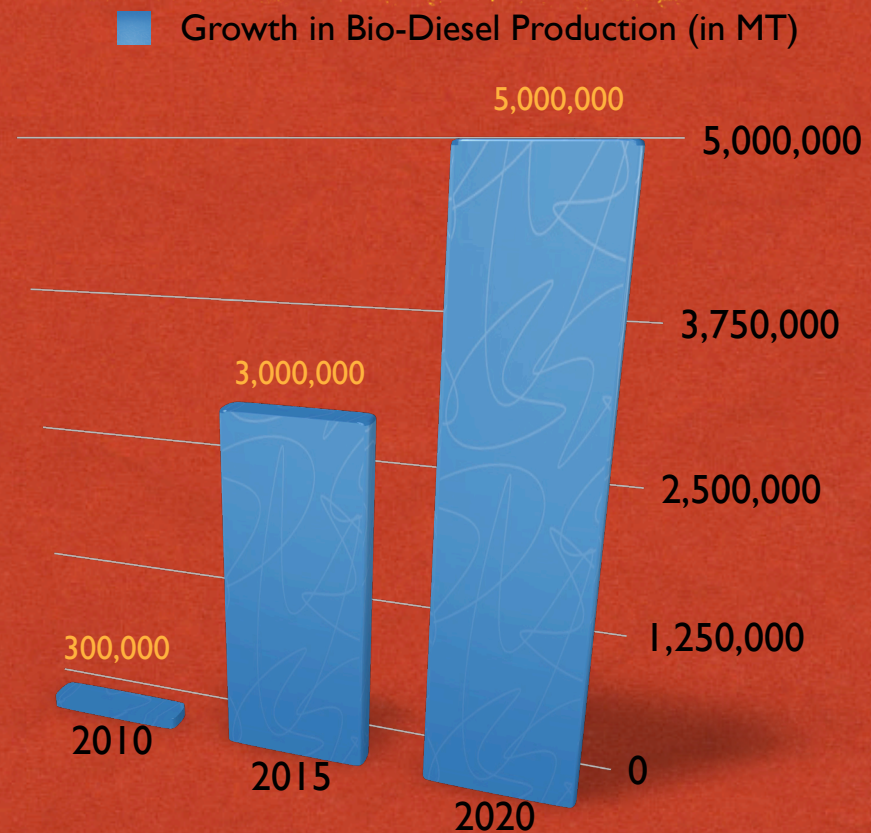


CHINA'S BIO-ENERGY INDUSTRY: BIO-DIESEL

As of the end of 2007 there were nearly 100 bio-diesel projects under construction or in planning. The principal raw materials for these refineries are rapeseed oil, the jatropha tree and imported palm oil. China also uses used cooking oil and other vegetable oils to produce bio-diesel.

Though there is as much as 3 million tpy of bio-diesel refining capacity, output is constrained by a lack of the raw materials.

Some of China's largest energy companies, including Sinopec and Petrochina are actively seeking projects to develop raw materials for bio-diesel production.

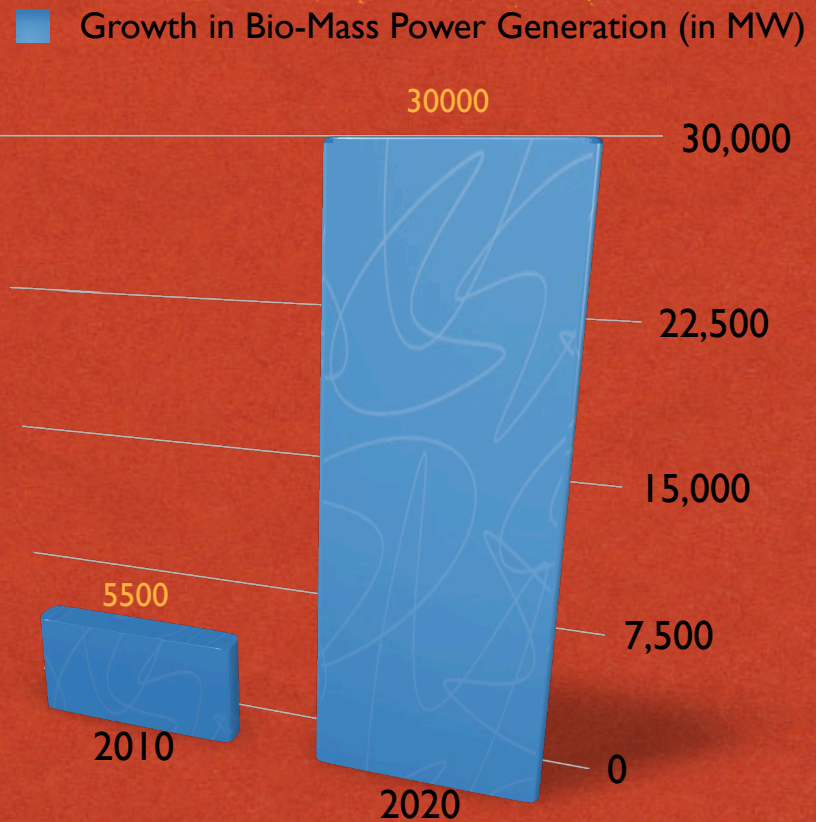


CHINA'S BIO-ENERGY INDUSTRY: BIO-MASS

Bio-mass power generation is considered an important source of additional income for Chinese farmers.

As of 2007 there were more than 30 bio-mass power generation projects which had been approved

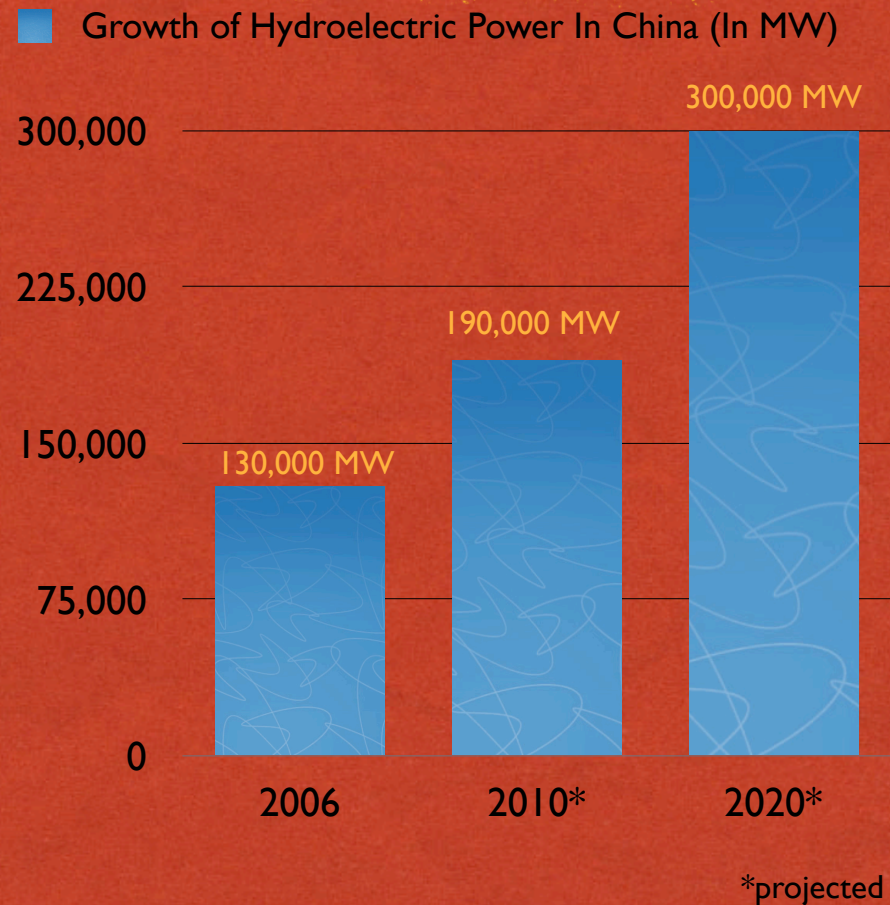
Bio-mass power generation now enjoys a 0.25 Yuan/kwh subsidy.



CHINA'S HYDROPOWER INDUSTRY

According to a 2003 survey of hydropower capacity in China, there is the potential to develop a total of 400,000 MW of economically viable hydropower in China, which would produce 1.75 trillion kwh/year.

In 2010 and 2020 hydropower will account for more than 22% of total electric power generated in China.



CHINA'S HYDROPOWER INDUSTRY

There are 14 hydropower companies that have their shares listed on the "A" share market.

CHALLENGES AND OPPORTUNITIES

机会与挑战并存

Power Prices:

Elimination of preferential power tariffs for large users of power (e.g. the aluminum industry). {Notice Concerning Relevant Questions on Further Implementing Differential Power Pricing Policies}, issued by the NDRC and the State Power Supervisory Commission.

The dilemma for Beijing is how to increase natural gas, oil and electricity prices to reflect actual supply and demand without causing a more pronounced increase in inflation in China: in November 2007 Sinopec raised natural gas prices by 50% for industrial users in accordance with a directive of the NDRC; this was the first increase in natural gas prices since 2005. One of the significant goal of the {11th Five Year Plan for Energy Development} which was issued by the NDRC in mid January 2008 is the rationalization of crude oil pricing.

天高皇帝远 Problem:

CHALLENGES AND OPPORTUNITIES

机会与挑战并存

Rationalizing the Administration of Energy and Environmental Policy:
The {Energy Law} (Discussion Draft) which was released by the State Energy Office on December 3, 2007 anticipates the creation of an Energy Bureau to rationalize energy policy making. Presently energy policy making is widely dispersed within the National Development and Reform Commission, the Commission on State Owned Assets, the Department of State Owned Lands, the Water Conservancy Department, the Electric Power Regulatory Commission and such SOE as Petro China, Sinopec, the China National Offshore Oil Company, the Shenhua Group and the State Electric Grid.

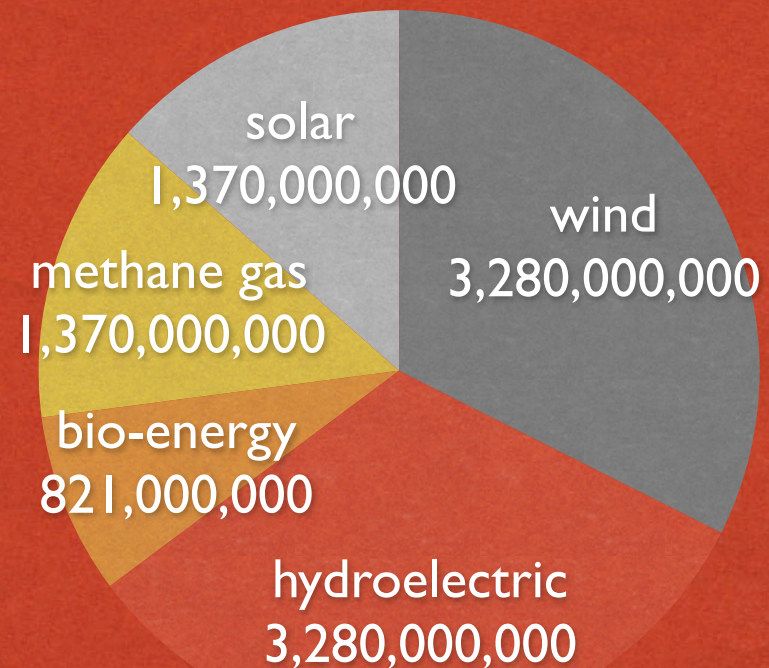
CHINA'S PROJECTED INVESTMENT IN POWER

Between 2005 and 2030 China will account for 23% of the world's investment in power, spending \$1.2 trillion U.S.

INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY IN 2007

A report issued by the National Industry and Commerce Joint New Energy Business Association estimates that investment in China's new energy and renewable energy industries in 2007 totaled 76 billion Yuan (~\$10.4 billion U.S.).

In 2007 an estimated 24 billion Yuan (~\$3.28 billion U.S.) was invested in China's wind power industry; 24 billion Yuan (~\$3.28 billion U.S.) was invested in China's hydropower industry; 6 billion Yuan (~\$821 million U.S.) was invested in China's bio-energy industry; 10 billion Yuan (~\$1.37 billion U.S.) was invested in methane gas development and 10 billion Yuan (~\$1.37 billion U.S.) was invested in China's solar industry.



INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: INVESTMENTS MADE BY BEIJING

Beijing plans to invest ~\$263 billion U.S.D. through 2020 to foster the development of sources of renewable energy

According to the {11th Five Year Plan for Environmental Protection}, which was issued by the State Administration for Environmental Protection, China will spend 1.35% of its GDP to invest in environmental protection measures.

BUILDING A LEGAL SYSTEM TO FOSTER RENEWABLE ENERGY DEVELOPMENT IN CHINA

[《能源法》意见稿全文\(三\)](#)

[《能源法》意见稿全文\(二\)](#)

[《能源法》意见稿全文\(一\)](#)

[中华人民共和国节约能源法](#)

[电网企业全额收购可再生能源电量监管办法](#)

[中华人民共和国清洁生产促进法](#)

[可再生能源发电有关管理规定](#)

[可再生能源发电价格和费用分摊管理试行办法](#)

[中华人民共和国节约能源法](#)

[中华人民共和国可再生能源法](#)

[节能发电调度办法（试行）](#)

[关于有序开发小水电切实保护生态环境的通知](#)

[煤炭工业部节约能源监测管理办法](#)

[发改委：我国将出台可再生能源税收优惠政策](#)

[可再生能源中长期发展规划\(五\)](#)

[可再生能源中长期发展规划\(四\)](#)

[可再生能源中长期发展规划\(三\)](#)

[可再生能源中长期发展规划\(二\)](#)

[可再生能源中长期发展规划\(一\)](#)

INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: FOREIGN PARTICIPATION

Beijing estimates that China's renewable energy sector will attract ~\$700 million U.S.D. in foreign investment in 2008 and that by 2010 foreign investment in China's renewable energy industries will grow to \$2 billion U.S.D./year.

USING LAW AND POLICY TO FOSTER RENEWABLE ENERGY DEVELOPMENT

- Financial Incentives

- Tax subsidies and rebates (likelihood that Beijing will soon formulate regulations which provide preferential tax rates for enterprise income taxes for renewable energy enterprises and reduced import duties for imported renewable energy machinery and equipment)
- Subsidies (e.g. Shandong Province Village Renewable Energy Regulations, which took effect on 1/1/08 have governments at the county level and up in Shandong incorporating into their budgets funds to support renewable energy construction in farming villages). (e.g. in October 2007 the NDRC and the State Electricity Regulatory Commission issued the {Notice Concerning Year 2006 Renewable Energy Price Subsidies and Allocations} which initiates the system to distribute renewable energy costs across China's power system; in 2006 the total subsidy for renewable energy projects in China was 260 million Yuan (~\$36 million U.S.).
- Lower VAT rates for renewable energy businesses (likelihood that VAT for wind and small hydroelectric projects will be reduced to 6% and that a similar policy will be put in place for solar) and higher export tariffs on products which were produced in energy intensive industries.
- Specialized funds to defray costs in setting up a renewable energy enterprise.

INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: INVESTMENT BY CHINESE COMPANIES

The China National Petroleum Corporation (CNPC) is expected to invest 10 billion Yuan (~\$1.4 billion U.S.) to develop new energy resources, including coal-bed methane, geothermal power, oil shale and wind power.

USING LAW AND POLICY TO FOSTER RENEWABLE ENERGY DEVELOPMENT

- Better Enforcement:
- Coupling of Renewable Energy Projects with Coal-Fired Power Plant to obtain Approval
- Clean Energy Incentives:
 - Asia's First Carbon Exchange in Beijing is a joint effort of the UN, the Ministry of Science and Technology and the Ministry of Commerce

INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: FOREIGN PARTICIPATION

International Participation in China's Wind Power Industry

Vestas Wind Systems AS (Denmark)

Xantrex Technology, Inc. (Canada)

Windtec GmbH (Austria)

Gamesa Technologica SA (Spain)

Honiton Energy Ltd. (UK)

REpower Systems AG (Germany)

Electric Power Development Co., Ltd (Japan)

Acciona, SA, Inceisa (Spain)

International Participation in China's Bio-Energy Industry

Daiki Axis Co., Ltd. (Japan)

Keppel Integrated Engineering (Singapore)

Biosphere Development Corp. (US)

USING LAW AND POLICY TO FOSTER RENEWABLE ENERGY DEVELOPMENT

- **Mandatory Implementation:**
 - **Compulsory installation of solar hot water heaters** (e.g. the Implementing Opinion on Energy Conservation and Emissions Reduction in the city of Lianyungang, which took effect on 1/1/08, require the design and installation of solar hot water systems in all residential buildings up to 12 stories high and new construction and renovations or expansions of hotels, restaurants and commercial buildings.)
 - **Industry Permitting Standards** (e.g. the aluminum industry). Effectively mandates energy efficiency standards for new construction of industrial projects.
 - **Renewable Portfolio Standards** (ie., requiring utilities to purchase renewable energy)
 - **Requirement that power transmission companies must provide access to the grid for energy generated from renewable sources.**

INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: FOREIGN PARTICIPATION

International Participation in China's Hydropower Industry

Alstom SA (France)

EnterpriseAsia plc (UK)

General Electric Co. (US)

Toshiba Corp. (Japan)

International Participation in China's Solar Industry

PV Enterprises Sweden AB

Renewable Energy Corp. ASA (Norway)

GT Solar Inc. (US)

Conergy AG (Germany)

Canadian Solar, Inc. (Canada)

United Solar Ovonic Corp. (US)

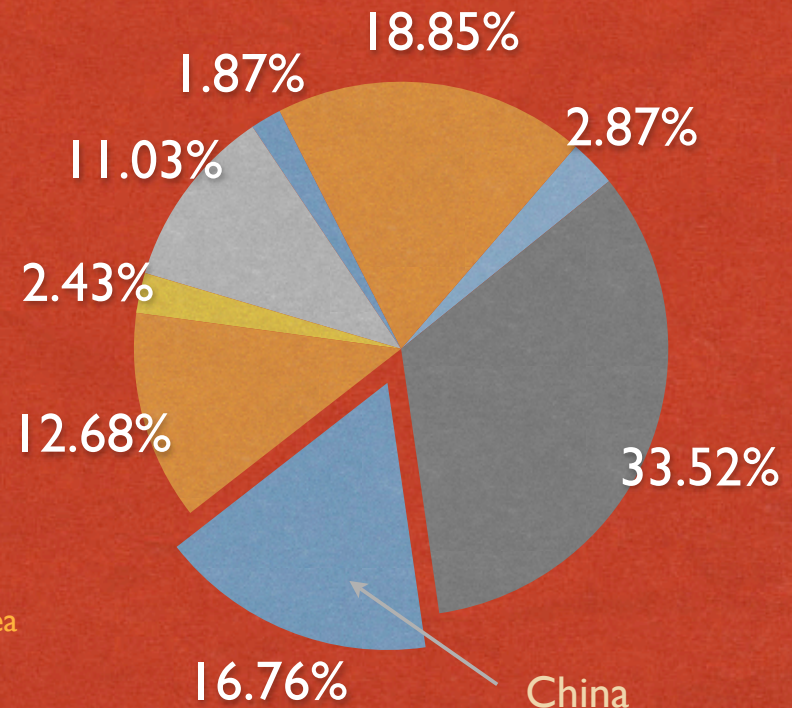
BP Solar (UK)

INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: CDM INVESTMENTS

Registered CDM Projects by Host Country
Total: 907

As of January 2008 the Executive Board of the UNFCCC had registered 148 Chinese CDM Projects

Second only to India's 303 registered CDM projects.



- India
- China
- Brazil
- Chile
- Mexico
- Republic of Korea
- Others
- Malaysia

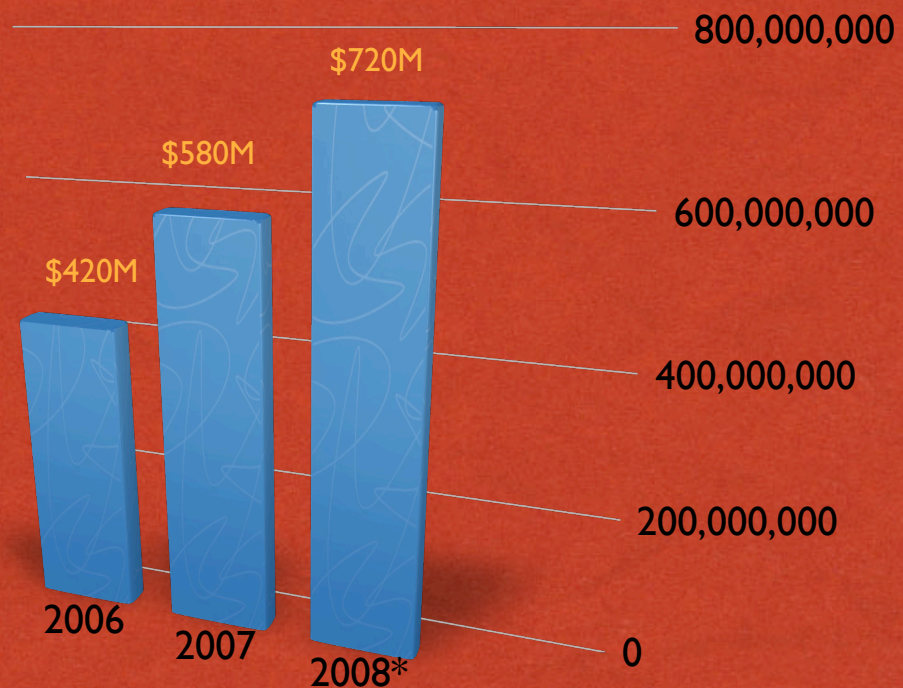
INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: VENTURE CAPITAL

Seventy percent of venture capital investments have been in solar.

One of the largest venture capital deals in China was the \$82 million investment by Goldman Sachs in Jiangsu Sunda, the solar module manufacturer.

There were a total of 26 cleantech deals in 2006, 147% greater than 2005.

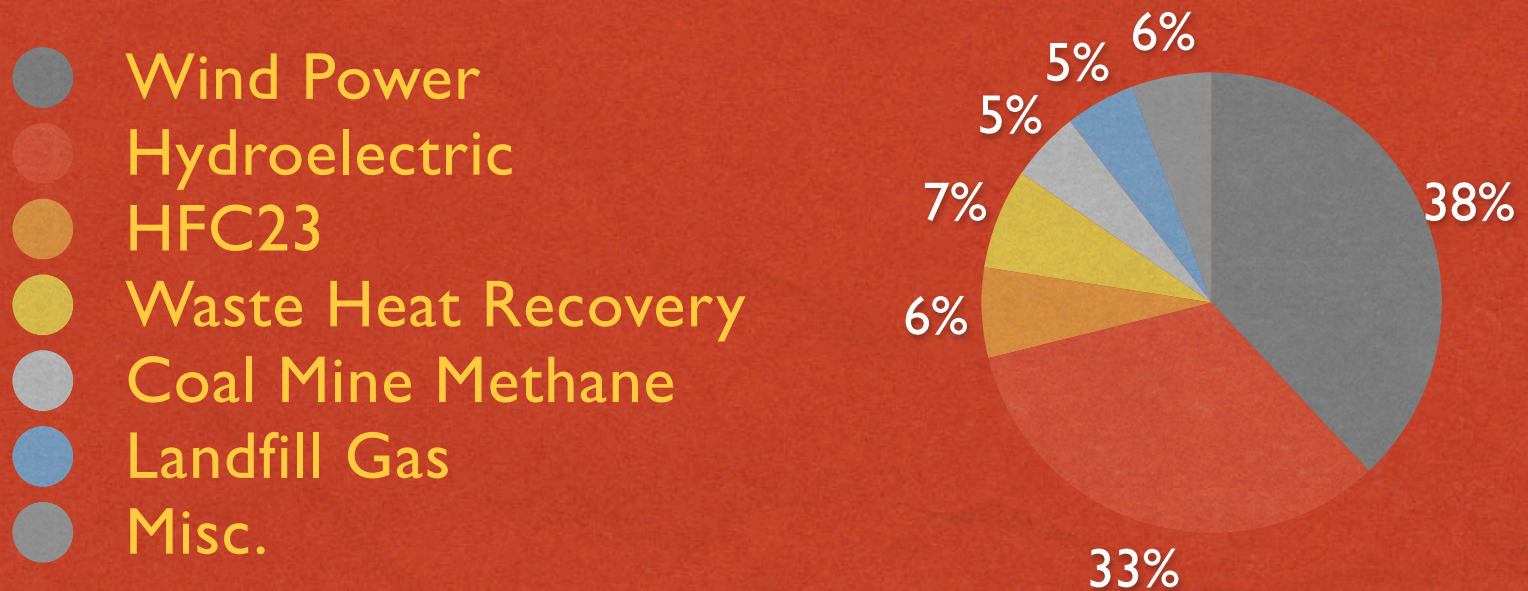
■ Venture Capital Investment in Clean Technologies (\$)



*projected

INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: CDM INVESTMENTS

Distribution of Chinese CDM Projects Among Renewable Sectors (as of 1/08)

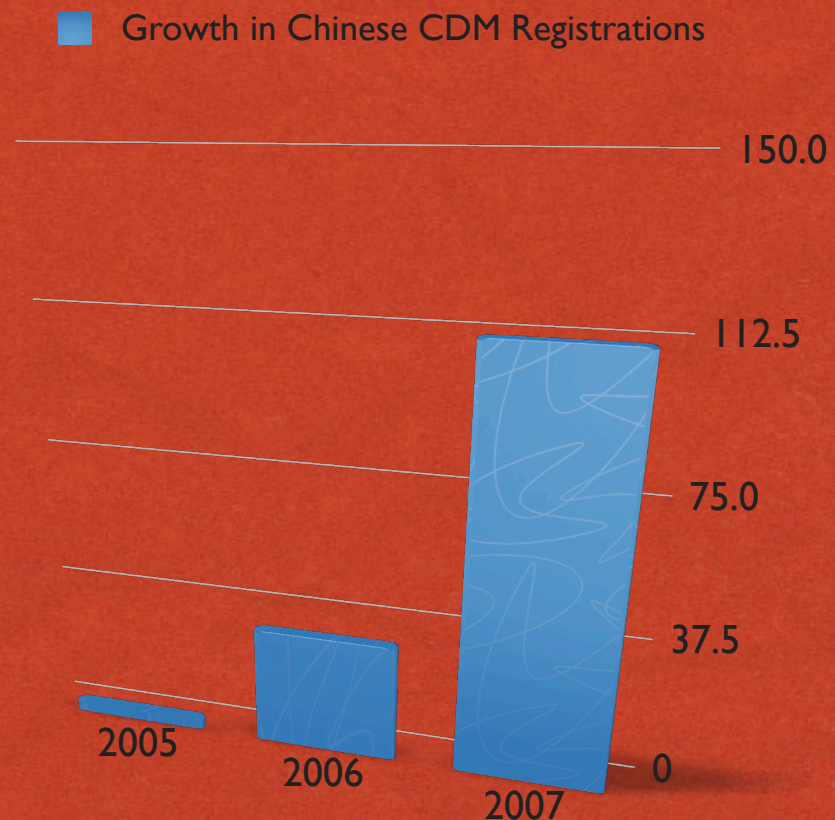


INVESTMENT IN CHINA'S RENEWABLE ENERGY INDUSTRY: CDM INVESTMENTS

148 CDM Registrations through Year End 2007

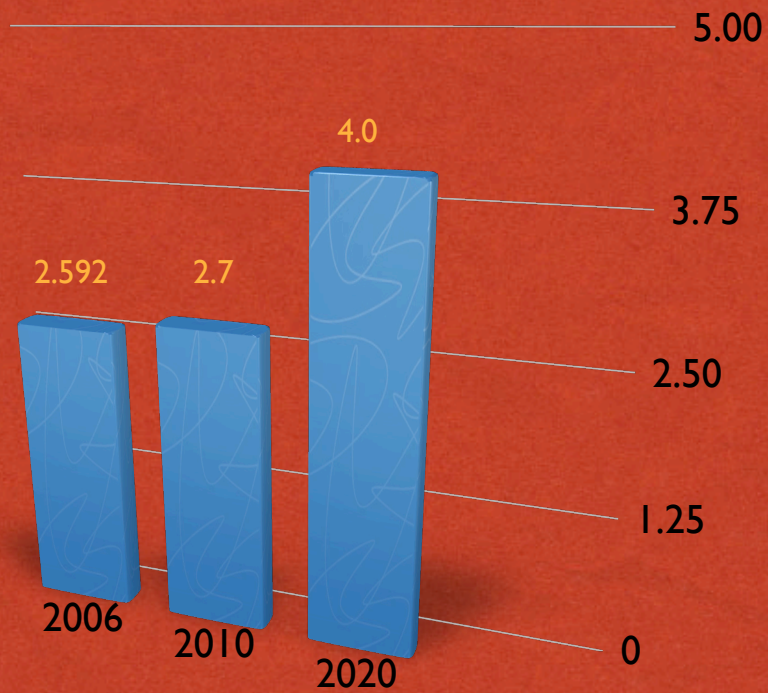
China's registered CDM projects account for ~48% of total certified emissions reductions (CERs). Each CER equals 1 MT of carbon dioxide reduction.

China's potential share of CER market (through 2012) is ~\$10 billion U.S.D.



GROWTH IN CHINA'S DEMAND FOR ENERGY

■ Total Energy Consumption (in billions of MT of coal equivalents)

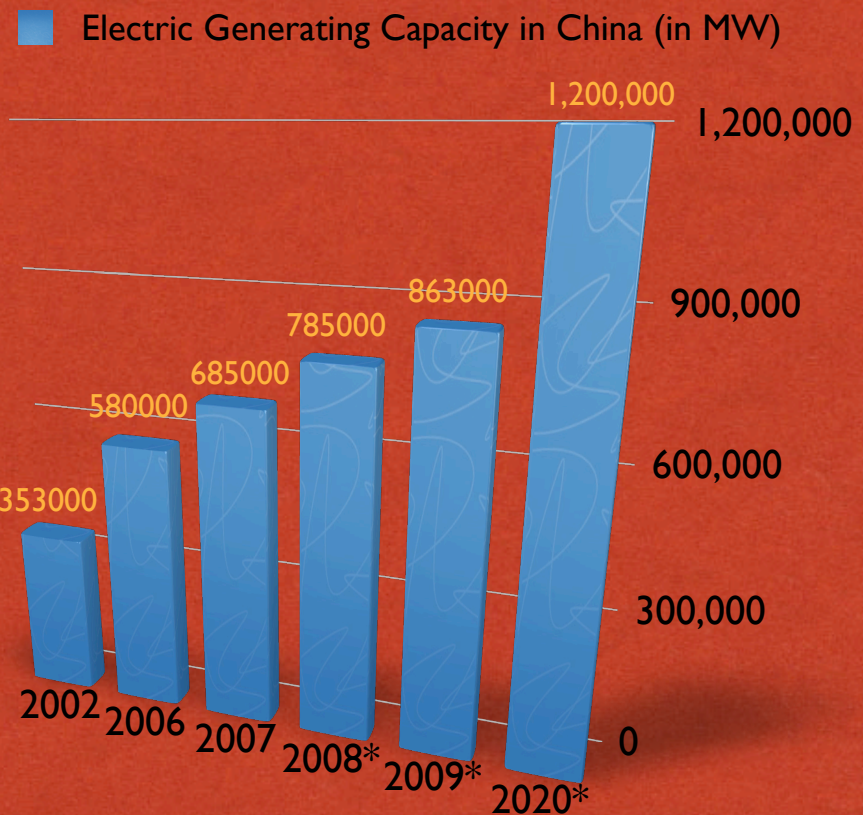


GROWTH IN OUTPUT OF ELECTRICITY IN CHINA

In 2006 power generated from coal accounted for 69% of total energy consumption in China; by 2050 coal fired power plants will account for 30% to 50% of China's energy needs.

In 2006 alone China added an additional 92,000 MW of coal-fired power plants.

In 2007 11,000 MW of the worst coal-fired power plants were closed. In 2008 another 13,000 MW of outdated capacity will be closed.



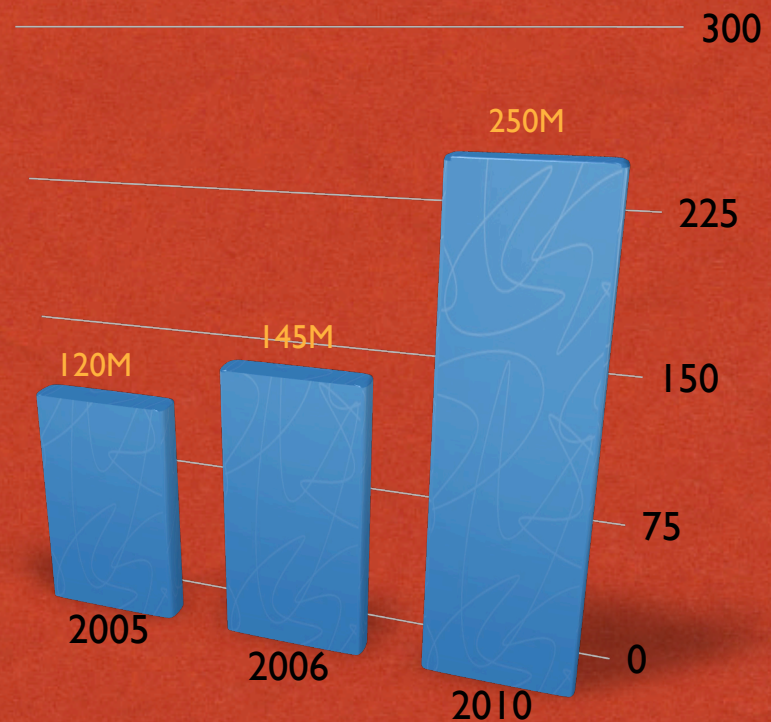
*projected

GROWTH IN IMPORTS OF OIL INTO CHINA

China produces ~180 million MT/year of crude oil.

China relies on imported oil for ~44% of its oil needs at present; by 2020 China's reliance on foreign sources of oil will rise to ~60%.

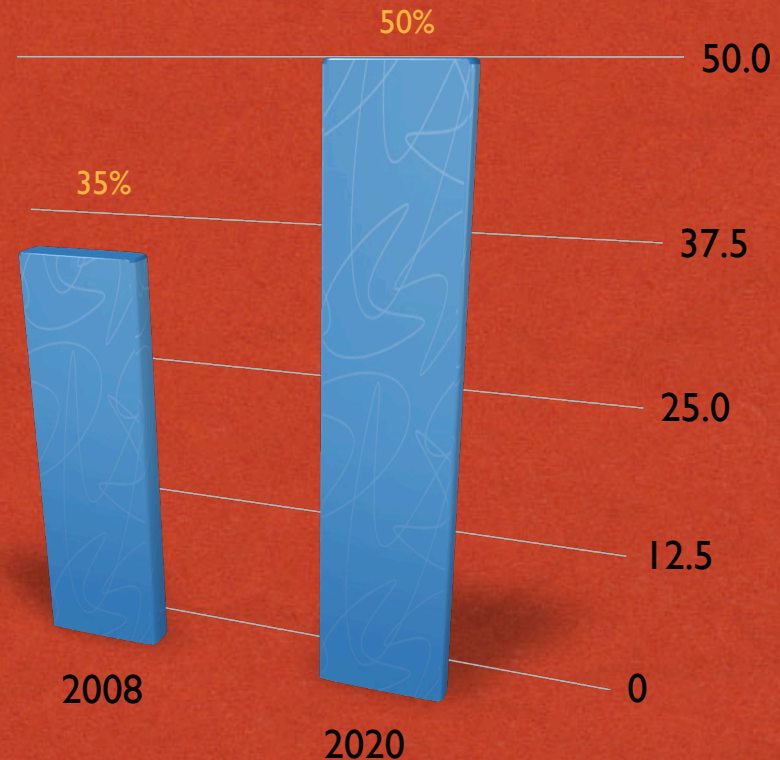
Oil Imports (millions of MT)



GROWTH IN CONSUMPTION OF OIL FOR TRANSPORTATION USES

■ Growth in Transportation's Share of Crude Oil Consumption in China (%)

In 2007 China had approximately 50 million vehicles of which total 30 million are passenger cars; anticipated growth in car ownership: 20%/year.



ENERGY CONSERVATION

China's utilization of energy is much less efficient than the U.S., France, Japan and other nations. China's consumption of energy required to produce a \$10,000 U.S. increase in GDP is 4x greater than the U.S., 7x greater than France and 14x greater than Japan.

Goal of 11th Five Year Plan Period was a cumulative reduction in energy consumption per unit of GDP of 20%; in the first year (2006) Beijing achieved a savings of only 1.4%.

On October 28, 2007 the revised {Energy Conservation Law} was passed by the NPC Standing Committee. It will take effect on April 1, 2008.

ENERGY CONSERVATION: INDUSTRY

The energy efficiency improvement efforts directed at China's 1000 largest enterprises aim to save 100 million MT of coal and 242 million MT of carbon dioxide emissions by 2010 or 5% of China's 2004 emissions.

Structural changes are needed to bring about substantial reductions in energy consumption; these must include restraining the growth of energy and resource intensive industries, such as steel, aluminum, concrete, etc.

ENERGY CONSERVATION: RESIDENTIAL AND CONSUMER

New efficiency standards for consumer appliances aim to cut residential electricity use by 10 percent in 2010 (or the equivalent of 30 large coal-fired power plants).

New energy efficiency standards for residential and public buildings aim to reduce energy consumption in new buildings by 65% in the four directly administered cities in China.

Beijing intends to renovate 25% of existing residential and public buildings in large cities (15% in medium-sized cities and 10% in small cities) and gradually implement new energy efficiency standards for existing buildings. China's buildings on average consume 2x to 3x as much power as comparable buildings in other countries in comparable climates.

State Council issued a decree in 2007 prohibiting thermostats from being set below 26 degrees C (78 degrees F) in summer or above 20 degrees C (68 degrees F) in winter.

China's automotive fuel economy standards are more stringent than those in the U.S., but less than auto efficiency standards in Europe. China projects that average fuel economy standards will be 36.7%.