

Prospects and Impacts of Biofuel Development in China

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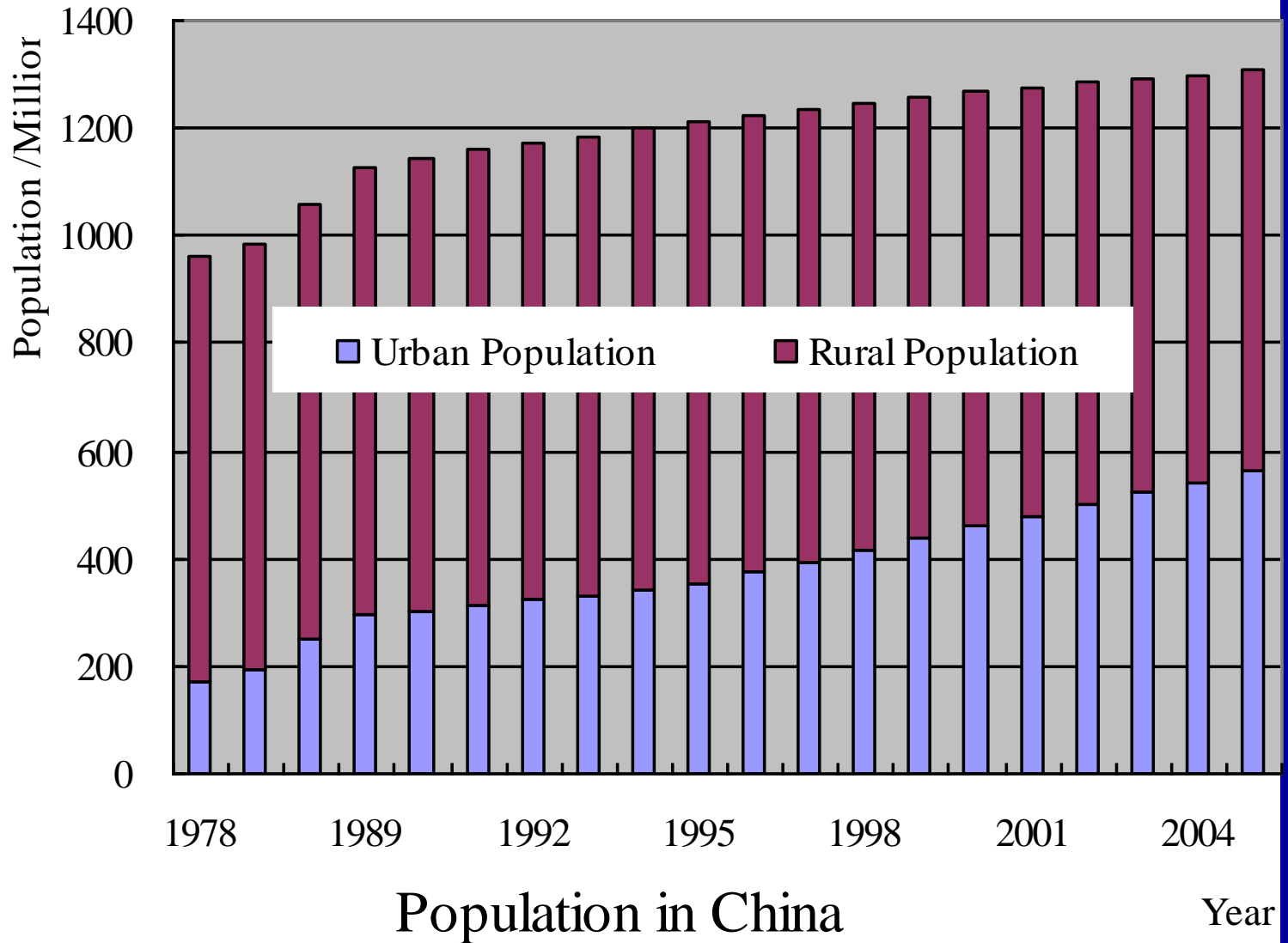
Energy Status in China

- **Energy demand increase with rapid economy development**

Energy needs rose 47% since 2000 and will rise at 3-5% annually between 2005-2020 with quadrupling of 2000's GDP in 2020.

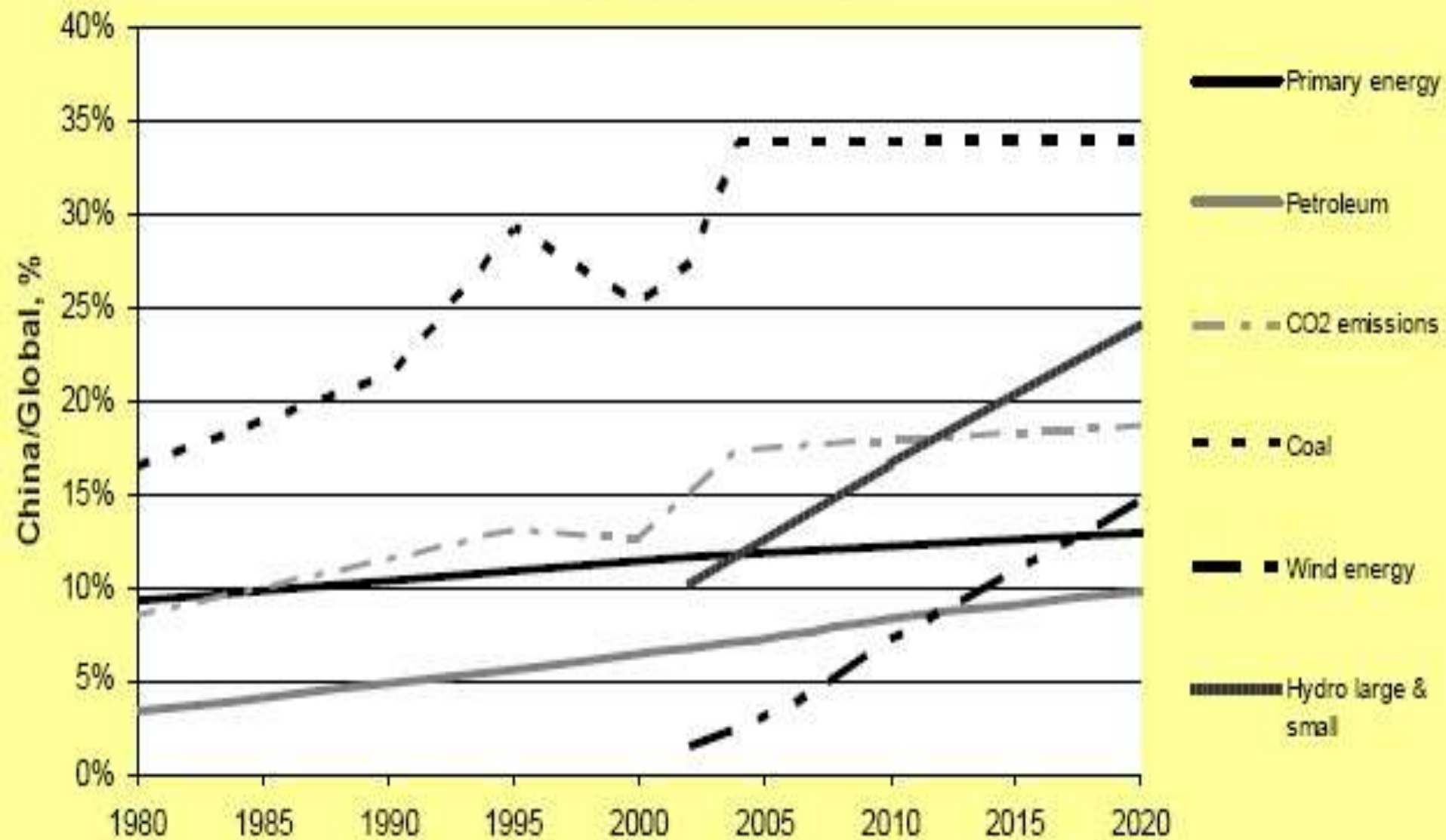
- **Second largest consumer of primary energy
~1429 Million TCE (Ton of standard Coal Equivalent)**
 - **Second largest importer of oil
about 40% and 50% in 2004 and 2006**
-

Population in China



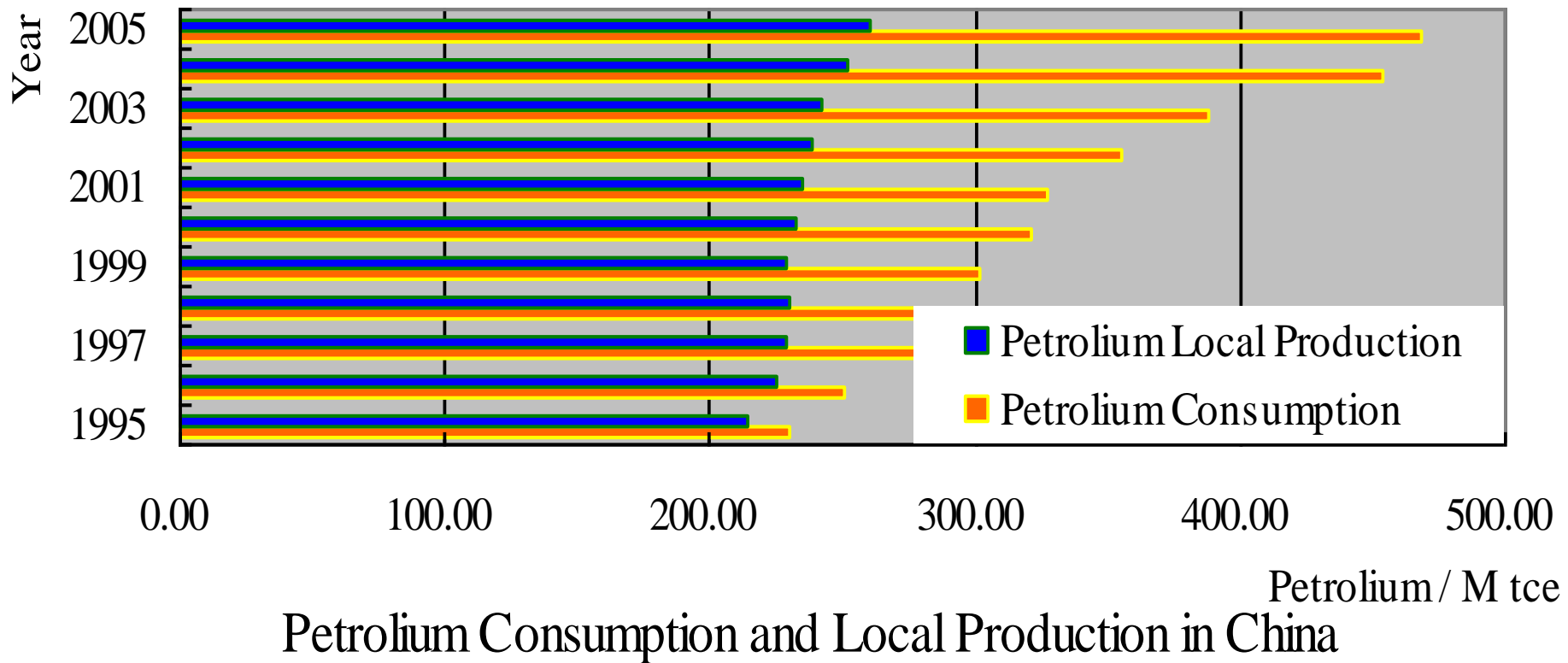


China's Share of Energy Consumption & CO2 Emissions (China / World)



Source: International Energy Agency (WEO 2002), Azure International

Liquid Fuels Shortage



Prediction of Available Energy Reservation in China

	Coal	Petroleum
Available reservation	114.5-189.2 B tons	15 B tons
Years affording	60-100 years	until year 2040

* Predicted at the energy consumption rate of 2004.

** Reference: Gansheng Wang, 2005

Renewable Energy Law in China in 2007

中华人民共和国主席令

中华人民共和国可再生能源法

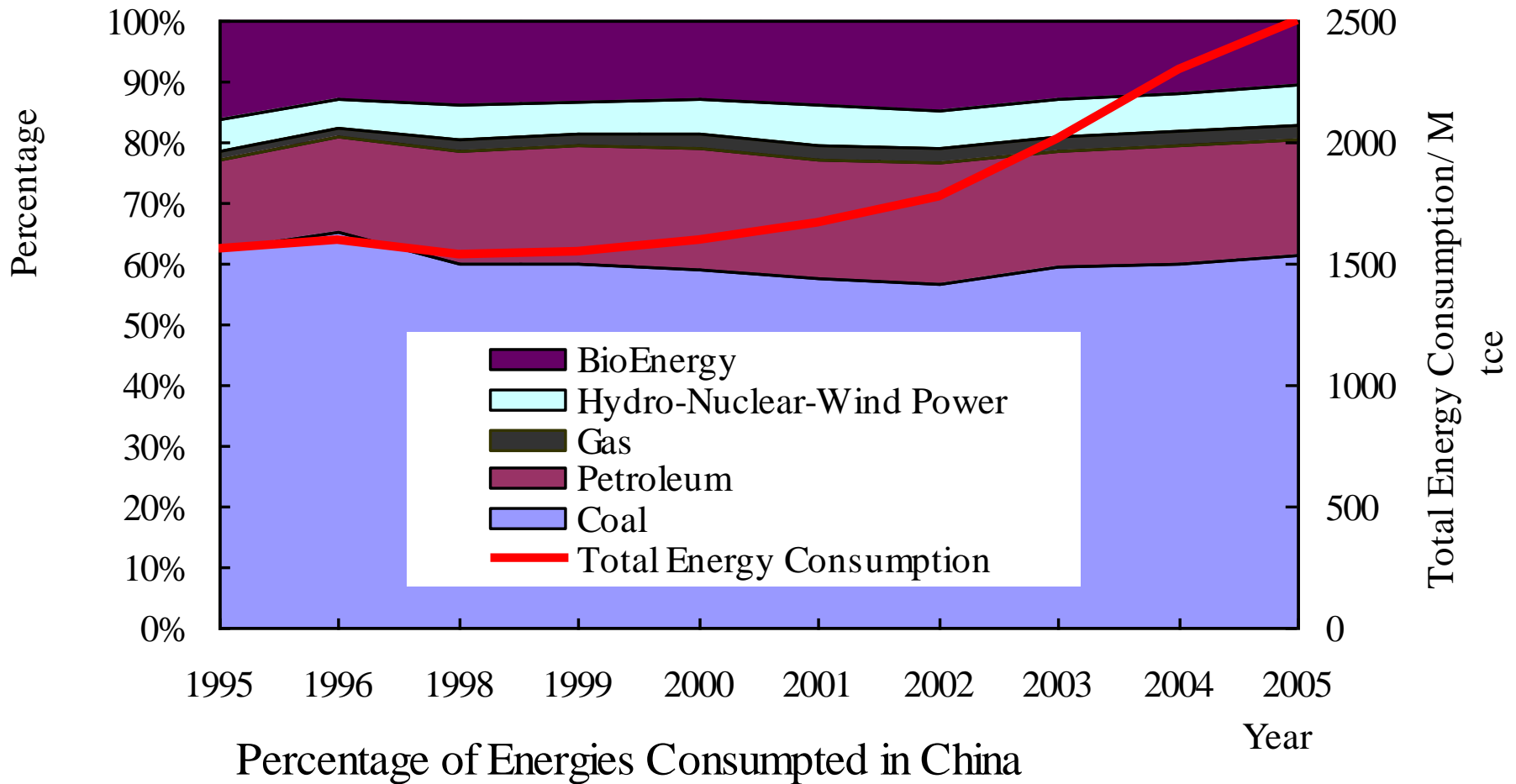
第十六条 国家鼓励清洁、高效地开发利用生物质燃料，鼓励发展能源作物。利用生物质资源生产的燃气和热力，符合城市燃气管网、热力管网的入网技术标准的，经营燃气管网、热力管网的企业应当接收其入网。

国家鼓励生产和利用生物液体燃料。石油销售企业应当按照国务院能源主管部门或者省级人民政府的规定，将符合国家标准生物液体燃料纳入其燃料销售体系。

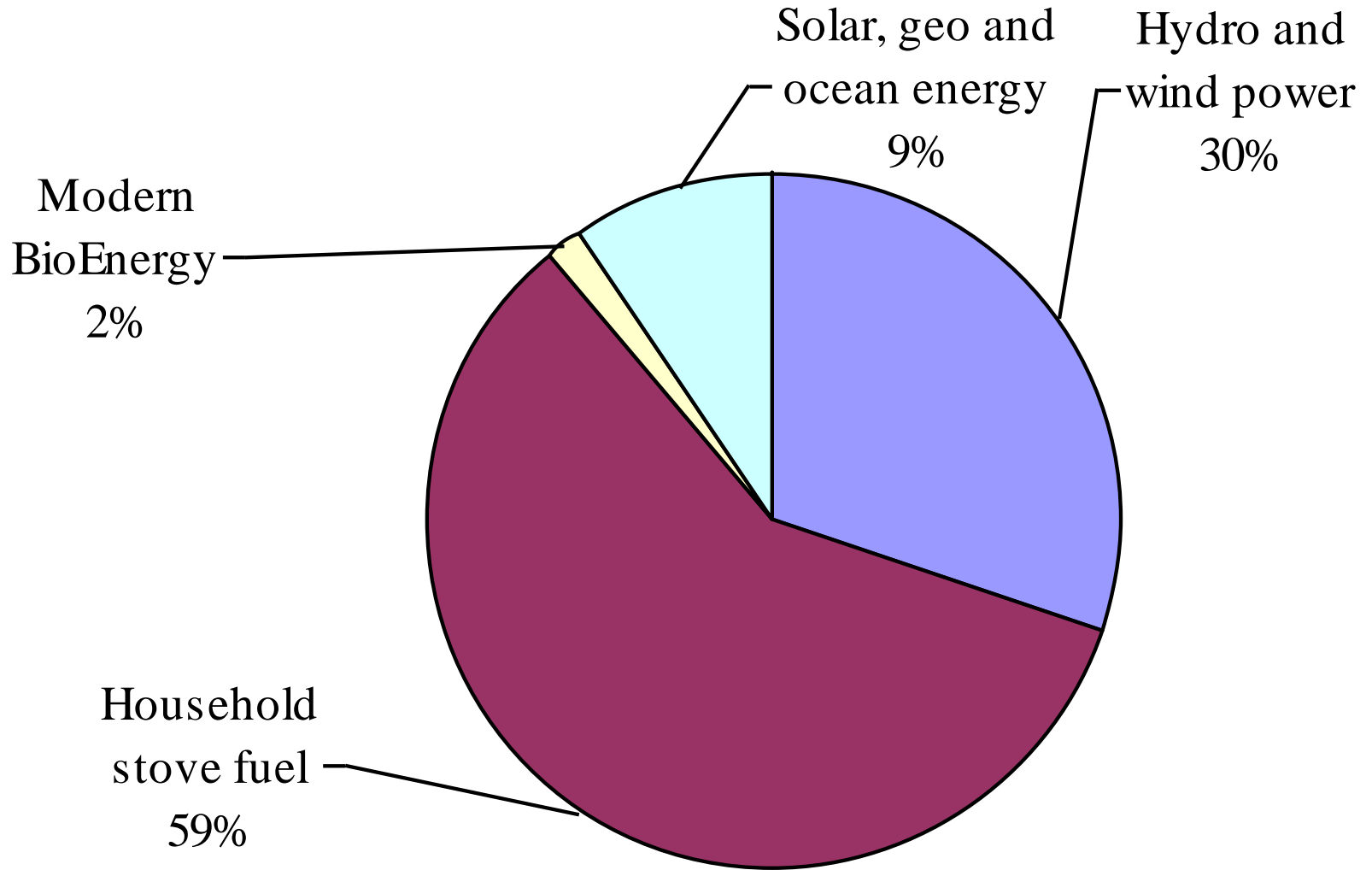
The government encourages clean and high efficient utilization of Bioenergy and the development of energy crops.....

The government encourages the application of liquid biofuels,will permit the liquid biofuels, which reach the national fuel standards, into fuels market.

Total Energy Consumption in China



Bioenergy in Renewable Energy

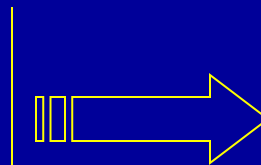


Renewable Energy Structure in China in Recent Years

Bioenergy Approaches in China

➤ Direct combustion

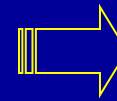
stove combustion
boilers/burners
Briquetting
garbage combustion



Heat
Electricity
Solid Fuel Products

➤ Physical conversion technology

wood carbonization
Gasification by hydrogenation
oil by hydrogenation (BTL)



Charcoal
Liquid Biofuels
Gas Fuel Products

➤ Chemical conversion technology

landfill and composting
biogas fermentation
ethanol technology
oil from energy-plants

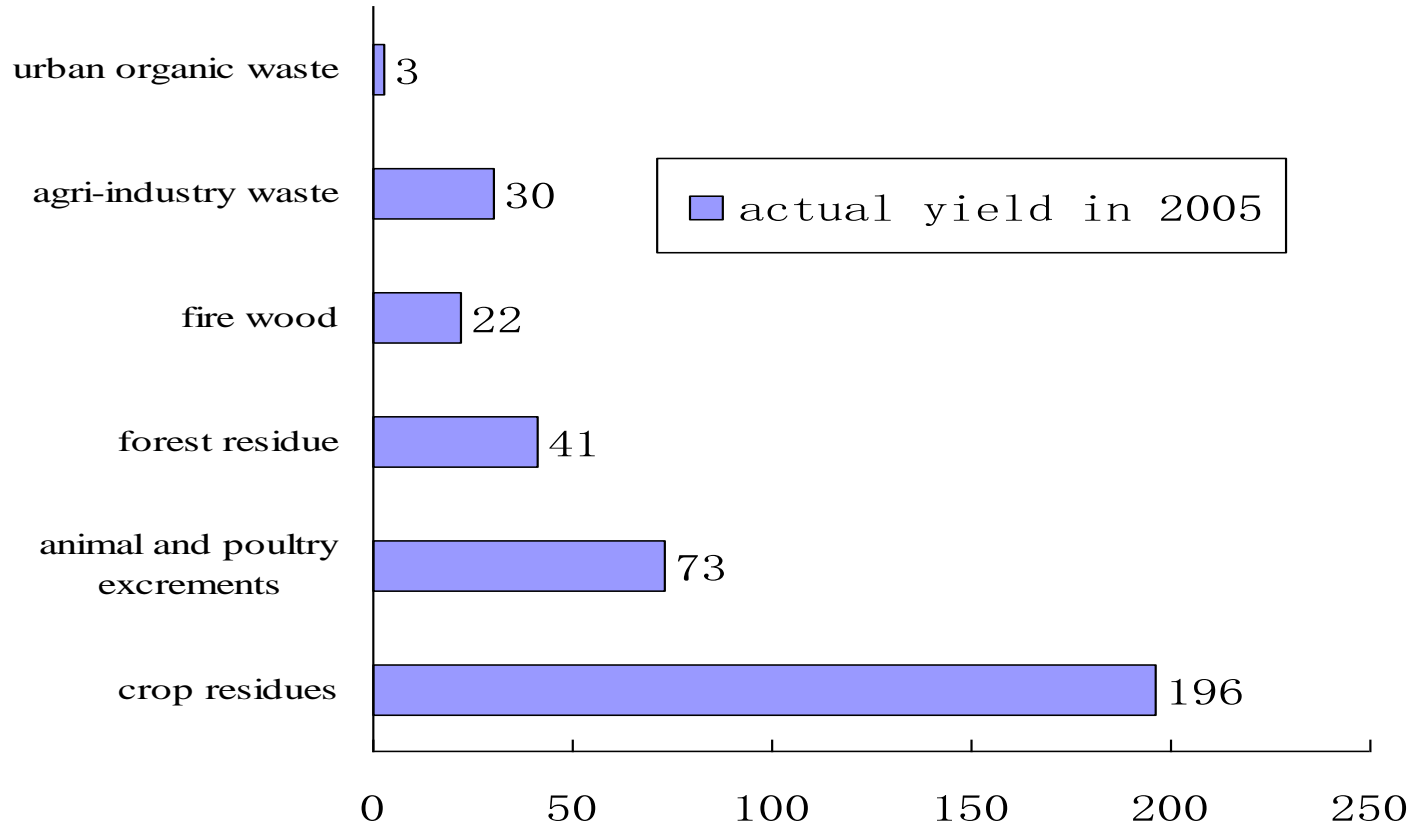


Biogas
Liquid Biofuels

Resources for Bioenergy Production

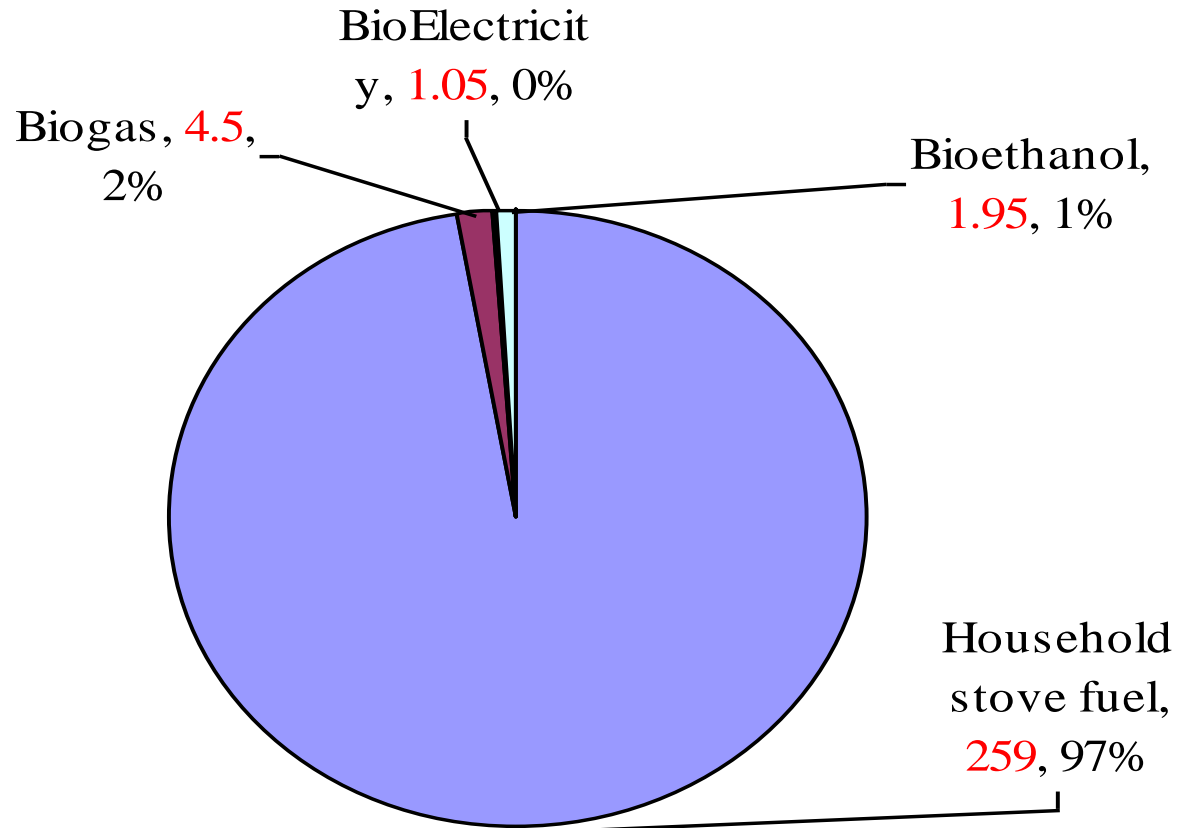
- **Unused organic existence from agricultural, forest and industrial sectors:**
 - crop residues/stalks**
 - animal manure**
 - organic waste from processing industries**
 - wood processing wastes**
- **Energy crops**
 - fire woods**
 - biofuel plants**
- **Municipal solid waste (MSW)**

Biomass Materials (Energy Crops Excluded), M tce



Total Amount: 365 M tce

Bioenergy Structure (Mtce) in 2006



Approach 1: Direct Combustion

Household Stoves
Gasification

Direct Combustion for Electricity



Pellets from plant residues



Biomass Gasification

China's first BioPower plant in Shandong in 2007



Peanut shells

- **Installed Capacity: 25 MW**
- **500 tons of stalks consumed per day**
- **Farmers get 5 M USD per year**
- **CO2 Emission Reduction: 100 K tons annually**

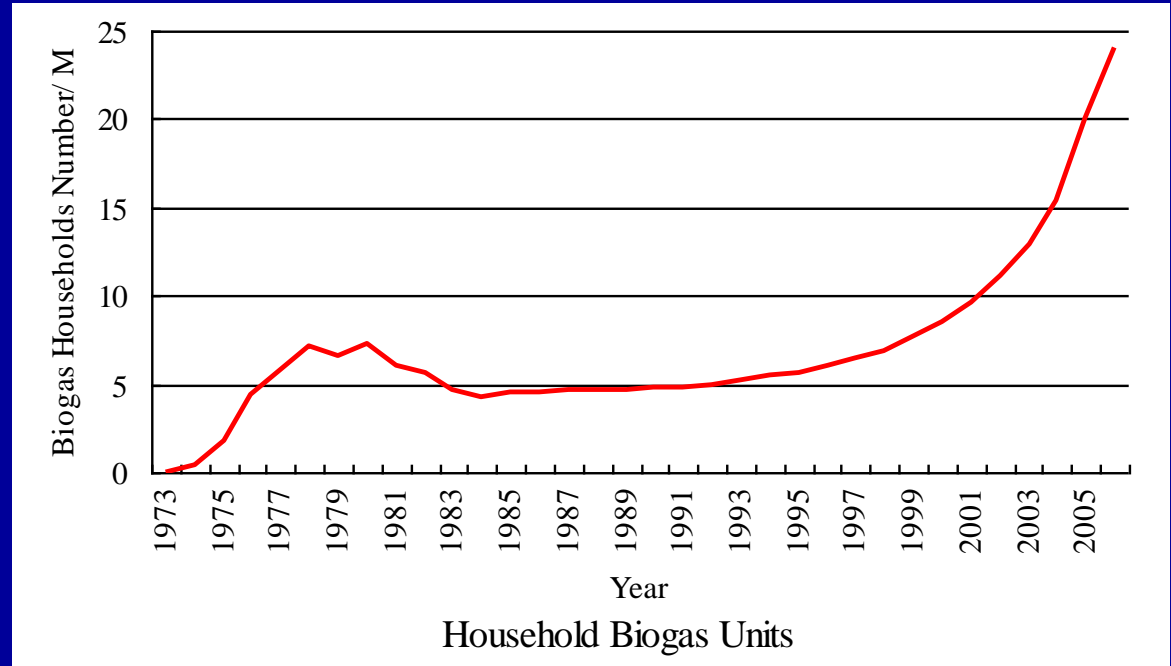


Mixed fuels

100 % of crop straw

Mixture of coal (as high as 20%) and crop straw

Approach 2: Biogas



Year **Household's Biogas Number**

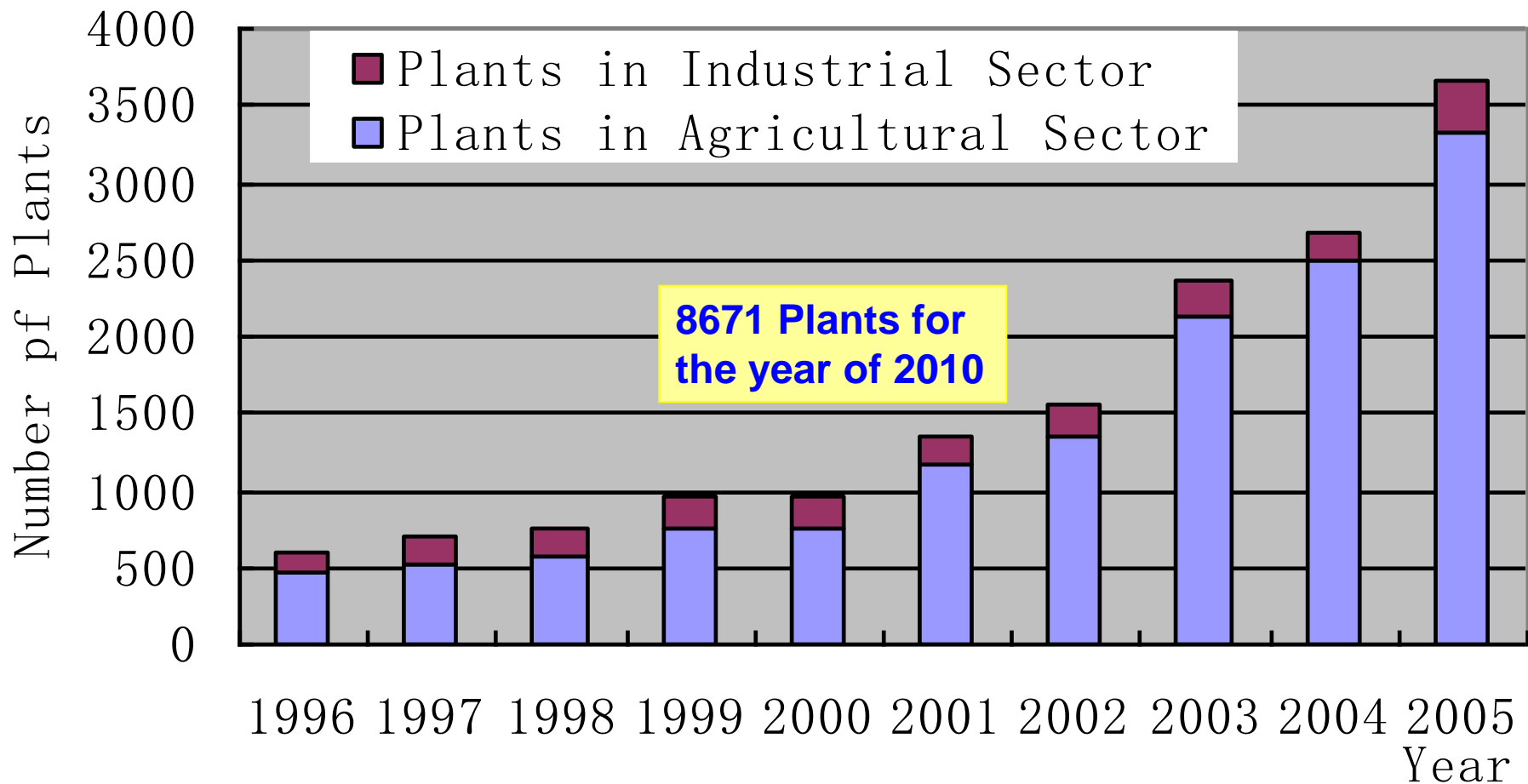
2004 **15.41 million**

2010 **27.37 million**

Potential households for biogas utilization: 146 million

Total Households in rural area: 254.05 million

Large and Medium Biogas Plants in China



Large and Medium Biogas Plants in China

Approach 3, Liquid Biofuels: ethanol, Diesel

1986-Bioethanol technologies available

1999-Four ethanol factories approved

2001-Four ethanol plants built and operated

**2002-First test of blending ethanol into gasoline
(10%) in Henan and Heilongjiang**

**2003-Use of blending gasoline in Anhui, Henan,
Heilongjiang, Jilin, Liaoning; and some
cities in Hubei, Jiangsu and Shandong**

**2003-18% of total gasoline (10 M tons of E10)
consumption in China**

Actions for Promoting New Bioenergy

- **2003-2004, Former president of China Agricultural University first proposed to Government to invest in new bioenergy R&D**
- **2004, New bioenergy R&D was listed in the National Long and Medium S&T Plan**
- **2005, National Renewable Energy Development Strategy**
- **2006 Long and Medium Renewable Energy Develop Strategy**
- **2006 NDRC planning on Liquid BioFuels, Bioethanol**
- **Up to Now-About 1billion US\$ has been put into biomass energy development through Ministries of Agriculture, S&T, NDRC and Forest Bureau as well as SEPA**

Bioethanol Production

The four plants were designed initially for outdated grains consumption.

1 M ethanol production capacity



Jin Yu Inc., Heilongjiang Province, built in 1996, corn-based, 100,000 t/y

Jilin Fuel Ethanol Co., built in 2001, corn-based, 600,000 t/y

Henan Tian Guan Fuel-Ethanol Co., built in 2004, wheat-based, 200,000 t/y

Fengyuan Group, Anhui Province, built in 2005, corn-based, 320,000 t/y

Biodiesel Production

➤ Still very limited in China in 2006

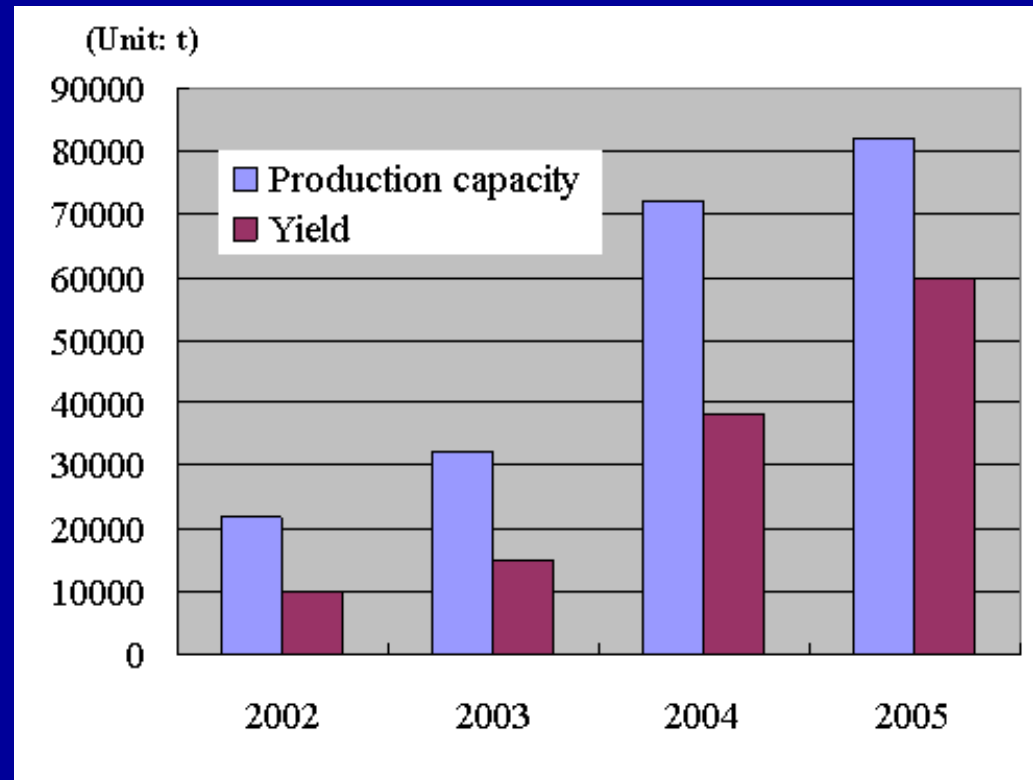
20 small plants; 500 Kton/y

➤ Materials

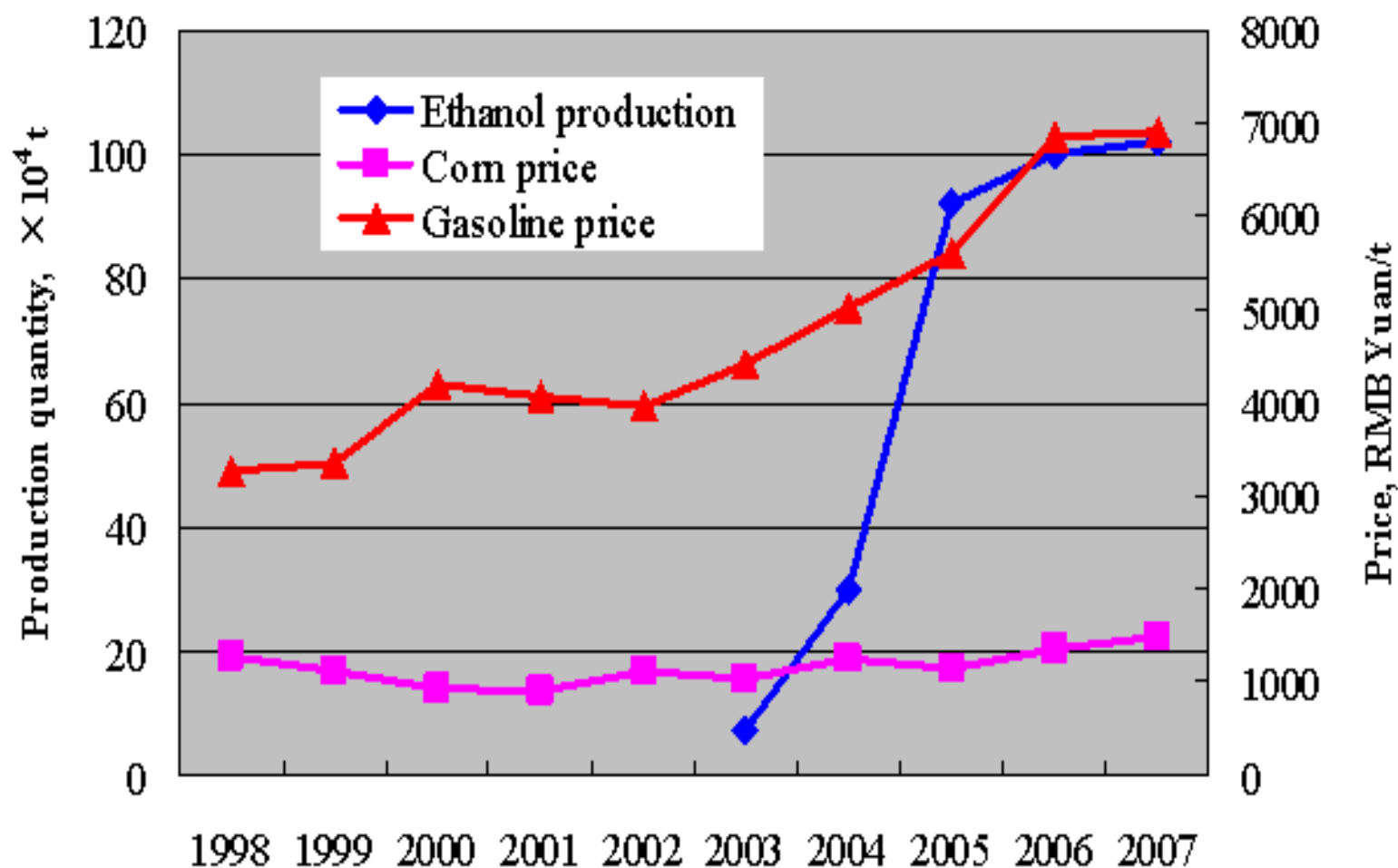
edible oil mostly
some mixed with
waste edible oil
acidified oil
oil bottoms

➤ Leading companies

COFCO
Sinopec
PetroChina



Impact on Corn Price with the Production of Bioethanol



Soybean: Import and Export in China, 1983 to 2006

10,000 ton

3000

2500

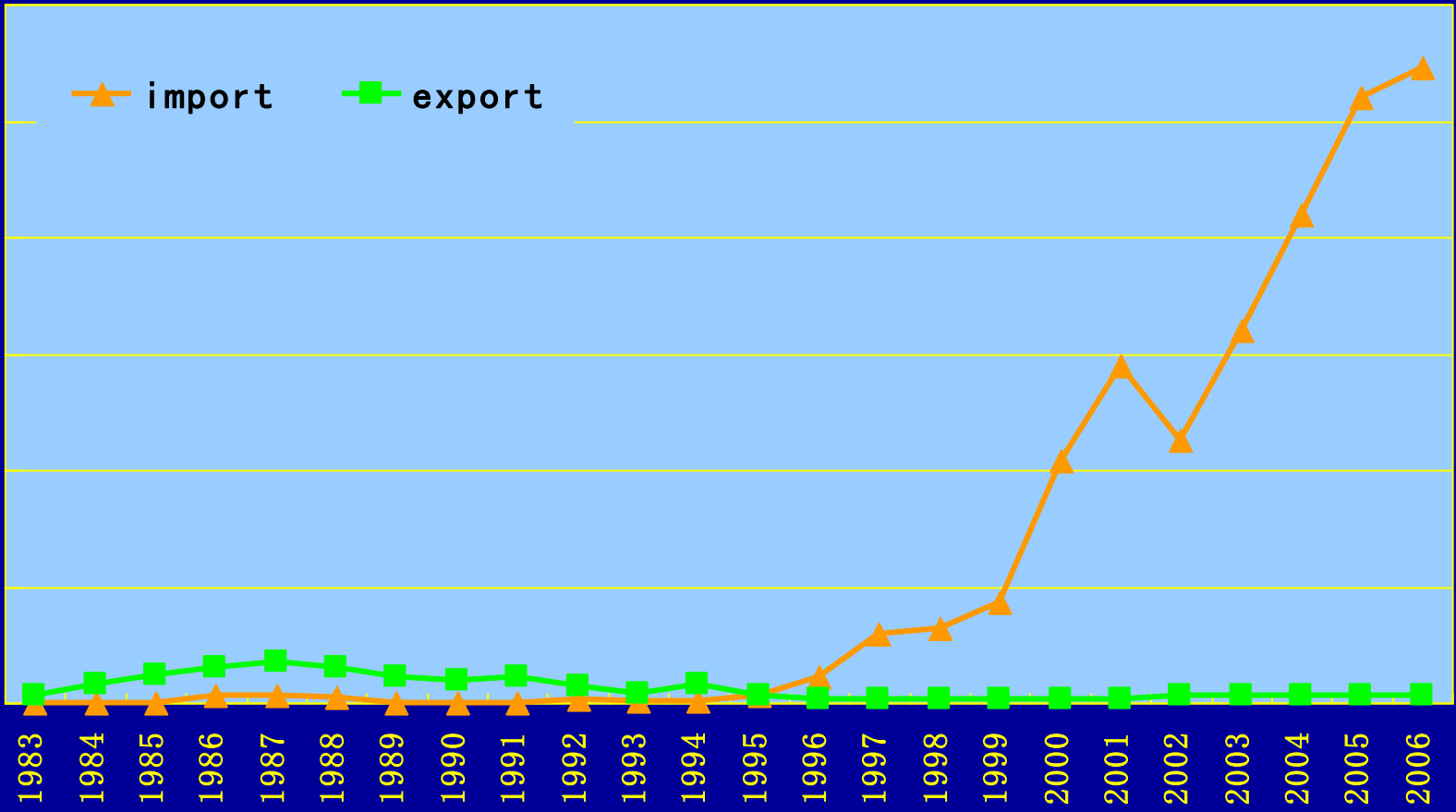
2000

1500

1000

500

0



Import: 28 million ton from USA, Brazil and Argentina

in 2006. China produced only 15.5 million tons

8.26 million ton ordered from USA in May this year

New Policy on Bioenergy Production

No competition with food for people
No competition with land for crops

New producers: Non-food feedstocks
Current producers: Switch to non-food feedstocks
Cellulose biomass-to-liquids (BTL)

New Factory of Bioethanol Production

China Resources Alcohol Co., Hebei Province, built in 2007, sweet potato, corn-based, 230,000 t/y



COFCO:
1 M ton/y non-grain based ethanol in southern China
Cooperating with Thai and Myanmar



COFCO partnering with Sinopec built cassava-based plant in 2007. 110 K ton/y, targeting 200 K ton/y

Regions for Biofuels Materials

Corn



Sugar cane

Cassava

Sweet sorghum



Regions for Sugar Cane

Sugar Cane: 6-8 tons of bioethanol per hectare, 2 times higher than corn.
Suitable for grow in south China



Corn

Sugar cane

Cassava

Sweet sorghum

Regions for Cassava

Cassava: 6-8 tons of bioethanol per hectare,
2 times higher than corn.

Suitable for grow in south China



Regions for Sweet Sorghum

Sweet Sorghum: 5-6 tons of bioethanol per hectare, 1.5 times higher than corn.
Suitable for almost whole China

Corn

Sugar cane

Cassava

Sweet sorghum



Other Biofuels Materials

Oily trees: 150 species of oily trees seeds containing 40% oil.

Jatropha and Pistacia, Cornus, etc.



Jatropha seeds(麻疯树)



Some oily trees



Fire woods: 4-5 tce productivity per hectare on 50 M hectare marginal lands available.

More Technology Required for Bioenergy

➤ Energy crops breeding

High-quality/high-yield

Region specific/environment appropriate

➤ Cellulose derived bioethanol

➤ Agricultural Engineering Innovation

Agricultural machinery systematic innovation
from field preparation to biofuels generation

LCA for biofuels production

for positive energy and environment benefit analyses

➤ Engineering for Biogas and utilization /Pellets/Gasification and power generation



Jatropha breeding in Yun'nan

Challenges of Biofuel Development in China

➤ Motivation

Technology availability
Economic value

➤ Water

➤ Plant Diversity

➤ Uncertainties

GHGs emission reduction
Positive energy generation

➤ Food/Fuel Balance

No Meals for Wheels

CAU Biomass Engineering Center (BEC)

- **2004 Biomass Engineering Center (BEC) established in China Agricultural University**
- **2004 BEC was funded with National 985 Program**
- **Four main researches**
 - National Strategy**
 - Cellulose Pretreatment for Conversion**
 - Energy Crops Breeding**
 - Biogas and Wastewater Treatment**
- **International Training Programs for renewable energy promotion in developing countries**

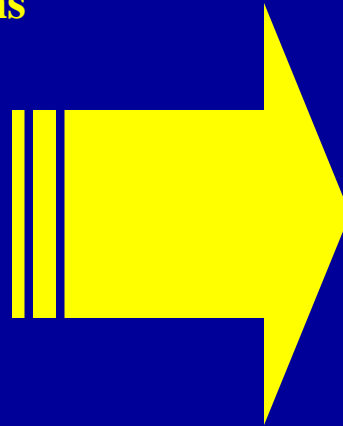
Biofuels Prospect in China

➤ Bioethanol M tons

2005	2010	2020
1.02 ¹	6	15

➤ Biodiesel M tons

2005	2010	2020
0.06 ¹		5



**15% transportation
fuel in 2020**

Investment estimated¹ between 2000-2020

biomass thermal use	bioethanol	biodiesel	biogas	B USD
27.8	5.1	1.4	1.2	

Acknowledgement

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**Thank
you**

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