

# **Development and Production of Natural Gas of China**

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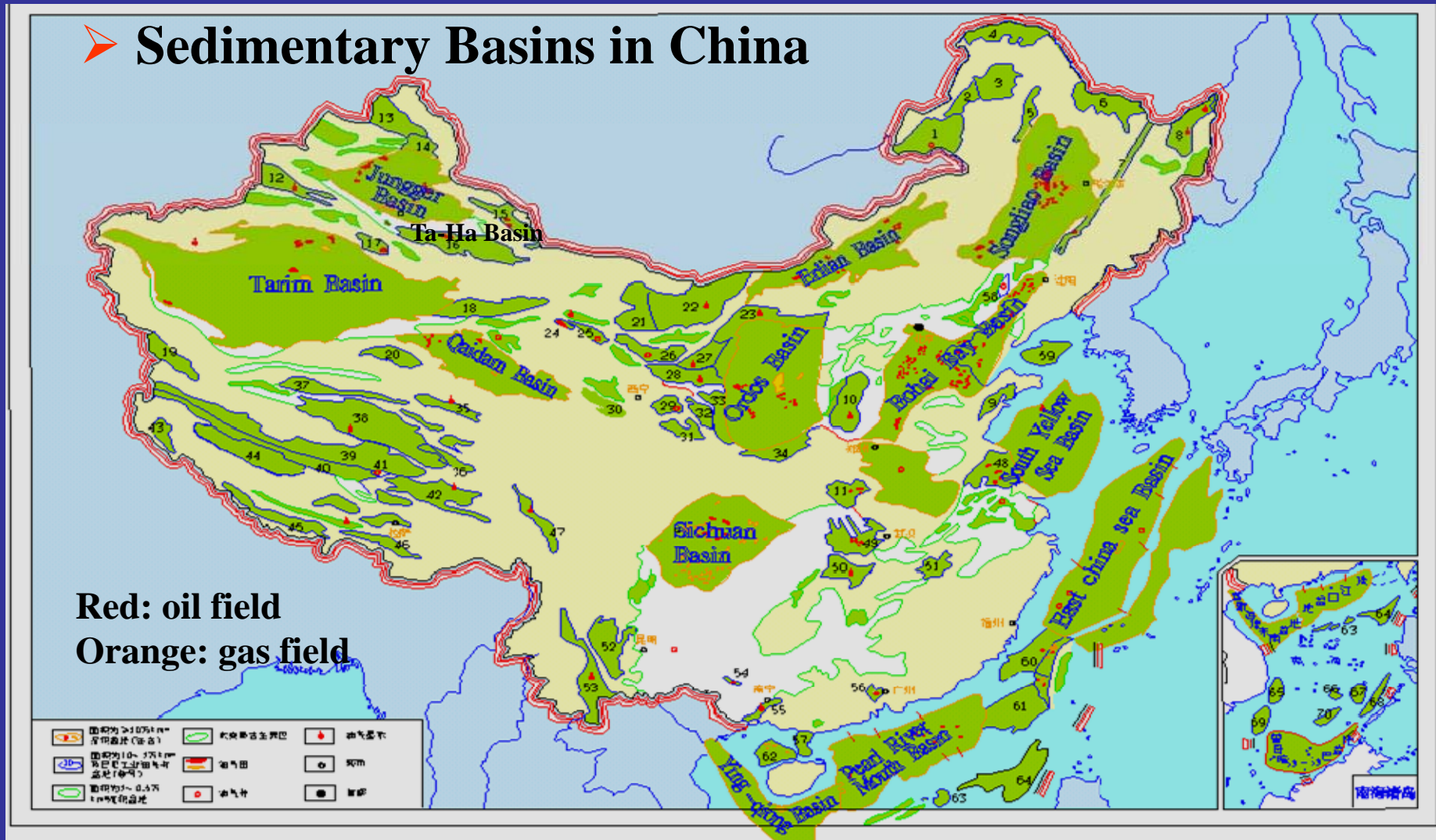
# Outlines

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- ◆ **General Overview on Geology and Resources**
- ◆ **Exploration and Development**
- ◆ **Gas Markets and Pipelines**
- ◆ **Gas Supply and Demand Scenario**
- ◆ **Issues and Challenges**
- ◆ **Recommendations**

# General Overview on Geology and Resources

## ➤ Sedimentary Basins in China



Since the first oil discovery in Ordos Basin in 1907, **over 500 oil fields** and **over 200 gas fields** have been found in China.

# General Overview on Geology and Resources

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➤ **By the end of 2006, more than 80% of gas reserves discovered in forelands and cratons, like Kuche of Tarium, Orodus and Sichuan, less than 20% in rifts and depressions.**

# General Overview on Geology and Resources

## ➤ Source Rocks

### •Coal Measure Strata

- ✓ Coal and Coal-Bearing Strata
- ✓ Over 64% of gas reserves
- ✓ mostly III kerogen and partly II kerogen
- ✓ Carboniferous-Permian, Triassic, Jurassic and Tertiary
- ✓ Sichuan basin, South China and North China

### •Non-Coal Source Rocks

- ✓ Mudstone and Shale
- ✓ II kerogen(49%) and I kerogen(23%) and III (28%)
- ✓ Neo-Proterozoic to Quaternary
- ✓ Marine dark shale (Lower Paleozoic: Cambrian and Silurian, Sichuan basin )
- ✓ Lacustrine (Mesozoic and Cenozoic: Zunger (P,T), Orodus (T), Songliao (K), Bohai bay, Jiangnan, Subei (E))

# General Overview on Geology and Resources

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## ➤ Source Rocks

### • Carbonate Rocks

- ✓ Limestone and Dolomite
- ✓ II kerogen and I kerogen
- ✓ Neo-Proterozoic to Triassic
- ✓ Sichuan basin (Z-T) and Tarium basin (Ordovician-Cambrian), South China (P-T ) and North China (P-O)

# General Overview on Geology and Resources

## ➤ Reservoir Rocks and Traps

- **Geological times:** from Sinian (Neo-Proterozoic) to Quaternary
- **Lithology:** Terrigenous Clastic Rocks (Sandstones), Carbonate Rocks (Dolomite), and Non Conventional Reservoir Rocks.
- **Sedimentary Facies:** Marine, Terrestrial, Marine-Terrestrial Transitional Facies.
- **Marine Reservoir Rocks:** Karst (diagenesis), Reef and Beach Reservoir
- **Terrestrial Reservoir Rocks:** Porous Sandstones, Tarium basin, Quaidam basin and Yinggehai-Qiongdongnan basin

# General Overview on Geology and Resources

## ➤ Reservoir Rocks and Traps

Basin	Fields	Geological Time	Lithology	Porosity (%)	Permeability (mDC)
Tarium	Kela 2	E	Sandstone	8-20	51.5
	Dila 2			4-10	0.1-1.5
	Yaha			14-18	10-86
Qaidam	Tainan	Q	Sandstone	26.8	595.2
	No.1/2 Sebei			30.6	104.9
Orodus	Sulige	P1	Sandstone	7-15	<10
	Daniudi	C3-P1		2-10	<2
	Jingbian	O	Dolomite	5.3-6.7	1-2.63
Sichuan	Xinchang	J2-3	Sandstone	12.3	2.56
	Puguang	T1	Dolomite	6.7-7.1	100.8
	Luojiazhai	T1	Dolomite	5.5	0.01-1160
	Weiyuan	P1,Z	Dolomite	3.5-4.5	0.1-2.0
Songliao	Qingshen	K1	Volcanic	0.3-18.7	0.1-1.0
Y-Q	Dongfang1-1	N	Sandstone	12.0-21.33	0.02-8.32
	Yacheng13-1	E-N		14.8	100



# General Overview on Geology and Resources

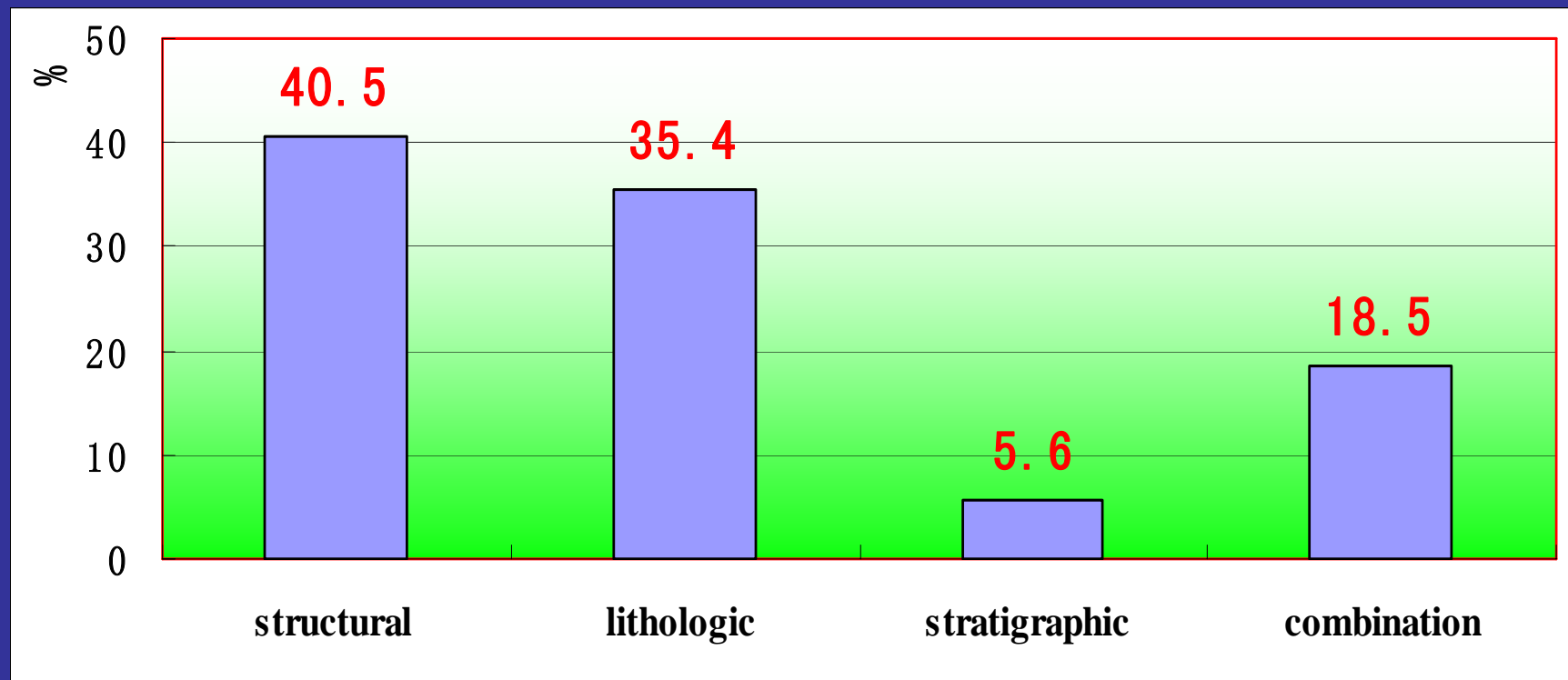
## ➤ Reservoir Rocks and Traps

### • Carbonate Rocks

- ✓ mainly marine carbonate rocks (dolomite), partly lacustrine
- ✓ space types: pore, fracture, pore-fracture and fracture-pore
- ✓ **Sinian tidal-flat facies fracture-pore dolomite**: Sichuan and Tarium, typical example: Weiyuan gas field in Sichuan basin
- ✓ **Ordovician fracture-pore weathering crust** : Orodus basin, Tarium basin and North China
- ✓ **Carboniferous tidal-flat facies fracture-pore dolomite** : east part of Sichuan basin
- ✓ **Upper Permian porous reef** : Sichuan basin and Pearl River Mouth basin (Tertiary)
- ✓ **Lower Triassic porous grain beach**: oolitic beach in feixianguan fm, east part of Sichuan basin

# General Overview on Geology and Resources

## ➤ Reservoir Rocks and Traps



Gas Reserves in Different Types of Traps in China

# General Overview on Geology and Resources

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## ➤ Resources and Distributions

- According to nationwide natural gas resource assessment by Ministry of Land and Resources, total recoverable resource of natural gas in China mainland and offshore reach **Trillion Cubic Meters (Tcm)**, **61.1% of which** distribute in onshore, 19.1% in the offshore.

# General Overview on Geology and Resources

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- Natural Gas Resource in Gas-Bearing Basins
  - About 70% of total natural resource distribute in 9 basins.
  - Generally, **big basins control distributions of natural gas resource.**

# General Overview on Geology and Resources

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## ➤ Unconventional Gas Resource

- **Tight Sand Gas**

- ✓ mainly distribute in Erodus basins of Midland, where this gas has been produced now.

- **Coal Bed Methane**

- ✓ widely distribute in many coal bearing basins.

- **Shale Gas**

- ✓ widely distribute in dark shale zones.

# Exploration and Development

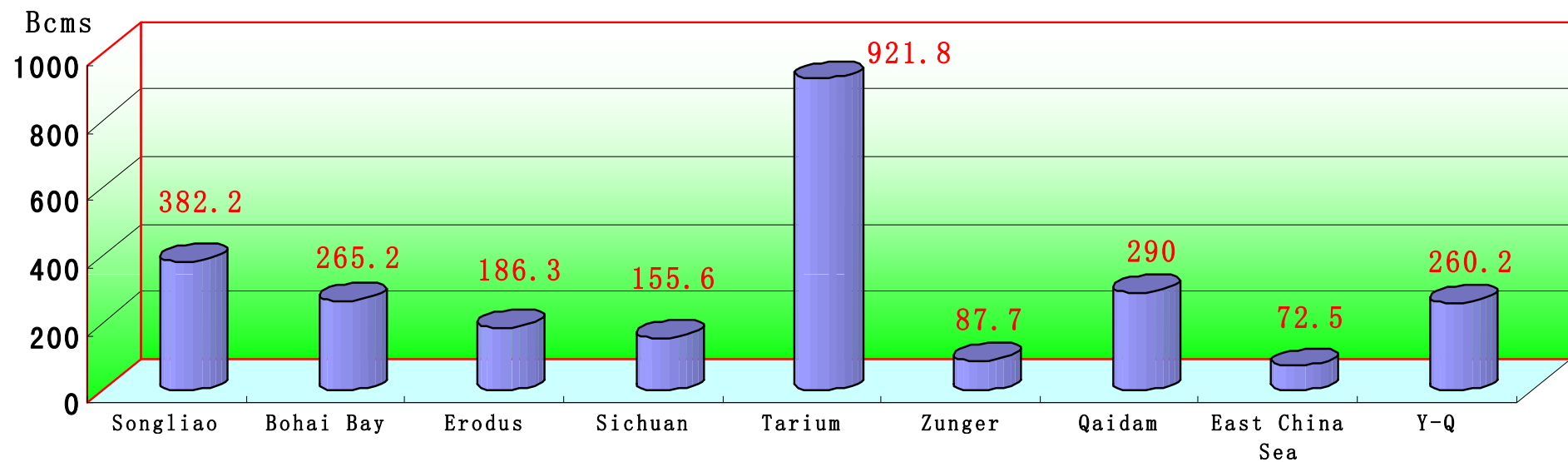
## ➤ Exploration and Discoveries

- In the past twenty years, China gas exploration has been developed greatly , concentrating on basins of Sichuan, Orodus, Tarium, Qaidam, Yinggehai-Qiongdongnan(Y-Q) and East China Sea.
- By the end of 2008, over 200 gas fields have been discovered in China, and most distribute in the above basins.
- In the recent years, some giant fields, e.g., Kela 2, Puguang, Sulige have been found.

# Exploration and Development

## ➤ Reserve and its Growth

- By the end of 2008, accumulative total in-place proven reserve of natural gas in China add up to 7.83 Tcms.



# Exploration and Development

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## ➤ Reserve and its Growth

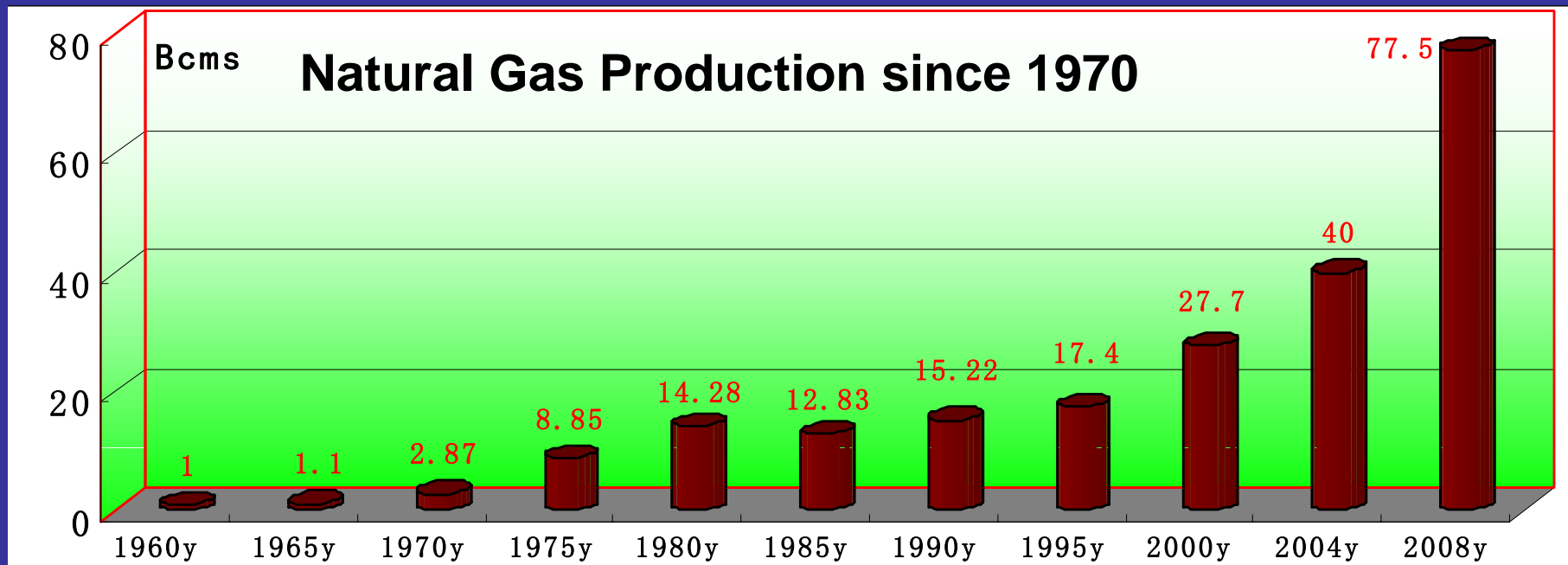
- Since 1990s, gas reserve has increased fast, especially since 2000, gas in-place reserve growth per year exceeds 400 Billion Cubic Meters (Bcms), in 2007, exceeds 600 Bcms. Gas exploration enters a stage of fast reserve growth.



# Exploration and Development

## ➤ Development and Production

- Totally, **development and production of natural gas** in China obviously **drop behind gas exploration**. By the end of 2008, China accumulatively produced natural gas about 1.0 Tcms (936.7 Bcms). In the recent years, gas production has increased relatively fast. **From 2004 to 2008, production nearly doubled.**



# Exploration and Development

## ➤ Development and Production

- In 2008, China produced natural gas 77.5 Bcms, accounting for 2.5% of world natural gas production, ranking 9th in the world.
- Basins with gas production of over 3.0 Bcms include Tarium, Sichuan, Orodus, Qaidam, Bohai Bay, Zunger, Songliao and Y-Q, and gas production from these basins reached 67.9 Bcms, accounting for 87.6% of total gas production in China.

# Gas Market and Pipelines

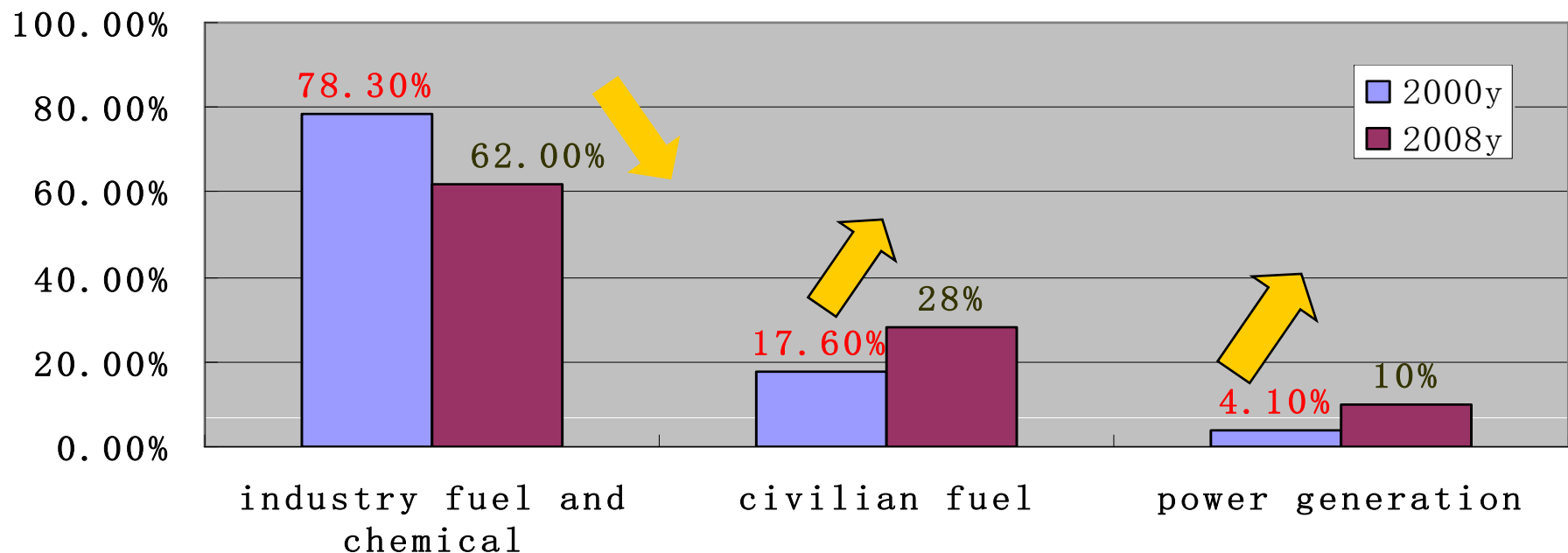
## ➤ Gas Market and Consumption

- In the recent years, China's gas market has developed rapidly, and gas consumption has increased sharply. From 2000 to 2008, China's gas consumption averagely grew by 15.8% each year, and in 2008, it reached about 80 Bcms, including 77.5 Bcms and 3.4 million tons of LNG imported from Australia.
- In the past eight years, gas share in China's primary energy consumption mix increased from 2.4% to 3.8%.

# Gas Market and Pipelines

## ➤ Gas Market and Consumption

- Gas market in China has expanded from peripheral areas of oil & gas fields before 2000 to eastern provinces of China with relative good economic conditions.
- Gas use and consumption mix in the recent years has become more reasonable and rational.

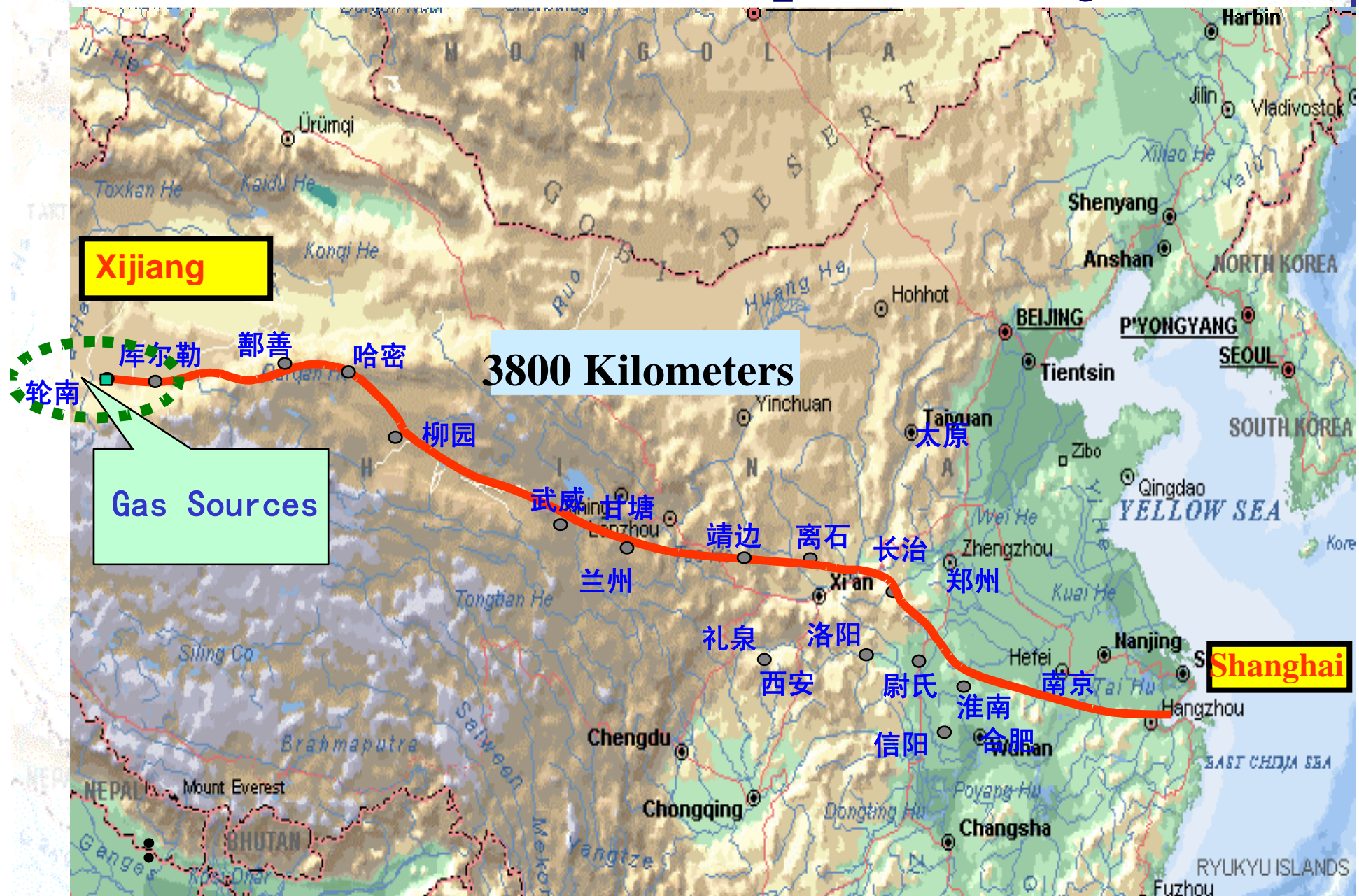


# Gas Market and Pipelines

## ➤ Pipelines and Other Infrastructures

- **With rapid growth of natural gas exploration and development, infrastructures of gas industry, including pipelines and LNG terminals and underground gas storage tanks, have been constructed plentifully in the past ten years in China.**
- **By the end of 2008, China's gas pipelines reached over 30 thousands kilometers, and two regional gas pipeline systems in North China and Sichuan-Chongqing areas.**

# West to East Gas Pipeline Project



# Gas Market and Pipelines

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- By the end of 2008, two LNG projects, Dapeng LNG in Guangdong and Putian LNG in Fujian have finished. In the end of 2009, Shanghai LNG project will be put into use.
- LNG projects in Dalian, Jiangsu (Rudong) and Zhejiang are being constructed.
- LNG industry will continue to maintain fast growth in the coming years.

# Dapeng LNG Terminal Project in Guangdong

Capacity: 3.7 million ton/385 km

Total Invest over one billion USD



**BP has 30% interest of the project**



# Gas Supply and Demand Scenario

## ➤ Gas Supply Scenario

- On the basis of following conditions (presumptions):
  - **more investment on gas exploration and development,**
  - **more reasonable gas tax and fee policies,**
  - **good gas price systems,**
  - **more open management system of gas resource,**
- **China's natural gas production and supply will keep fast growth in the coming 10 to 20 years.**

# Gas Supply and Demand Scenario

## ➤ Gas Demand Scenario

- On the basis of following conditions:
  - **fast industrialization progress,**
  - **fast urbanization progress,**
  - **energy mix adjustment and more clean energy use,**
  - **continuously rapid GDP growth (over 8% per year),**
- **natural gas demand in China will increase highly in the coming 10 to 20 years.**

# Issues and Challenges

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## ➤ National Energy Strategy and Plans

- What kind of China's national energy strategy and plans will decide to a great extent what China's gas industry will be in the future of 10 to 20 years.
- Energy mix adjustment and clean energy use also influence development of gas industry in China in the coming 10 to 20 years.

# Issues and Challenges

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## ➤ Gas Prices and Tax

- gas prices controlled by government
- relative low gas prices (well price)
- unreasonable gas tax polices

# Issues and Challenges

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## ➤ Gas Market System

- monopolization of gas upstream market **by CNPC, Sinopec, CNOOC**
- gas pipelines controlled by above three companies
- gas consumption market not open to all investors
- gas consumption mix need to be improved more

# Recommendations

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- **Adjust national energy strategy, increase use of clean energy**
- **Strengthen gas E & D to discover more gas reserves to meet basic gas demand (not less than 70%) in the coming 20 years**
- **Reinforce constructions of infrastructures of gas industry, including pipelines, underground gas storage and LNG Terminals.**
- **Reform gas prices and tax polices**
- **Open gas markets more, and intensify market regulations**

**Thank you for your  
attention!**

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