

# **Long Term Perspectives of Gas Demand and Production in China – Key Technology Scenarios and Challenges**

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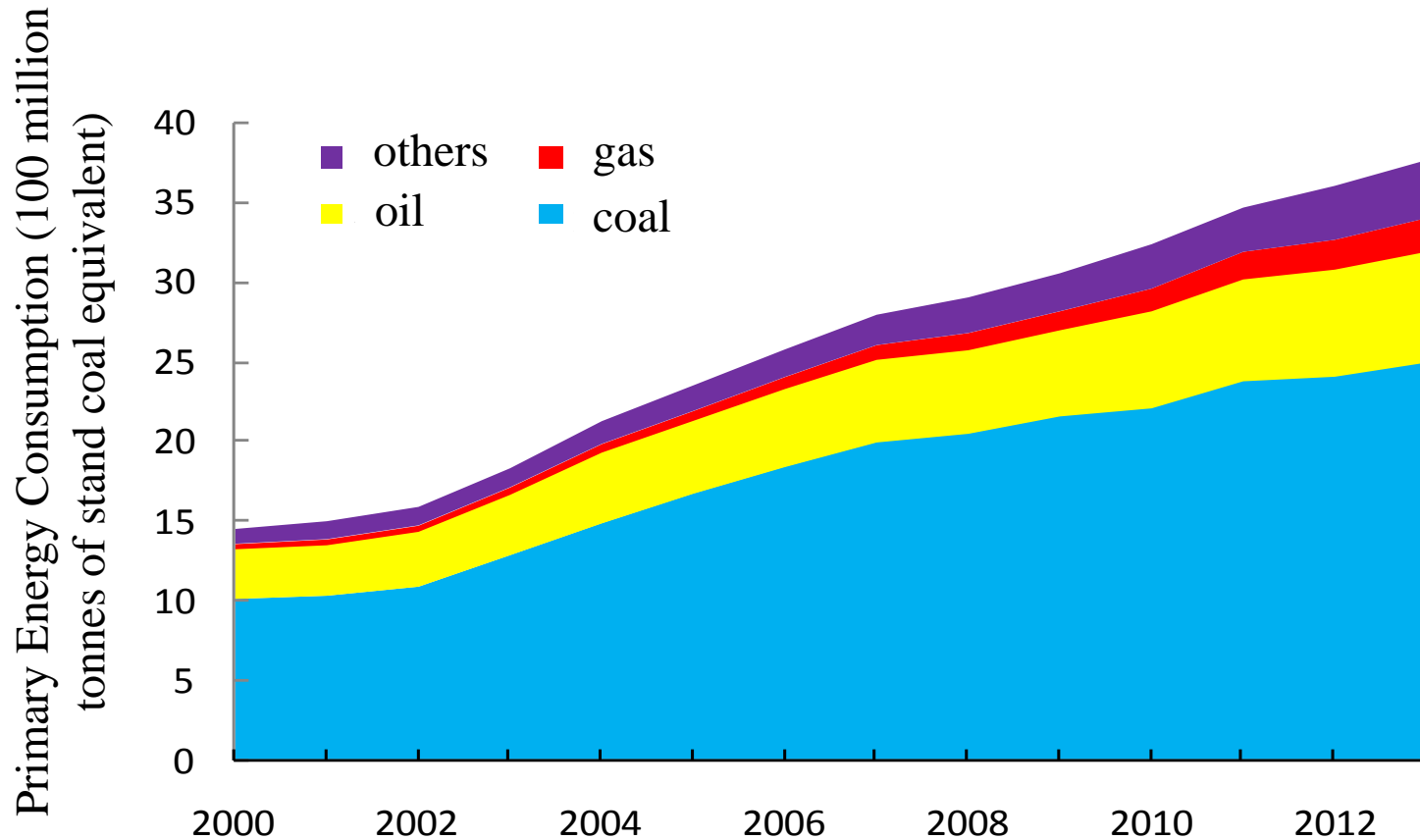
# OUTLINE

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- **GAS CONSUMPTION AND DEMAND**
- **GAS RESOURCES**
- **EXPLORATION FOCUS AND TECHNOLOGY CHALLENGE**

# China's Primary Energy Consumption

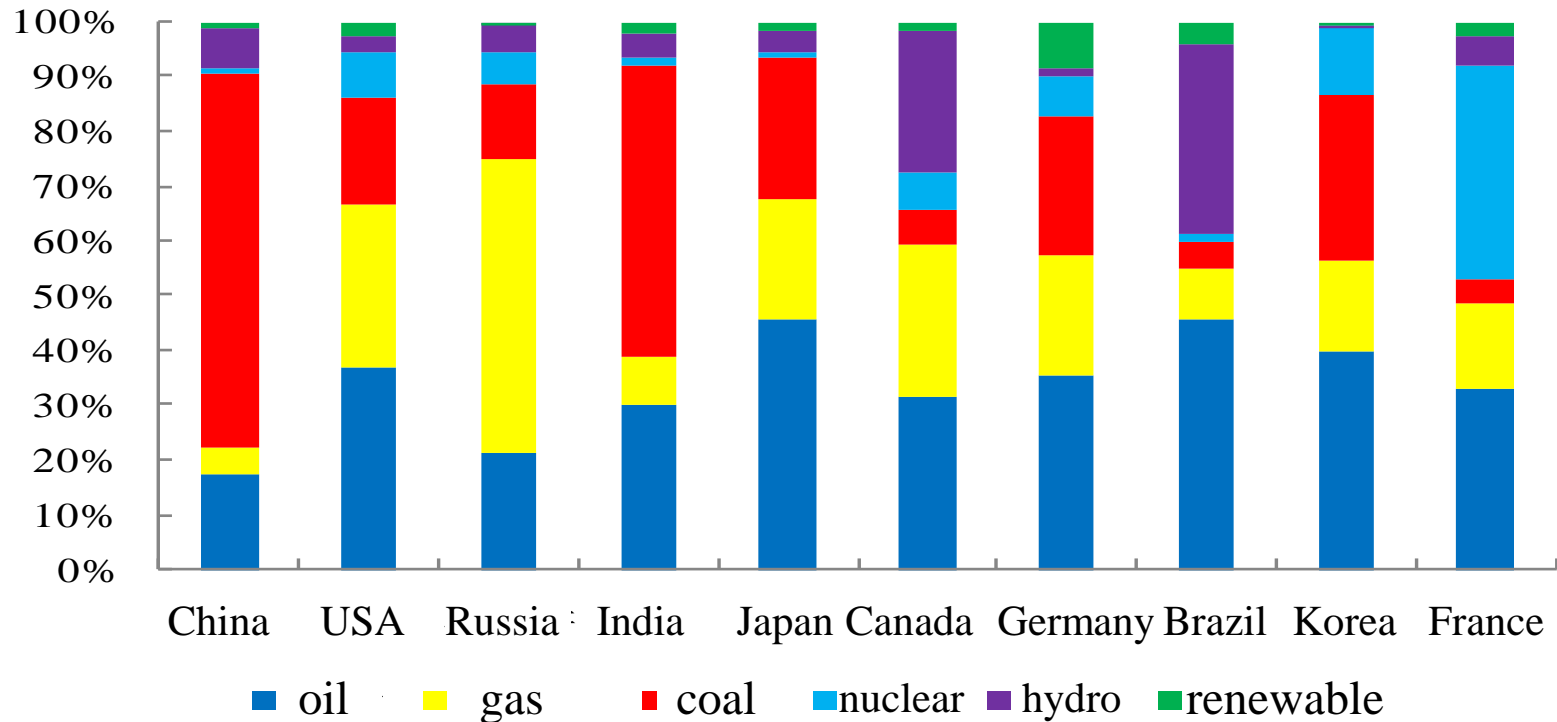
**Oil and gas make up a small proportion of the primary energy consumption**



Data: National Bureau of Statistics of China, 2013

# China's Primary Energy Mix

## Energy mix for the top 10 energy consuming countries

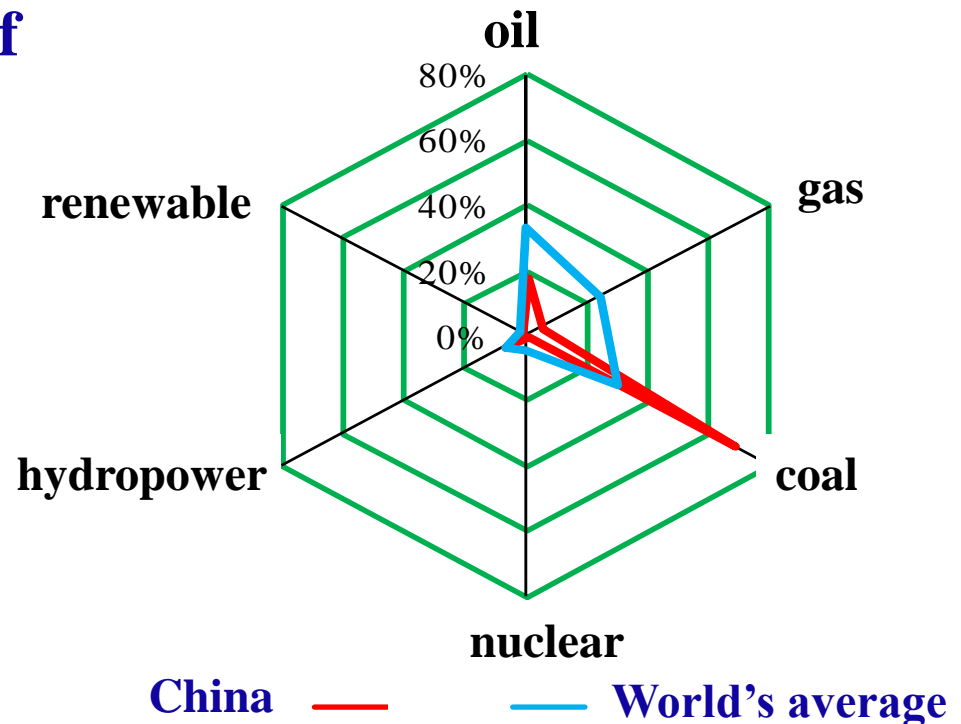


**China is one of the few countries with a dominate coal consumption, which is quite different from the energy mix of developed countries.**

# China's Primary Energy Mix

## Percentage of oil and gas of energy consumption

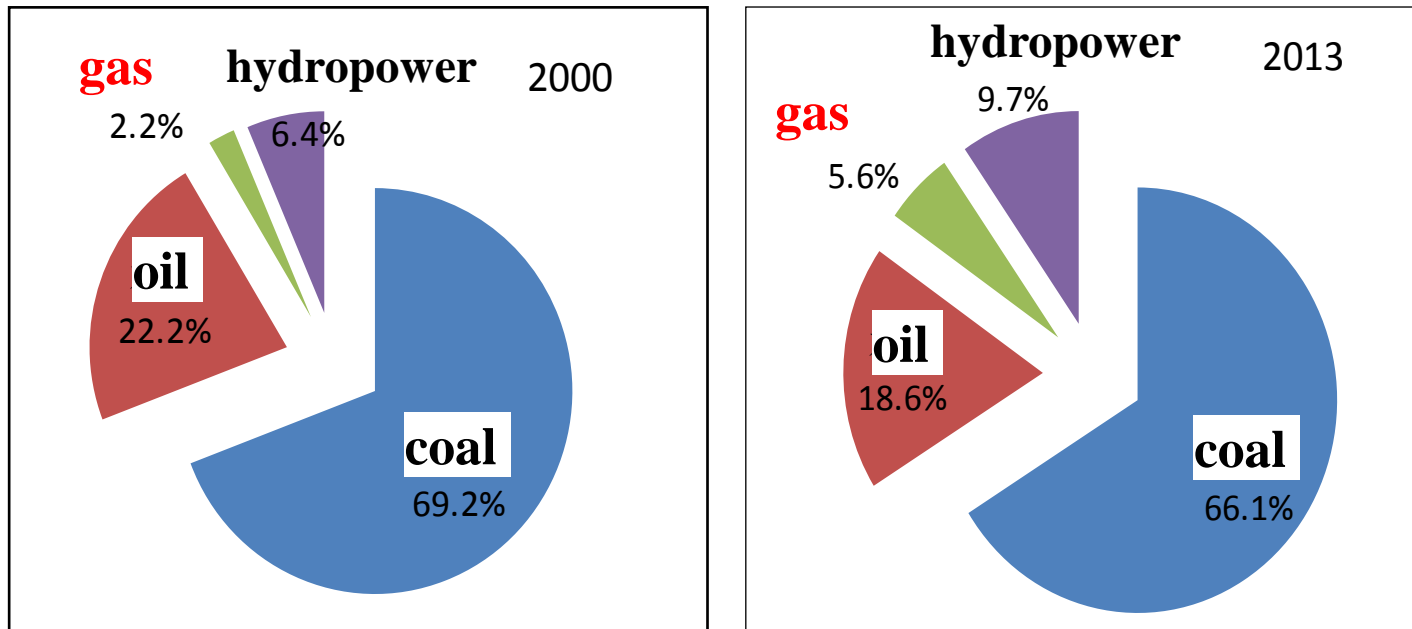
- **China: 22.42%**
- **Russia: 75.21%**
- **USA: 66.73%**



Comparison of China's energy mix with world's average for 2012

# China's Primary Energy Mix

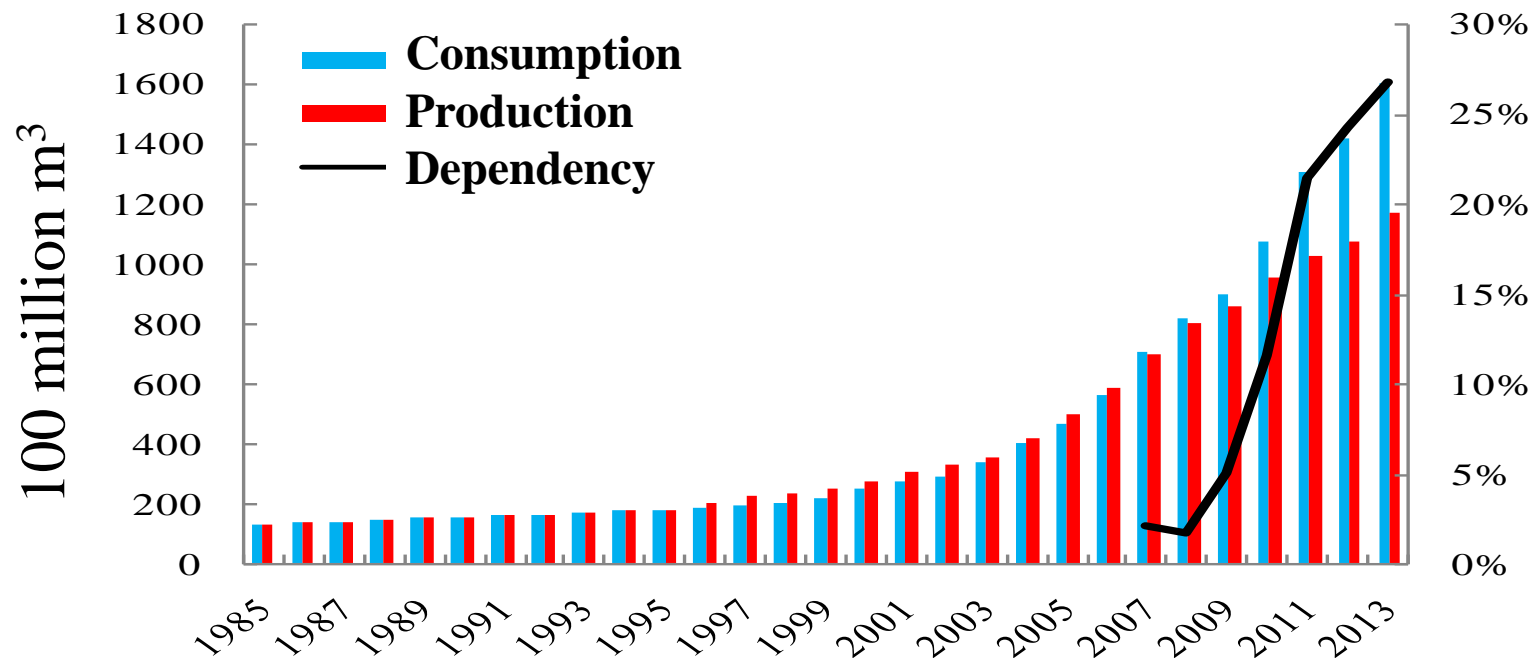
- From 2000 to 2013, oil and gas made up about 1/4 of primary energy consumption.
- Oil's share is decreasing but gas's contribution is increasing.



## China's energy mix for 2000 and 2013

# China's Gas Consumption and Production

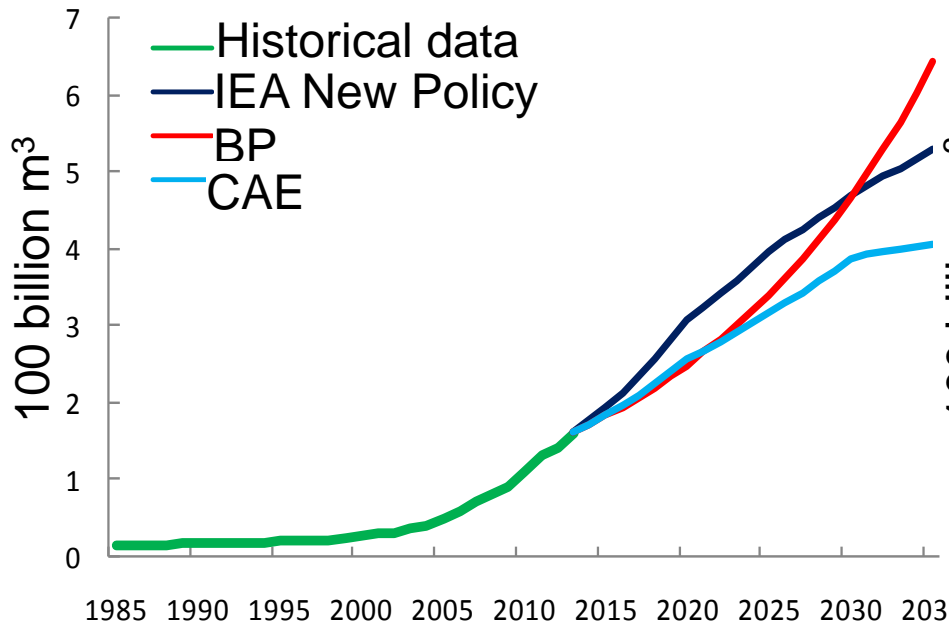
- Since 2007, China became a net gas importer. Dependency on foreign gas is increasing.
- In 2014, China's gas consumption reached to 181.6 Bcm with foreign gas making up 32.4%.



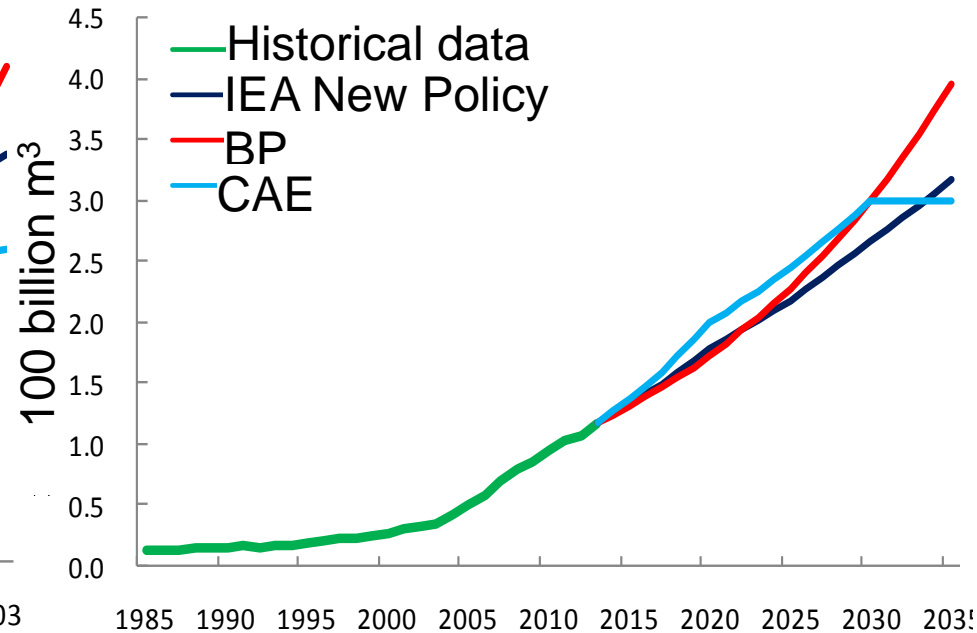
**China's gas production and consumption between 1985 and 2013**

# China's Gas Consumption and Production

## China's historical and future gas consumption



## China's historical and future gas production

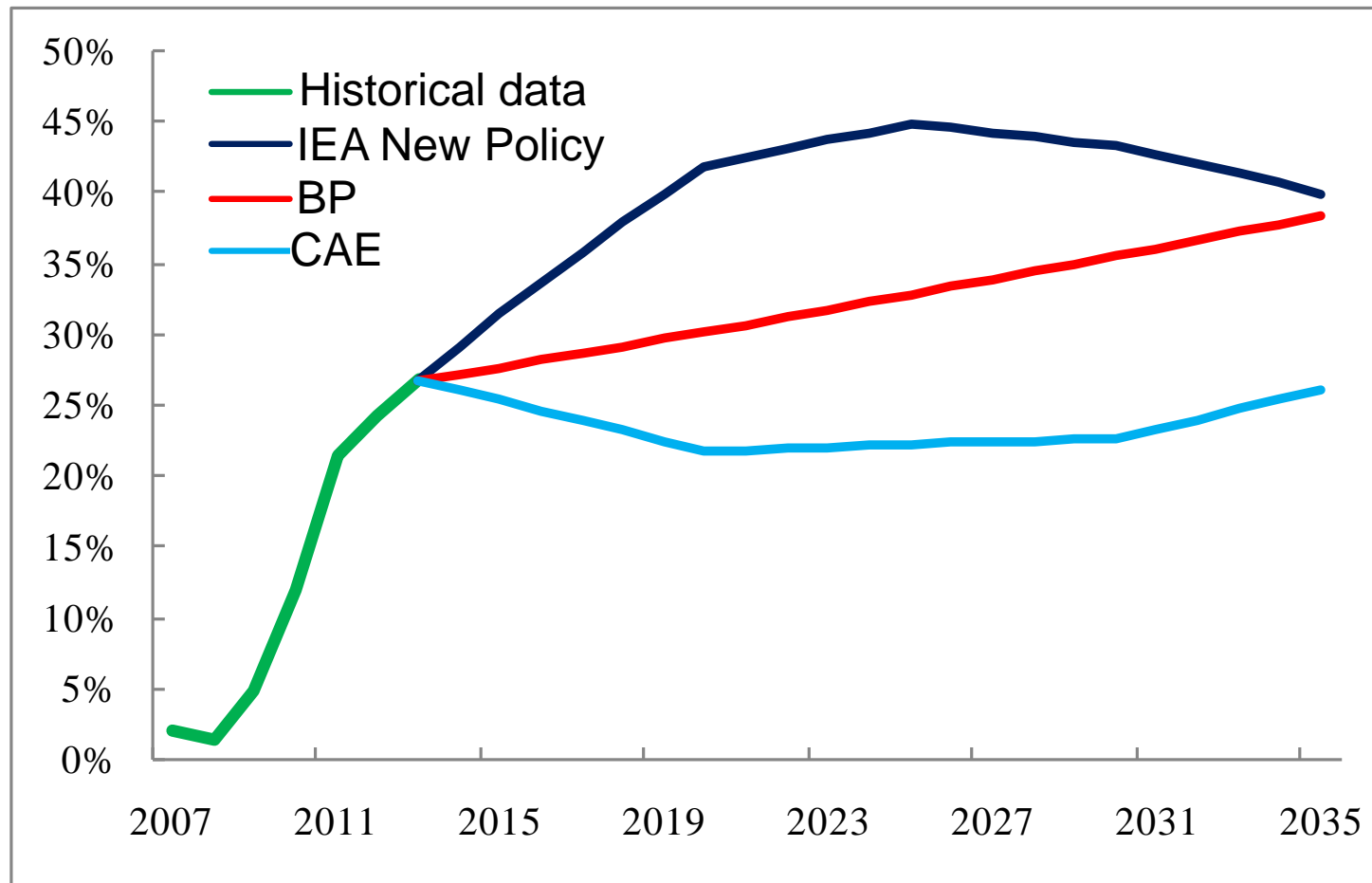


CAE(Chinese Academy of Engineering): conservative on consumption  
optimistic on production



# China's Gas Consumption and Production

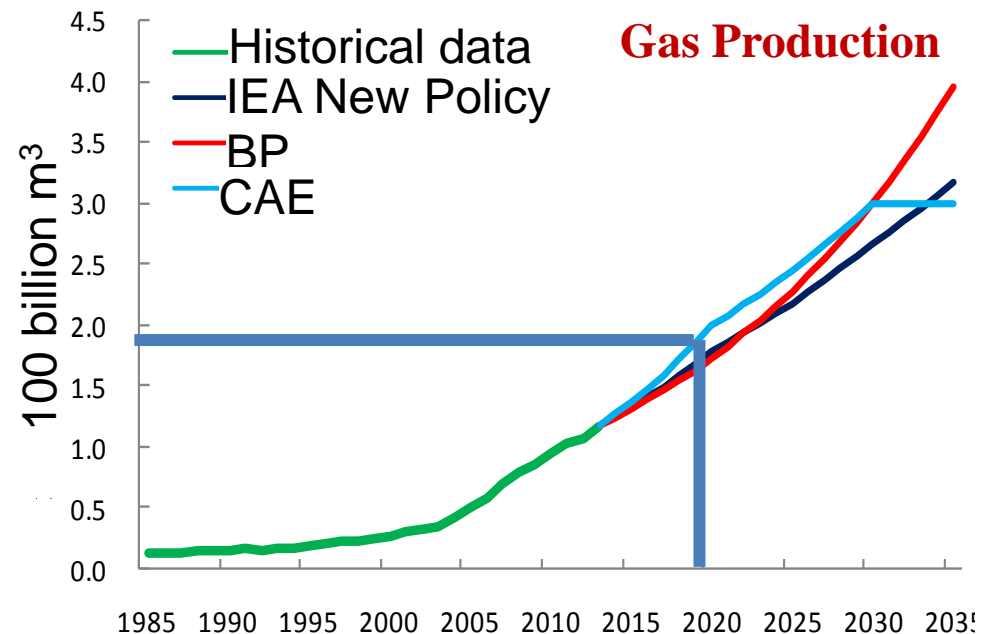
## China's historical and future dependency on foreign gas



# Energy Development Strategy Action Plan (2014-2020) released by the State Council

By the year of 2020, following tasks are listed.

- Coal will constitute no more than 62%;
- Gas will make up at least 10% of energy mix;
- Conventional (including tight) gas production up to 185 bcm
- Shale gas 30 bcm
- CBM 30 bcm
- Total annual gas production 245 bcm (vs. 131 Bcm in 2014; increase at annual rate of 11%).



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# Gas Resources

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## China's total recoverable gas resources

- **Conventional gas (including tight gas): 37.42 tcm**  
**Tight gas: 8.0-11.42 tcm**
- **Shale gas: 25.08 tcm**
- **Coalbed methane: 10.87 tcm**

Data: Ministry of Land and Resources



# Conventional Gas Resource

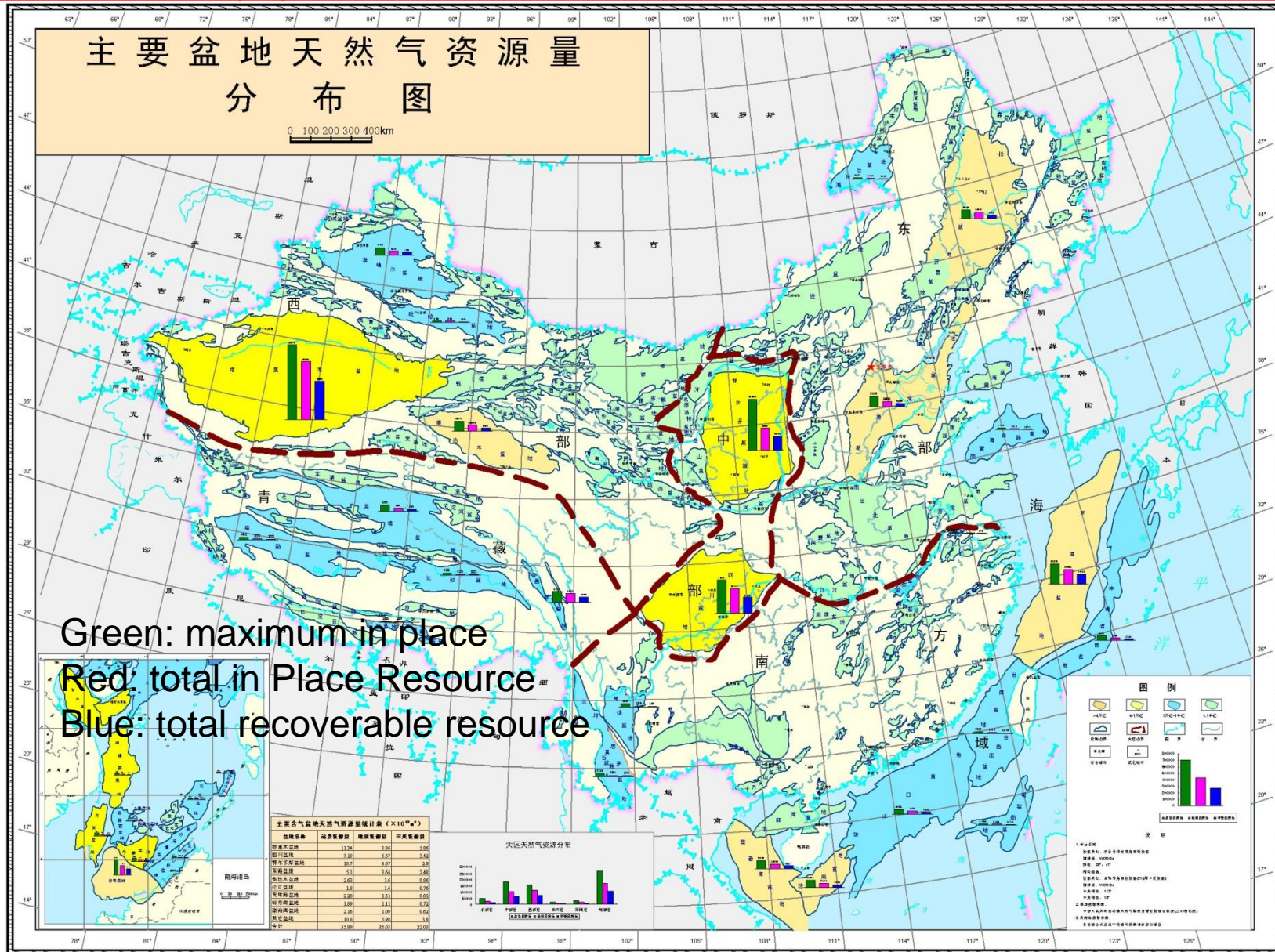
## Resources and Reserves in Different Basins

BASIN	BASIN SIZE (10 <sup>3</sup> KM <sup>2</sup> )	RESOURCES (TCM)		INITIAL RESERVE AS 2012 (BCM)		Discovery
		IN PLACE	RECOVERABLE	IN PLACE	RECOVERABLE	Maturity (%)
SONGLIAO	260	3.9	2.12	717.6	340.4	16.1
BAHAI BAY	173	1.66	0.85	1060.8	406.6	47.8
ORDOS	250	15.16	8.93	3279.7	1697.3	19.0
SICHUAN	200	9.32	5.83	2725.6	1536.4	26.4
TARIM	560	14.77	9.11	1573.2	932.0	10.2
JUNGGAR	134	2.32	0.97	349.0	170.6	17.6
CHADAM	104	1.6	0.86	326.4	171.2	19.9
E. CHINA SEA	241	3.64	2.48	114.5	68.5	2.8
PEARL RIVER MOUTH	203	1.96	1.65	144.1	92.4	5.6
QIONGDONG NAN	41	1.81	1.18	103.8	80.5	6.8
YINGER SEA	99	1.31	0.08	190.3	116.8	146.0
CHINA	4878	62.14	37.42	10808.9	5699.8	15.2

Source: Ministry of Land and Resources

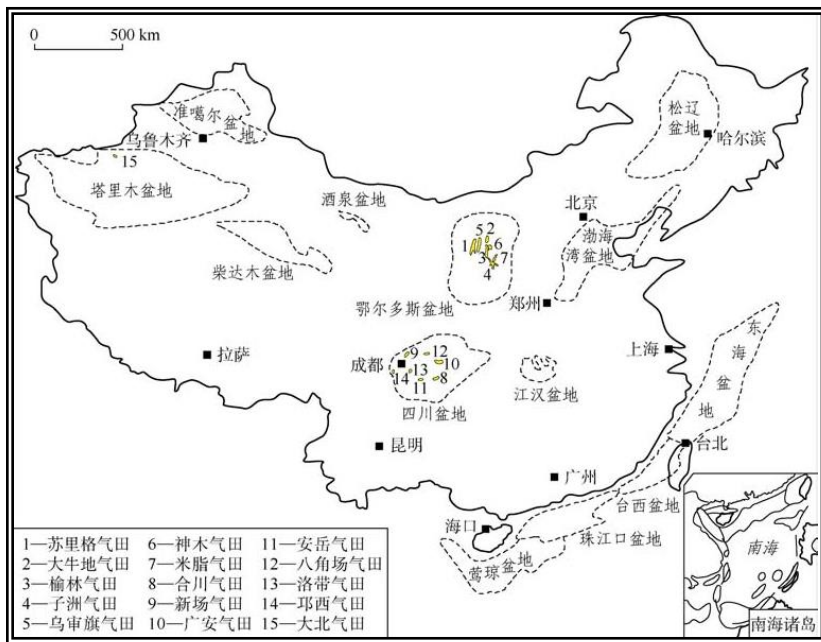


# Distribution of Conventional Gas Resource



# Tight Gas Resource

As end of 2011, proved tight gas in place volume reached to **3.3 Tcm**, making up **40%** of China's total proved gas in place volume. Initial proved tight gas reserve was **1.8 Tcm**, accounting for 1/3 of China's total initial proved gas reserves.



Tight gas resources in key basins

Basin	Size (10 <sup>4</sup> km <sup>2</sup> )	Strata	Fairway (10 <sup>4</sup> km <sup>2</sup> )	In place (Tcm)	Recoverable (Tcm)
<b>Ordos</b>	25	C-P	10	6-8	2.76-3.64
<b>Sichuan</b>	18	T <sub>3</sub> x	5	3-4	1.38-1.82
Songliao	26	K <sub>1</sub>	5	2-2.5	0.92-1.14
<b>Tarim</b>	3.5	J+K+S	6	4-7	1.84-3.19
Tuha	5.5	J	1	0.6-0.9	0.28-0.41
Bohai Bay	8.9	Es <sub>3-4</sub>	3	1-1.5	0.46-0.68
Junggar	13.4	J	2	0.8-1.2	0.37-0.55
<b>Total</b>	<b>152.8</b>		<b>32</b>	<b>17.4-25.1</b>	<b>8.0-11.42</b>

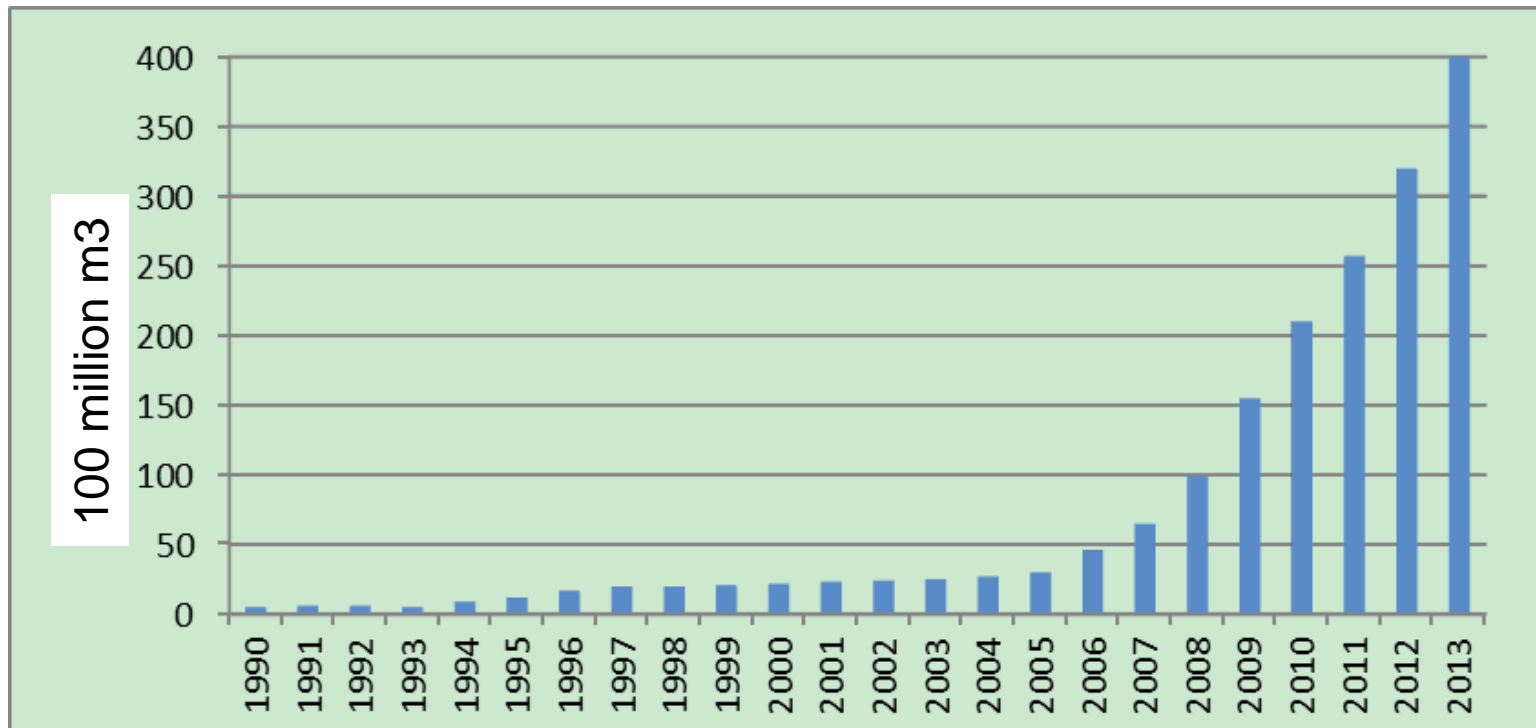
## Distribution map of tight gas fields in China

Tight gas was first found in Sichuan Basin in 1960s. Its development was hindered by technology and progressed slowly. Recently, annual addition of tight gas in place volume of 300 Bcm has been achieved. Production from tight reservoirs has been increasing at annual rate of over 5 Bcm.



# Tight Gas Resource

**Tight gas production in 2013 was 40 Bcm, making up 33% of the total**



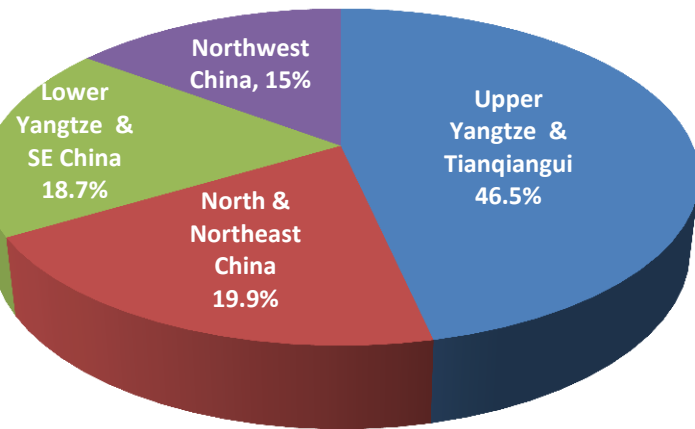
**Tight gas production in China**

# Shale Gas Resource

**Total in place resource: 134.42 Tcm;**

**Total recoverable resource: 25.08 Tcm**

## Total in place shale gas resource

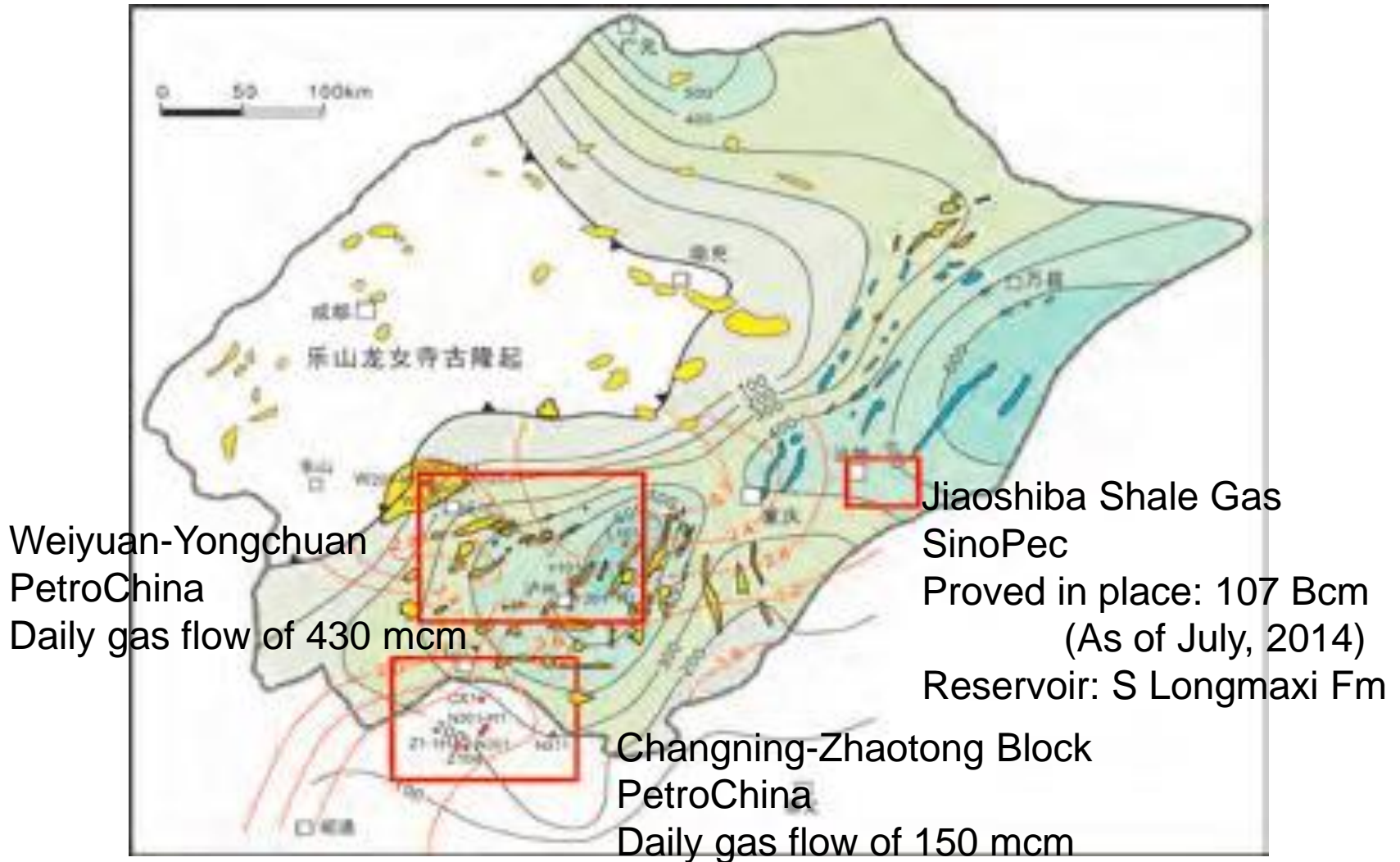


Region	Percentile (Tcm)		
	P <sub>5</sub>	P <sub>50</sub>	P <sub>95</sub>
Upper Yangtze & Tianqiangui	122.08	62.56	20.49
North & Northeast China	44.98	26.79	13.47
Lower Yangtze & SE China	40.92	25.16	13.14
Northwest China	38.48	19.90	8.94
Total	246.45	134.42	56.04

Breakthroughs have been made in Sichuan Basin by both PetroChina and SinoPec.

# Shale Gas Resource

## Shale Gas Breakthroughs in Sichuan Basin, SW China



# Shale Gas Resource

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- Development of shale gas started late but progressed rapidly
- Production was 25 million m<sup>3</sup> (mmcm) in 2012, 200 mmcm in 2013, and 1300 mmcm in 2014.

## Jiaoshiba Shale Gas Field

Gas production: 3 bcm in 2015  
and will double in 2016.

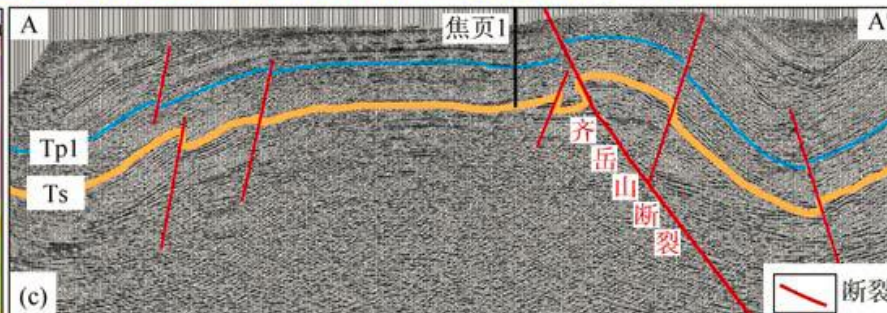
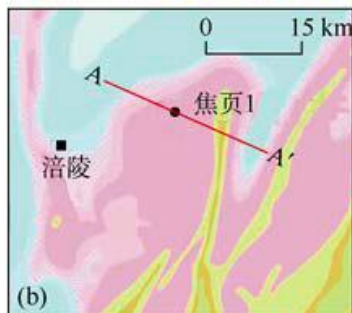
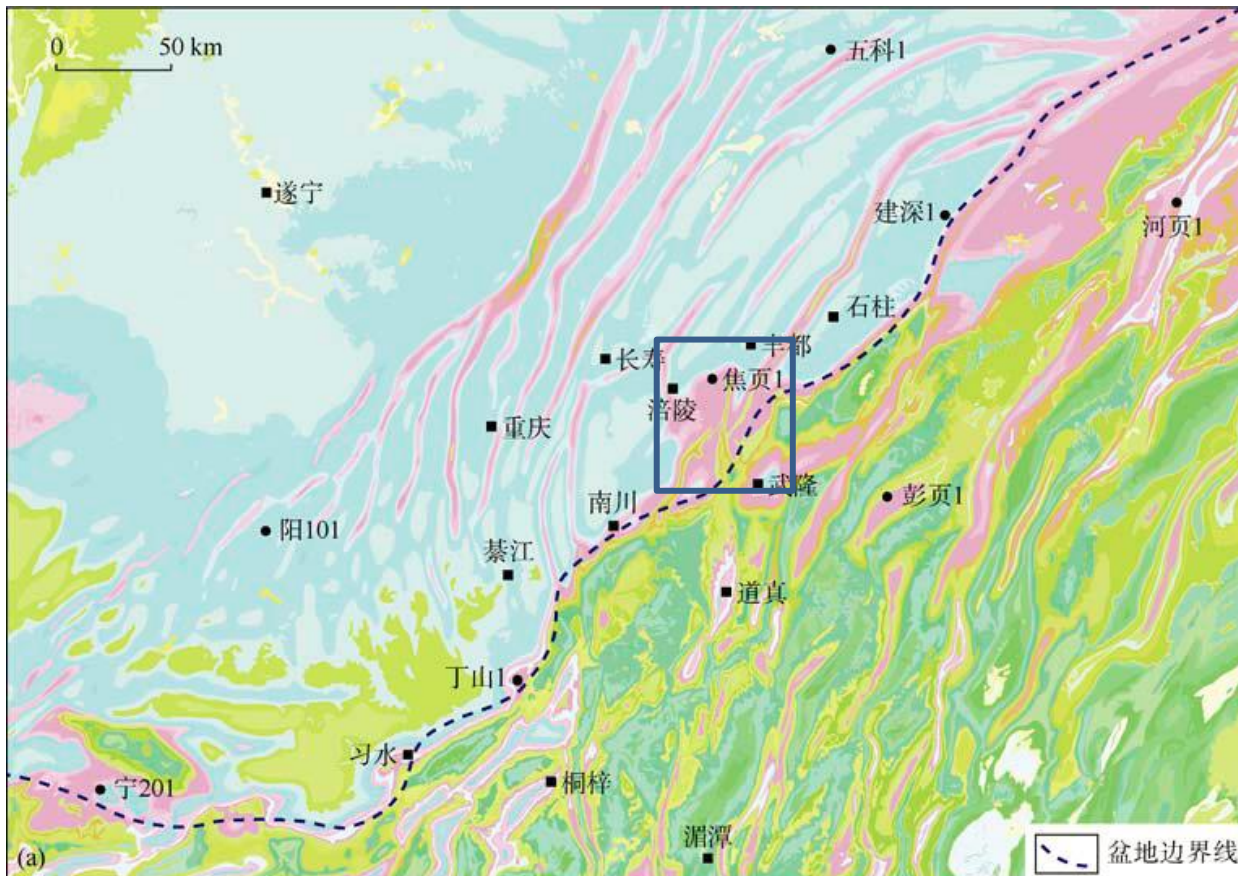




# Shale Gas Resource

## Jiaoshiba Shale Gas Field

- Faulted broad anticline
- Burial depth: 2400~3500m
- Pay: 35~45m
- Reservoir: S Longmaxi, overpressure
- Gas flow: 314 mcm/day
- Brought on steam.
- Expected production for 2015: 3 bcm



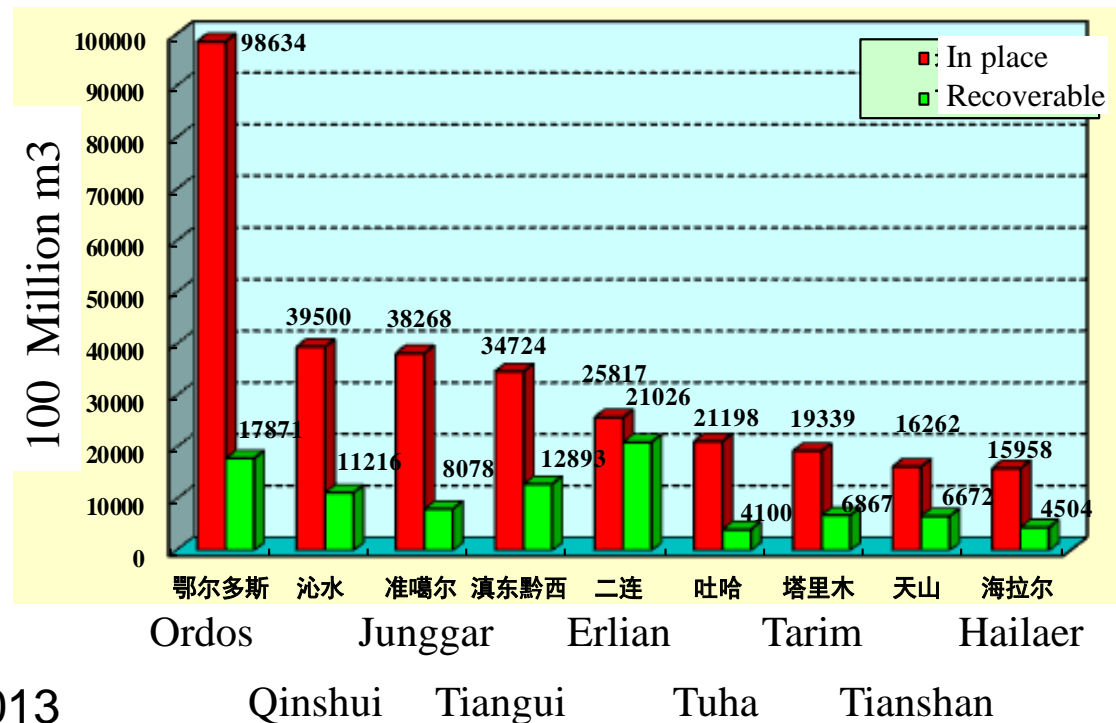
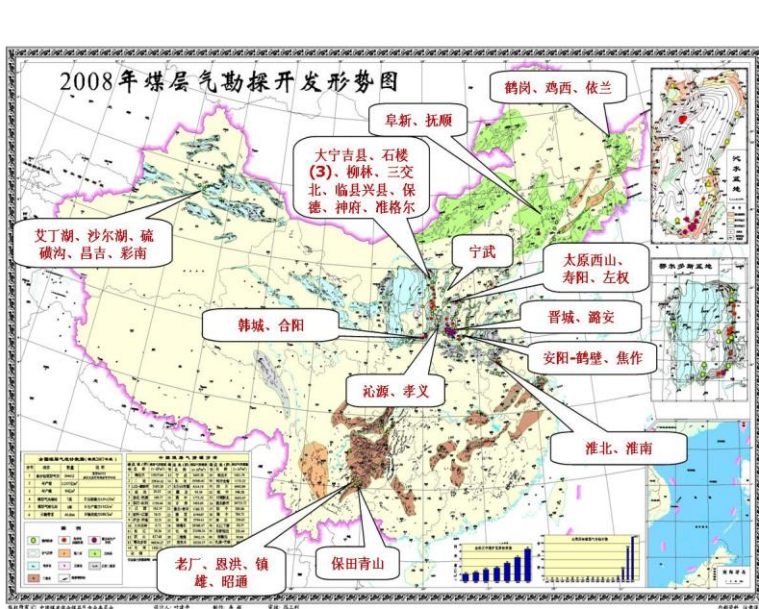
# Coalbed Methane Resource

Total in place: 36.81 Tcm at depth of less than 2000m in 42 basins

Total recoverable: 10.87 Tcm at depth of less than 1500m in 42 basins

Top basins: Ordos, Qinshui and other 7 host 84% of the total recoverable.

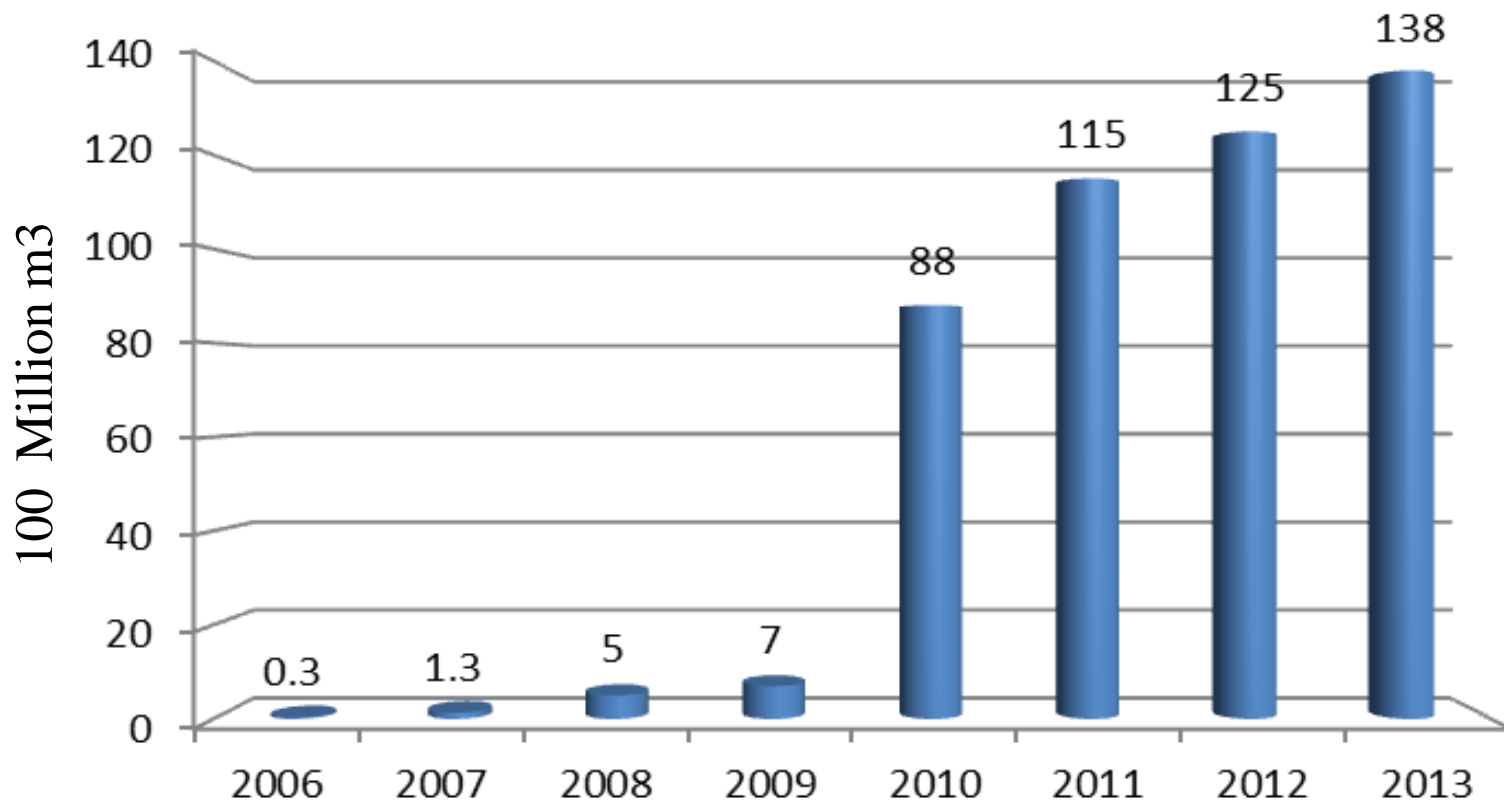
## Coalbed methane resource in different basins



Ministry of Land and Resources, 2013

# Coalbed Methane Resource

## Coalbed Methane Production in China



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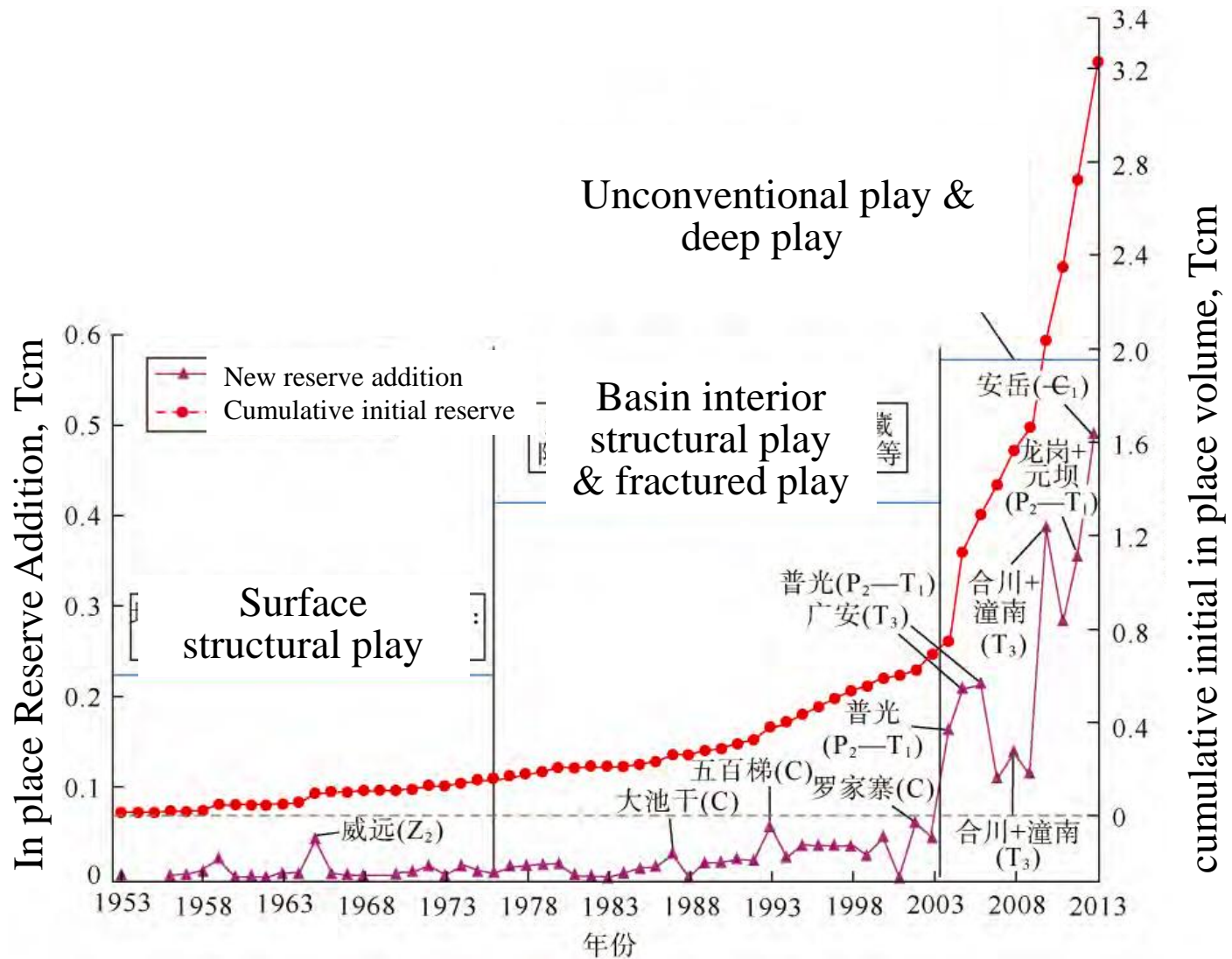


# Exploration and Development Focus

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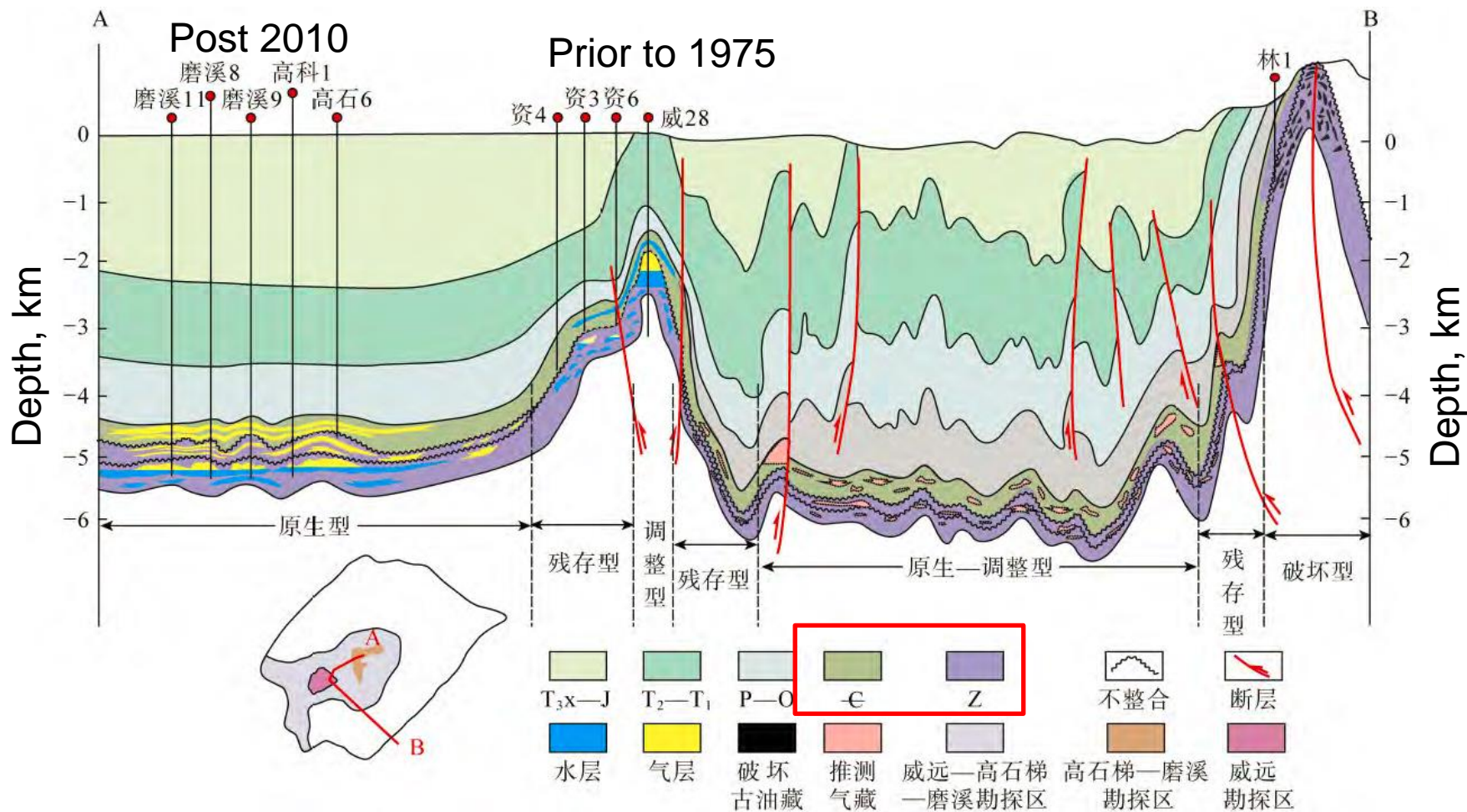
- Deep play: Anyue giant field (440 Bcm proved gas in place) in Sichuan Basin in 2013
- Offshore play: Liwan 3-1 giant field in Pearl River Mouth Basin in 2002
- Unconventional (tight, shale, and CBM) gas plays

# Sichuan Basin Gas Exploration



Zou et al., 2014

# Sichuan Basin Gas Exploration



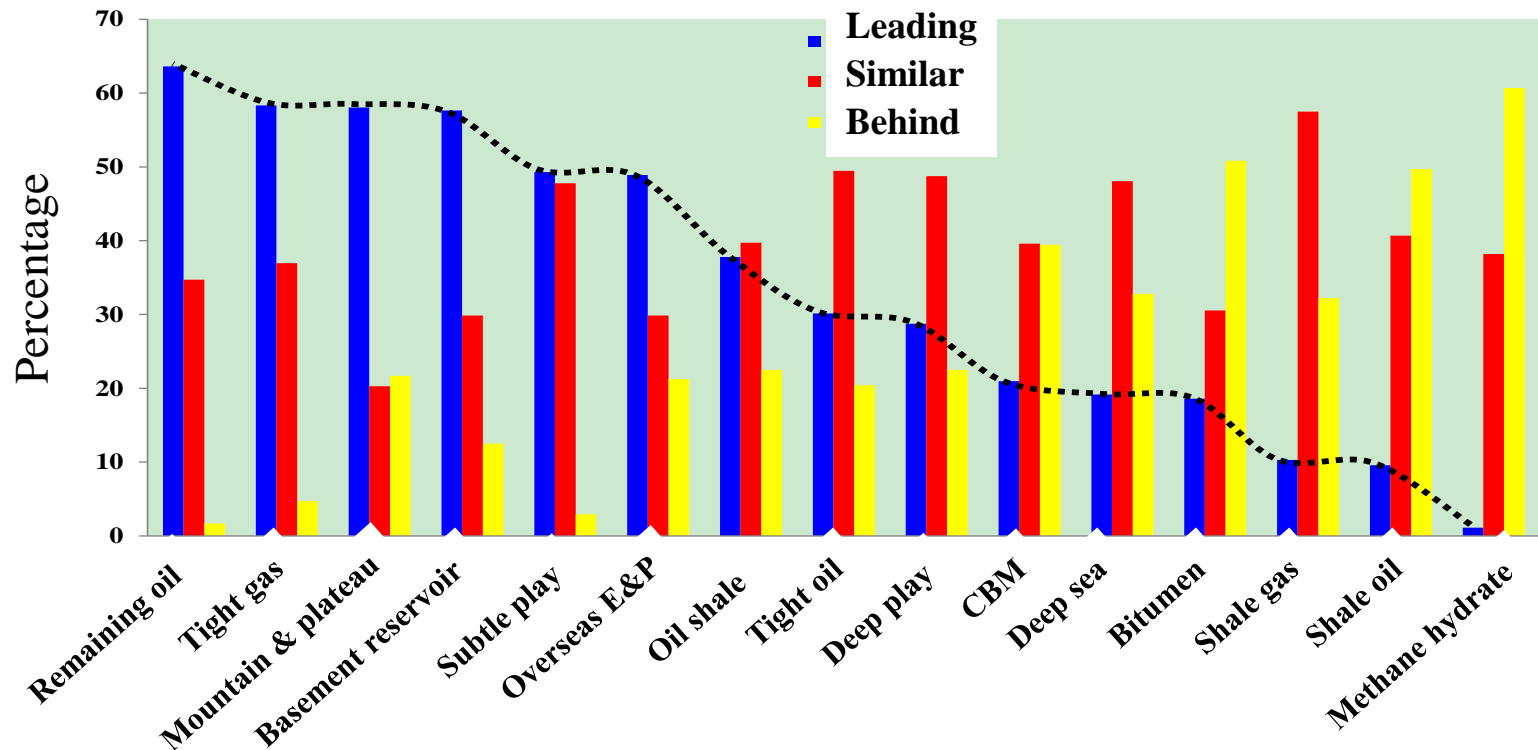
# Salient Features of China's Gas Resources

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- Rich but low quality
- Located in areas with complex subsurface conditions
- 60% hosted in reservoirs with burial depths of greater than 3500m
- Concentrating in gobi-desert, loess, and hilly areas.
- Significant proportion in low to very low permeability reservoirs.

# Survey Statistics (literature, patent, scientist's views)

## 3 Level: leading internationally, similar, and lagging behind



**China has advanced technologies for remaining oil, tight gas, hydrocarbon fields in mountain and plateau areas, and basement reservoirs, but lags behind in technologies related to CBM, shale oil, shale gas and methane hydrate.**

# Technology Challenges

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- ◆ Shale gas
- ◆ Coalbed methane
- ◆ Deep gas play

**THANK YOU**