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Status on the unconventional resource development in China and its effect on China's Economy

Korea-China-Japan Joint Energy Conference for KEEI's 28th Anniversary Celebration

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Contents

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Recent Gas Consumption Growth in China

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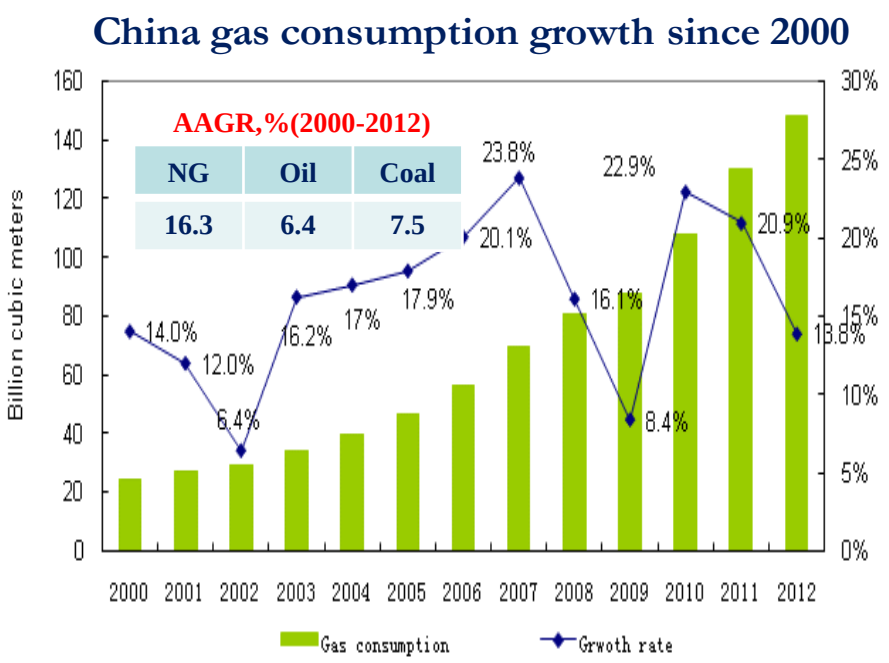

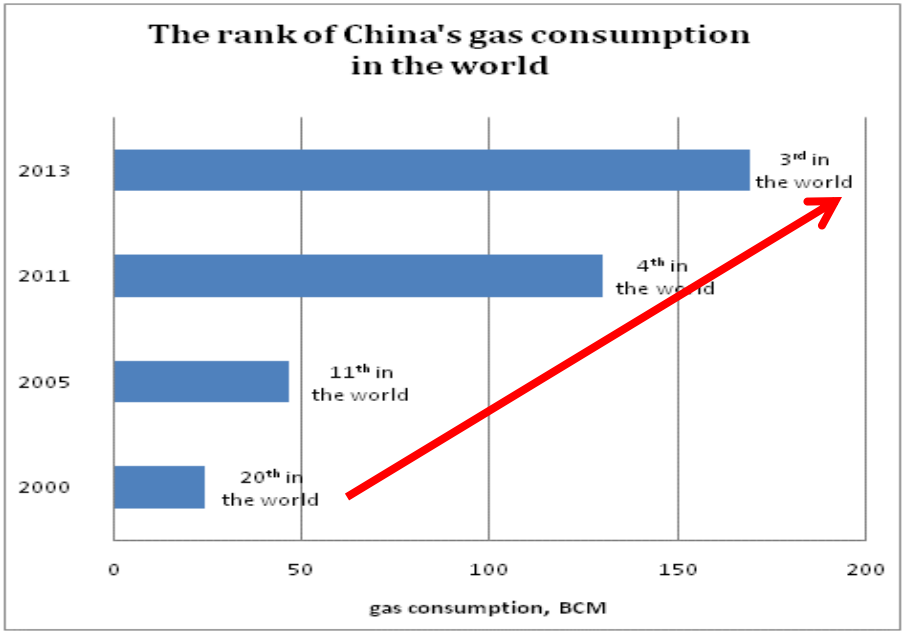

- Natural gas has been the fastest growing fuel in both supply and consumption in China's primary energy mix since 2000.
- China's gas consumption reached 169.7 BCM in 2013, 12.9% higher than that of 2013.
- Incremental demand for gas accounted for over 16% of the global incremental demand in 2012.
- Become the third biggest gas consuming country in the world in 2013.

Gas Supply Development in China

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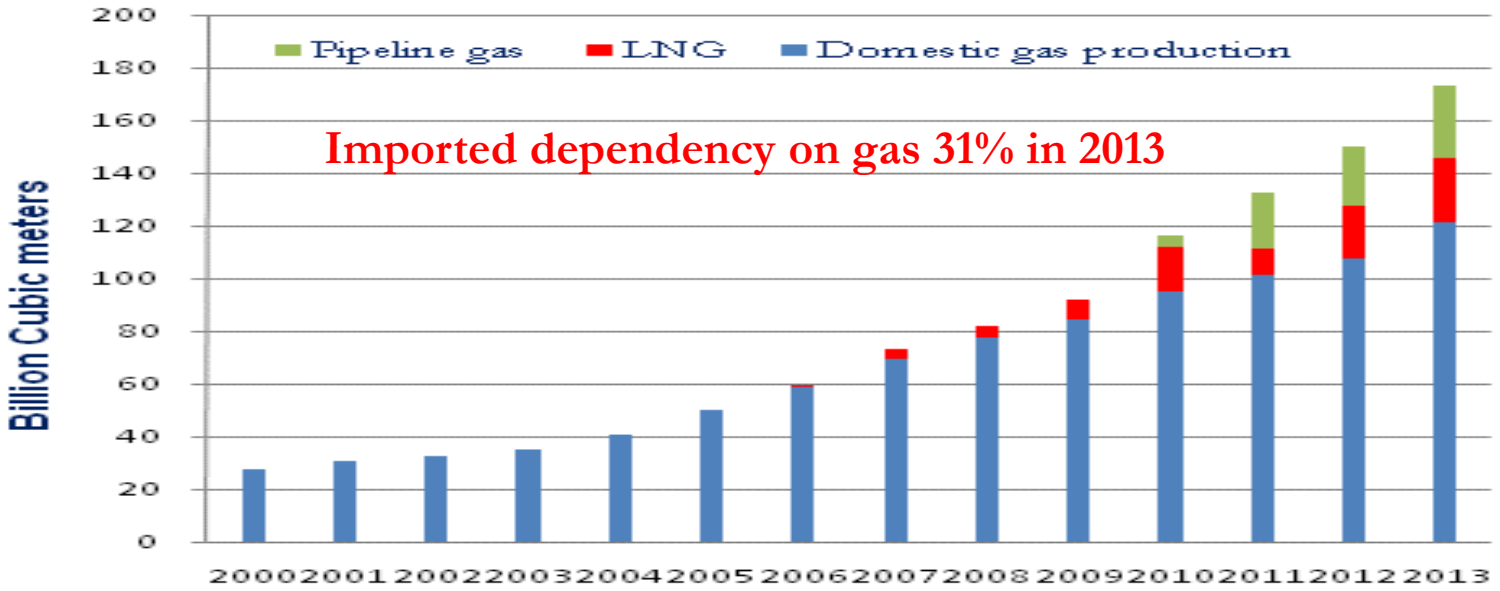
- In 2013, domestic gas production was 117.8 BCM, the 4th biggest gas producer in the world.
- 9 LNG receive terminals with the total capacity of 28 Mt/yr. and 5 ongoing LNG projects with the total capacity of 15 Mt/yr.
- West to East second gas pipeline and China – Myanmar gas pipeline have been put operation with import gas of 28 BCM in 2013.
- National pipeline trunk line network takes shape with the gas infrastructure build-up.



China Shale Gas Development Process

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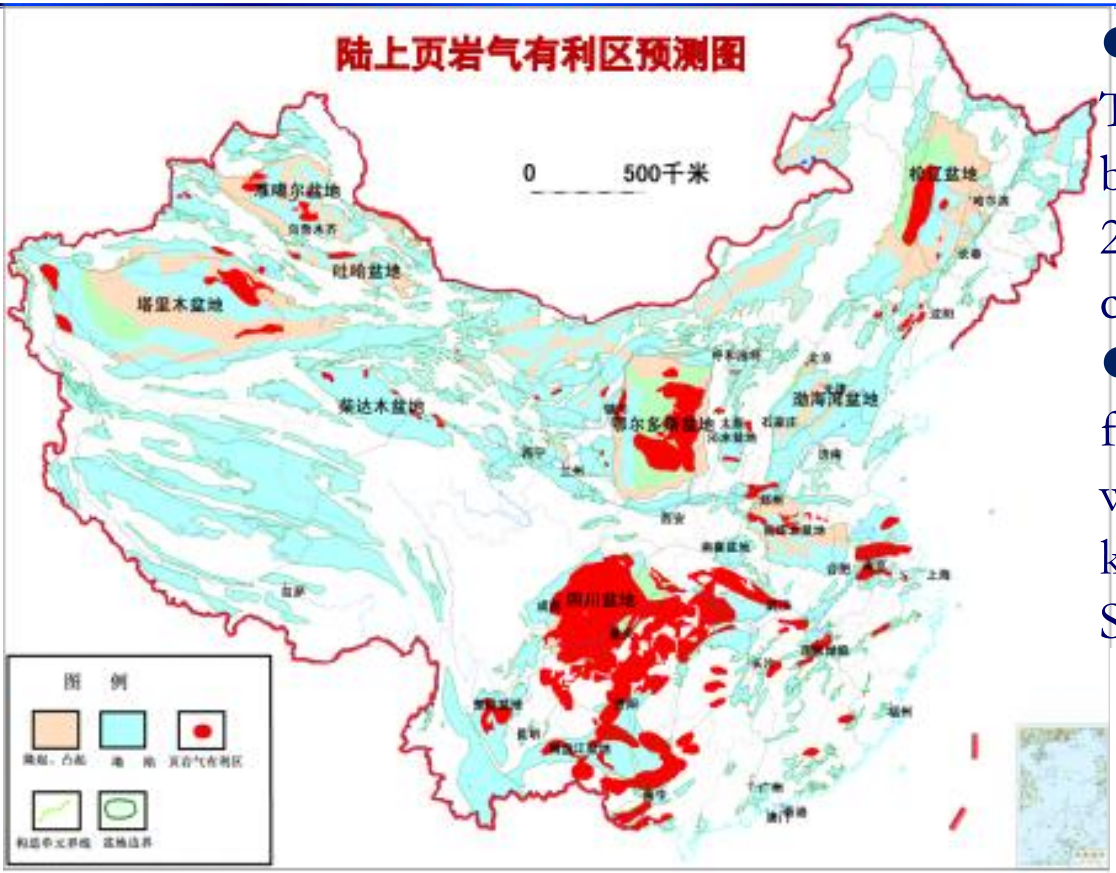
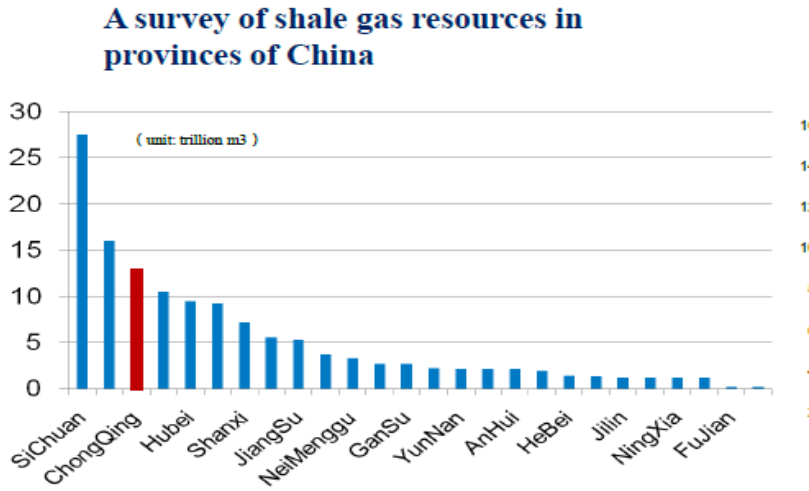
- 2004: Started tracking research and investigation on oversea shale gas development by MLR
- 2009: Started evaluation of shale gas resources potential and favorable blocks discrimination for key areas;
- 2011: Started evaluation of national shale gas resources potential and favorable blocks discrimination;
- 2011: Defines shale gas as an independent mineral(172) by the State Council
- 2011: Successfully drilled the first shale gas well in China(Pengshui, Chongqing)
- 2011: Conducted the first round of exploration right bidding;
- 2012: Shale Gas Development Plan (2011-2015)
- 2012: Conducted the second round of exploration right bidding
- 2012: Subside policy to shale gas
- 2013: the Shale Gas Industry Policy by NEA

Shale Gas Resources and Its Distribution

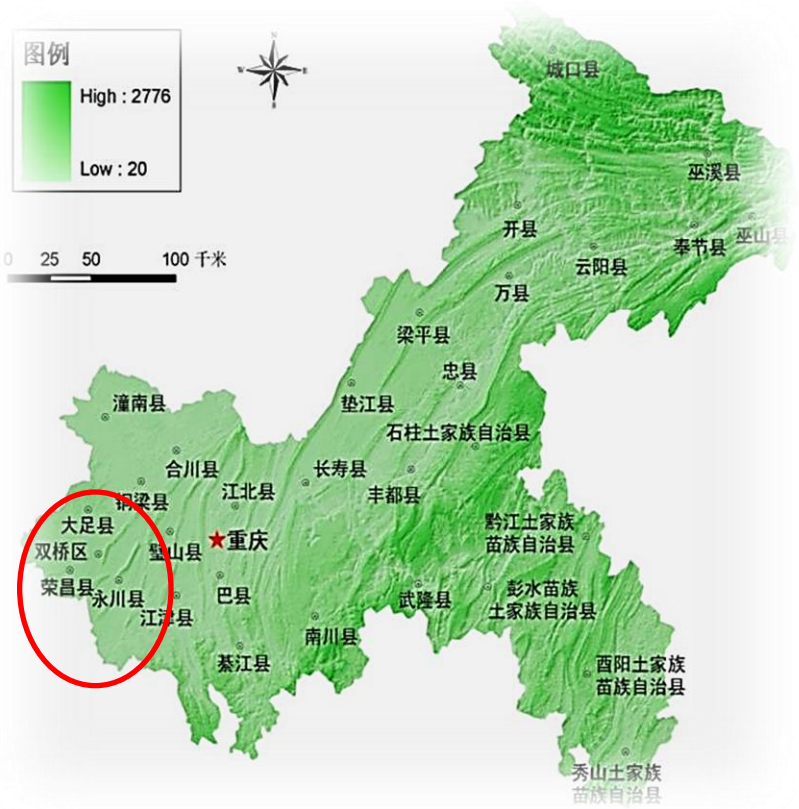


- China is rich in shale gas resources. The recoverable reserves, which is buried below 4500 meters, amounts to 2.5 bcm that is close to the reserve of conventional NG(2.2bcm).
- During the period 2011-2013, 233 favorable blocks have been selected with accumulative areas of 88 10^4 km^2. They are mainly distributed in Sichuan, Chongqing & Guizhou, etc.



Source: MLR report

- 50 wells has been drilled in Weiyuan-Changning, Zhaotong and Fushun-Yongchuan blocks (23 vertical wells and 27 horizontal wells), of which 6 horizontal wells delivered initial daily output of over 100,000m^3, producing 79.22 million m^3 shale gas on a cumulative basis.
- The Weiyuan-Changning block produced 10.20 million m^3 shale gas in 2012 and developed and utilized 2.50 million m^3 in 2013.
- The Zhaotong block in Yunnan developed and utilized 1.88 million m^3 in 2013.
- The first shale gas pipeline has been built.



SINOPEC

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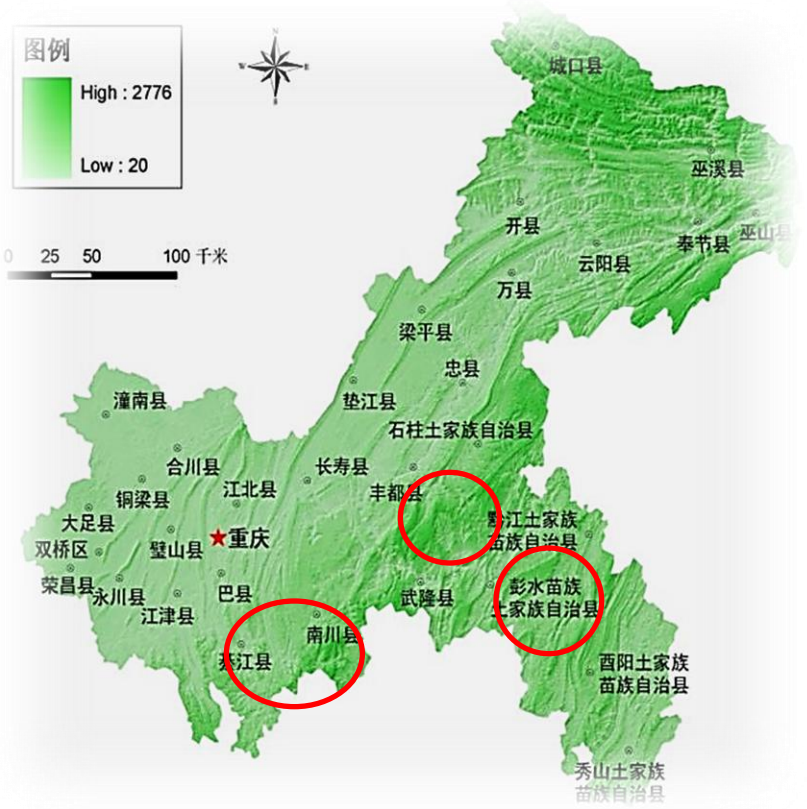
- Started shale gas geology research and block evaluation in 2006.
- Made major breakthroughs in marine shale gas in Fuling, Chongqing in 2012 and started capacity building in 2013.
- So far, finished drilling 79 wells, 21 of which have daily output of over 100,000 m^3.
- The maximum daily output of Pengye HF-1 in the Pengshui block is 25,000 m^3.
- The Jiaoshiba region has produced 150 million m^3 of shale gas.



Yanchang Petroleum

- Started research of shale gas in 2008;
- Approved the establishment of Shaanxi -Yanchang continental shale gas demonstration base;
- Successfully drilled the first shale gas well in China in 2011(2350m^3/day);
- Finished drilling 39 wells (3 vertical wells and 4 horizontal wells), with the maximum daily output of 8,000m^3/day,

Other Blocks

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序号	中标企业	区块名称	区块面积（平方公里）	2013年完成工作量			
				航遥测量（平方公里）	大地电磁（公里）	二维地震（公里）	钻井（口）
1	中国石油化工股份有限公司	渝黔南川	2197.9			830	1
2	河南煤层气有限公司	重庆秀山	2038.87		20.4	523.5	1
3	华电煤业集团有限公司	贵州绥阳	1204.5			391.8（未完）	
4	中煤地质工程总公司	贵州凤岗1	1053.37			540（未完）	
5		湖南桑植	760.36			490（未完）	
6	贵州永泰能源页岩气开发有限公司	贵州凤岗2	1030.4			305.34	
7	北京泰坦通源天然气资源技术有限公司	贵州凤岗3	1167.49			288.3	1
8	铜仁市能源投资有限公司	贵州岑巩	914.63		250	430.23	1
9	重庆市能源投资集团公司	重庆黔江	1272.4			402.7	3
10	重庆矿产资源开发有限公司	重庆酉阳东	1002.09	1002.09	29	329	2
11	国投重庆页岩气开发利用有限公司（国家开发投资公司）	重庆城口	1020.95			12.68	3
12	湖南华晨能源投资发展有限公司	湖南龙山	878			245	
13	神华地质勘查有限责任公司	湖南保靖	1189.7			325	1
14	中国华电工程（集团）公司	湖南花垣	400.43			206.31	
15	湖南省页岩气开发有限公司（中国华电工程（集团）有限公司）	湖南永顺	982.23			281.71	
16	华电湖北发电有限公司（中国华电工程（集团）有限公司）	湖北鹤峰	2306.71			434.31	
17		湖北来凤咸丰	369.23			210.65	
18	江西省天然气（赣投气通）控股有限公司	江西修武	598.28			275	
19	安徽省能源集团有限公司	浙江临安	580.09			493	
20	河南豫矿勘查投资有限公司	河南温县	1377.909			130.27	
21		河南中牟	1395.992			156.28	
合计			23741.531	1002.09	299.4	6167.58	13

Achievements Made in Shale Gas Development

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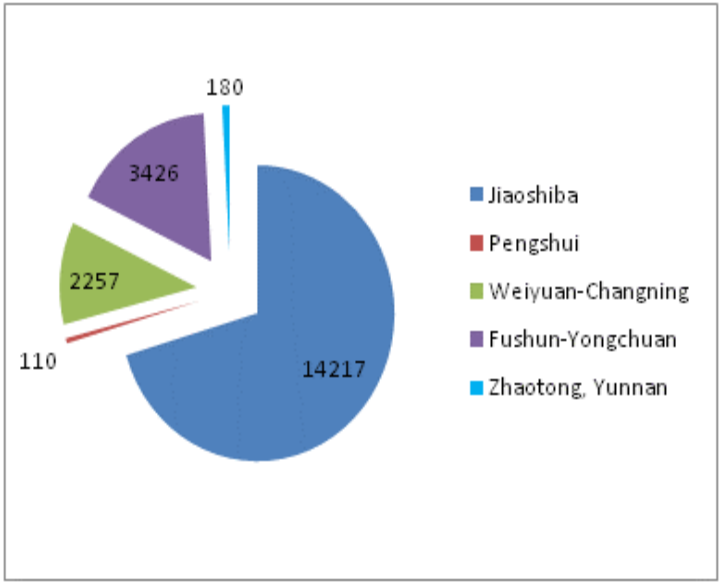
- By the end of July 2014, China's cumulative investment in shale gas development amounted to RMB 20 billion, with 400 shale gas wells drilled on a cumulative basis, including 130 horizontal wells.
- China produced 25 million m^3 of shale gas in 2012. The figure grew eight times to 200 million m^3 in 2013.
- Sichuan and Chongqing are now producing most shale gas, while established capacity is not available in other blocks yet.

Shale gas production mix in 2013



Status on Coal Bed Methane (Coal-Mine Gas) Development

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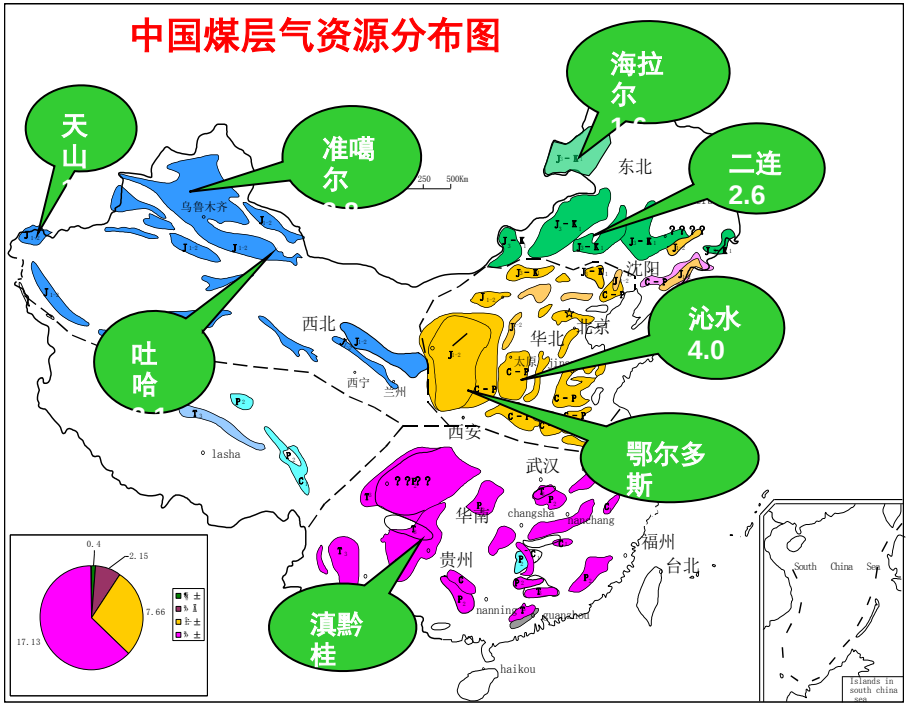
- China' CBM resources: 36.81 Tcm (no deeper than 2,000 meters underground in five major accumulated gas belts and forty coal basins)
- CBM production(including Coal-Mine Gas) in 2013: 15.6 Bcm
- 5 CBM pipelines with the transportation capacity of over 10.2 billion m^3has been constructed and 3 CBM pipelines with the capacity of 3.4 billion m^3 are under construction.



Coal Bed Methane (Coal-Mine Gas) Outlook

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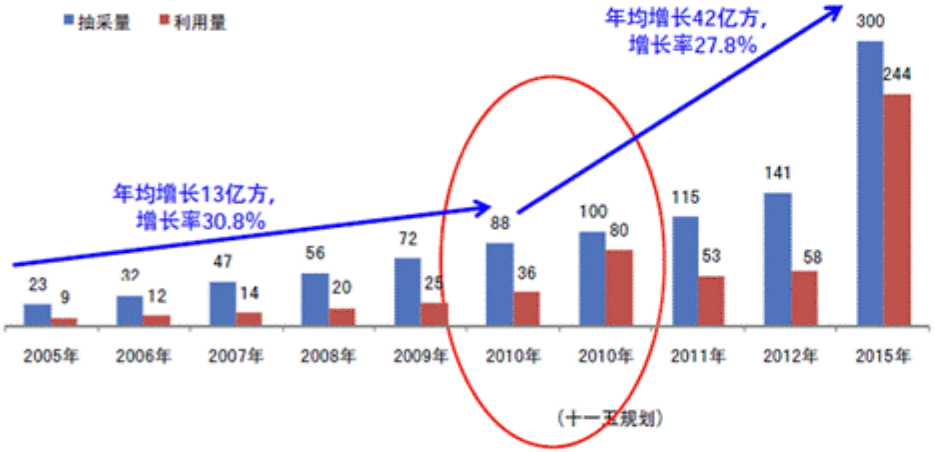
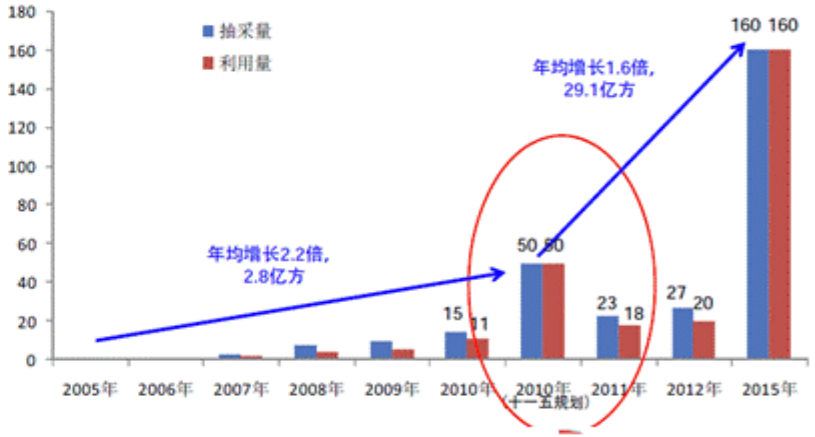
- Targets by 2015 (the 12th five-year plan for CBM development):
  - The incremental proven CBM reserves: 1 Tcm
  - CBM production(coal mine gas): 30 Bcm
  - Building CBM industry bases, such as Qinshui Basin, eastern margin of Ordos basin
  - Investment in exploration and development of CBM (2011-2015): 120 Billion yuan RMB





Major Challenges in Unconventional Gas Development

- Evaluation of China's unconventional gas resources is at the initial stage
  - Although generally believe that China's shale gas resource is rich, but the resources assessment also has bigger difference.
  - Key problems in the previous resource assessment
    - ✓ Inconsistent assessment standards
    - ✓ Uncertain amount of resources
    - ✓ Not decide favorable areas and "sweet spot"
- Be lack of the technical know-how for unconventional gas resource exploration & development

Release Time	Research Institute	Recoverable resources (Tcm)
2008.6	University of Geosciences （Pro. Zhang Jinchuan）	15-30
2009.12		26
2010. 9	Research Institute of petroleum exploration and development of Langfang branch （Liu Honglin）	21.5-45 Mid 30.7
2011. 4	EIA	36. 1
2012. 3	Ministry of Land and Resources	25.08（Tibet not included
2012. 7	The Chinese Academy of Engineering	11. 5
2012. 8	Research Institute of petroleum exploration and development （Li Jianzhong）	15-25
2013. 5	EIA	31.6

Major Challenges in Unconventional Gas Development

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- **Low-cost exploration of unconventional gas is necessary**

Low production

	Vertical well(m^3/d)	Horizontal well(m^3/d)
CBM	1500～4000	10000～40000
Shale gas	3000～10000	1000～70000

  - **Localization of imported equipment and technology**
  - **Service expertise**
  - **Equipment and technology improvement**

- **Mining right issue**
  - Central Government or Local Government?
  - How to Access and Quit

Major Challenges in Unconventional Gas Development

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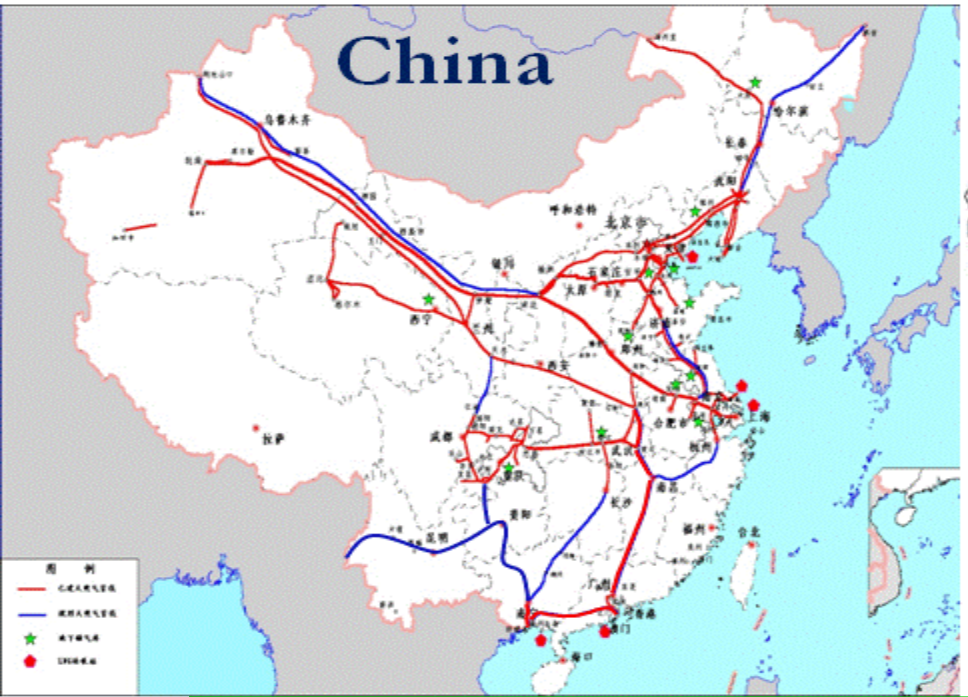
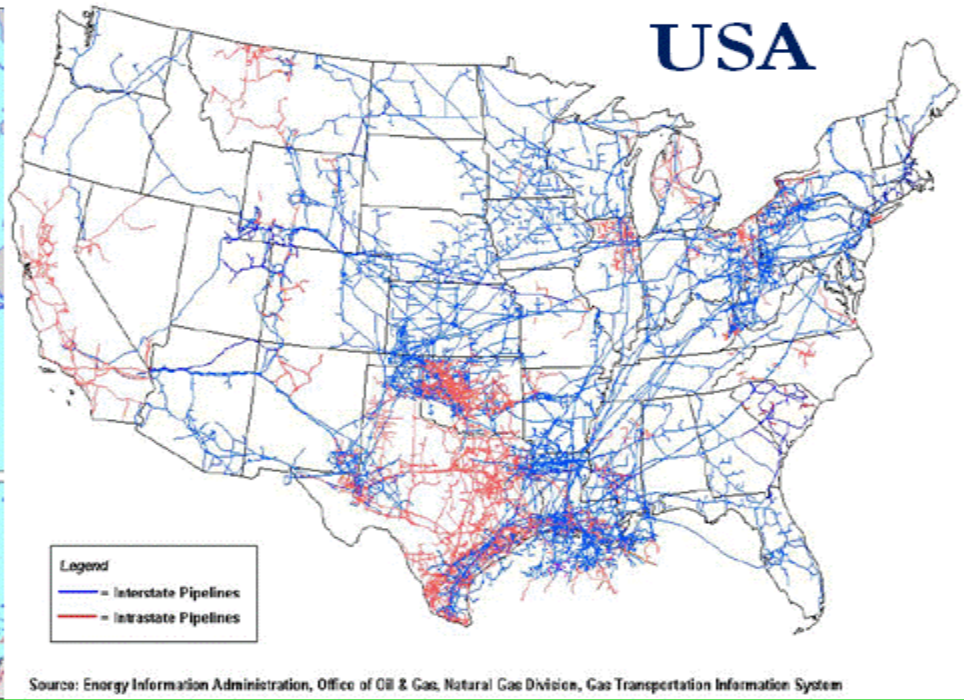
- **Gas infrastructure and the third-party pipeline accessibility**
  - Gas infrastructure: 60 thousand km VS 49 thousand km
    - Be specially lack of gas infrastructure in unconventional gas resources areas
  - The third-party pipeline accessibility
  - Road infrastructure need to upgrade





Major Challenges in Unconventional Gas Development——shale gas

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- Environment issues and regulatory challenges
  - Water availability in shale gas development
    - ✓ regional water shortage, seasonal shortages, project-use water shortage in West China
  - Potential environmental risks in groundwater, surface water pollution, land pollution, and greenhouse gas emissions caused by methane gas leaks
  - Acreage access and population density
    - ✓ acreage access is more difficult & industrial land acquisition costs in China are high
    - ✓ land remediation cost high
  - Effective environmental regulation and supervision of drilling and developing process of unconventional gas resources

Unconventional gas development's effect on China's Economy

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- As a clean and higher efficient fossil energy, unconventional gas is the important pillar of low-carbon economy;
- Shale gas will become one of the most important supplementary resources for natural gas supply;
- Unconventional gas development is making contribution to reforms in the oil and gas sector;
- Unconventional oil and gas technology R&D will trigger a leap in the energy industry in manufacturing level, production efficiency and progress of industrial organization form.
- Be very conducive to promote transformation and upgrading of the energy industry, drive the development of local and even national economy.

Conclusion

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- China has abundant unconventional gas resources and basic geological conditions to speed up unconventional gas development.
- China's unconventional gas industry will certainly develop fast with the continuous improvement of the technologies, and improve exploration right management, environment supervision and accelerating national gas pipeline network construction as well as establishing the third-party access to the pipelines etc.
- The unconventional gas will make a significant contribution in improving the energy mix, ensuring energy security and environmental protection of the country.

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감사합니다!

ありがとう!

谢谢!

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