China Energy And Shale Industry

May, 2015

ECF Introduction

- Leading China Energy Thinking Tank and Research & Consulting Institution in Asia, focus on multilayer China energy development & integration among Governmental Energy Agency, Private Energy Enterprise, R&D and Financial Institution from policy/strategy development, market standardization, business practice establishment, energy education to a wide range of energy consulting practice.

ECF Founders

Shanghai Academy of Social Sciences	Shanghai Environment Energy Exchange	China Petroleum Pipeline Bureau	SZ Energy Intelligence Co.,Ltd	Baker's Institute for Public Policy,Rice University
China's Largest Regional Academy for Social Sciences	A Comprehensive Trade Platform for Environment and Energy Equity	Major Oil&Gas Pipeline Engineering and Constrution Company in China	China Independent Energy Consultant	Top 30 Energy Think Tank in United States

Introduction - ECF

ECF – Develop network with U.S. based Global Energy HQ to improve and strengthen existing U.S.- SINO bilateral energy business relationship and to establish business opportunity for energy collaboration between the two nations.

ECF - To develop new product, establish quality and standard for China unconventional energy industry and to support players to promote its business principle and practice in China.

ECF – In exploration to develop the 1st China Energy Trading Facility for technology, equipment, supply chain, financial investment, legal consulting, and insurance service in Shanghai Free Trade Zone.

ECF Values

- US Technology export to China
- Chinese Capital Investment for US Energy
- Chinese Energy Equipmet/Material Export to US

ECF Historical Activity

Introduction - ECF

ECF Partnerships

COORDINATING COMMITTEE FOR GEOSCIENCE PROGRAMMES
IN EAST AND SOUTHEAST ASIA
(CCOP)

CCOP Building
75/10 Rama VI Road Phayathai,
Ratchathewi Bangkok 10400,
THAILAND

Tel: +66 (0) 2644 5468
Fax: +66 (0) 2644 5429
Email: ccopts@ccop.or.th
Web: http://www.ccop.or.th

CCOP-ECF / 699

16 October 2014

Mr Jeffrey Jiang
SZ Energy Intelligence Co., Ltd.
ECF International Shale Gas Forum
Tel: 0086-21-31159336
Fax: 0086-21-31159335
E-mail: ecfchina1@gmail.com

APPRECIATION LETTER
4th ECF Asia Shale Gas Summit (Shanghai) 2014 &
Asia Pacific Unconventional Resources Technology & Equipment Exhibition
Oct 14-16, 2014, Shanghai, China

Dear Mr Jeffrey Jiang,

Greetings!

The 4th ECF Asia Shale Gas Summit (Shanghai) 2014 and Asia Pacific Unconventional Resources Technology & Equipment Exhibition have been successfully co-organized on 14-16 October 2014 in Shanghai, China by the Energy China Forum (ECF) and the Coordinating Committee For Geoscience Programmes in East and Southeast Asia (CCOP). The workshop is kindly sponsored by Energy China Forum and co-hosted by Shanghai Energy Economy Committee, National Energy LNG R&D Center, CNPC, China Petroleum Pipeline Bureau, SZ Energy Intelligence Co., Ltd and Shanghai Academy of Social Sciences. There were attendants from governments and private sectors related to conventional and unconventional oil and gas resources, including resource persons and speakers from CCOP Member Countries (China, Cambodia, Thailand and Vietnam) and Director from CCOP Technical Secretariat.

On behalf of CCOP Technical Secretariat, we would like to deeply thank for ECF and all the co-organizers for continuing support, kind cooperation with CCOP and wonderful arrangement for CCOP participants during the meeting. We also acknowledge and thank you and Chinese colleagues, who worked hard for months and generously support, making this summit possible. It is obvious that all participants were interested in sharing national issues of potential and development strategy of shale gas, and will be possible to share experiences and information with fellow colleagues from CCOP and ASEAN countries.

We enjoyed meeting with you all and especially appreciated your ideas, commitments on cooperation opportunities in CCOP Member Countries. We also do hope that this meeting will develop our network, connect our ideas and foster suggestion about collaboration opportunities amongst East and Southeast Asia countries. Please accept our best wishes to you and all staff in ECF with much success, good fortune and above all Good Health!

Sincerely yours,

Dr. Adichat Surinkum
Director
CCOP Technical Secretariat

CITY OF HOUSTON

Annise D. Parker
Mayor

P.O. Box 1562
Houston, Texas 77251-1562

Telephone – Dial 311
www.houstontx.gov

October 14, 2014

Greetings,

As Mayor of the City of Houston, I welcome all those participating in the **Energy China Forum's (ECF) 2014 Asia Shale Summit and Unconventional Resources Exhibition**. This exhibition will focus on news of unconventional resources in China and the Asia-Pacific while looking at the latest developing technology and equipment.

As the energy capital of the world, the City of Houston is especially honored to have the Houston-based US China Partnership organization as a co-sponsor of the summit and looks forward to its continuing and long lasting relationship with **ECF**. We also wish the new Shanghai United Unconventional Resources Institute much success and invite the institute to work closely with the many, outstanding energy related organizations in the greater Houston region to develop its programs further and we look forward to heightened cooperation between Houston and the organizing committee of the **Energy China Forum**.

Houston has so much to offer, and I hope you will share in the Houston experience taking with you lasting impressions of the spirit, vitality and tradition that characterize our city.

Best wishes for a successful event.

Sincerely,

Annise D. Parker
Mayor

Council Members: Brenda Stardig Jerry Davis Ellen R. Cohen Dwight A. Boykins Dave Martin Richard Nguyen Oliver Pennington Edward Gonzalez Robert Gallegos Mike Laster Larry V. Green Stephen C. Costello David W. Robinson Michael Kubosh C.O. "Brad" Bradford Jack Christie

Controller: Ronald C. Green

ECF International Shale Gas Forum 2015

5th Asia Shale Gas Summit & APAC Unconventional Resources Tech & Equip EXPO

EnergyChinaForum.com

- Time: Oct 12-14, 2015

- Venue: Shanghai World Expo Exhibition & Convention Center, China

- Latest Energy Policy and Market Trend in China
- New Chinese Players – NOCs and IOCs
- Establishment of Reputation and Network in China
- Business Partners, Distributors, Investments
- Valuable Assets with Great Potential
- Asia Procurement Cernters for Energy Players in Shanghai

China Energy And Shale Industry

Content：

1. China energy/shale/natural gas industry policies
2. China Shale E&P Development
3. China Shale Technology
4. China Natural Gas Market
5. Challenges

China energy/shale/natural gas industry policies

China Energy Development Strategy Action Plan, 2014-2020

Unit: Bcf	Production in 2020
Conventional Gas	6533
Shale Gas	1059
CBM	1059
Total	2771

Unit:tcf	2020	2020-2050
Exploitable Natural Gas	50	28

Consumption Structure	2013	2020
Coal	66%	62%
Oil	18.40%	13%
Gas	5.80%	10%
Non-Fossil Fuel	9.80%	15%

China Gas Price Reform

	Gas Pricing Reform - in 2013	Gas Pricing Reform - in 2014
Effective Date	Effective on July 10th, 2013	Effective on September 01st, 2014
Main Reform	-City gate price shifts away from cost-plus system to net-back mechanism; -Two tiered city gate price system for non-residential gas user: existing gas supply & incremental gas supply; -The price for existing volume: approx.15% higher than pre-July 2013 regulated price, increased to an average RMB1.95/m³; -The price for incremental volume: approx. 85% of weighted average of imported fuel oil and LPG price, increased to an average RMB2.9/ m³; -Residential gas price remain unchanged; -The new city gate price applies to domestic onshore gas supply and pipeline imports only;	-The price changing for the existing non-residential gas is by a flat rate of RMB0.4 ($1.69/MMBtu); - The price rose from last reform at RMB1.95/m³ to RMB2.35/m³ ($10.59/MMBtu); - Residential gas price remain unchanged; - Continue to open and implement ex-work price policy for LNG imports, unconventional gas (shale gas, coal-bed methane and coal-to-gas), its ex-work price shall be set up by market, pipeline transport tariff is charged by delivery price regulations;
The latest gas price after adjustment	-Existing gas (non-residential user): RMB1.95/m³ ($8.9/MMBtu) -Incremental gas (non-residential user): RMB2.9/m³	-Existing gas (non-residential user): RMB2.35/m³ ($11.33/MMBtu) -Incremental gas (non-residential user): RMB2.9/m³ ($13.3/MMBtu)

Avg. City-Gate Price after Apr 1st, 2015: RMB2.51/m³ ($11.5/MMBTU)

China LNG Import Cost in 2015 ($/MMBTU)

January	11.19
February	10.42
March	10.19

Shale Subsidy

	RMB/m^3	USD/MMBTU
2012-2015	0.4	1.83
2016-2018	0.3	1.38
2019-2020	0.2	0.92

In Sichuan, shale production reached 1,790 MMcf, with $3.3MM of subsidy applied in 2013 mainly by CNPC.

In Chongqing, Sinopec produced 4.6 bcf of shale gas with $8.7MM subsidy applied in 2013.

Foreign Investment in China Energy Industry

Catalogue for the Guidance of Foreign Investment Industries (Revision 2015)

by National Development and Reform Commission and Ministry of Commerce, effective as of Apr 10th, 2015

- **Mineral:** oil, gas (oil shale, oil sand, shale gas, CBM) E&P; Stimulation (engineering service); Technology development in geophysical prospecting, well drilling, logging, downhole operation;

- **Chemical:** Oil additives, Surfactant, Water treatment agent, Adhesive; Wastewater utilization and treatment

Foreign Investment in China Energy Industry

- **Special Equipment Manufacturing:** Geophysical prospecting, logging equipment; MEME; Digital telemetry seismograph; Digital imaging, computerized logging system; Horizontal, directional well drilling apparatus and instruments; MWD LWD tools; Unconventional water processing, recycling equipment and monitoring device;

- **Transportation Equipment Manufacturing:** Oceanic engineering equipment (module) construction and repairing (Chinese partner shall hold the majority of shares)

China Shale Operation PSC

1. No material difference from the PSC for conventional
2. From a regulatory perspective, Shale Gas is considered independent mining resources, unlike CBM, which is covered under Onshore Regulations like other conventional resources operation
3. The same Pilot Program concept do exist
4. Relinquish commitment remains part of bid despite the argument of it being conter-productive
5. Sole Risk and Non-Consent are retained, different from the 1982/1989 AAPL Operating Agreement

Action Plan for Water Pollution Prevention and Control

by State Council

- General Guideline Followed with More Detailed Regulation & Compliance, for Shale Production e.g.
- Positive Policy Signal for Water Processing, Environment Assessment & Protection Industry

China Shale Industry Policies Prospect

- **3rd round of shale block auction**
- **Shale gas standard system**： **resources assessment, drilling, well control, fracturing and environment protection**

China Shale E&P Development

China Shale E&P Target

China's resources are estimated at 882.8 tcf of exploitable shale gas, according to the Ministry of Land and Resources (MLR) .

The National Development and Reform Commission(NDRC） announced that the government target was to increase the production of shale gas to 229.5 bcf annually by 2015 and 1.06 tcf (30 bcm) annually by 2020.

China Shale Gas Potential

Size of Assessed Shale Gas, at Basins----published by MLR, Mar 2012

盆地或地区名称 Basins	地质资源量（万亿英尺）Geological reserves(tcm)	所占比例 Proportion（%）	技术可采资源量（万亿英尺）Technically recoverable(tcm)	所占比例 Proportion（%）
四川盆地及周缘地区 Sichuan Basin	1，412	29.77	227.4	25.67
黔中隆起及周缘地区 Central Guizhou Uplift	510	10.74	66	7.45
鄂尔多斯盆地及外围地区 Ordos Basin	417	8.79	95.7	10.80
塔里木盆地 Tarim Basin	350	7.37	55.8	6.30
准噶尔盆地 Junggar Basin	131.7	2.78	35.3	3.99
中扬子地区 Middle Yangzi Platform	346.4	7.30	56.2	6.34
下扬子地区 Lower Yangzi Platform	209.8	4.42	37.8	4.26
松辽盆地及外围地区 Songliao Basin	208.4	4.39	58.3	6.58
渤海湾盆地及外围地区 Bohai Bay Basin	178.7	3.76	47.3	5.34

Major Projects

List of Shale Projects with Biggest Potential Production

Owner	Block	Location
CNPC	Changning-Weiyuan	Sichuan
CNPC & Shell	Fushun-Yongchuan	Sichuan
Sinopec	Yuanba	Sichuan
CNPC	Zhaotong	Yunnan
Sinopec	Fuling	Chongqing

Major Progress

Total Investment	$3.23b
Total Well	400
Horizontal Well	130
Total Capacity	64bcf

By Oct, 2014, China is capable of horizontal well drilling and fracturing at 13,000 ft depth with 26 stages (7,000 ft max length). Some reached 15,000 ft depth.

Major Players

Sinopec in Fuling, Chongqing

Total 253 wells in 2015

$3.5b in 2015

35 bcf in 2014

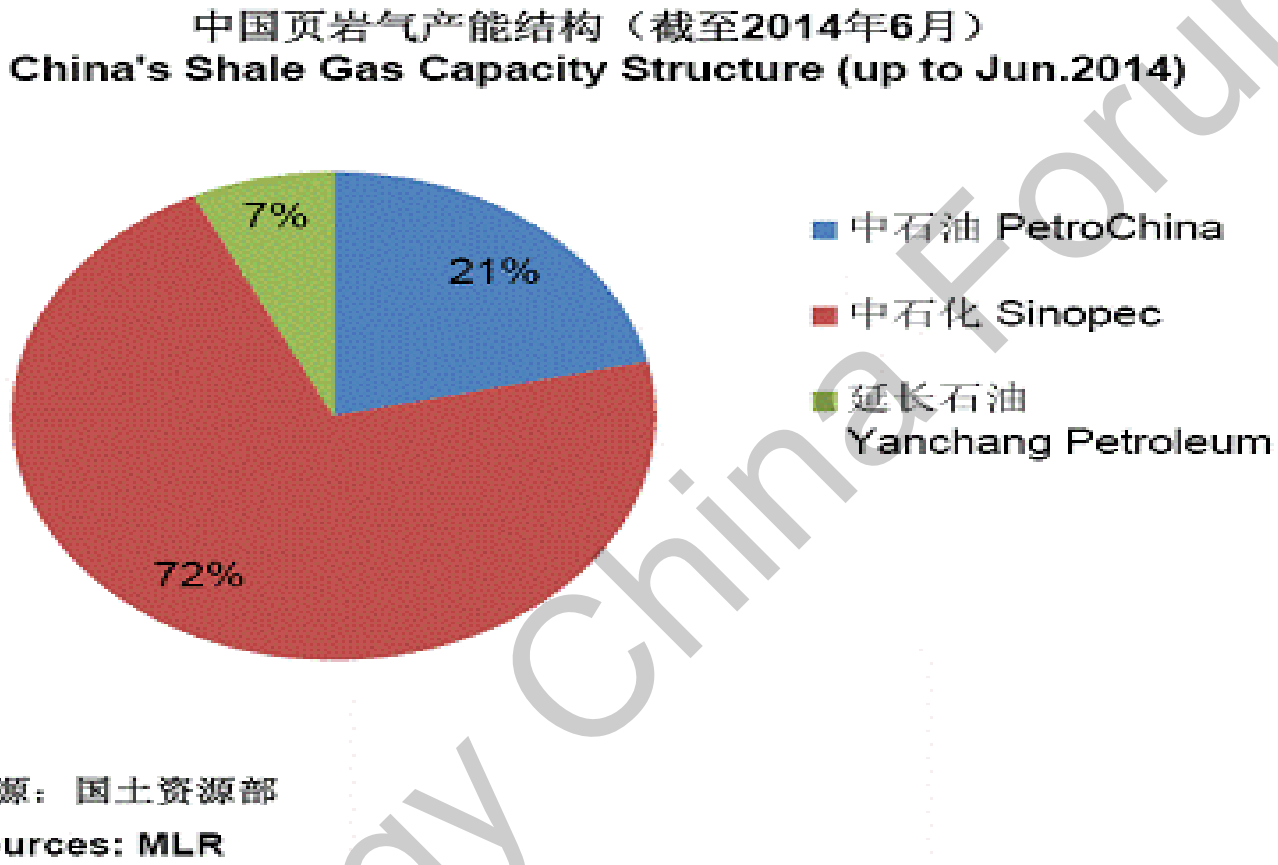
123.6-141.3 bcf in 2015

CNPC in Sichuan and Chongqing

154 wells in 2014-2015, 94 wells already finished

88.3 bcf in 2015

Exploration Progress



China had invested $ 2.38 billion in shale gas exploration and had drilled 322 shale gas wells by April 2014. 52 mining rights of shale gas had been allocated, covering an area of 63,321 square miles, mainly in the Sichuan Basin.

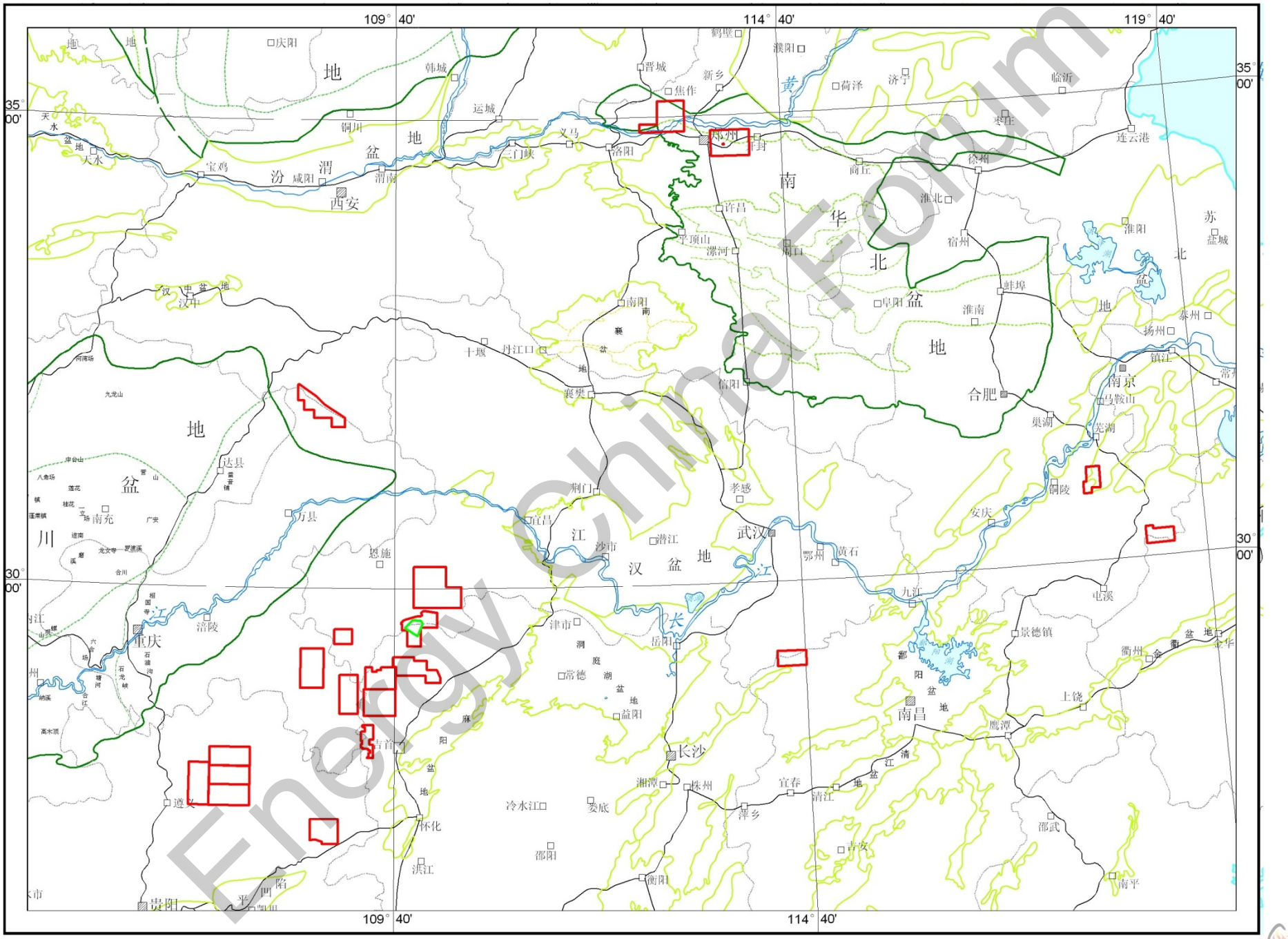
Shale Gas Auction

First auction of shale gas blocks

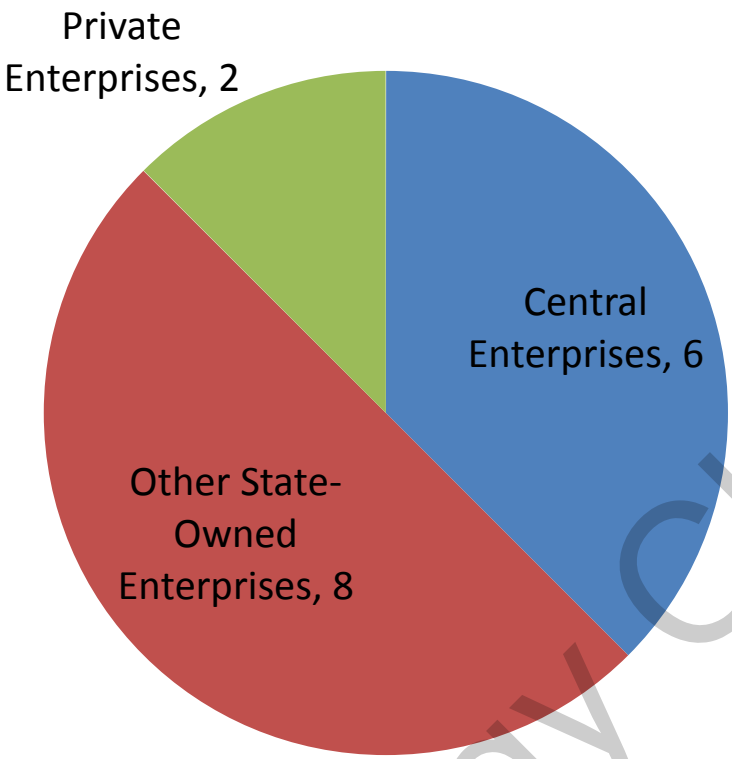
Time: 2011
Bidders: 6 Stated Owned Enterprises
Winners: 2 SOEs – Sinopec and Henan CBM Group
Block: over 772.2 mi^2 each
Location: Chongqing and Guizhou Province, Southwest China

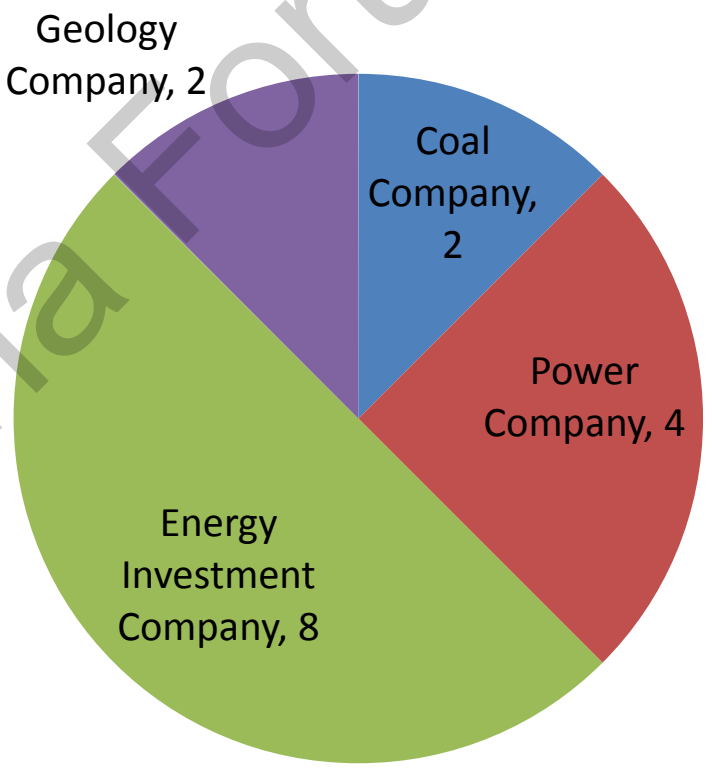
Second auction of shale gas blocks

Time: 2012
Bidders: 83 Companies, 1/3 Private
Winners: 16 Companies
Block: Over 7,723 mi^2 total, from 142 mi^2 to 772 mi^2



Shale Gas Auction Winners





Exploration Progress for 2nd Auction Blocks

Depth: 5,000 - 12,000 ft

What had been done in 2014:

2D Seismic Exploration, Geological Profiling, Sampling & Explanation, etc.

What to be done in 2015:

Test Wells, Logging & Analysis

China Shale Technology

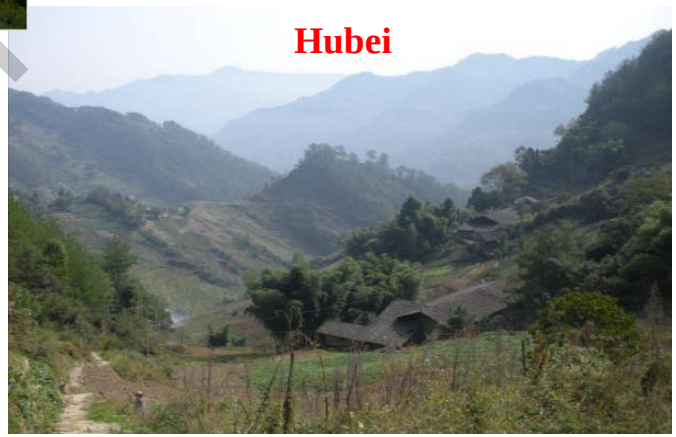
Construction Technology for China Shale Wells

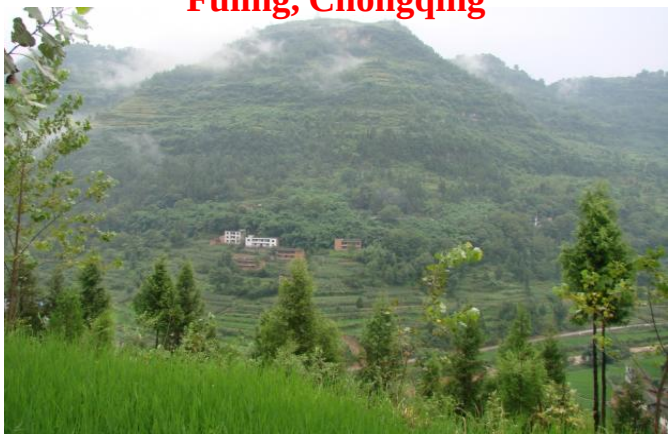
Well#	Technology	Well#	Technology
Weiyuan 201-H1	Bridge Plug + Wireline Perforating Fracturing	Yuanba 9	
Jian 111	Bridge Plug + Wireline Perforating Fracturing	Miye HF-1	Bridge Plug + Wireline Perforating Fracturing
Jianye HF-1	Bridge Plug + Wireline Perforating Fracturing	Huangye 1	Vertical
Pengye 1	Bridge Plug + Wireline Perforating Fracturing	Tun 1	
Xiangye 1		Yuye 1	
Yang 101		Jiao 68-2H	Bridge Plug + Wireline Perforating Fracturing
Jiao 68-1H	Bridge Plug + Wireline Perforating Fracturing	Cenye 1	
Liuping 177		Zheng 102	
Zhao 101		Fangshen 1	Vertical
Anshen 1井	Bridge Plug + Wireline Perforating Fracturing	Yang 1	
Xuanye 1		Boyeping 1	Bridge Plug Fracturing

Parameter	Fangshen 1	Anshen 1	Jian 111	Heye 1	Yuanba 9	US
Thickness	246ft	295ft	118ft	84ft	246ft	>100ft
Depth	5,700ft	8,200ft	2,060ft	7,054ft	13,400ft	<10,000ft
Resevior Temp	140℉	<90℉			210℉	<275℉
Organic Carbon	>2%	2.54%	0.71%	2.56-3.67%	2.54～3.69%	>2%
Thermal Evaluation		0.52-1.08%		2.62-2.80%	1.7%	1.4-3.5%
Mechanical Property		μ=0.21-0.24E=23-31Gpa	μ=0.31E=26.3Gpa	μ=0.198-0.354E=25.49-33.20Gpa	μ=0.30 E=25.4-31.3Gpa	μ=0.235-0.27E=27-33Gpa
Properties of Matter	K=0.05md	K=227nd Φ=6.67%	K=0.3-0.58nd Φ=3.8-4.5%	K=0.1-0.3nd Φ=2.4-3.6%	K=1nd；Φ=0.1%	K>100nd；Φ>4%
Silicon %		14.97	54.01	63.12	50	>30
Calcite / dolomite %		28.89	18.33	1-15.08，平均1.95		<20
Caly %		20.15	24.44	24.10	30	<25

Comparison for 3 Major Fracturing Technology		
Technology	Advantages	Disadvantages
Bridge Plug + Wireline Perforating	1.Mature technology; 2.Low risk; 3.HTHP, Large Displacement	1.Extra time; 2.Coild tubing standby; 3.Displacement needed.
Sliding Sleeve/Packer	1.Fast; 2.No cementing; 3.Natural crack on borehole undamaged	1.Unfit for a complex borehole; 2.Sand plug.
Hydraulic Jetting/Fracturing	1.Open-hole completion	1.Low displacement; 2.Lacking on-site operation experiences; 3.Unfit for horizontal staged fracturing.

Challenges





Major Challanges in Fuling Shale E&P

- Complex near-surface geological condition with underground rivers, caves and cracks as well as shallow gas and water; high risk for well loss and kick;
- Cluster Horizontal Wells: Offset distance – 1,000ft, Pre-target displacement – 2,600ft, Horizontal interval length – 5,000ft; Large friction torque, hard to control 3D wellbore trajectory；
- Collapse and well loss during fracturing and drilling causes underground fault；
- Unmatching technologies in the early exploration and development stage; high cost.

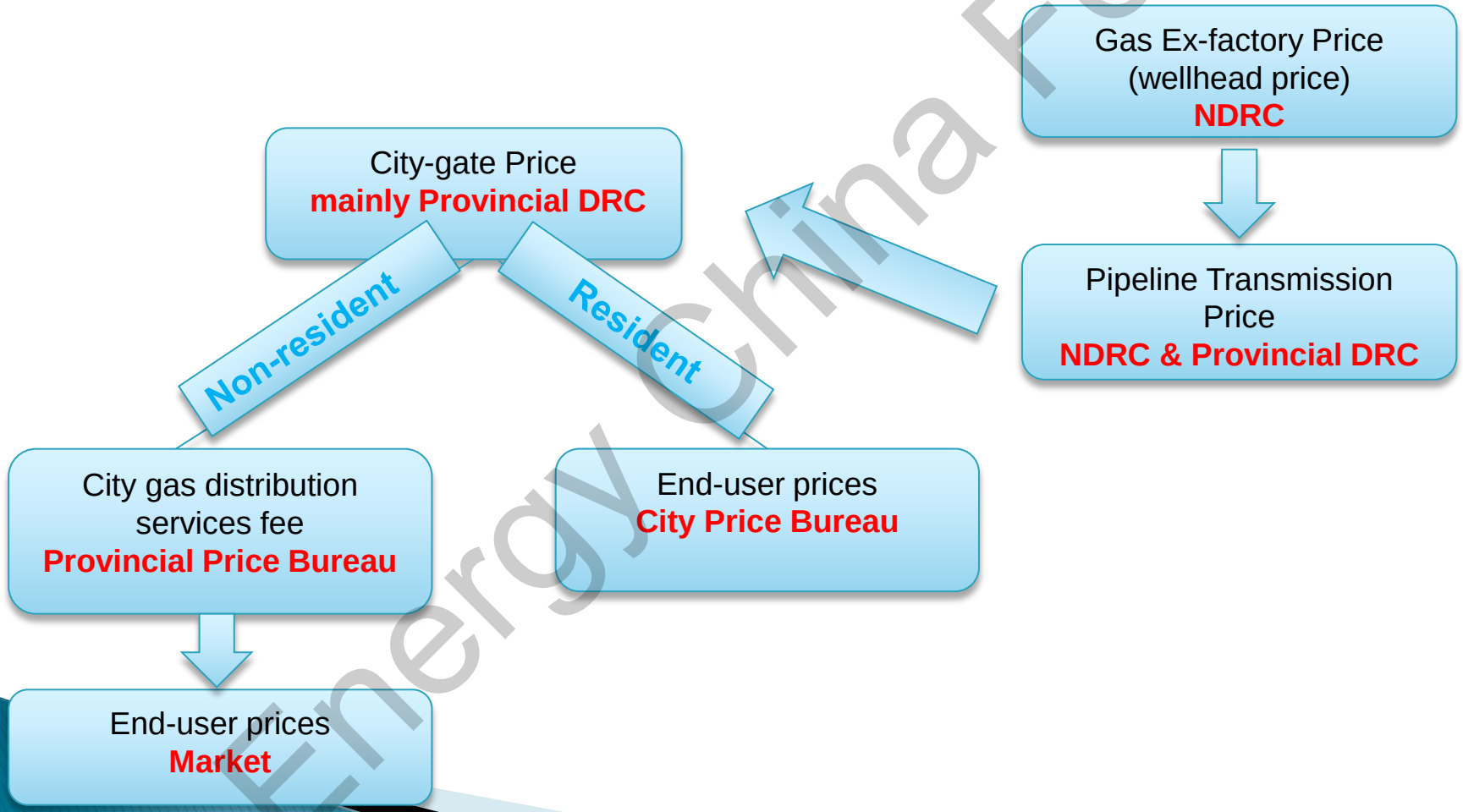
- Complex near-surface geological condition with underground rivers, caves and cracks as well as shallow gas and water; high risk for well loss and kick;
- Cluster Horizontal Wells: Offset distance – 1,000ft, Pre-target displacement – 2,600ft, Horizontal interval length – 5,000ft; Large friction torque, hard to control 3D wellbore trajectory；
- Collapse and well loss during fracturing and drilling causes underground fault；
- Unmatching technologies in the early exploration and development stage; high cost.

China Natural Gas Market

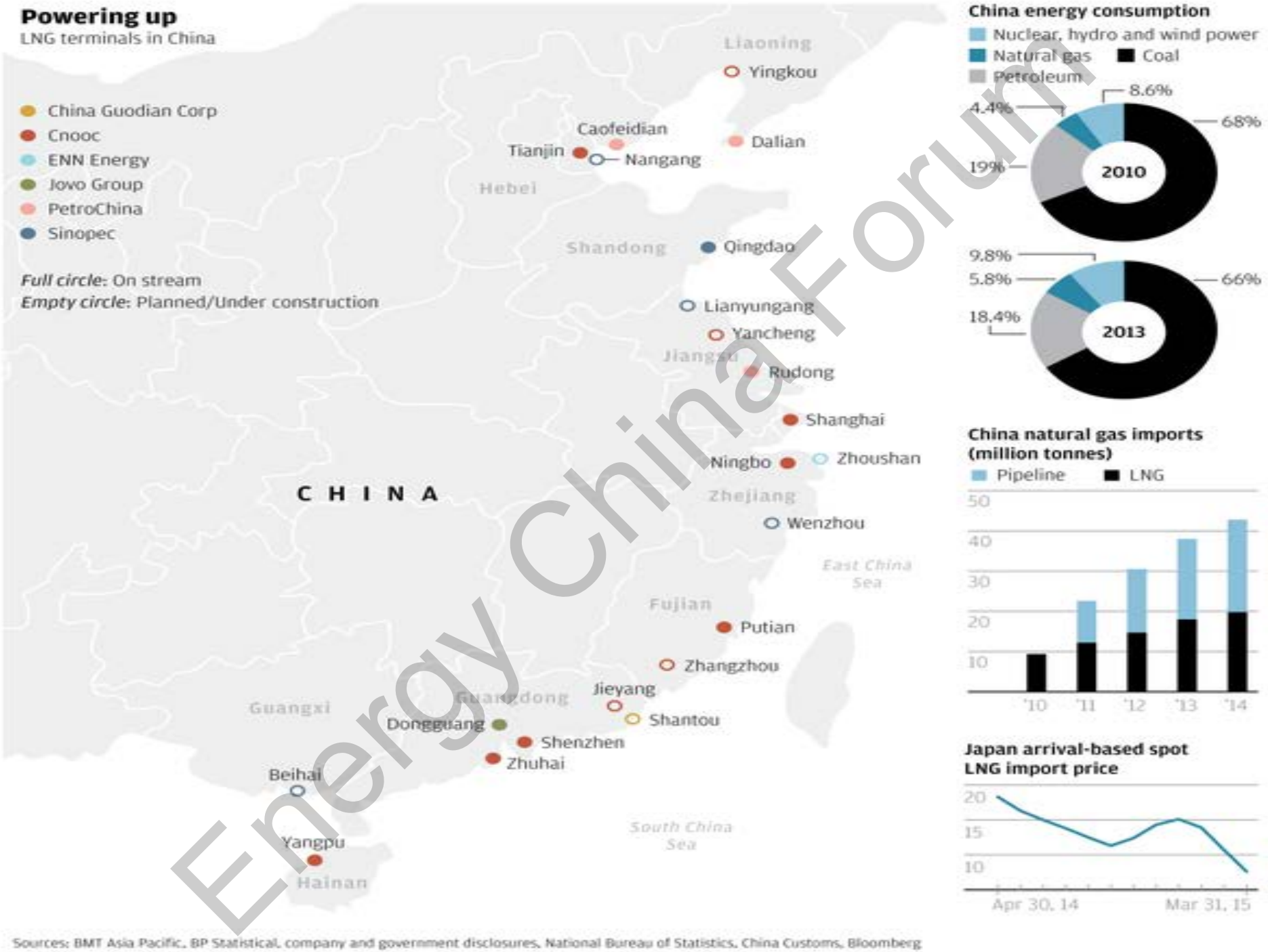
- Not a pure commercialized market with domestic market obligation
- Gas price reforms and pricing mechanism
- China wellhead gas prices (Sichuan)

China gas pricing mechanism

Prices & Supervising Departments：

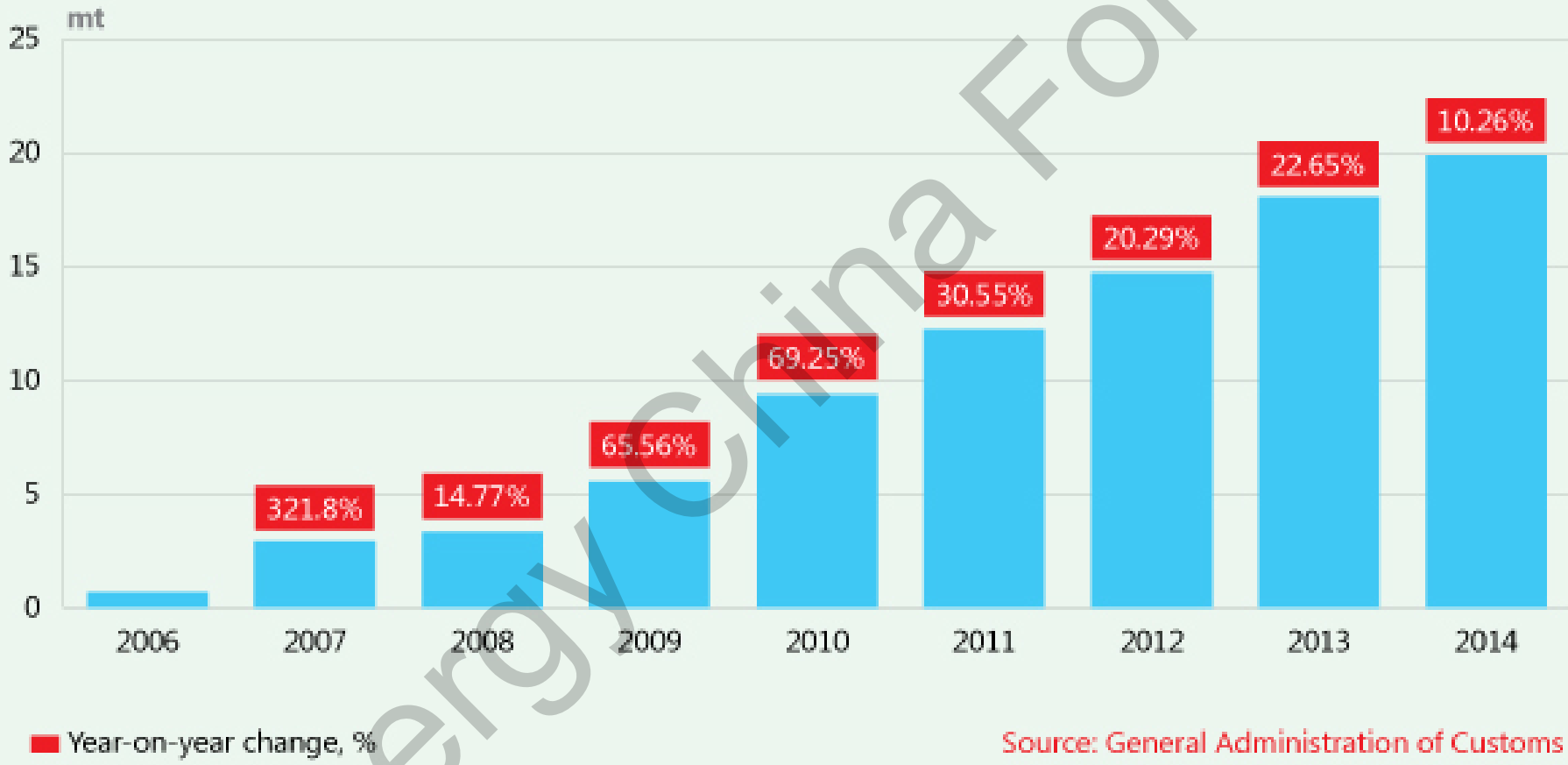


Shale vs Conventional Gas Cost	
Gas Field	Avg. Cost Estimated (USD/MMBTU)
Sichuan Shale (Early Stage)	4.17
Sichuan Shale (Maturation Stage）	3.21
Sichuan-Chongqing Gas Field	2.89
Changqing Gas Field	2.98
Qinghai Gas Field	2.75
Xinjiang Gas Field (WEP Field Excluded)	2.34
Others (Dagang, Liaohe, Zhongyuan)	2.75
US (Conventional, Shale)	



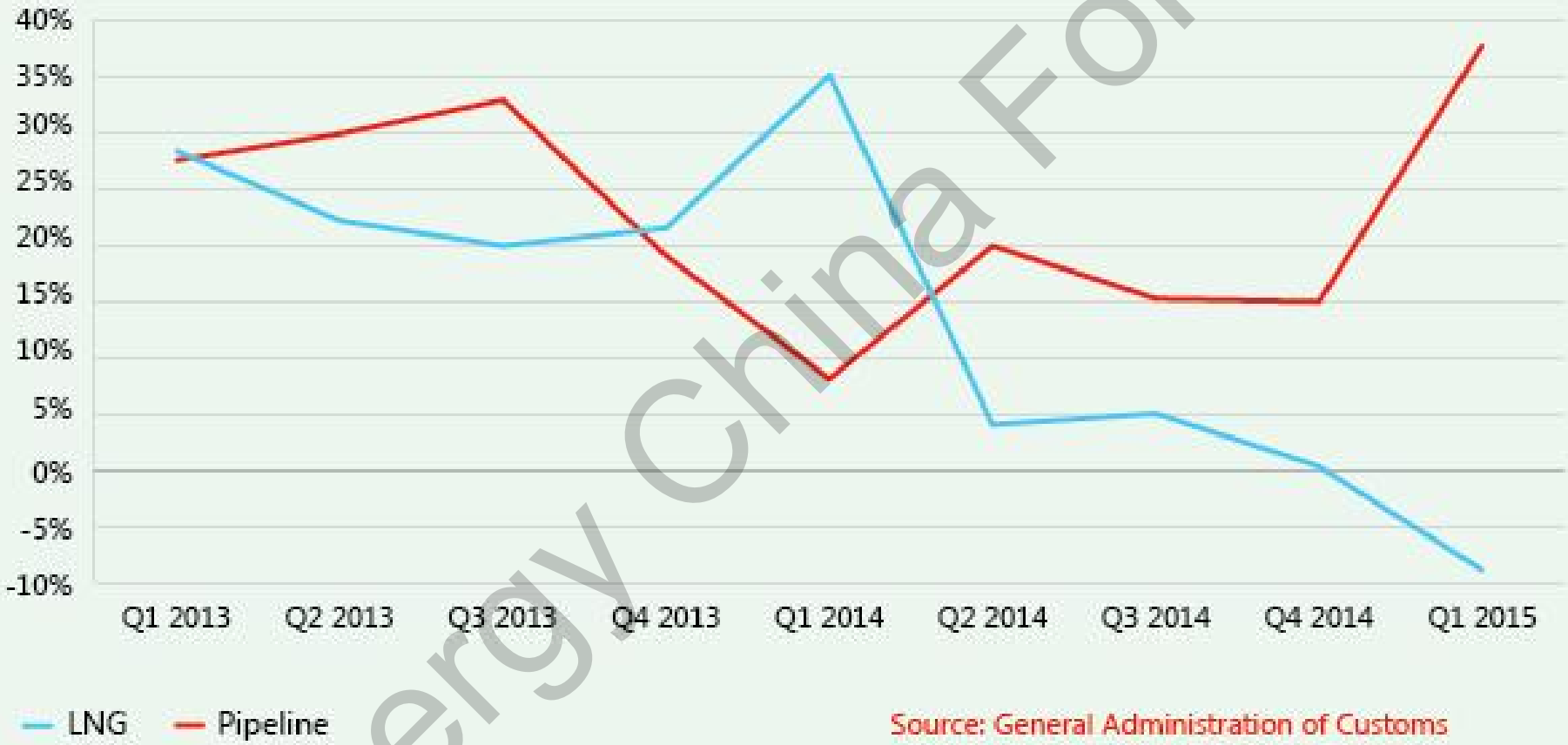
Sources: BMT Asia Pacific, BP Statistical, company and government disclosures, National Bureau of Statistics, China Customs, Bloomberg

China's LNG imports



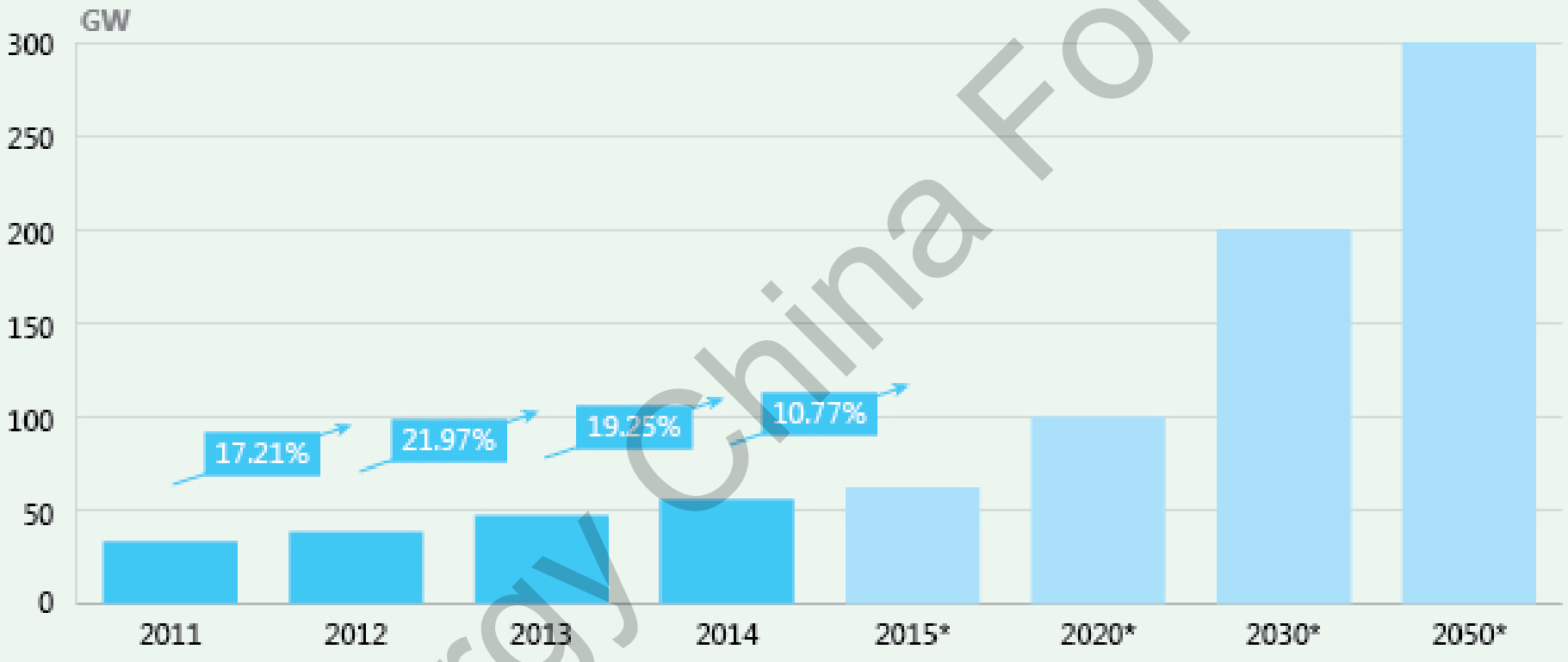
Source: General Administration of Customs

China's gas imports, year to year change



Source: General Administration of Customs

Chinese gas-fired power generation capacity with year-on-year changes



*Forecasts

Source: China Electricity Council

Shanghai United Institute for Unconventional Resources

An Unconventional Resources Think-tank

Functions

- SUI works on research, exchange and cooperation of unconventional res ources ranging from resource evaluation to equipment to environmental protection technologies.SUI also takes on projects commissioned by gov ernment agencies.

- By bringing together world-class researchers and organizations seeking s olutions to complex problems, the institute fosters and stimulates under standing of this emerging resource.

Shanghai United Institute for Unconventional Resources

- As an exchange platform across the value chain of unconventional resources, SUI brings together industry enterprises, organizations and experts to deliver domestic and international research and projects on energy business, policy and technology cooperation.

Questions?

Thank you!

Energy China Forum

For shale gas

TEL：021-54383583， FAX：021-31159335

EMAIL：ecfchina1@gmail.com

www.shalegaschinasummit.com