Gas Infrastructure and Technology Development of China Gas Industry
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4 Liquefaction plant construction

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I Natural Gas Infrastructure Construction

1 Overview of Gas Industry Development in China
   ➢ Consumption, production data
   ➢ Foreign dependence on natural gas

2 Natural Gas Pipeline Construction
   ➢ Gas resource, imported gas
   ➢ Transmission pipeline
   ➢ Distribution pipeline

3 Natural Gas Storage Construction
   ➢ Storage, volume, ratio

4 LNG Terminal Construction
   ➢ Numbers, quantity

5 Liquefaction Plant Construction
   ➢ Type, numbers
Overview of Gas Industry Development in China

Production: 107.2 billion m³
Consumption: 147.1 billion m³
New challenge for energy safety

**Optimize**
- natural gas consumption structure

**Develop**
- efficient domestic supply
- more unconventional gas resource
Natural Gas Pipeline Construction

Total length of transmission pipeline more than 40,000 Km

Total length of distribution pipeline
- 2010: 350,000 Km
- 2015: 600,000 Km

Urban gas coverage 94%
200 million homes access

Domestic gas resources (Off-shore in Nanhai)
- China
- Middle Asia, Russia, Burma

Natural gas pipeline construction
- Talimu: Shanxi, Gansu, Ningxia
- Chaidamu: Sichuan, Chongqing
- Nanhai: Sichuan to East Gas Transmission
- West to East Gas Transmission

Pipeline Examples
- West-East Pipeline
- Sichuan to Wuhan
Natural Gas Storage Construction

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Gas Volume</th>
<th>Gas Injection Capacity</th>
<th>Gas Production Capacity</th>
<th>Date of Establishment</th>
<th>Position</th>
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</thead>
<tbody>
<tr>
<td>Dazhangtuo</td>
<td>gas condensate reservoir</td>
<td>$6 \times 10^5 \text{m}^3$</td>
<td>$320 \times 10^4 \text{m}^3/\text{d}$</td>
<td>$1000 \times 10^4 \text{m}^3/\text{d}$</td>
<td>2000$^\circ$</td>
<td>Dagang oil field$^\circ$</td>
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<td>Ban 876</td>
<td>gas condensate reservoir</td>
<td>$2.17 \times 10^3 \text{m}^3$</td>
<td>$100 \times 10^4 \text{m}^3/\text{d}$</td>
<td>$300 \times 10^4 \text{m}^3/\text{d}$</td>
<td>2001$^\circ$</td>
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<td>Banzhongbei High Point</td>
<td>gas condensate reservoir</td>
<td>$10.97 \times 10^3 \text{m}^3$</td>
<td>$150 \times 10^4 \text{m}^3/\text{d}$</td>
<td>$300 \times 10^4 \text{m}^3/\text{d}$</td>
<td>2003$^\circ$</td>
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<td>Banzhong North High Point Completion</td>
<td>gas condensate reservoir</td>
<td>$10.97 \times 10^3 \text{m}^3$</td>
<td>$150 \times 10^4 \text{m}^3/\text{d}$</td>
<td>$600 \times 10^4 \text{m}^3/\text{d}$</td>
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<td>Banzhong South High Point</td>
<td>gas condensate reservoir</td>
<td>$4.7 \times 10^3 \text{m}^3$</td>
<td>$225 \times 10^4 \text{m}^3/\text{d}$</td>
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<td>Ban 808, 828</td>
<td>gas condensate reservoir, oil reservoir</td>
<td>$6.74 \times 10^3 \text{m}^3$</td>
<td>$360 \times 10^4 \text{m}^3/\text{d}$</td>
<td>$600 \times 10^4 \text{m}^3/\text{d}$</td>
<td>2006$^\circ$</td>
<td>Hubei oil field$^\circ$</td>
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<tr>
<td>Jing 58 Group</td>
<td>gas condensate reservoir, oil reservoir</td>
<td>$7.535 \times 10^3 \text{m}^3$</td>
<td>$400 \times 10^4 \text{m}^3/\text{d}$</td>
<td>$700 \times 10^4 \text{m}^3/\text{d}$</td>
<td>2010$^\circ$</td>
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<td>Jintan (Phase 1)</td>
<td>salt cavern</td>
<td>$5.4 \times 10^3 \text{m}^3$</td>
<td>$640 \times 10^4 \text{m}^3/\text{d}$</td>
<td>$1500 \times 10^4 \text{m}^3/\text{d}$</td>
<td>2006$^\circ$</td>
<td>Jintan, Jiangsu$^\circ$</td>
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</table>

2010
8 gas storages
4.35 billion m$^3$

2015
24 storages
increased capacity 22 billion m$^3$
9.5% of consumption
## LNG Terminal Construction

### Quantity: 2011, imported LNG 12.2 million ton

### Terminal: 16 are planned, 7 finished in 2012

### Total designed capacity of Phase 1: >20 million t/y

<table>
<thead>
<tr>
<th>Position</th>
<th>Area</th>
<th>Share-holder</th>
<th>Status</th>
<th>Start-up Time</th>
<th>Capacity (I)</th>
<th>Capacity (II)</th>
<th>Capacity (Total)</th>
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<tr>
<td>Dapeng</td>
<td>Shenzhen, Guandong</td>
<td>CNOOC</td>
<td>Finished</td>
<td>2006</td>
<td>370</td>
<td>670</td>
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<td>Xiuyu</td>
<td>Putian, Fujian</td>
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<td>2008</td>
<td>260</td>
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<td>760</td>
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<td>Zhongximengang</td>
<td>Yangshan, Shandong</td>
<td>CNOOC</td>
<td>Finished</td>
<td>2009</td>
<td>300</td>
<td>600</td>
<td>900</td>
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<td>Yangkougang</td>
<td>Rudong, Jiangsu</td>
<td>CNOOC</td>
<td>Finished</td>
<td>2011</td>
<td>350</td>
<td>650</td>
<td>1000</td>
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<td>Nianyugang</td>
<td>Dalian, Liaoning</td>
<td>CNOOC</td>
<td>Finished</td>
<td>2011</td>
<td>300</td>
<td>600</td>
<td>900</td>
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<td>Huangmaodao</td>
<td>Macao</td>
<td>CNOOC</td>
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<td>2012</td>
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<td>Shatian</td>
<td>Dongguan, Guangdong</td>
<td>Jufeng</td>
<td>Finished</td>
<td>2012</td>
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<td>Beilunwan</td>
<td>Ningbo, Zhejiang</td>
<td>CNOOC</td>
<td>Under Construction</td>
<td>2012</td>
<td>300</td>
<td>600</td>
<td>900</td>
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<td>Gaolanwan</td>
<td>Zhuhai, Guangdong</td>
<td>CNOOC</td>
<td>Under Construction</td>
<td>2013</td>
<td>350</td>
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<tr>
<td>Huilai</td>
<td>Jieyang, Guangdong</td>
<td>CNOOC</td>
<td>Under Construction</td>
<td>2015</td>
<td>200</td>
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<td>Yangpu</td>
<td>Haikou, Hainan</td>
<td>CNOOC</td>
<td>Under Construction</td>
<td>2014</td>
<td>200</td>
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<td>Qinhuangdao</td>
<td>Qingshuangdao, Hebei</td>
<td>CNOOC</td>
<td>Under Construction</td>
<td>2015</td>
<td>200</td>
<td>300</td>
<td>500</td>
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<td>Caofeidian</td>
<td>Tangshan, Hebei</td>
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<td>Beihai</td>
<td>Beihai, Guangxi</td>
<td>Sinopec</td>
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<td>2014</td>
<td>300</td>
<td>200</td>
<td>500</td>
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<td>Dalian</td>
<td>Dalian, Liaoning</td>
<td>Sinopec</td>
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<td>2015</td>
<td>300</td>
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<td>Dongjiakou</td>
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<td>Sinopec</td>
<td>Under Construction</td>
<td>2015</td>
<td>300</td>
<td>600</td>
<td>900</td>
</tr>
</tbody>
</table>

**Total (10,000 ton)**

- Capacity: 4680
- Capacity: 5370
- Capacity: 10050

**Total (100 million m³)**

- Capacity: 636
- Capacity: 730
- Capacity: 1366
LNG Liquefaction Plant Construction

**Type**
- peak-shaving station
- baseload station

**Plants in 2012**
- 48 completed, 5 under construction

**Production capacity 2015**
- 7.5 million ton/year
II Technology Development of China Gas Industry

1. **Gas supply security technology**
   - Diversifying transmission pipeline and gas resources
   - Improving emergency gas resource is a target for domestic gas operators

2. **City Gas Pipeline distribution technology**
   - Supply with multi-stage network, build with large diameter and high pressure
   - Peak and valley problem
   - Electronic information technology is applied for operation and dispatching.
   - Advanced leak detection technologies have been applied in China
   - Advanced anti-corrosion technology with IT approach
   - Trenchless technologies is widely applied.

3. **Gas application technology**
   - NGVs develop fast.
   - Gas distributed energy technology and its supporting policy have got some achievement.

4. **New energy technology**
   - China has got more high-level technologies.
   - The development of shale gas is still on the early stage.
Diversifying transmission pipeline and gas resources

Diversify transmission pipeline gas source

Gas storage facilities peak-shaving, emergency and strategy

Such as Shanghai, Shenzhen, Beijing

Natural gas resource structure of Beijing
Improving emergency gas resource

According to the plan

storage facilities construction scale for emergency 1.5 billion m³ (2015)
City Gas Pipeline Distribution Technology

Supply with multi-stage network, build pipeline with large diameter and high pressure

Gas Distribution Network Pressure
Shanghai: 60 bar
Beijing: 40 bar
Shenzhen: 40 bar

DN1016
City Gas Pipeline Distribution Technology

Peak and Valley Problem

- Storage tanks
- Linpack
- LNG or CNG

Daily peaking-shaving technology Means

Daily peak and valley problem - high level
Seasonal peak and valley problem - lack of efficient solution depends on upstream
Electronic information technology is applied for operation and dispatching.

- Production dispatching
  - network dispatching
- SCADA
  - equipment condition
  - Consumption
  - alarming
- Supervisory of Cathodic protection
  - electric potential
  - estimation result
- Operation
  - running coverage ratio
  - blind spots
  - leak inspection
  - equipment maintenance
- EAM
  - equipment list
  - maintenance plan
  - calibration
  - special equipment
  - technology improvement and overhaul
- Emergency Command
  - event source
  - event process
  - Vehicle position
  - emergency supplies
  - onsite video
  - commanding and dispatching
  - rescue result
- GIS
  - image database

**Research**
- early warning technology
- fault diagnosis technology

**Real-time control**
- improve the equipment and facilities reliability and safety
Advanced leak detection technologies have been applied in China.

City gas pipeline distribution technology
City Gas Pipeline Distribution Technology

Advanced anti-corrosion technology with IT approach

- Anti-corrosion Coating
- Cathodic Protection

Remote control technology

Avoid the potential corrosion

Corrosion is recorded and handled in time

a guarantee to the safety operation of gas pipeline
City Gas Pipeline Distribution Technology

Trenchless technology is widely applied

Avoid
- digging wide area on pipes
- traffic-jam
- destruction landscape

Apply
- the sites that can’t be dig

Trenchless Technology: Pipeline Construction and Repair

- directional drilling
- U-lining
- Pipe ramming
- inversion lining rehabilitation
- Slurry balance pipe-jacking
- Static Pipeline Bursting
Gas Application Technology

Gas application
CCHP, power generation, cooling, industry application, NGV etc.

Competitive energy Vs. coal and electricity
Key figure

> 1 million natural gas vehicles; ½ from road service party: taxi, bus, intercity traffic

Mastered key technology of NGV
	natural gas engine, and the refilling system, etc.
Gas distributed energy technology and its supporting policy have got some achievement.

**Past**
A lot of pilot projects after 2000

**Now**
equipment, already domestic supply experience in design and operation standard established gradually network access policy published in 2013

**Future**
policy, subsidy, and access rule

2020, installed capacity 50 million Kw
New Energy Technology

- Coalbed methane
- Fuel ethanol
- Geothermy
- Wind and solar

Problems solved
Projects established
Efficient back-up
New Energy Technology

China’s coalbed methane development.

- Estimated recoverable reserve: 10.87 trillion m³
- Wells: 5400
- Production capacity: 3.1 billion m³

- High-level technology
- Achievement in exploration, drilling purification, etc.
- Core technologies are applied
The development of shale gas is still on the early stage.

- Recoverable volume: 25 trillion m³ (except for Qinghai and Tibet)
- 2009-2012: 129 related wells
- Production in 2012: near 30 million m³

Technology gaps
- Technical and financial limits
- More vertical drilling than horizontal drilling
- Fracking and completion

Shale Gas Well Drilled by Petrol China: Wei 201
Thank you!

车立新  CHE Lixin
Phone：010-64256601
Mail:chelx@bjgas.com