

3rd ConferenzaGNL
1st FieraGNL

LNG experiences from China toward Mediterranean area

By Wensheng LIN

*Deputy Director, Institute of Refrigeration and Cryogenics, Shanghai Jiao Tong University
Deputy Secretary General, China LNG Association*

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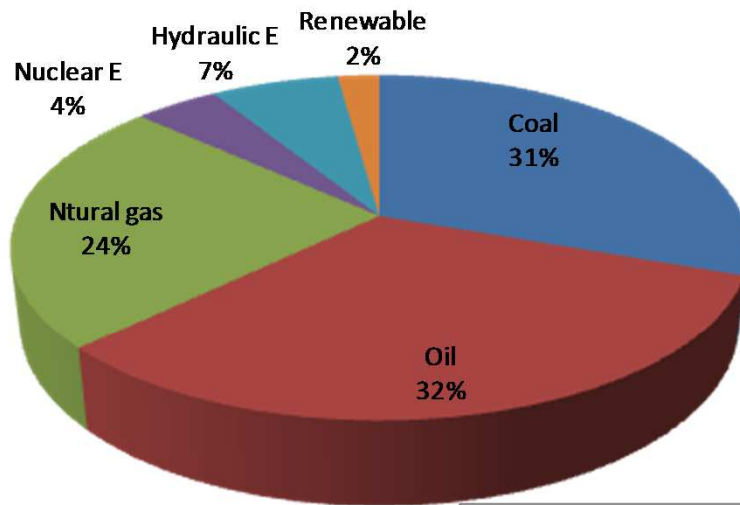
1 LNG industry in China

1.1 China as an LNG importer

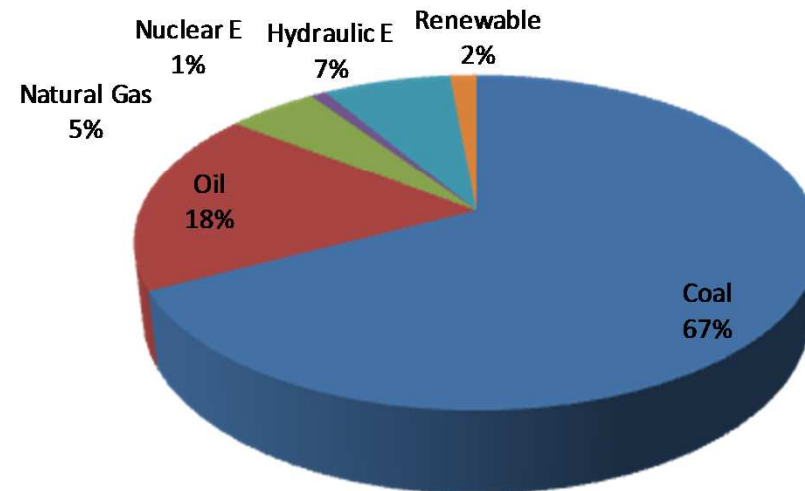


Energy mix: world and China

World energy mix 2013



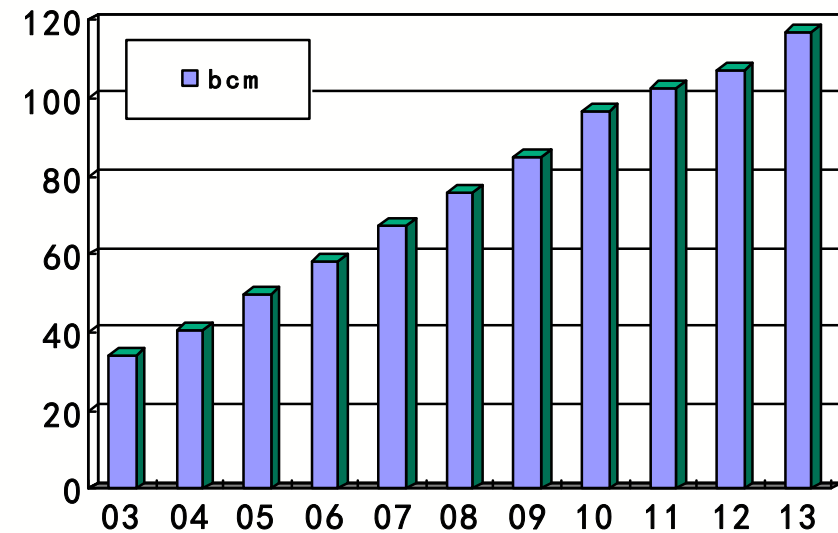
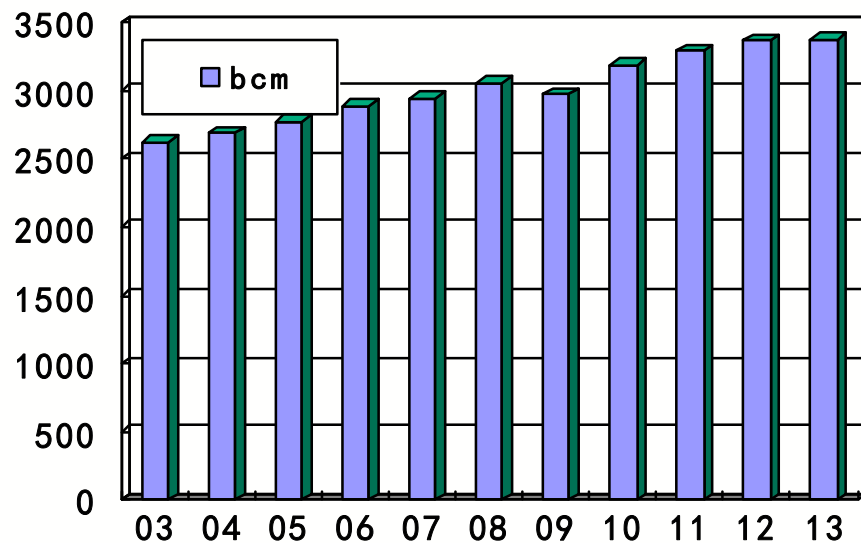
China energy mix 2013





Natural gas production

- World natural gas production was 3369.9 bcm in 2013, while 117.1 bcm in China



- For the 10 years period, the world production increased 25.2%, while 240% in China.

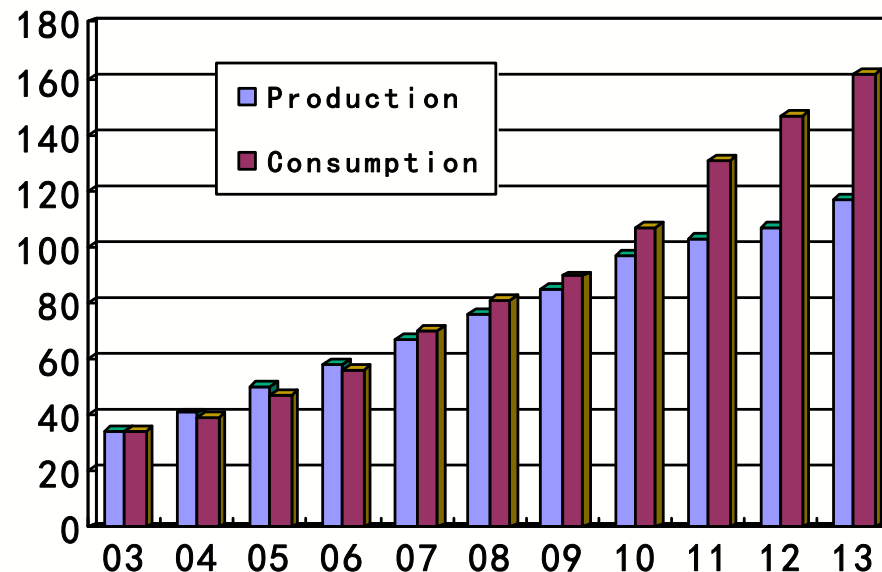


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LNG is an important supplement

- For the same period, China's natural gas consumption increased **377%**!
- The shortage of natural gas is also increasing, and this must be supplemented by imported natural gas. In 2013, China imported 27.4 bcm natural gas by pipeline, and 24.5 bcm by LNG.

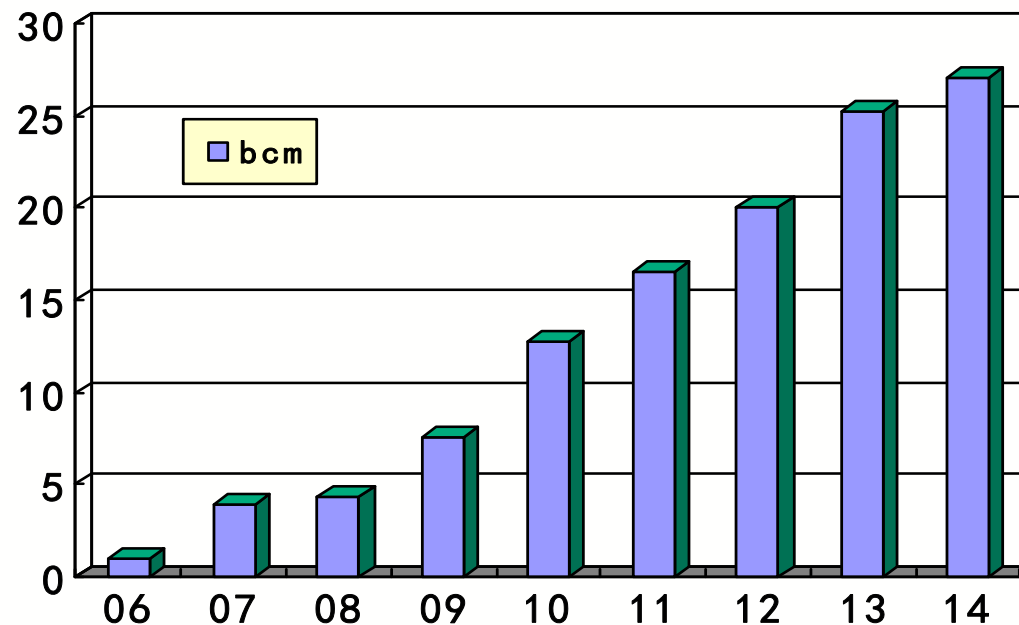


NG production and consumption in mainland China (bcm)



A large LNG importer

- Mainland China began to import LNG in 2006
- It is now **the third largest importer** in the world





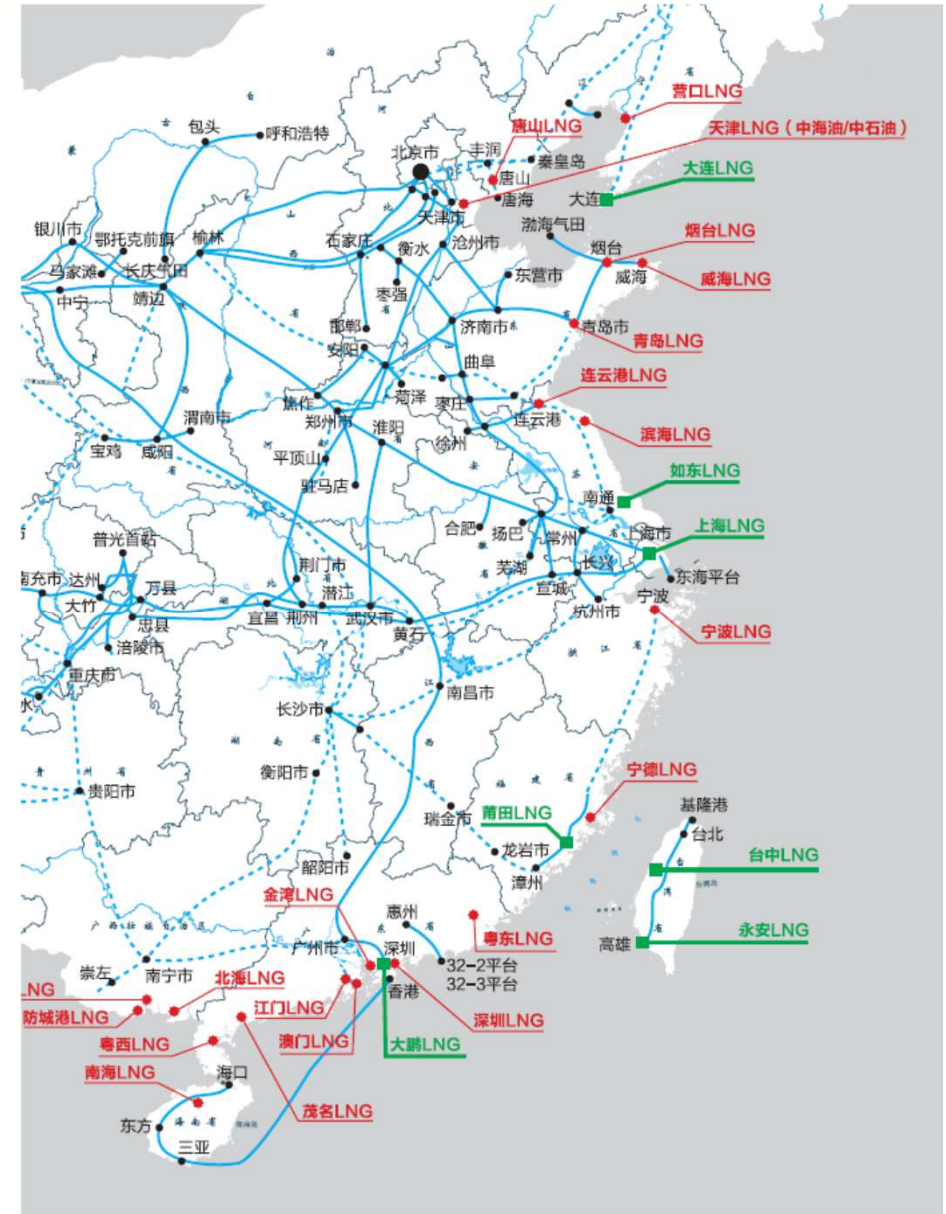
上海交通大学 LNG receiving terminals



16 LNG receiving terminals have been built in mainland China



More are under construction or planned, including some by private company





Shenzhen Dapeng Receiving Terminal

- ① **Location:** Dapeng Bay, Shenzhen, Guangdong
- ① **Completion:** 2006, first one in mainland China
- ① **The project**
 - ① LNG receiving terminal;
 - ② Gas supplying line;
 - ③ Construction of new-built power plant, reconstruction of old power plant;
 - ④ Building of the city pipe net.
- ① **Purpose:** about 70% of the LNG utilization on industry and power generation, the others on civilian use.
- ① **Resource supplier:** Australia (3Mt/a, for 25 years)



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Rudong Receiving Terminal

- ④ **Location: Rudong, Jiangsu**
- ④ **Completion: 2010, the first one by CNPC**
- ④ **The project**
 - 1st phase, 3.50 Mt/a
 - 2nd phase, increase to 6.50 Mt/a
 - Long-term offloading capacity 10.0 Mt/a
- ④ **Resource supplier: Qatar**



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Significance of the Rudong Terminal

- ④ **China's Huanqiu Engineering Company was the project's general contractor**
- ④ **Realizing for the first time the independent design, independent procurement, independent construction and independent operation**
- ④ **The terminal has been running successfully**



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1.2 Domestic production of LNG

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- ④ Natural gas liquefaction is an important part of China's LNG industry
- ④ More than 100 LNG plants have been built
- ④ A very special type of development
- ④ The LNG plants provide LNG to many areas where pipeline natural gas is not available



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Shanghai Peak-shaving LNG Plant



Completion: 2000, 1st industrial plant in China



Purpose

- (1) Upstream offshore gas field stops production
- (2) Accident of the supply pipelines
- (3) Peak-shaving in winter



Performance:

- (1) Storage tank: $20 \times 10^3 \text{m}^3$
- (2) Evaporation rate: 0.08%/d
- (3) Liquefaction capacity: $100 \times 10^3 \text{m}^3/\text{d}$
- (4) Gasifying capacity: $72 \times 10^3 \text{m}^3/\text{h}$



Process: CII



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Guanghai Shanshan LNG Plant

- Gas source: Tuha oil field;
- Designed liquefaction capacity:
 $1.5 \times 10^6 \text{ Nm}^3/\text{d}$
- LNG storage volume: $3.0 \times 10^4 \text{ m}^3$
- Process: LIMUM by Linde



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Huanggang LNG plant

- ❶ **Gas source: CNPC pipeline**
- ❷ **Designed liquefaction capacity: 5×10^6 Nm³/d, by far the largest one in China**
- ❸ **Process: Cascade**



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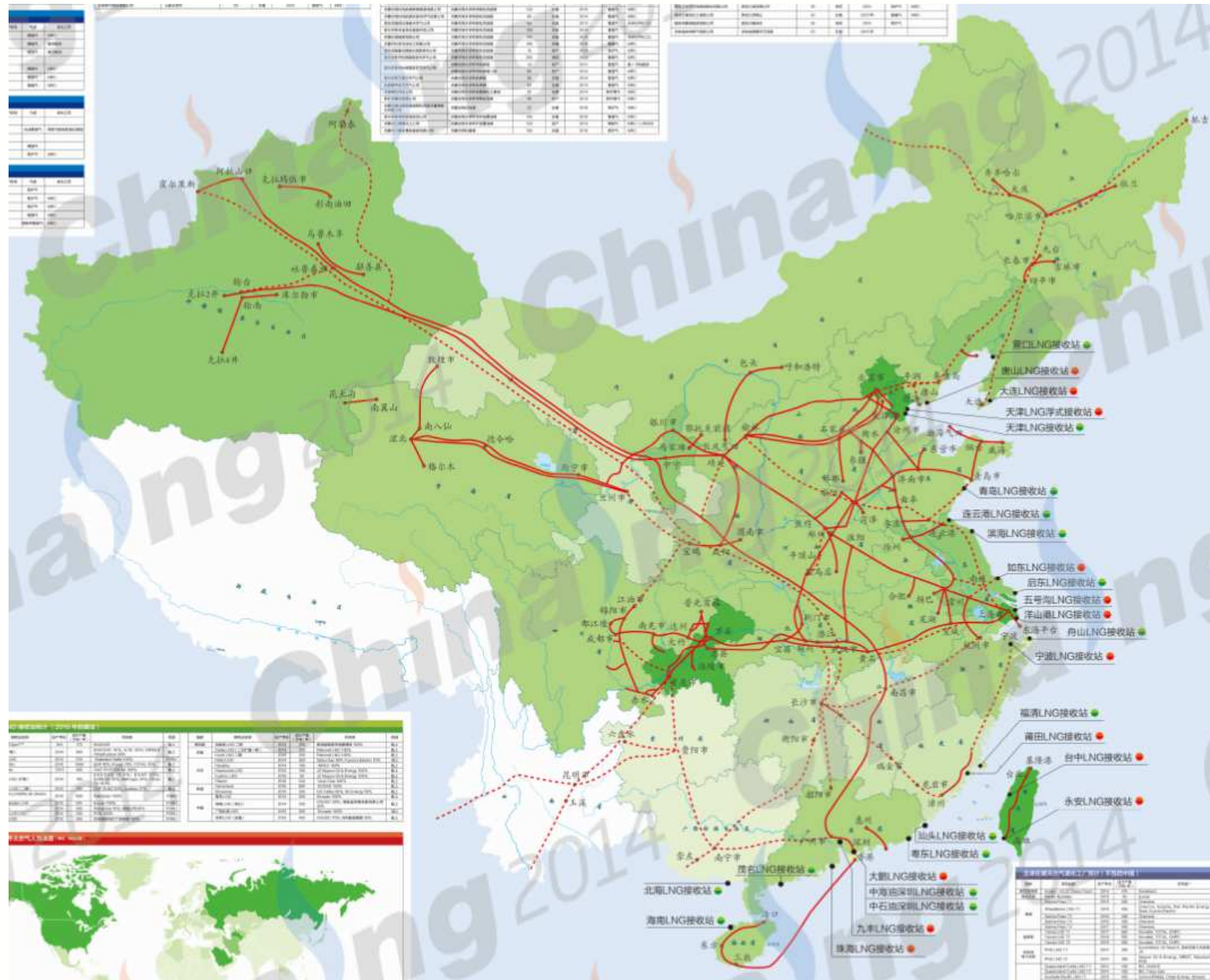


Summary of LNG plants in China

- ④ **Mostly small to medium size, although plant with capacity up to 5 million Nm³/d has been built**
- ④ **Process suppliers**
 - **Home companies have strong abilities in competition**
 - **State-owned companies such as Huanqiu**
 - **A number of vivid private companies: Chengdu Shenleng, GreenEnergy, and so on**
 - **International Technology is still welcome: BV, Linde, AP...**
- ④ **Various feed gases: NG, CBM, SNG, COG, shale...**
- ④ **Innovations are common in China LNG industry**



China LNG map





1.3 LNG carrier

- As of 2012, 6 large membrane type LNG carriers of 147,000 cubic meters manufactured in China have been delivered to customers. The manufacturer is Hudong Zhonghua Shipbuilding (Group) Co. Ltd.
- The first of four H1670A carriers Mobil / mol of 172,000 m³ with low-speed diesel engine and reliquefaction plant was delivered this year
- The small LNG vessel of 20,000 m³ R & D for coastal and inland water transport has began



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2 Development of LNG-Powered ship in China



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Just at the beginning

- ④ **The industry of China's LNG-powered ship is just at its very beginning**
- ④ **The LNG-powered ships are mostly refitted from oil-powered ones**
- ④ **The first experimental LNG-powered ship refit was completed in 2010, and the first approval for commercial running of LNG-powered ship was issued in 2012**



The first trial of refit

- ④ The first trial of using LNG as ship fuel was the developing of a diesel-LNG hybrid system
- ④ The diesel supplying system remained unchanged, while a new LNG fuel system and an ECU were added



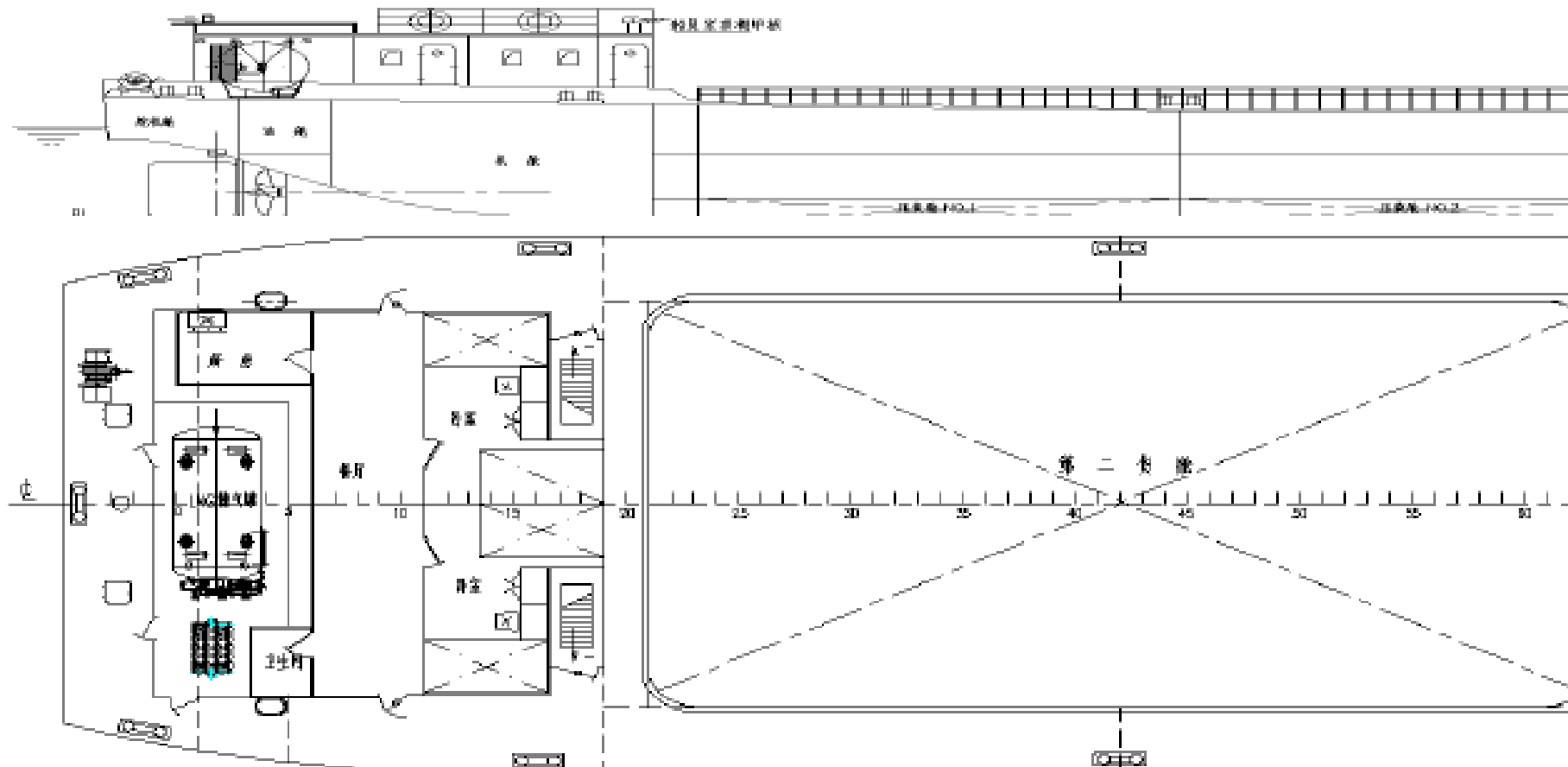


The performance of the diesel-LNG hybrid system was tested and verified on an experimental stand





The hybrid system was then equipped onto a real ship – Susu Huo 1260, a bulk freighter (dwt=2700t, L=68m, W=15m, D=4.5m)





The performances before and after the refit

- **Power remains almost the same**
 - Torsion: 1772 Nm; Tested power: 167 kW
- **Consumption: NG accounts for 73% fuel consumption**
 - Diesel: 32.98 kg/h vs 10.51 kg/h
 - Natural gas: 0 vs 28.51 Nm³/h
- **Emission: decrease significantly**
 - CO₂: 3186 kg/t(diesel) vs 2464 kg/t(LNG)
 - SO₂: 16 kg/t(diesel) vs 0.142 kg/t(LNG)



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After refit, a round voyage of “Susu Huo 1260” costs more than CNY 3,000 less. The ship usually go on at least 3 round voyages monthly, thus, more than CNY 100,000 can be saved annually.





Spreading period

- After the experiment period, it is now the spreading period. By far, more than 100 ships have been refitted.
- “Changxun 3” running from Chongqing to Maoping is the first ship to be approved for commercial voyage. The fuel cost lowered by 22% after refit.





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Case 1: Kunlun Energy

- As the main natural gas company of CNPC, Kunlun Energy has finished 33 LNG-fuelled ships, and 8 are being built or refitted. Among them, 4 use LNG as single fuel, including 3 new built ones.



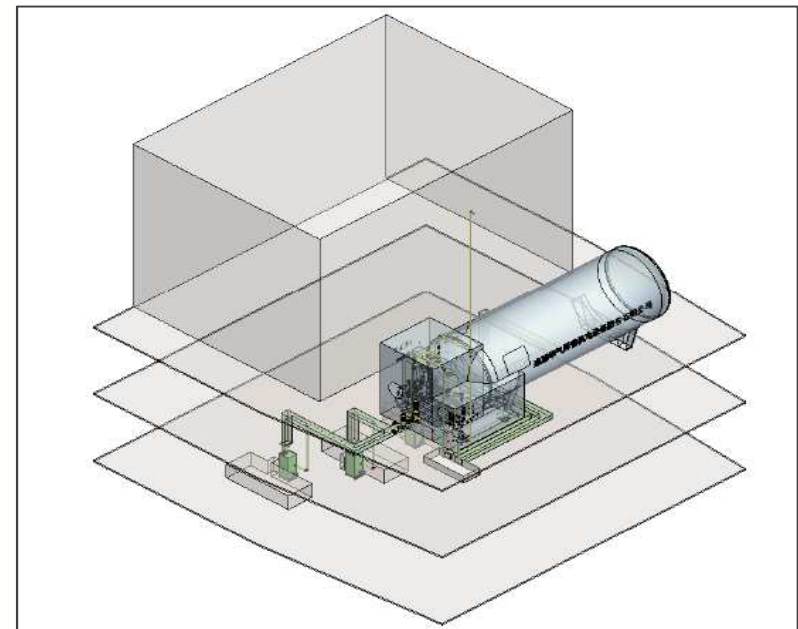


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Kunlun Energy is building a sand ship only fuelled with LNG in Chongqing. (dwt=2000t, L=62m, Propulsion power 516kW)





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Kunlun Energy has built 2 marine LNG bunkering wharfboats, with 500m³ storage each. A moveable bank-based LNG fuelling station has also built at Wuhu. The 200m³ LNG bunkering ship is being designed.



The 500m³ LNG bunkering wharfboats

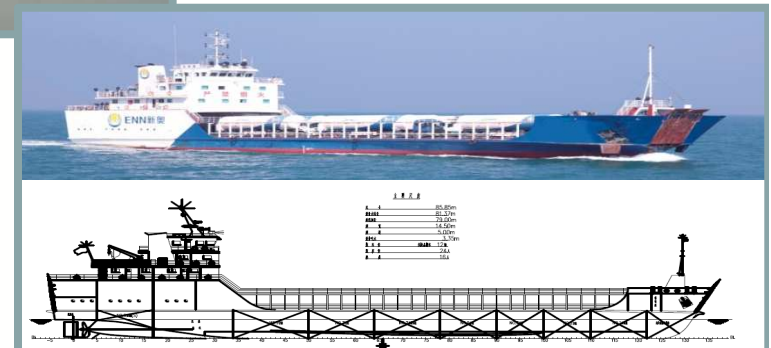


Case 2: ENN



As a leading private gas company, ENN has many kinds of LNG-fuelled ships

- Single or dual fuelled ships
- LNG-ready ships
- Cargo ships and ferries





And all kinds of LNG-fuelling for ships



3 Prospects



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Promotion use of NG

- ④ **China is suffering from severe air pollution**
- ④ **Using NG can greatly reduces emissions of CO₂, NO_x and particles**
- ④ **The 12th FYP aims to increase NG use to 7.5% by 2015**



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LNG is suitable as ship fuel

- ④ **With its high energy density, LNG as ship fuel is a reasonable alternative**
- ④ **Assuming the price of diesel CNY8,500/t, and LNG CNY6,000/t, and assuming that 60~70% of diesel is replaced, the cost will be about 20% less by using hybrid system**



Global trend of stricter emission regulations

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From 2015 ship owners who operate within an ECA must choose between fuel switch, installing a scrubber or converting to LNG or lost business





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LNG application is encouraged

- ④ The “natural gas utilization policy (2012) ” released in 2012 repeatedly mentioned the liquefied natural gas, especially giving priority of the using of natural gas **to LNG vehicles**.
- ④ It can be expected that related industries will develop rapidly. The massive replacement of vehicles with LNG will reduce the total carbon emissions significantly.



Aim for energy saving and emission reduction

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According to “12th FYP scheme for overall promotion of energy saving and emission reduction for marine transportation”(《“十二五”水运节能减排总体推进实施方案》),

- **The ship energy consumption in 2015 should be at least 15% less comparing to that in 2005, with 16% for sea ships and 14% for river ships, respectively**
- **The ship CO₂ emission in 2015 should be at least 16% less comparing to that in 2005, with 17% for sea ships and 15% for river ships, respectively**



- ④ **2011, MOT “12th FYP scheme for overall promotion of energy saving and emission reduction for marine transportation”** “十二五”水运节能减排总体推进实施方案
- ④ **2012, MOF “Notice about the tax policy of using new energy vehicle for energy saving”** 关于节约能源 使用新能源车船车船税政策的通知
- ④ **2012, MOT “Guidelines for energy saving and emission reduction at ports”** 关于港口节能减排工作的指导意见
- ④ **MOT “Scheme for promotion of ship type standarization during 12th FYP”** “十二五”期推进全国内河船型标准化工作实施方案



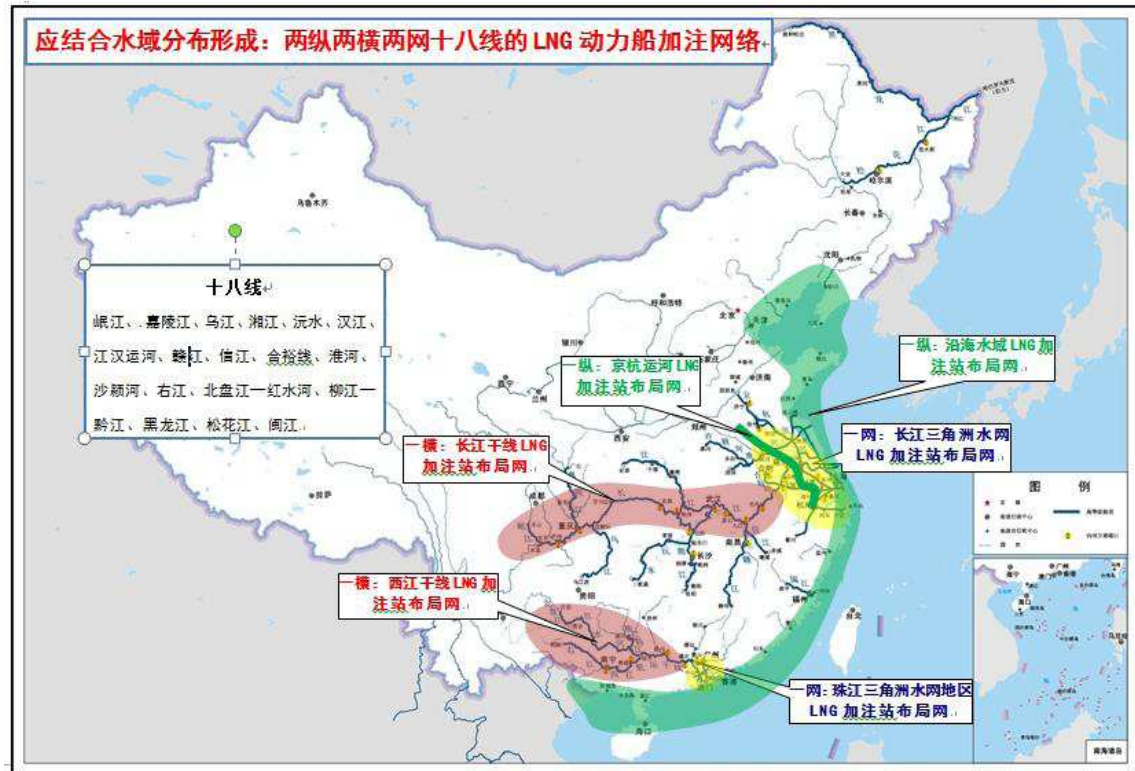
The subsidy policy for new LNG-fuelled ship issued in April 2014

- **Before Mar 2015**
 - CNY 0.85M for ship power under 300 kW
 - CNY 1.05M for ship power 300-600 kW
 - CNY 1.20M for ship power 600-1000 kW
 - CNY 1.40M for ship power above 1000 kW
- **April-December 2015, may extend to end of 2017**
 - CNY 0.63M for ship power under 300 kW
 - CNY 0.78M for ship power 300-600 kW
 - CNY 0.90M for ship power 600-1000 kW
 - CNY 1.00M for ship power above 1000 kW



Bright future in China

- Looking back to China's road NGV development, there were only thousands of road NGV in 2002, but the amount exceeded 1 million in 2012
- The prospects of LNG-powered ships will surely be bright in China





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Possible cooperation

- ④ **Shanghai Jiao Tong University (SJTU) is the top university in China**
- ④ **China LNG Association (CLNGA) has nearly 300 members**
 - Oil and gas companies
 - Manufacturers
 - End users
- ④ **Both SJTU and CLNGA are willing to cooperate**
 - R&D cooperation
 - Product and service
 - Strategy
 - Conferences, seminars



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Finally...

- Welcome to Shanghai, China
- to attend the great event of International Conference & Exhibition on LNG
- the 19th edition, but the 1st time in China
- **LNG 2019** (sponsored by IGU/GTI/IIR)
- And also **ChinaLNGexpo**, annually in Shanghai



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Thank You!