How does Natural Gas Re-shape the Low Carbon Economy / Energy Market

The Latest Development and Application of Natural Gas Distributed Energy System in China

IGEM Far East District Section
Shanghai Aerospace Energy Co. LTD

Guo Jiasheng

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Natural Gas Pipeline Network

Main pipeline: 40,000 km, 2010

New natural gas pipeline (including extension) 44,000 km, 2015
Natural Gas Consumption

Annual increase: 14%

2000: 2.2%;
2010: 4.4%;
2015: 7.5%
Distributed Energy System

- energy cascade utilization,
- The primary energy efficiency: >70%
- located load centers nearby
  - high energy efficiency,
  - environmental friendly,
  - energy supply security,
  - load shifting,
- economic returns.
Distributed Energy System

Hospital

Hotel

Shopping mall

Airport/ Railway station

Regional Energy Center

Industrial Park
Targets & Policies

- 1,000 natural gas distributed energy by 2015
- 10 typical DES demonstration area
- Total 50,000 MWe by 2020

- Subsidies (Shanghai, 2013-2015)
  - 3000 RMB/kW;
  - Gas Price discount:
    - 3.89 RMB/m3 (gas boiler)
    - → 2.43 RMB/m3 (Commercial user)
    - → 2.73 RMB/m3 (Industries)
Targets & Polices

- **State Grid**
  - 10 kV and below;
  - < 6 MW
  - solar, natural gas, biomass, wind, geothermal, ocean energy, etc..
  - Three modes
  - 2013. 3.1
Green Building

- 50% energy for building construction & operation
- 34% pollution
- 40 billion m\(^2\), 1.8~2 billion m\(^2\) new built annual
- Energy consumption/m\(^2\) 2~3 times
Green Building

- **New building**
  - 1 billion m² of new green building during 2010-2015
  - 20% of urban new buildings, by the end of 2015.

- **Public buildings**
  - government investment buildings
  - over 20,000 m², full implementation of green building standards since 2014.
Energy Saving

Cogeneration

100% Fuel

13% Losses

44% Electricity

43% Heat

> 25% Energy saving

Separate power production

158% Fuel

110%

66% Losses

5% Losses

71% Total Loss

44% Electricity

43% Heat

(Electricity in conventional powerplant, Heat in a boiler)
Green Building

- Eko Profile
- Promis E
- BREEAM
- ESCALF
- Eco Effect
- Eco Quantum
- GOBA
- CASBE
- SBAT
- NABERS
- LEED-Canada, GBTool
- BREEAM-Green Leaf
- LEED
- HK
Green Building

- Outdoor environment
- Energy-saving and energy use,
- Water conservation and water resources utilization
- Material utilization
- Indoor environmental quality
- Operations management
Green Building

- GB/T 50378-2006

- LEED
Shanghai Tower

Building area: 560000 m²;
Capacity: 2 MWe;
Height: 632m
Data Center

- 430,000 data center
- approximately 500 million server units
- PUE (Power Usage Effectiveness).
  \[
  \text{PUE} = \frac{\text{Total facility power}}{\text{IT equipment power}}
  \]
- the PUE value of advanced data center can reach 1.7
- PUE of data center in China: 2 to 2.5.
Data Center

- The PUE value for new designed data center is recommended as 1.6 to 1.8.
- 20000m² data center, cabinet about 4500, annual electricity consumption: 200 million kWh.
the standby power generators and the input of the UPS, computer room air conditioning, emergency lighting and other equipment by the mains switch to the generator by automatic transfer switch (ATS), to prevent the back-up battery of UPS is depleted caused system power interruption.
Data Center

- Power distribution system: 24%
- Lighting etc.: 1%
- IT equipment: 30%
- Cooling devices: 45%

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Data Center

- Cooling
- Heating
- Electricity
- Hot water

Load vs. Time/h

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Data Center

- Summer cooling load: 8000
- Summer electricity load: 6400
- Winter cooling load: 7200
- Winter electricity load: 4800

The graph shows the load distribution over time for different seasons.

- Cooling (summer) and electricity (summer) have peaks during the day.
- Cooling (winter) and electricity (winter) have lower loads compared to summer.

Time/h: 2 4 6 8 10 12 14 16 18 20 22 24

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Data Center

- Electric/cooling load ratio: 1.1.
- Gas engine generator + double-effect absorption chillers is about 1.1.
CNPC data center in Beijing

Building area: 226000 m²; Capacity: 5* 3.3 MWe; Annual gas consumption: 284 million m³.
three main industrial by-product hydrogen sources,
Industrial by-product hydrogen

- Shanghai: 1.7 billion m³ annually.
- The chlor-alkali industry,
  - 1 t of caustic soda = hydrogen 280 m³,
  - about 947 million m³ per year,
  - about 30% is used to produce hydrogen chloride
  - The byproduct hydrogen purity: 99.84%,
  - main impurity: oxygen, nitrogen and water vapor.
Industrial by-product hydrogen

2.0 RMB/Cube meter  
2.5 RMB/Cube meter  
3.0 RMB/Cube meter  
3.5 RMB/Cube meter  
4.0 RMB/Cube meter

Fuel cost (RMB/kWh)

Hydrogen percentage in natural gas- hydrogen blends (%)
The opportunities for the LDCs

- Downstream market,
  - Local state-owned enterprises,
  - Hong Kong enterprises,
  - Central enterprises
  - Private enterprises
The opportunities for the LDCs
Role transition

Natural gas supplier → Natural gas → customer

Energy station:
- Electricity
- Cooling
- Heating
- Hot water

Natural gas supplier → Natural gas → customer

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Energy service

- Shanghai Shenergy Energy Services Ltd.,
- Beijing Gas Energy Development Co., Ltd.
- Hangzhou City Energy Development Co., Ltd.
- …
Summery

- The increase natural gas supplies in China;
- Targets & polices;
- Large-scale development of natural gas distributed energy has come true;
- Green building, data center and industrial byproduct hydrogen applications show a new application for DES;
- The opportunities for the LDCs in DES.
Thanks for your attention.

Jiasheng GUO
Mobile: 86-186-0160-4265
E-mail: guojs@sae.sh.cn