

CHP & Distributed Energy in China

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Bowman POWER STM POWER Solar Turbines

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CHINA5E.com Bowman POWER STM POWER Solar Turbines

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Links

Bowman

http://www.china5e.com/news/power/200310/200310150098.html

China CHP Development

- CHP Annual increase in capacity

			/
1997	230	294.412	1.28
1998	84	296.75	3.53
1999	90	322.06	3.578
2000	95	174.7	1.05
2001	108	233.55	2.163
2002	331	519.511	1.57
2003	184	625.51	3.4

6000

Signal Unite with the capacity above 6MW in China

6000		2003	2002	2001	2000	1999	1998	1997
		2121	1937	1606	1498	1403	1313	1229
Total Capacity	10MW	4369	3743	3224	2990.	2815	2493	2197
5		262	223	187	172	161	140	124
	10MW	2270	1831	1583	14701	1374	1137	937
2.5~ 5								
high pressure		140	142	119	112	120	120	119
	10MW	360	365	301	282	301	301	298
		97	77	96	88	81	70	59
	10MW	252.	200	247	227	210	182	1485
1.2~ 2.5								
		29	27	18	15	14	14	14
	10MW	39	37	25	20	18	18	18
		712	631	538	499	455	426	387
	10 MW	907	798	672	618.	564	525	475
0.6~ 1.2								
		872	828	646	610	570	541	524
		532	504	392	369.	345	327	318

21
2003

20

5.6

16.03

3.91

1.91

16.67

2.44

2020

9.5

20

6.3

4.5

6.1

3000

6

2.45

5000

4000

2000

2003

China CHP Development in 2003

2121

6000

4369

14.84

15.69

11.16

22

66

3000

2020

China CHP Development forecasting in 2020

2020

2

2020 CHP CAPACITY:

2001

1.6

30

1

Residential CHP

6500

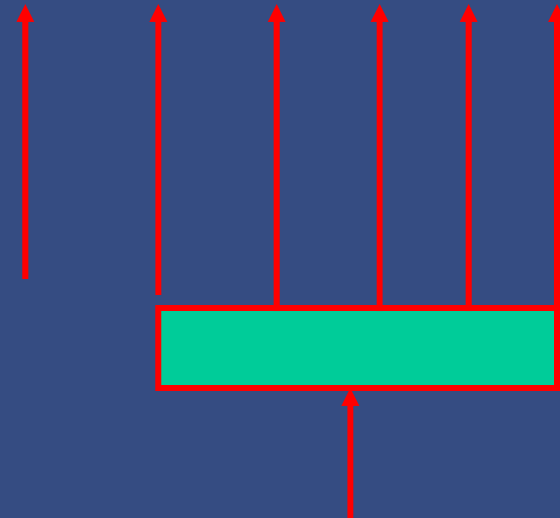
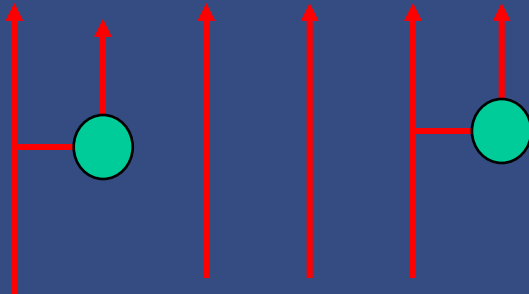
Industrial CHP

2001

4200

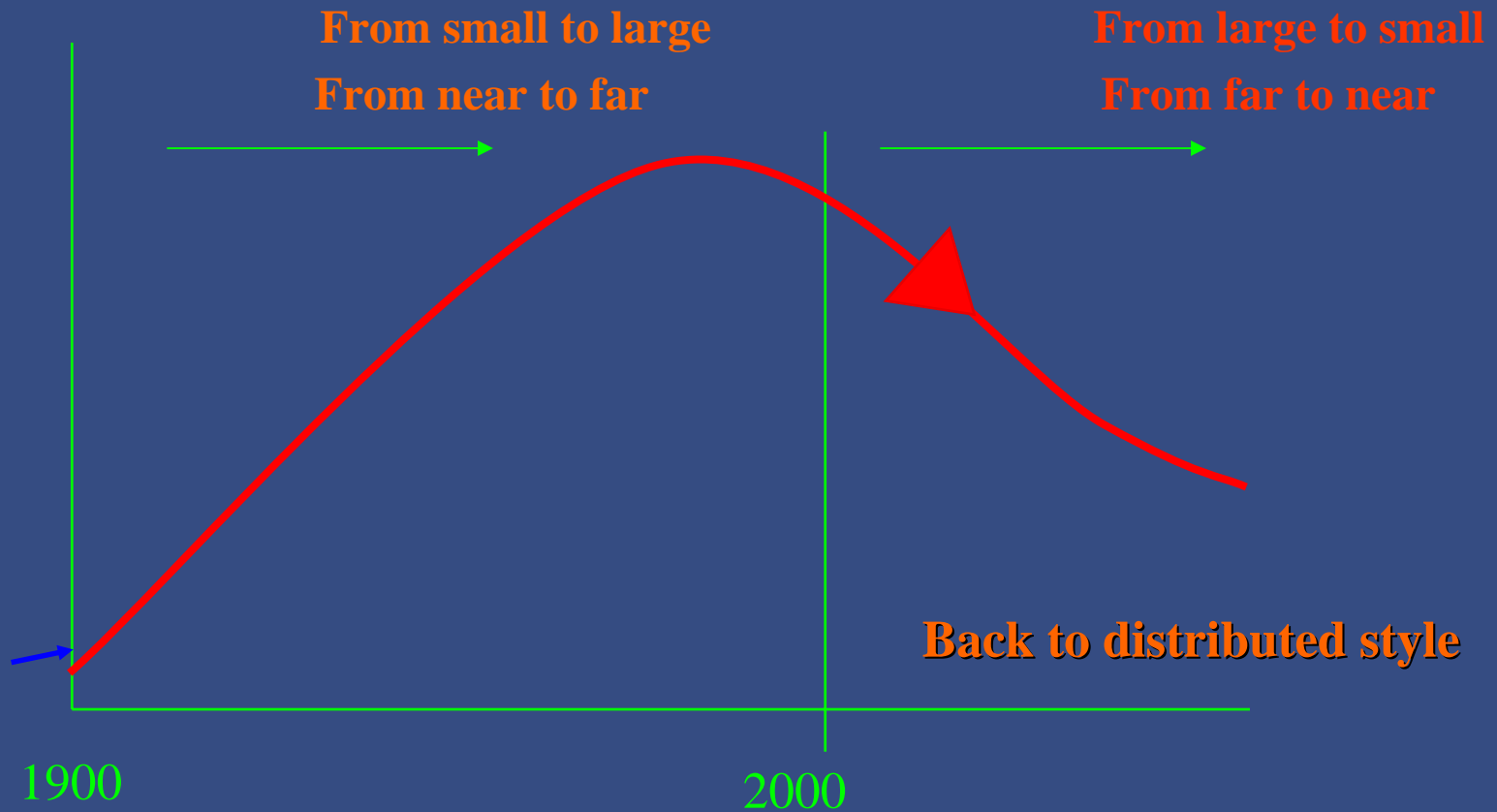
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Distributed Energy in China



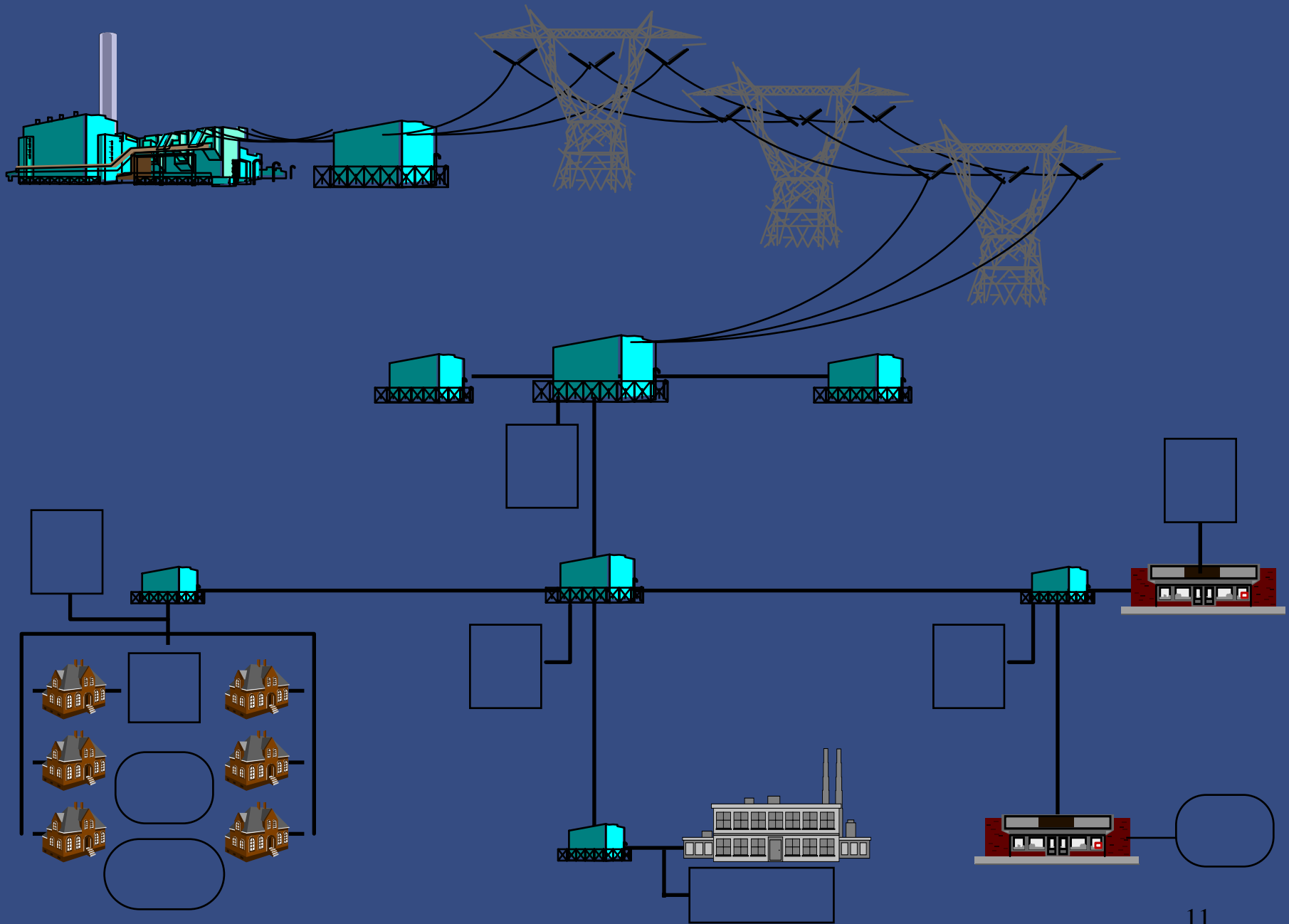
Trend of installation scale of world power generation facilities

1000
MW



Key part of 21st century energy system

Normal thermal power plant, hydro power plant and nuclear power plant have been challenged biologically and environmentally, along with the development of energy technology and reformation in energy structure, distributed energy shall serve mankind by forming a stronger energy network with traditional large grid power supply with its advantages of environmental friendly, highly efficient, energy saving and flexible, etc.



CCHP Of Distributed Energy



New wave of 21st century

Historical Dialectic

Result of technological progress

Environmental & High utilization rate of energy

--

Energy facilities From large to small --from Far to near



Advantages Of Distributed Energy

Low emission, high environmental protection

Nox 25ppm CO2

The Nox emission from the gas turbine can be as low as to below 250ppm, and the emission of CO2, sulfur ride and power is low.

Highly efficient utilization of energy in a comprehensive way

75%

With CCHP, the comprehensive utilization of energy can be above 75%.

Intelligent & Felxible

Controlled automation, information, managed grid, remote control, free of man duty

Advantages Of Distributed Energy

Enhance the safety of power utilization

Be directly placed nearby customers, work with large grid and so significantly enhance the safety of power utilization

Improve economic benefit of city grid and natural gas pipeline

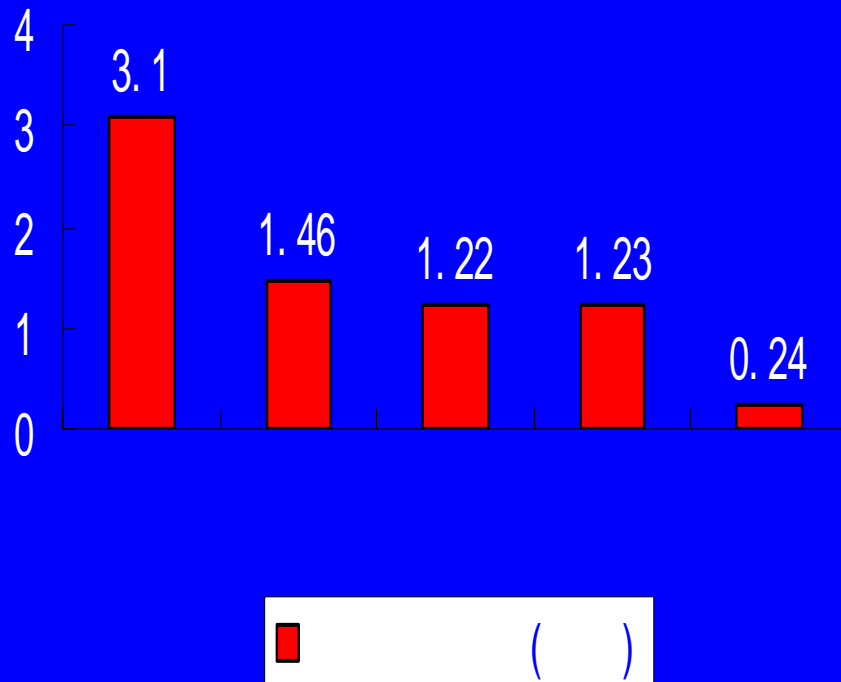
Supply cooling air in summer, supply heat in winter, improve the utilization rate of power grid and natural gas pipeline

Necessity of promoting CCHP technologies in China

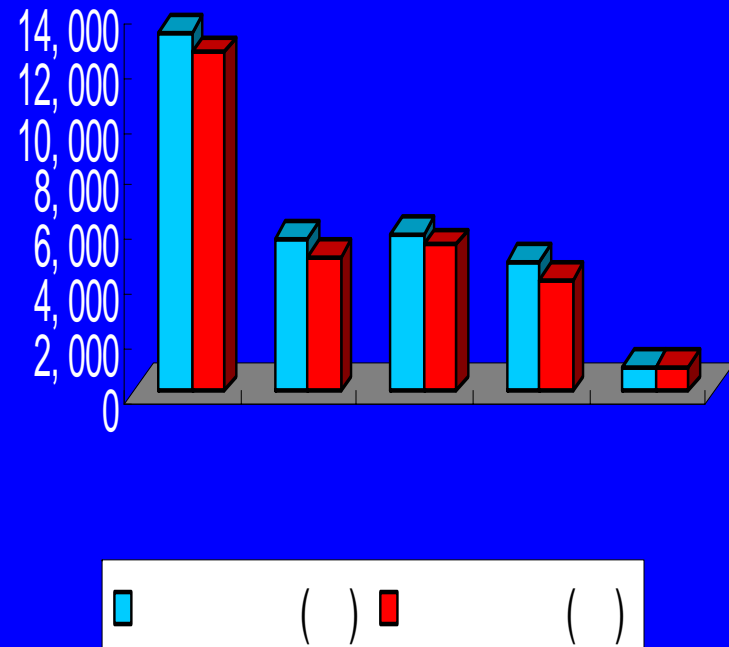
2001

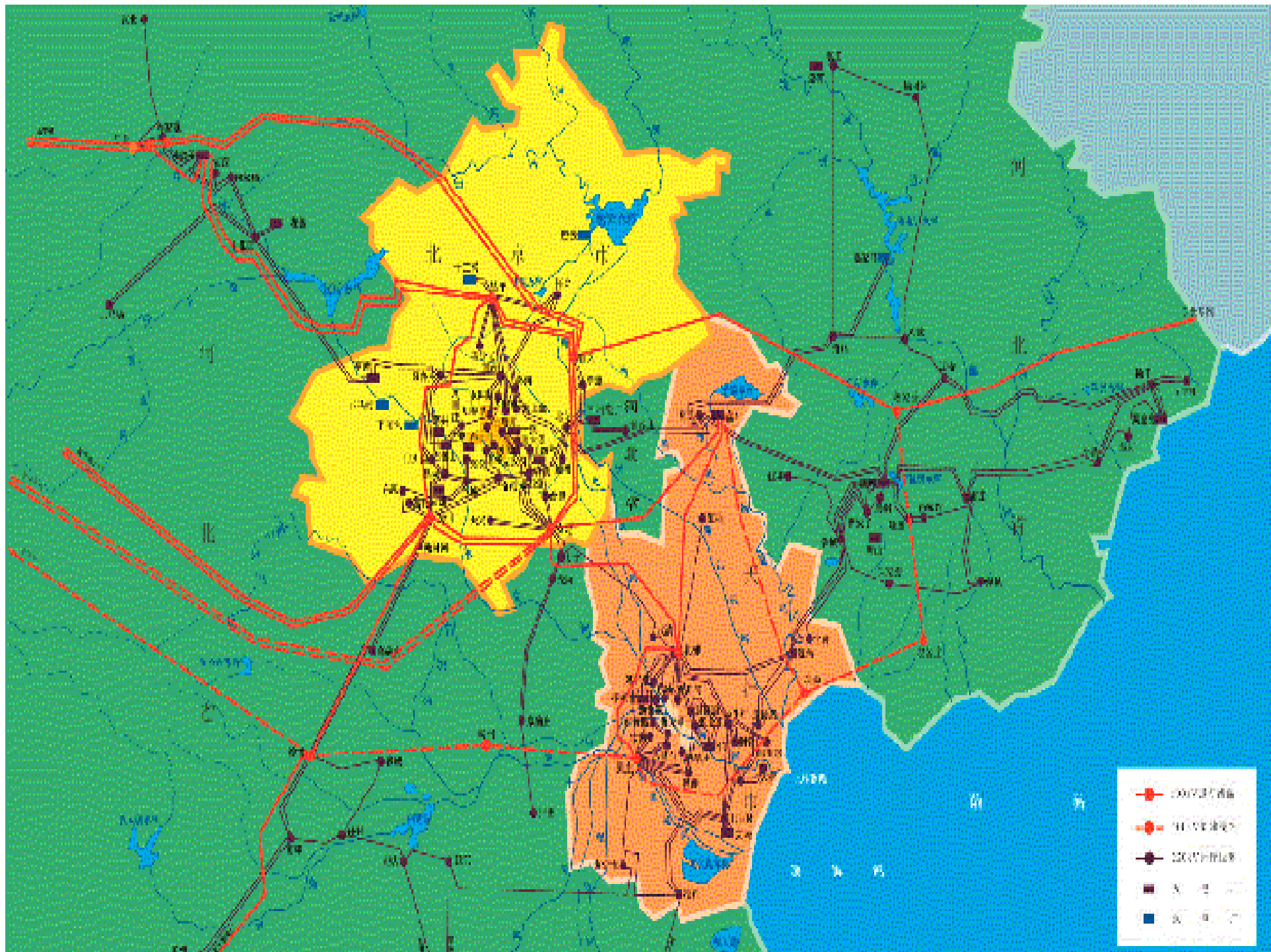
Huge Development Potential of China Electric Power Industry

1/10
Average installed capacity per head is less than 1/10 of that in the US



/ **1/10**
Average generation/utilization of power per head is less than 1/10 of that in the US





2003-2004

**Power Outage and Shortage in
the summer of 2003-2004**

26 (2003 19)

**24 provinces of China are heavily short of power
(19 provinces in 2003)**

2003 7 8 during June and July in 2003

14

**Cumulatively, more than 140,000 lines/time were shut down to restrict the
power supply**

19 kwh

Cumulatively, about 1.9 billion kwh power were restricted

4000 kw

**The maximum restricted power load in one day exceeded 400
billion kwh.**

Electric power development fails to keep up with the rapid and continuous growth of national economy

2004 9.5 % 14.9% “ ”
 3.6%

During the first half of 2004, the economy of China grew with 9.5% while the power consumption of whole society for the same period increased by 14.9%. However, the growth rate of average installed capacity targeted by 15th Plan is only 3.6%.

2204 267

The maximum load of the grid of Beijing, Tianjin and Tangshan increased up to 22.04 million kwh, 2.67 million kwh over that of the last year.

30 40

The specific weight of the load caused by cooling of air conditioning in the grid of East China, South China and Central China has exceeded 30%, and near 40% in individual provinces.

Nature Gas Pipe Line



2008

50

Completion of the the second Sanxi to Beijing Natural Gas Pipeline
By 2008, the gas utilization volume shall be 5 billion cubic meter

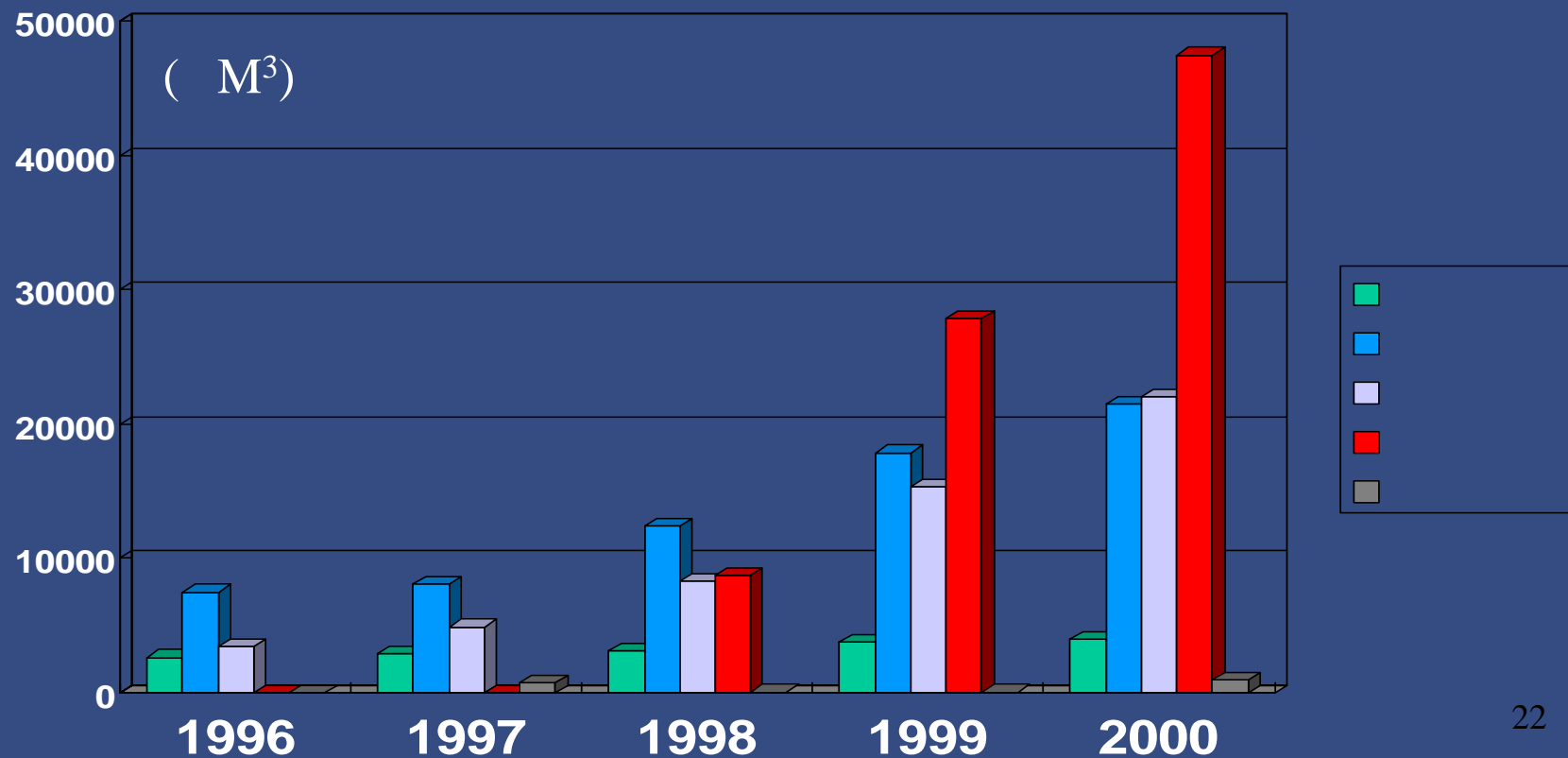
Project		2002		2005	
		Gas Utilization	%	Gas Utilization	%
Residents, Public servants		55918	31.28	80491	20
Industry		55918	31.28	53548	13
Heating, cooling	Cooling	94885	(94.77)	145759	(96.)
	Heating	4400	(4.39)	5842	4
	Direct gas engine	842	(0.84)		
	Subtotal		100127	56	151601

Situation of natural gas utilization volume of various consumers in Beijing

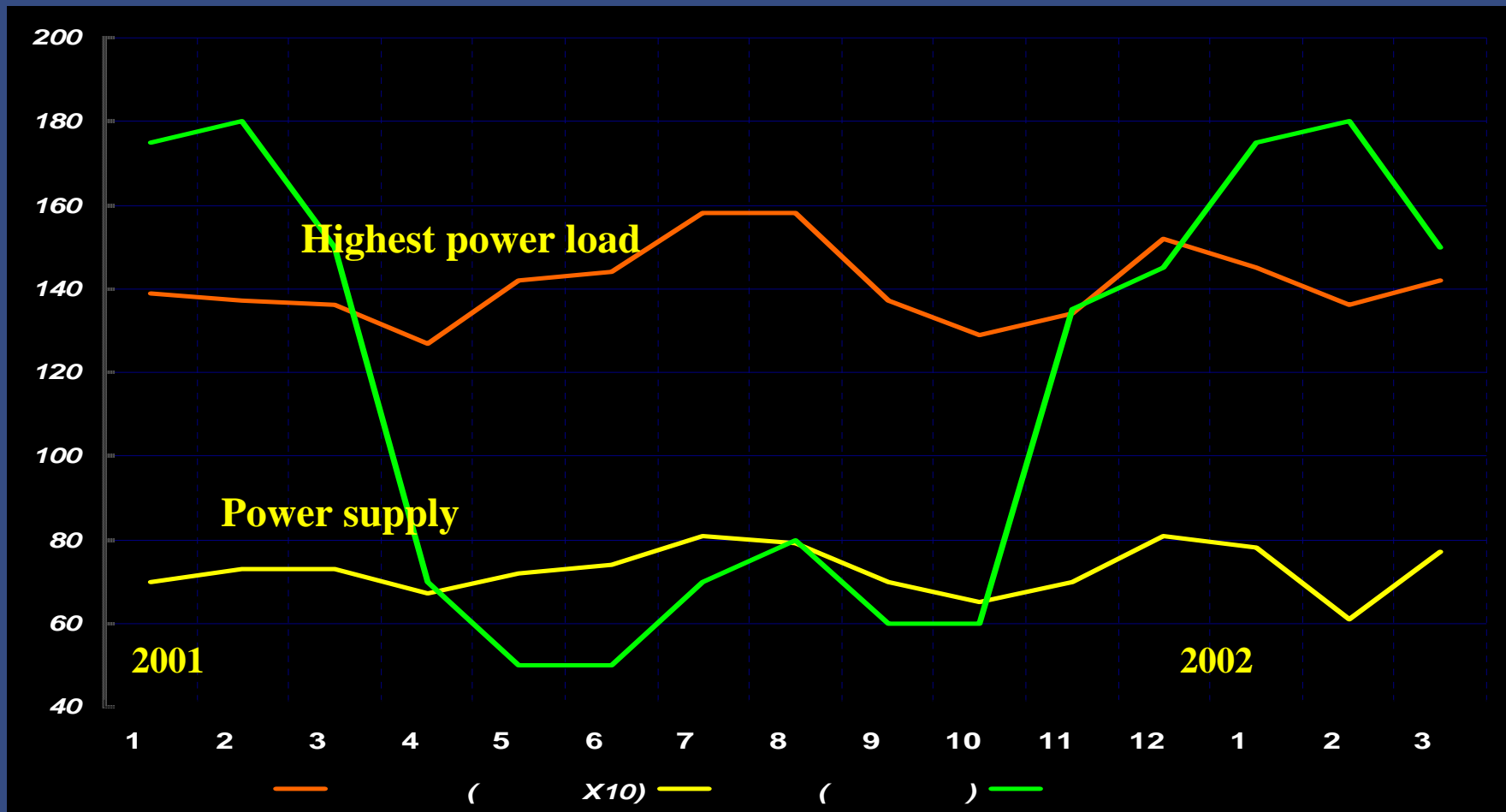
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6

Natural gas used for heating accounts for more than 50% of the total of whole year, and the difference between winter and summer is 6 folds



Grid annual load curve of Beijing, Tianjin and Tangshan & Beijing nautral gas annual load curve



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í¼Ø¼ÈÈξ§ 公共交通路线



ÇàÈ¼ÈÈξ§



° ÒÈÈ¼ÈÈξ§



μξÓÈ¼ÈÈξ§



±¾@¶ËÈËËÄε



¹ÄÈÿÛÄ¿



Òò©ËÄÄ¿

BEIJING CITY MAP



ÒàÈ¼ÈÈξ§

Shanghai has piloted the project

Huangpu Central Hospital

- **20**
Use Solar Saturn 20 gas turbine unit
- **1,100kW**
Generate 1,100kw power
- **Satisfies the needs of power, heat, cooling, hot water and disinfect steam of whole hospital.**

Shanghai has piloted the project

Pudong International Airport

- **50**
- **Use Solar Centaur 50 gas turbine**
- **4,000kW**
- **Generate 4,000kw power**
- **Satisfied the needs of power, heating and cooling of part of the airport**

Minhang Central Hospital

- **400kW**
- **Jiantai 400kw gas engine**
- **400kW**
- **Generate 400kw power**
- **Satisfies the needs of power, heat, cooling, hot water and disinfect steam of part of hospital .**

Shanghai PuDong Inter'l Airport

- ◆ Gas turbine 3.5MW
- ◆ Exhaust heat boiler 9.7t/h



- Vapor Generated: 0.9Mpa
- Overall efficiency 77%

CCHP Policy Of Shanghai

- Government coordinates the interconnection of Co-Gen project.
- Imported equipment is exempted from VAT and import duty
- Assist enterprise in doing feasibility study, setting up project, organize, review and approve project
- Provide financial support low interest loan research budget
- Favorable natural gas price 2.1-2.4 RMB/cubic meter; 1.9 RMB / cubic meter for co-gen
- Reduce or exempt natural gas resources package fee
- Actively promote pilot project Organize abroad visit,etc.

Testing being actively performed in Beijing

Already constructed and being commissioned

- 1 480kw+1 725kw

1 set of 480kw + 1 set of 72kw gas engine

- 1 BZ100 +1 BZ200

1 set of BZ100 + 1 set of BZ200 Waste Heat direct gas turbine

-

Guarantee power consumption of the basically, the shortage shall be supplemented by the grid

-

Satisfies the heating, cooling, and hot water of the building

Beijing Gas Monitoring & Controlling Center

- **Equipment:**
**725 KW gas engine +
2 million Kcal DFA**

**480KW gas engine +
1 million Kcal DFA**
- **Construction Area:**
32,800 m²
- **Maximum Load :**
Electrical : 1640 Kw
Cooling : 3148.8 Kw
Heating : 2296 Kw



Comprehensive building of Beijing Ciqumen Natural Gas Station

Already constructed and commissioned successfully

1 TG80 80kw

1 set of British Bowman TG80 80kw micro gas turbine

1 20

1 set of China Yuanda 200,000 mega pscal waste heat direct gas engine;

▪

Satisfy the needs of power, heating, cooling and water of the office building

Extra power be interconnected (system testing project)

CiQu Gas Pump Station BCHP



- A gas pump station
- Floor area 2900 m²
- Electrical power:80KW
Bowman Microturbine
- Exhaust heat DFA:66USRT
- DFA:66USRT



Zhongguancun Software Park

During design stage

1 1200kw

1 set of 1200kw gas turbine

1 500×10^4 kcal/h

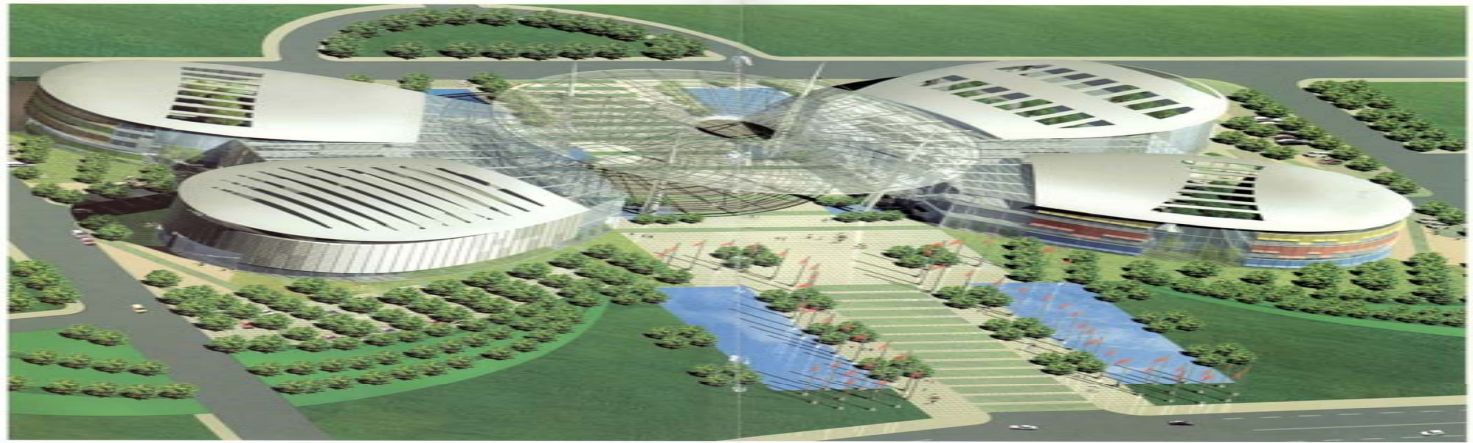
1 set of 500×10^4 kcal/h waste heat direct gas engine

Satisfy power consumption partially, support safe power utilization

Satisfy the heating, cooling and hot water of the square

ZhongGuanCun Software Park

Financial analysis



Estimated total investment: RMB	39 million
Estimated incremental investment compared with using DFA only (RMB)	13.6 million
Energy-net RMB	10 million
Project owner: RMB	29 million
Estimated project IRR	12.46%
Payback period	7.16 years

**Project of CCHP with Qinghua University Sterlin outer combustion turbine
Successfully commissioned and operate normally**

- **20kW 35.5kW**
20kw Sterlin generator, 35.5kw heating supply
- **30 53**
30% power generation efficiency, 53% heating supply efficiency
- **55 250**
Outlet hot water temperature is 55 degree C, exhaust gas temperature is 250 degree C
- **Extreme low equipment emission**
- **8ppm 1/15**
Nitrogen Oxide is 8ppm, 1/15 of

ZhongGuanCun Medical Park

➤ Northwest Beijing

➤ Total occupied area:

119.66 hectare

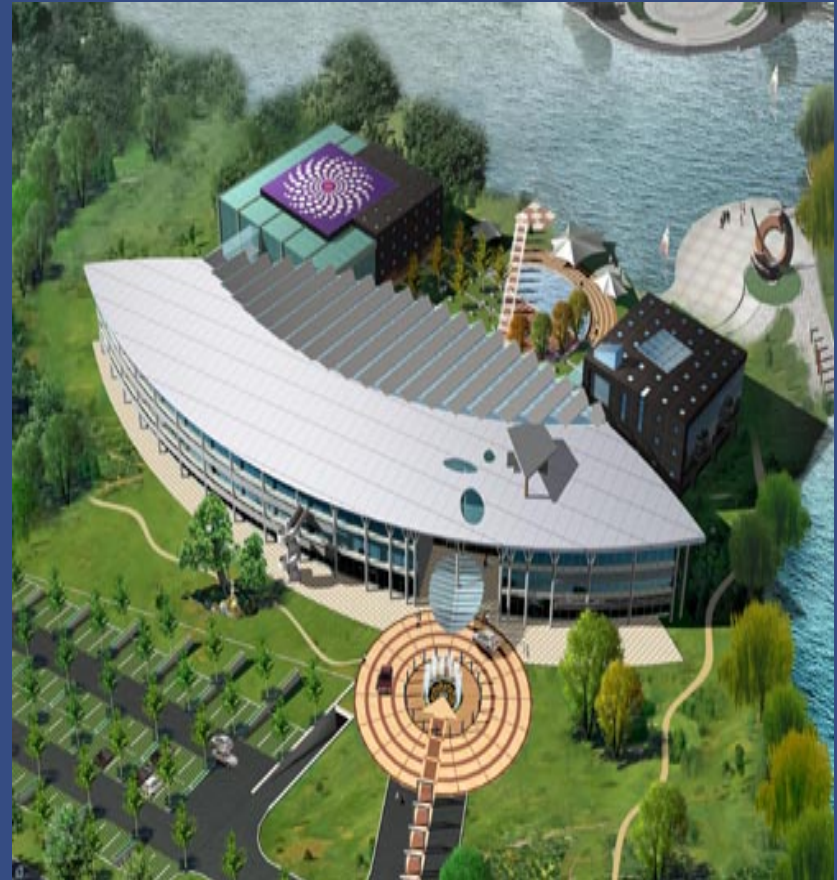
Cooling $5,633 \times 10^4$ kcal/h

Heating $4,501 \times 10^4$ kcal/h

Electricity 43.608 MW

Hot water 168×10^4 kcal/h

Steam 40 t/h



China World Trade Center Phase 3 BCHP

- **Construction area:**
540 000 m²
- **Total investment:**
800 million USD
- **Commercial use date:**
the end of 2007



**Gguangzhou University City DE Projects
have been set up and being tendered**

LNG

LNG is main fuel;

2

Form up 2 sets Gas-steam gas turbine combined cycle CCHP unit;

126 Mw

52.1%

generation capacity: 126MW, combined cycle power generation

Heating supply capacity

120t/h 3.5Mpa

130°C

80%

120t/h 3.5Mpa high temperature and high pressure steam, total efficiency of energy utilization of 130 degree C low temperature flue gas recovery such as free from living water system is above 80%;

2005

Phase 1 of University City (before 2005)

18 / 18 square kilometer

25 / 250,000 population

Phase 2 University City

43 / 43 square kilometer

30 / 300,000 population

/ Medium sized cities

Largest university city in the country



**Plan of Phase 1 of University
New District of Guangzhou
area (Xiao Guwei Island)**

Difficulty faced by promoting the application of CCHP in Buildings

- **Hard to interconnect**
- **Restrictions from fire-fighting rules**
- **Too high gas price**
- **Restrictions on power sales**
- **Restrictions of Beijing emission rules**
- **Too expensive and less localized on the main equipment**

Difficulty of interconnection

-
- **Currently, Beijing power bureau believes that the grid will be affected if interconnected by small capacity power source. However, technically, the interconnection of generator that conforms with national standards with the grid is a matured technology**
-
- **Indeed there is certain difficulties in dispatching and managing the interconnection. However, the difficulties can be solved technically.**

Solution: The difficulties can be solved technically. The issue lies in mind.

Restrictions of fire-fighting rules

- **2kg** **5kg 15kg**
Current fire-fighting rules restrict the gas with pressure higher than 2kg from entering into household though the pressure of gas turbine is usually between 5kg and 15kg.
 - **10kg**
 - **The pressure of the gas that is allowed to enter into household in Japan and US is usually above 10kg. But both countries have formulated a complete set of corresponding managerial and technical measures to solve the problem resulted from the high pressure gas rather than inhibiting the application of such gas.**
- Solution:** Along with the technical development, corresponding rules and measures should be formulated in terms of different new technologies and equipment. Otherwise, it will be the obstacle to the technical progress.

Gas price is too high

- CCHP

The high gas price has been the main reason that has been inhibiting the application of CCHP and other industries.

Chinese gas price is one fold higher than that of US and Russia.

Suggestions: Governmental agencies to formulate a reasonable price, balance the interests of various agencies, or provide favorable treatment and support to the application of such highly efficient energy. Beijing Gas Group has granted certain favorable treatments to CCHP projects though not enough.

Restrictions on power sales

- **For the time being, the domestic power market is still a monopolized one. Although the reformation designed to break such monopoly has started, still far away from being marketed.**
- **CCHP**
CCHP is only allowed to sell power to its own customers, and is restricted from selling power to neighboring customers through the grid. And even it is allowed, the tariff is unreasonable which affected the economy of distributed energy.
- **CCHP**
Suggestions: Rules should be formulated to allow CCHP to sell neighboring customers through grid at a reasonable and relatively low wheeling fee to grid.

Restrictions of Beijing Emission Rules

- NO_x 200mg/m³ NO_x 200mg/m³

The standards of Beijing to the emission of Nox of boiler is restricted below 200mg/cubic meter, and that the Nox emission of gas turbine is below 200mg/cubic meter. However, it is extremely difficult for gas engine to satisfy this standards.

- NO_x 250mg/m³

Gas engines have been widely used in abroad, the Nox emission is controlled below 250mg/cubic meter. In addition, Gas engine is completely different from boiler in terms of operation principle. If boiler standards are used to regulate gas engine or other equipments, it is obvious improper.

Suggestions: Corresponding rules should be formulated with respect to different technologies and rules so as to guarantee that the advanced technologies get fully and effectively applied.

Too expensive and less localized on the main equipment

- CCHP

CCHP

The main equipment of CCHP are gas turbine and gas engine, and these two equipments are almost vacant domestically, I.e. must be imported from abroad which results high price accounting for more than half of the investment which eventually cause the high investment in CCHP project.

-

863

Both gas turbine and micro-gas turbine are part of state 863 program.

CCHP

CCHP

CCHP

Suggestions: The development of CCHP is fully integrated with the localization of equipment, and the active development of CCHP shall promote related domestic industries which will in turn promote the development of CCHP.

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Thanks