

Building Energy Supply Infrastructures and Urban Sustained Development of Shenyang

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Abstract: Urban energy supply is a necessary infrastructure of civic development. Shenyang is an old industrial-based center in the northeast. Its development influences the economic development of the whole old northeast industry base. This paper analyses the present situation of Shenyang's infrastructure, especially the energy supply infrastructure. The current situation of problems with Shenyang's energy supply infrastructure are also analyzed. At the same time, the paper points out that defects in the current situation of Shenyang's building energy supply take a back seat to urban sustained development. Recent strategies and suggestions for Shenyang building energy consumption have been presented.

Key words: Building energy supply; infrastructure; urban sustained development.

1. THE CURRENT SITUATION OF BUILDING ENERGY SUPPLY AND INFRASTRUCTURES

1.1 The Current Situation Of Heating Supply

At present, the urban heating area of Shenyang is 86 million square meters, in which that of residence is 70.2 million square meters that of public building is 15.8 million square meters. There are three kinds of heating forms, including heating by co-generation power, immaculate energy and coal boiler. The heating area of combination between heat and electricity is 18 million square meters. The heating area of immaculate energy is 1.4 million square meters, in which that of electric, oil and gas heating areas are respectively 700,450 and 260 thousand square meters. The heating area of coal is 66.6 million square meters. The ratio of urban central heating is 55 percent. The consumption of coal used in central heating is 2.4 million tons.

Now, there are 3338 boilers for heating in Shenyang. Overall tonnage is 17, 845T/h. The number of boiler which tonnage is above 10T/h is 645. Its overall tonnage is 6, 622T/h. The number of boiler which tonnage below 10T/h is 2, 693, is 80.7 percent of all of boilers. Its overall tonnage is 11, 223T/h. There are three large-scale heating networks, including Shenhai thermal power station's heating networks, Shenyang thermal power station's heating networks, Huanggu thermal power station's heating

networks. Shenhai thermal power station's heating network which heating area is 8.47 million square meters is hot water networks. Shenyang thermal power station's heating networks which heating area is about 2 million square meters consist of hot water and steam networks. The steam networks consist of 4 steam heating pipelines. It distributes heat for 24 factories and enterprises in Tiexi district. Its overall quantity of distributing steam is 380T/h. The heating networks established by Hanggu's heat power station are divided into hot and cryogenic water networks. The former was indirectly joined. The temperature of flown and returned water in the major pipe network are 120°C and 70°C. The temperature of flown and returned water in the minor pipe network are 80°C and 60°C. The heating area is about 1 million square meters. The temperature of flown and returned water in the cryogenic water network which is heated directly are 65°C and 47.5°C. The heating area is about 0.5 million square meters.

1.2 The Current Situation of Gas supply

At present, the length of gas pipeline in Shenyang is 1, 331 kilometers. The overall pipeline's length in city and courtyard is 2, 456 kilometers. Their two-store and distribution gas station, which can store 300-thousand-cubemeter gases. The compressor is designed to distribute 63, 000m³/h gas.

At present, in Shenyang there are oil gases, coal seam gases, mine gases, coke oven gases, liquefied petroleum gases with air, liquefied petroleum gases and so on. They are distributed by pipeline except liquefied petroleum gases. There are three kinds of LPG. They are equipment with bottle, pipeline and vehicle usage. The market's share of pipeline LPG is very little. Now, there are only few districts, which are applying with this manner. Furthermore, they are changing for natural gas. Table I shows the situation of gas district unification and selling in Shenyang from 1999 to 2003.

1.3 The Current Situation of Electricity Supply

The total quantity of electricity consumed in Shenyang is 9.922 billion kWh in 2002. The largest loads is 1, 924MW. The average rate of increase in the quantity of electricity consumed is 6.4 percent from 1990 to 2003, and the average rate of increase in the largest load is 8.47 percent. Shenyang Power Supply

Company counted directly 13 million households . The amount of power supply arrived at 10.58 billion kWh, and the largest loads was 1, 924 million MW. By the end of 2003,there were 3, 990 employees. The total fixed assets 3, 843.77 million yuan. The net value 2, 751.31 million Yuan in Shenyang Electric Power Supply Company. The total charge of selling is 518.63 million yuan. The taxes of selling are 148.97 million yuan. The received charge is 128.97 million yuan. The charge for large-scale repair is 24.54 million yuan. There are 1, 371, 676 users in which the number of residence is 1, 287, 550, the number of non-residence is 29, 535, the number of large-scale industry is 1, 428, the number of common industry is 5, 897, the number of non-industry is 13, 545, the number of agriculture is 2, 066, the number of repaying is 103. the number of commerce is 31, 552. Table II shows the status of area of supplying electricity and population of supplying electricity in different district of Shenyang.

2. THE MAIN PROBLEMS IN BUILDING ENERGY SUPPLY AND INFRASTRUCTURES

2.1 The Problems in Heating Supply

2.1.1 Central heating rate and heating facilities in efficiency are low

Many small-scale heating sources are built repeatedly so that environment is polluted. However,

Tab. 1: The situation of gas distribution and selling in shenyang from 1999 to 2003.

Verities	1999		2000		2001		2002		2003		Heat value kJ/Nm ³
	Supply	Selling									
Oil gas	3507		2793		403						21767
Coke oven gas	5267	7470	5323	5870	4989	3824	5039	3592	5582	4475	18487
Produced gas	857		297								4916
Oil field gas	7986	6899	7249	6268	7008	6048	7758	6679	6938	5972	36256
Coal seam gas	2780	2376	2421	2074	2432		2248		2346		36256
Liquefied petroleum gas with air					558	2097	350	1938	157	2196	45320
Mine gas									3		25100
In system	16017		19687		17175		13443		1834		
LPG Out of system	50574		46546		57402		47728		45903		

Note: The unit of LPG is ton; other else is ten thousand cube meters

the large-scale heating sources are built slowly, which lay behind the development of the city. At the same time, the small-scale heating sources have low-level management and big arbitrariness that pollute environment. Several-style heating develops too fatly which do badly to economic energy and be contrary to energy structure of Shenyang City. Meanwhile quantity isn't consistent with price. The heating enterprise can't specialize and be run in a large scale and intensive way.

2.1.2 The-heating enterprises have small scales low efficiently and consider revising management

There are 8.6 million square meters heating-areas, while 1093 heating enterprises, in which there are only 30 special companies. The-heating enterprises can't be run in a special and large scale and intensive way, which severely hinders the development of heading enterprises.

2.1.3 The problems of charge in heating consumption are apparent.

Since a long time, conventionally welfare heating has been carried out in our country so that people think heating is relative with our government and persons and families enjoying the heating shouldn't charge. Since the reform and opening, heating enterprises has carried out the model running according to the market. However heating charger are still the users' enterprises, and employees' salaries don't comprise

Heating charges, which are charged by them. So

Tab.2: Area of supplying electricity and population of supplying electricity in Shenyang

Item	Area		Population		
	Area (km ²)	Percent of whole city (%)	Population (ten thousand)	Percent of whole city (%)	
Whole city	12980	100	685.1	100	
Urban district	9 districts	3495	26.93	485.1	70.81
Including	Center	1150	8.85	417.7	60.97
	Core	468	3.6	367.5	53.95
Suburb	Xinmin	3352.5	25.82	68.8	10.05
	Liaozhong	1667.5	12.84	52.2	7.62
	Faku	2290	17.64	44.6	6.51
	Kangping	2175	16.75	34.4	5.03
	Total	9485	73.07	200	29.20

relative departments and heating enterprises has been puzzled by this problem. Some users aren't able to take on heating charges, while a few users capable of charging don't charge or delay charge. These cause that heating enterprises don't run well, even in debt. Recently, the rate of heating charge received in Shenyang is low (1999-2000 70 percent, 2000-2001 75percent, 2001-2002 80 percent) which severely hinders the development of heating enterprises. The problems not only relate to the society and economy but also result in the heating quality, which doesn't satisfy the user and unreasonable charge. Whether the heating qualify equal to its charge the user get the heating after paying the charge and whether the user get the heating after paying the charge .All these questions should be taken into account.

2.1.4 The-heating equipments are short of funds to renew and rebuild

Because of the shortage of funds, many heating equipments haven't been reformed for a long time and served past the limit. Heating should enter market like other departments, especially international market, meanwhile foreign funds can be used to establish and develop the heating enterprises of Shenyang City.

2.2 The Problems In Distributing gas

2.2.1 The source of gas is shortage

The supply of urban gas-fired was less than demand during the 9th five-year plan in Shenyang City. During the 10th five-year plan, the imbalance between supply and demand will be more severe, the shortage of gas-fired development in Shenyang City. Because RSFSR natural gas plan will enter Shenyang in 2007.The economic feasibility in introducing new sources of gas-fired descend during the 10th five-year plan. Therefore, in the long run, it is very urgent to search for new sources of gas-fired during the 10th five-year plan.

2.2.2 The problems in transport system

It is overwhelming to use gas-fired in whole city, especially introducing RSFER natural gas will create an advantage condition in natural gas in total. However, the following problems in the transport system of our city will affect the use of natural gas in

total.

①The junctions between cost-iron pipeline and cement are not fit for transporting natural gas.

At present, there are still many junctions between cost-iron pipeline and cement in 500-kilometer pipelines, which should be dialed with before the use of natural gas in total.

②The corrosion of pipelines is considered revising.

Gas-fired enterprises started early, now there are still some pipelines sets up during Manchuria period. The indoor pipelines about 1, 000 kilometer in whole city corrode severely. Emphatically and gradually reforming these pipelines will be an important item in the construction of transport system in severe years.

③Insufficient capability of supply in transport system

At present, in some parts of transport system, there are following problems, insufficient capability of supply, the capability of storage and supply during peak hours has been satiated. Insufficient capability of transport in pipelines under middling presser in partial districts and a large amount of pressure loss.

④The problems in scientific research and exploitation of gas-fired.

The enterprises threw a great deal of labor power and material resources into scientific research of gas-fired, and received some gratifying achievement during the 9th five-year plan. However, scientific research of gas fired in the enterprises lying in preceding three ones has spatial difference in forming" throwing gout put-throwing again", and defects exist in the persons who major in exploiting and resolving important technical problem do not meet itch the demand. Scientific research and exploitation of gas-fired does not rapidly improve the benefit and becomes an efficient way in the product of company.

2.2.3 The problems of macroscopic policy about developing gas of Shenyang

The government pays little attention to high quality, high efficient and clean energy sources in laws and corresponding policies. The coal-polluting environment occupies a large proportion in the

contest of energy market. Because foreign government are strict with using coal and carrying out corresponding policies and laws. Financial resources are thrown into equipment and run accordingly clean energy source have dominant position in market, and environment can be protected so as to create an advantage condition in continuous development of the city. Therefore, considering continuous development of the city. It is very urgent to draft corresponding local policies and laws. Gas-fired, power and regenerate energy sources should be put in the same conditions with low quality energy sources such as coal and heavy density oil.

2.3 The Problems in The Supply of Electric Power

2.3.1 The volume of electric power being supply is insufficient.

In Shenyang, six local power plants have only the total volume 596 thousands kilometer watt. 220kV substations are main supply power now, and the total capability of all these substations and their arrange do not meet with the increasing loads. Five of these ones, which are already beyond their loads or equal to their loads are 41.7 percent of the total substations. Besides four of these ones are running only by one transformer so that the supply of power is not dependable.

The total volumes of these substations do not fit the density of the loads. This problem is apparent in Heping, Shenhe, Huanggu, Dadong district. In 1999, 11 substations are beyond their loads or equal to their loads in central district, which are 22.4 percent of all substations. There are 22 substations do not meet N-1 standard (44.9 percent of all substations). In addition, some substations were founded in 1960s whose equipments are very old and whose walls has been damaged. Meanwhile these substations do not have space for development and need to reform. All these problems directly affect the normal supply and run of power. Besides, some substations founded in 1950s or 1960s need to reform, which are 25 percent of the total substations.

The equipments of 66kV power nets in urban districts are in bad station. This kind of power net in Tiexi district has run for 60 years and cannot be depended on. Recently there are many accidents in Taxi power net. In the north of Huanggu district, there is not this kind of equipment so that the power net cannot run dependably in the middle of the district. The 66kV wires from Hospital substation to the urban center have been beyond their loads for a long time.

There are 272 wires in the 10kV power nets, 38 of which can not work normally, which are 14 percent of all wires. In Taiyuan, Zhong, Tawan, Sanhao, Shenhe Street, the south and southwest of Tiexi. Ming tang, the middle and north of Huanggu district, Shashan, Tahou etc. It is difficult to increase new loads in the old power nets. 50 percent

high-energy consumed transformers in 10kV power nets are working. 380V low-voltage power nets are so old and bad that they endanger people's lives and safeties, and limit the development of civil power too.

2.3.2 The credibility of power net is poor.

The appetents and wires established in 1950s or 1960s remain in power nets of Shenyang. These old employments supply low volumes so that they are liable to make wrong and cut power in a large area, even lead to a great number of financial losses.

2.3.3 The volumes of equipments in substations do not match the present density of loads.

In some old substations, the distance between 10kV outdoor wires is so short that there isn't adequate space to extend, which limit to the development of electric power in the city.

2.3.4 The funds in establishing power net are insufficient.

Power employments are fundamental ones, which relate to the development of our country and the life of people. Since a long time, the funds in establishing 66KV have neither been thrown nor included in electricity costs. The funds in establishing power equipments were only from the user's joint establishment costs and the subsidiary costs of supply. However, recently the Plan of Committee of our country reduced gradually the standard of the subsidiary cost so that the distance between the standard and one needed in practical engineering project got farther and farther.

In 1997, the government of Shenyang published the 16th file, which announced to cancel the joint establishment costs. The establishment of power nets cost financial sources which brought a considerably amount of negative effect on economic development of shenyang. At present, the contradiction between power supply of demand is more remarkable.

Besides, the power net construction of the city involves the housing removal, digging the road, urban environment etc. The investment due to these factors is equal to the investment of the power net construction. With the development of urban standardization, the construction of electric power equipments will be more difficult.

3. ASSESSMENT OF BUILDING ENERGY CONSUMPTION AND SUPPLY STATUS

3.1 Inferior Thermal Performance Of Building's Circumferential Structure, Large Energy Loss in Building

In Shenyang the energy-saving buildings take a very small proportion in all the heating buildings. The total heating area of the city is 86 million square meters, but only 10% are energy-saving buildings. If follows our country's professional criterion, standard of energy saving design in civil buildings, this proportion is merely 50% of the demand of

JGJ-26-95. However, the index to thermal performance of the building's circumferential structure, which follows the current civil professional criterion, is only half of that in the developed countries which have the similar atmosphere conditions. So it is clearly to conclude how huge the energy consumption of the buildings and how large the difference to the world advanced level of energy-saving buildings.

3.2 Low Efficiency Of The Heating Services, Lavish Of Energy And Polluting Environment

2693 boilers which single capacity is less than 7 Mw take 80.7% of total quantity of boilers in Shenyang. The efficiency of most boilers are less than 55%, also the boilers have large coal consumption and heavy air pollution. Considering the reasons, it has many aspects, mainly are such small capacity of single boiler, the equipments' ageing, lack of compatible accessory, low rate of operating load, the coal not conform to the boiler, inferior quality of the coal, the water treatment of the boiler not up to standard, large water loss, bad heat preservation, lack of operating adjustment, insufficient support of maintenance, and so on.

3.3 Insufficient Functions of the Heating Services And Inferior Heating Quality

Heating services almost are designed for winter heating. Such case doesn't meet the demands of heat sources, which cannot only supply the hot water and steam, but also provide central absorption refrigeration in the summer.

During the heating period, for the former reasons, it is difficult to have the heating quality satisfied. These also relate to some other factors, such as the heating method, the type of network, insufficient charge for heating, incomplete administration of the operation, and so on.

4. DEFICIENCY OF BUILDING CONSUMPTION AND SUPPLY TAKE A NEGATIVE EFFECT ON URBAN SUSTAINABLE DEVELOPMENT

4.1 The Energy Consumed By Building Is Considerable .The Energy, Which Ensure Urban Sustainable Development Is Facing With The Exhausted Threat.

Coal, oil and natural gas are the leading sources as building supply heat in ShenYang district .If they are exploited in present speed, their dried up day is already not faraway, and native productivity in Shenyang supply lack. In several years, the product of coal in ShenYang is about 300-400 ten thousand ton. In 2015, the consume of coal for supply heat is estimated 504.18 ten thousand ton. Obviously, the amount of coal for supply heat cannot meet it. In

recent years, 65% coal need buy from the other city and it becomes the load to the city's developing. In the other respect, it is a pity that these precious minerals are used as the fuel of supply heat.

4.2 More Heavier Environment Pollution. The Environment That People Depend On Is Being Destroyed.

Because of the large energy consumption of the buildings, there need huge heating load. So a lot of smoke and dust are produced in the fuel burning. These lead to the water pollution, thermal pollution and the air pollution, which is heavier. During the heating period of ShenYang, in January, the SO₂ in the air reaches to 0.257 mg/m³ which 2.89 times as much 0.89 mg/m the annual average value and 13.38 times as much the value of non-heating time, and the NO_x in the air reaches to 0.12 mg/m³ which 1.7 times as much 0.89 mg/m³ the annual average value and 2.65 times as much the value of non-heating time, and the TSP (total solid parcels) in the air reaches to 0.552 mg/m³ which 1.52 times as much the annual average value and 2.1 times as much the average value of non-heating time.

4.3 Insufficient Utilization of High Quality Energy .the Precious Energy, Which Supports Urban Sustainable Development, is Being Wasted Severely.

City heating mainly depends on coal burning boiler. Its heating area is 66.6 million square meters recently; the area that heat by oil, gas and power is only several million square meters. The area heating by cogeneration combination heating and power is 1.8 million square meters, which is about 21% of the total area. As the basic heating services of the city, the ending thermal parameters are all less than 100degrees according to the demands of heating and hot water. In the opinion of thermodynamics, it is lower efficient to use mineral fuel directly to heating so that meet with the need of low quality heat loads, and it is a great waste of the valuable resource.

5 THE PROBLEM OF BUILDING CONSUMPTION AND SUPPLY IN SHENYANG

5.1 The Policy of Energy Supply And Direction

Courage is not enough for energy saving constructor project, the heating project of energy comprehensive utilization which energy is high and transformation for the non-energy saving construction, In fact, the punish is not restrict for the new non-energy saving constructor project.

It hasn't a clear restricted direction to those now mainly depend on using mineral fuel for direct heating utilizing electric energy and the method of supplying hot water. As the thermal performance of the circumferential structure (especially the strict

restriction to the heating quantity of the outer window and the ratio of window and wall). This power of the supervisory measure is not enough to be put into effect.

(1)The method of heating is not always consistent with the economy and technology of society.

(2)The plan has not the seriousness and authority enough .The conflict exists between some government official's approving and the plan of heating in the item of construction.

5.2 Heating Plan

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5.3 Capital Used on Infrastructures

There have not enough and stable fund to construct .The item of heating the combined heating and power station and the big central network of heating.

5.4 Policy of Heating Charge

In the north codling area there have the vague reorganization of the public property of winter heating. The commercial separating system also needs strength and it has too big error in charging by the unit calculation standard.

5.5 Pollution Control

Now, it only depends on the fine to deal with the smoke and dust pollution that cause by heating boilers. There has not form the positive circulate system which transform the sources of pollution with complete economic method. Also we don't know how much the fine has been applied to the polluting treatment.

5.6 Idea Of Service

The conception that heating services should serve the public well has not strongly formed in the mind of

the master in the separating company. It is urgent to enhance the sense of service responsibility and the professional complement of the leaders and staffs in most heating companies.

6 RECENT COUNTERMEASURE AND SUGGESTION ON BUILDING ENERGY SUPPLY AND INFRASTRUTURES OF SHENYANG

(1)Combining the overall plan of urban construction, make harmony plan of heating, distributing gas and electric power.

(2)Fully consider urban characteristic in north and the idea that infrastructures serves for the People. Make the rational policy of heating and consumption.

(3)As to newly built building execute compulsively energy-conservation build thermal technology standard. Carry on transformation actively for original building.

(4)Insist on the policy of giving priority to central heating. Improve the central heating rate.

(5)Support and encourage the technology of utilization of renewable energy and research, development and application of the high efficient equipment. Technology of Hot pump. (Including air source, water source, geothermal power and remaining energy). New energy (Including solar energy, nuclear energy and creature energy)

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