(3) Heat Energy Demand Forecast and Peak Load Forecast Based On Microscopic Method

General principle

Microscopic heat energy demand forecast is made to clarify the heat energy demand of each district of Astana City as well as the entire demand of Astana City. As a result, new concentrated demand areas in Astana City are grasped for installing new district heating facilities.

The following data have been utilized for the heat energy demand forecast,

- Population of each district
- Commercial floor area of each district
- Office floor area of each district
- Unit heat energy consumption at industrial area
- Other special or public facilities or buildings

In order to calculate the heat energy demand at each district area, the following district numbering and name of district are used as per Figure 3.4.1

District No. 1 to 19 including 4A and 4B

Northern industrial district

Central industrial district

Industrial district Station 40

Planning district I to IX

In addition, some settlements located far from the city center are listed and they are divided into two areas, one is the area located on the right bank of Ishim River and the other is the area located on the left bank of Ishim River.

Basic Data for Microscopic Heat Demand Forecast

Table H.2.15 shows sales data of heat load to each consumer in 1999 and data required for calculation of the basic data for microscopic heat demand forecast.

Table H.2.16 shows the summary of the basic data to be used for microscopic heat demand forecast.

Tables H.2.17, H.2.18, H.2.19 and H.2.20 show average heat demand of each district in the years of 2000, 2010, 2020 and 2030 based on population, industrial sector, commercial floor area, and office floor area.

Tables H.2.21, H.2.22, H.2.23 and H.2.24 show the summary of average heat demand at user end in the years of 2000, 2010, 2020 and 2030 respectively.

Tables H.2.25 shows summary of heat demand forecast at user end. The calculation bases are as follows:

1) The figure of independent boiler on the table means the amount of heat for which heat source will be changed from independent boiler to the district heating system in future. The amounts of heat at the areas on the right and left banks of Ishim River will be 10 % and 20 % of the total demand of each area respectively in the year range from 2010 to 2030.

2) The calculated results on Tables H.2.22, H.2.23 and H.2.24 correspond to 70 % of the total heat demand of each area including heat amount not supplied by the objective heat sources.

3) From the above items 1) and 2), sub-total on the right and left banks of Ishim River on the table are 80 % and 90 % of the said total heat demand respectively.

Table H.2.26 shows heat demand forecast at the supplier end.

The following table shows heat supply rate to obtain heat amount at a supplier end from the heat demand at a user end.

Heat Supply Rate to obtain Heat Amount of Supplier End

Year	2000	2010	2020	2030
Right bank Supplier End	1.72	1.61	1.34	1.32
Left Bank Supplier End	-	1.50	1.50	1.50

Table H.2.27 shows peak load capacity at heat supply end.

Maximum (Peak load) demand forecasts by three forecasting methods are shown table below and shown in Figure H.2.2 as a bar graph.

Maximum Heat energy Demand Forecast

Unit: Gcal/Hour

	2000	2005	2010	2015	2020	2025	2030
Macro. Eco. Index	783	1,203	1,562	1,790	1,913	2,037	2,140
Macro. Population	757	940	1,151	1,386	1,621	1,762	1,879
Microscopic method	764	1,045	1,306	1,465	1,619	1,797	1,974
Proposed	**764**	**1,045**	**1,306**	**1,465**	**1,619**	**1,797**	**1,974**

(4) Conclusion of Heat Energy Demand Forecast

It is usual practice to adopt a microscopic method when heat energy demand forecast in short term is calculated and the calculation results are checked with calculation results obtained from macroscopic heat energy demand forecast.

The following table shows features of the used demand forecast methods.

Features of Load Demand Forecast Methods

	Appropriate for term	In case of short term forecast	Probable errors in
Macroscopic M. by Economic Index data	Long Term Forecast	Check microscopic method results with these results	GRDP per capita Annual growth rate of heat energy generation
Macroscopic M. by Population	Long Term Forecast	Check microscopic method results with these results	Population growth Average heat energy generation per capita
Microscopic M.	Short Term Forecast	Use this method	Basic data of population, commercial, and office floor area, population of industrial workers Average power consump. per unit for the above basic data

In the meantime, long term demand forecast is required, macroscopic demand forecast is adopted rather than microscopic demand forecast because the results might be distorted by cumulated errors. As the heat energy demand forecast in this Present M/P requires not only the load demand of the entire Astana City but also district-wise load demand, microscopic load demand forecast was made for 30 years.

As a result of the above three heat energy demand forecasts, the calculation result based on microscopic method may be most applicable data because of the following reasons:

- When the calculation results of microscopic demand forecast are compared with those of macroscopic heat demand forecast based on population, both results are almost same throughout the years. Therefore the calculation results of the microscopic method are applicable for the heat demand forecast.
- As the microscopic demand forecast includes heat demand forecast not only each district but also the areas divided by both right and left banks of Ishim River, these data are immediately applicable without any correction.

H.2.3 Power Transmission and Distribution Plan

(1) Study on the Existing Transmission Lines to be replaced or relocated

When formulating Present M/P, there is one important point for the existing 110 kV transmission lines that need to be replaced or relocated.

As shown Figure 4.5.1 in the main report, the existing Airport switching substation will be main switching substation in near future for sending electric power to new developing areas on the left bank of Ishime River. Accordingly, the existing transmission lines from TETs-2 to Airport switching substation should be newly constructed because of the following reasons:

1) The capacity of the transmission lines will not be enough to send electric power to new developing areas in future

2) The existing transmission lines from TETs-2 to Airport switching substation will be an obstruction for developing the new city residential areas at District Nos. 16 and 19 which are located on the left bank of Ishim River. (Refer to Figure 3.4.1)

3) The existing transmission lines have been in service for 30 years.
After construction of new transmission lines, the existing transmission lines will be removed.

(2) New transmission lines to be laid

New 110 kV transmission lines will be constructed based on the demand requirements of developing areas of Astana City. (Refer to Figures 4.5.1 in the main report.)

The new transmission lines to be laid are shown below.

1) New 110 kV transmission lines from TETs-2 to Airport switching substation will be newly constructed as over head cabling along with the outer ring road as close as possible from the viewpoint of landscape and the expansion of Astana City. (the same item as item (1))

2) New 110 kV transmission lines will be constructed as over head cabling from 500 kV central substation to Airport switching substation through Western switching substation for the line reinforcement

3) New 110 kV extension lines will be constructed at high demand areas such as New City Center, District No.14, District No.17 and High-Tech Parks in District I, II and III.
Type of branch cabling from new 110 kV transmission lines along with

the outer ring road to each district will be of underground duct type especially at the central areas and high residential density areas as much as possible from the reasons of long life of the laid cable and also townscape except for the cabling to High-Tech Parks.

For approximate lengths of 110 kV transmission lines to be laid are shown in H.3 Power and Heat Supply Development Plan.

(3) New Substations and Extension of the Existing Substations

Table H.2.28 shows electric power peak load demand at substation level and Table H.2.29 shows name of existing 110 kV/10 kV substations, number and capacities of transformers, new substations to be constructed and extension of the existing substations in future.

The followings show new substations and extension of the existing substations.

In 2010

- District N0. 13, New City Center
- District No. 17 on the right bank of Ishim River
- High-Tech. Park District No. I
- Extension of Transformers at Airport S.S.
- Extension of Transformers at Koktem S.S.

In 2020

- District No. 14
- High-Tech. Park District No. III
- Extension of Transformers at Zarechinaya S.S.
- Extension of Transformers at Pump Station S.S.

In 2030

- High-Tech. Park District No. II
- Extension of Transformers at Western S.S.
- Extension of Transformers at Southern S.S.

For further details, refer to H.3 Power and Heat Supply Development Plan.

H.2.4 Heat Supply and Distribution Plan

(1) Study on the Existing Heat Supply and Distribution Pipelines to be replaced

Many of the existing hot water supply and return pipelines are laid above the ground level from the viewpoints of long service life and easy access for maintenance and repair, although the appearance is not good. There is the scheduled plan by AES to replace the existing above ground pipelines with underground pipelines from the viewpoint of townscape.

Among the entire hot water pipelines distributed in the city, the hot water supply and return pipelines between Pump Stations No.1 and No.2 will be changed for underground pipelines from 2000 to 2005 and the works were carried out approximately 3.6 km in length in 2000.

(2) Heat Energy Generating Facilities and Heat Energy Distribution Pipelines

Basic thoughts of heat energy generating facilities and heat energy distribution pipelines to new developing area and also the existing high developing areas are as follows:

1) Heat supply to the developing areas on the right bank of Ishime River will be made by TETs-1 and TETs-2 with their facilities and pipelines extended.

2) Heat supply to the developing areas on the left bank of Ishime River will be made by TETs-1 and TETs-2 till the end of 2010 through the extension pipelines from the existing central district heating system.

3) From the beginning of 2011, heat supply to the developing areas on the left bank of Ishim River will be made by new district heating systems consisting of natural gas firing hot water boilers, heat exchangers, hot water circulating pumps, other ancillary equipment and district pipelines.

   It is our assumption that natural gas may be applicable for heat source of the district heating system from the beginning of 2011 because a large amount of gas consumption is required for the district heating facilities and there will be a limitation of gas usage amount at the beginning of gas supply.

4) Where the heat supply amount increases with the district development, number of hot water boiler sets will be increased as extension.

(3) Feature of the District Heating System

Features of the district heating system are as follows:

1) The district heating system has the centralized heat generating facilities and supplies heat energy to each building, therefore each building has no heat generating facilities. Accordingly the building space without the facilities would be effectively utilized for other purposes.

2) As heat generating facilities (hot water boilers) for the district heating system have bigger capacities than those of an independent sector, heat efficiency of hot water boilers of the former is higher than those of the latter, thereby attaining lower air pollution emission gas, lower operation cost when comparing to the sum of those of individual buildings having their own heat generating facilities.

3) Natural gas as fuel of the district heating system is the best fuel among fossil fuels from the viewpoint of ecology, because of no emission of dust particles and least emission of SOx. It is not sure, however, there is a plan to transfer natural gas to Astana City around 2005.

When planning the district heating system to new city development areas is proceeded, the following items should be taken into consideration.

- Each district heating facility should be designed so that the heat capacity is more than 5 Gcal/hour from economical viewpoint.
- It is preferable to select a heat supply area of approximately 500 m square that means within a radius of 250 m when the heat generating facility is located at the center of the area.
- It is important for the district heating facility to increase the density of heat load, which allows reduction of heat transfer cost.
- The heat generating facility and its operation must comply with the environmental protection law.
- It is preferable that there are various kinds of usage of buildings with different peak time, thereby reducing fluctuation of high and low load.
- The hot water should be of low unit price under the consideration of the development period of the planning area, purpose, usage and scale of each building.

The followings are brief explanation of the basic systems of the district heating system shown in Figures H.2.3 and H.2.4.

1) The system in each center is composed of primary hot water system and secondary hot water system. The hot water of the secondary water system in a closed cycle flows from heat center with heat exchanger to

each building and returns to heat center thereby minimizing make up water amount to secondary water system.

2) A thermostat will be installed on hot water supply pipe in each house or space to control room temperature in the range of 21 to 23 centigrade thereby restricting excess usage of heat and saving consumption of natural gas which will probably be imported from other country.

3) Installation of a calorie meter or flow meter on hot water receiving pipe makes a contribution to energy saving as well as securing of charge rate for hot water use and the problem about non-payment will be improved.

For hot water pipeline network and locations of each heat center, refer to Figure 4.5.2 in the main report.

(4) The Location of District Heating Facilities

The district heating facilities (heat center) will be located at the high heat demand areas, namely District Nos. 11, 12, 13, 14, 15, 16 and 19 on the left bank of Ishim River.

For installation plan of the district heating facilities in each heat center, refer to H.3 Power and Heat Supply Development Plan.

(5) Particulars of Hot Water Boiler

The following particulars are one of the choices of hot water boiler

- Heat capacity ..... 16 Gcal/h
- Heat transfer medium ..... Hot water
- Outlet pressure and temperature at primary heat source supply
  Pressure..... approx. 5 kg/cm^2
  Temperature ..... approx. 175 degrees centigrade
- Natural gas consumption per boiler ..... 2.10×10^3 Nm^3/h

(6) Natural Gas Consumption of Each Heat Center

The following table shows the estimated natural gas consumption at each heat center.

Natural Gas Consumption of Each Heat Center

Unit: x 1,000 kg/h

Heat Center (District No.)	At the beginning of 2011	2020	2030
HC-1(13)	8.8	12.8	15.3
HC-2(14)	8.1	15.3	22.3
HC-3(12)	2.7	2.7	2.9
HC-4(15)		2.5	3.1
HC-5(16)		3.7	7.8
HC-6(19)		3.2	3.4
HC-11(11)			10.2
Total	19.6	40.2	65.0

Note: Heat required at district other than the above will be prepared by user's own facility such as mini-boiler because the heat demand of each district is too small for the district heating system.

(7) Water source for the district heating facilities

Primary water (boiler water) ..... Drinking water

Secondary water (hot water circulation in closed cycle)....Technical water

H.2.5 Plan of Electric Power and Heat Energy Generating Facilities

Figures H.2.5 and H.2.6 show installation plan of electric power and heat energy generation plants required for electric power and heat energy demands in the year range from 2000 to 2030.

In those figures, 115 MW, 150 MW and 200 MW electric power and heat energy generating plants are required at the beginning of 2006, 2011 and 2021 respectively.

(1) Particulars of Each Plant

115 MW Conventional Electric Power and Heat Energy Generating Plant at TETS-2

1) Rated output Electric power.....115 MW (Max. 125 MW)
Heat energy .....approx. 175 Gcal/h

2) Expected date of commercial operation .....At the beginning of 2006

Refer to (2) Outline of Main Equipment of Sub-Section H.1.4 for the particulars.

150 MW Combined Cycle Electric Power and Heat Energy Generating Plant

1) Rated output Electric Power 150MW
Heat Energy.....approx. 220 Gcal/h

2) Type of electric power and heat energy generating plant..... Natural gas firing gasturbine combined cycle

3) Heat energy for hot water service .....All of steam required for the service will be generated by HRSG (heat recovery steam generator).

4) Kind of fuel ..... Natural gas

5) Location TETs-1

6) Expected date of commercial operation.....At the beginning of 2011

200 MW Combined Cycle Heat and Electric Power Generation Plant

1) Rated output Electric Power 200MW
Heat Energy.....approx. 290 Gcal/h

2) Type of electric power and heat energy generating plant..... Natural gas firing gas turbine combined cycle

3) Heat energy for hot water service .....All of steam required for the service will be generated by HRSG (heat recovery steam generator).

4) Kind of fuel..... Natural gas

5) Location..... TETs-2

6) Expected date of commercial operation.....At the beginning of 2021

(2) Project Site

TETs-2 (for 115 MW, 200 MW Plants)

TETs-2 is located in the central industrial zone of Astana City and there is still a large amount of allowance of land area to construct electric power and heat energy generating plant.

In the 1990's, there was a plan to construct 185MW electric power and heat energy generating plant, however the plan was canceled on the way.

The turbine house and boiler house constructed for the plans are available as turbine house and boiler house for new plant. The same idea is applicable for flue gas stack, railway for material transportation to turbine house and boiler house and cranes constructed for maintenance of the existing facilities as well as for construction of 185 MW plant.

As there is a very large ash disposal pond with an approximate area of 1.0 km^2 for the existing coal fired boilers, the area is also applicable for the new ash disposal area.

TETs-1(for 150 MW Plant)

TETs-1 is located in the northern industrial zone of Astana City and there is still a large amount of allowance of land area too, the machine building will be located at the existing outdoor material storage area on which there are no material at present.

(3) Water Intake and Water Discharge from the Site

TETs-2

1) Water Intake

There are two water sources to be received from outside for operating and managing new electric power and heat energy generating plant, one is drinking water, the other is technical water.

Usages of both water sources are as follows:

Technical Water

i) Water filling after periodical inspection of circulating water system

ii) Make up (supplement) to circulating water system

iii) Water filling after periodical inspection of bearing cooling water system

iv) Make up to bearing cooling water system

v) Make up water required for wet type ash treatment system

vi) Water feed to garden in TETs-2

vii) Make up to hot water system for district heating system

Drinking Water

i) Production of treated water (pure water) by water treatment facilities for using:
   - Boiler water filling after periodical inspection of boiler and feed water system
   - Make up to boiler water system

ii) Domestic water for office service
   - Canteen
   - Toilet
   - Etc.

Estimated drinking water and technical water amount for 115 MW new plant are as follows:

Estimated drinking water amount ..... 63.5 t/h

Estimated technical water amount ..... 245 t/h

2) Water Discharge from the Site

Waste water from the office building will be discharged to outside without any treatment and sent to the city's waste water treatment facilities as the same as the existing office building.

General waste water from electric power and heat energy generating plant will be sent to new waste water treatment facilities and discharged outside after treated to the allowable quality range of waste water.

Waste water containing oil will be sent to new oily water treatment facility and then the waste water will be sent to new waste water treatment facility.

TETs-1

Usage of technical water and drinking water and provisions of water treatment facilities and waste water treatment facilities will be basically the same as those of TETs-2.

H.2.6 Environmental Management

(1) Air Pollution Management

In order to fulfill air pollution management, new electric power and heat energy generating plant will equip with the following facilities and design consideration:

1) Boiler design should include combustion control technologies to minimize NOx emission.

2) Electrostatic Precipitator will be installed to collect dust particles in the flue gas.

3) Flue gas desulfurization plant will be installed to remove sulfur oxide in the flue gas.

The followings are brief explanation of the said facilities and design.

Table below shows air quality standard in Astana City at the ground level.

Air Quality Standard at the Ground Level

Items	Air Quality Standard
Total Suspended Particles (TSP)	0.5 mg/m^3
Nitrogen Dioxide (NO_2)	0.085 mg/m^3
Nitrogen Oxide (NO)	0.4 mg/m^3
Sulfur Dioxide (SO_2)	0.5 mg/m^3
Carbon Oxide (CO)	5.0 mg/m^3

As mentioned in Sub-Section H.1.1 Present Condition, TETs-1 and TETs-2 have to control the flue gas emission based on the plan of annual emission amounts proposed by TETs and approved by the environmental control department of Astana City.

In general, the required emission standards for coal fired boilers are shown in the Table below.

Required Emission Standards for Coal Fired Boilers

Boiler capacity	Emission Standard		
	Emission Level at Excess O_2 = 1.4 ; mg / Nm^3		
	Total Suspended Particles	Oxides	
	Ash contents more than 4%	SOx	NOx
Steam generator 420t/h and below	150	600	340

NOx Control

NOx control technologies which are currently and widely available can be divided into two (2) categories, one is Combustion Control Technologies and the other is Flue Gas Treatment Technologies

The followings are three methods in the category of combustion control technologies required for boiler design.

1) Low NOx Burner Method
2) Two Stage Combustion Method
3) Flue Gas recirculation Method

Currently, the combination of the above three technologies is applied in the utility field to minimize NOx emission levels. Such a combination can produce a NOx emission reduction level to 100 ppm which is equivalent to 135 mg / Nm^3 therefore NOx control will be attained by the above combustion control technologies which belongs to the boiler manufacturer' s matter without any application of flue gas treatment technologies.

SOx Control

Flue gas from a boiler contains sulfur dioxide, other acid gases and particulate matter.

In order to remove sulfur dioxide in flue gas, flue gas desulfurization plant (FGD) is highly recommendable. The FGD consists of an absorption/ oxidation combined system designed to remove these contaminates as economically as possible. Among many treatment methods, wet limestone – gypsum process is recommendable because the method is the most popular method in the world.

Flue gas enters absorber where sulfur dioxide gas is substantially removed by contacting with limestone slurry. Oxidation air is introduced into the absorber sump to complete the chemical reactions converting sulfur dioxide into gypsum.

After the entrained mist is removed by demisting, the treated gas is discharged into the atmosphere through the stack.

The absorber slurry is pumped to the gypsum slurry tank, then to the gypsum disposal area

The calculated SO_2 emission amount and total flue gas emission amount are as follows:

SO_2 emission amount after treated by the FGD...approx. 540 t/year

Total flue gas emission per year.....approx. 2.40 x 10^9 Nm^3/year

SO_2 emission amount in flue gas..... approx. 225 mg/Nm^3

Total Suspended Particles Control

In coal firing thermal power plants, it is a common practice to use electrostatic precipitator (ESP) to remove fly ash in flue gas. Electrostatic precipitator is an electrical dust collector, which charges the dust in the flue gas and collects the charged particles.

Basic process of electrostatic precipitator is:

1) Particles to be charged.
2) Particles to be migrated to collecting electrode by Coulomb force.
3) Dust to be accumulated on collecting electrode.
4) Dust layer accumulated on collecting electrode to be dislodged by rapping.

As the coal for TETs-1 and TETs-2 contains very high ash amount (approx. 40%) comparing to 10 to 25 % in general coals for thermal power plants, it is very hard to attain the standard of total suspended particles of 150 mg/ Nm^3 even though high dust collection rate of ESP such as 99.0% although dust collection rate of ESP depends on a range of fly ash particle sizes and electric resistance of the fly ash.

It will be approximately 475 mg/ Nm^3 with ESP dust collection rate of 99.0%.

It is main factor of air pollution by flue gas discharging from TETs-1 and TETs-2.

It is one of the important points for a boiler manufacturer or an ESP manufacturer to conduct detail investigation to remove the dust more effectively by ESP at the time of the extension of TETs-2.

(2) Estimated Annual Discharge Amounts of Flue Gas, Carbon Dioxide and Others

The following table shows estimated annual discharge amounts of flue gas, carbon dioxide, dust and sulfur dioxide.

	115 MW Plant	150 MW Plant	200 MW Plant
Type of plant	Conventional plant	Combined cycle	Combined cycle
Fuel	Coal	Natural gas	Natural gas
Fuel consumption per year	3.86×10^8 tons	2.00×10^8 Nm^3	2.67×10^8 Nm^3
Flue gas amount per year	2.40×10^8 Nm^3	6.02×10^9 Nm^3	8.03×10^9 Nm^3
CO_2 discharge amount per year	6.06×10^5 tons	3.89×10^5 tons	5.19×10^5 tons
Dust discharge per year	1140 tons	-	-
SO_2 discharge per year	540 tons	-	-

(3) Ash Treatment

Fly ash collected at ESP or other flue gas duct hoppers and clinker ash collected from boiler furnace bottom are mixed with water and discharged to an ash disposal pond located near TETs-2 by a special pump and the used water is reused as ash transportation medium without any discharge water to a river. The whole system is the almost same as those of the existing TETs-1 and TETs-2.

(4) Waste Water Discharge Management

As mentioned item (3) Water intake and water discharge from the site in Sub- Section H.2.5, Waste water from the office building will be discharged to outside without any treatment and sent to the city's waste water treatment

facilities as the same as the existing office building however the following waste water treatment facilities will be constructed in TETs-2 as one of the extension works.

1) Waste water treatment facility

2) Oily water treatment facility

Typical waste water treatment system and oily water treatment system are shown in Figure H.2.7 and H.2.8.

(5) Noise Management

As general rule, noise delivered from outside shell of every equipment and facilities of heat and electric energy generation plant under operation should be lower than 90 dB (A) and noise in central control room should be lower than 60 dB (A).

In this connection, the following equipment and valves will be equipped with silencer in general:

- Outlets of safety valve steam blow pipes such as blow pipes of safety valves for steam drum, superheater, power control valve, etc.
- Inlet of forced draft fans, primary air fans

Noise reduction insulation will be required for mills, boiler feedwater pumps, forced draft fans, primary air fans, induced draft fans, etc.

H.3 Power and Heat Supply Development Plan

The followings are the basic thoughts for electric power supply, heat energy supply and electric power and heat energy generating plants to respond to new electric power and heat energy demand in the developing areas in Astana City to make a chance for replacement or modification of old facilities or systems taking into consideration that Astana City is the capital of the Repablic of Kzakhstan.

(1) Electric Power Supply

New transmission lines required for new developing areas as well as increasing electric power demand on the existing areas will be constructed together with the construction or extension of 110 kV /10 kV substations as well as reinforcement of electric power supply sources. The existing transmission lines from TETs-2 to the airport switching substation will be replaced with new transmission lines arranged along with the planned outer ring road.because of the following reasons:

1) The existing transmission lines will be an obstruction for developing the new city residential areas at the District Nos.16 and 19.
2) The lines have been in service for 30 years
3) Transmission capacities will not be enough to send electric power to new developing areas in future.

As an urgent matter, 110 kV transmission lines from Airport switching substation to New City Center will be constructed including construction of the 110 kV/ 10 kV substation.

Refer to Figure 4.5.1 Plan of 110kV Transmission Lines, Switchyards and Substations.

In order to meet the electric power demand of Astana City, the following provisions are required for 110 kV transmission lines and 110 kV/ 10 kV substations:

Up to 2010

. New construction of 110 kV transmission lines from Airport switching substation to new substation of New City Center

Length	approx. 11 km
Period of completion:	by the end of 2001

. New construction of 110 kV/ 10 kV substation in New City Center
  110 kV/ 10 kV Transformers 2 x 63 MVA
  Period of completion: by the end of 2001

. New construction of 110 kV transmission lines from TETs-2 to Airport switching substation along with the planned outer ring road including removal of the existing transmission lines after the completion of new transmission lines
  Length approx. 35 km
  Period of completion: by the end of 2005

. New construction of 110 kV transmission lines from the branch (TETs-2 to Airport) to Eastern switching substation
  Length approx. 7.7 km

. New construction of 110 kV transmission lines from the existing switching substation Eastern to new substation in District No.17
  Length approx. 3.5 km
  Period of completion: 2010

. New construction of 110 kV/ 10 kV substation in District No. 17
  110 kV/ 10 kV Transformers 2 x 25 MVA
  Period of completion: 2010

. New construction of 110 kV transmission lines from 500 kV Central Substation to High-Tech Park in District I
  Length approx. 4.2 km
  Period of completion: 2010

. New construction of 110 kV/ 10 kV substation at High-Tech Park in District I
  110 kV/ 10 kV Transformers 2 x 6.3 MVA
  Period of completion: 2010

. Extension of transformers at Airport switching substation
  110 kV/ 10 kV Transformers 2 x 6.3 MVA
  Period of completion: 2010

. Extension of transformers at Koktem substation
  110 kV/ 10 kV Transformers 2 x 6.3 MVA
  Period of completion: 2010

Up to 2020

. New construction of 110 kV transmission lines from Airport switching substation to new substation in District No.14
  Length approx. 8.4 km
  Period of completion: 2013

. New construction of 110 kV/ 10 kV substation in District No.14
  110 kV/ 10 kV Transformers 2 x 40 MVA
  Period of completion: 2013

. New construction of 110 kV transmission lines from 500 kV Central Substation to the existing switching substation of Western
  Length approx. 15.8 km
  Period of completion: 2015

. New construction of 110 kV transmission lines from the existing switching substation Western to Airport switching substation
  Length approx. 15 km
  Period of completion: 2015

. From the branch (the transmission lines from TETs-2 to Airport) to High-Tech Park in District III
  Length approx. 1.3 km
  Period of completion: 2019

. New construction of 110 kV/ 10 kV substations at High-Tech Park in District III
  110 kV/ 10 kV Transformers 2 x 6.3 MVA
  Period of completion: 2019

. Extension of transformers at Zarechinaya substation
  110 kV/ 10 kV Transformers 2 x 6.3 MVA
  Period of completion: 2019

. Extension of transformers at Pump Station substation
  110 kV/ 10 kV Transformers 2 x 6.3 MVA
  Period of completion: 2019

Up to 2030

. New construction of 110 kV transmission lines from 500 kV Central Substation to TETs-2
  Length approx. 8.8 km
  Period of completion: 2025

- New construction of 110 kV transmission lines from the branch 500 kV Central Substation to TETs-2) to High-Tech Park in District II
  Length approx. 3.9 km
  Period of completion: 2029

- New construction of 110 kV/ 10 kV substation at High-Tech Park in District II
  110 kV/ 10 kV Transformers 2 x 10 MVA
  Period of completion: 2029

- Extension of transformers at Western switching substation
  110 kV/ 10 kV Transformers 2 x 6.3 MVA
  Period of completion: 2029

- Extension of transformers at Southern substation
  110 kV/ 10 kV Transformers 2 x 6.3 MVA
  Period of completion: 2029

(2) Heat Energy Supply

Heat energy required for the developing areas on the right bank of Ishim River will be supplied by TETs-1 and TETs-2 up to 2030 with the extension of the heat supply pipelines and reinforcement of heat energy supply sources.

Heat energy required for the developing areas on the left bank of Ishim River will be supplied by TETs-1 and TETs-2 with the existing central district heating system extended up till the end of 2010. From 2011, heat centers consisting of natural gas firing hot water boilers, ancillary equipment and hot water pipelines will be in service to cover the heat demand of the areas on the left bank of Ishim River with isolation of the heat supply tie lines connecting the right and left banks of Ishim River.

Therefore, TETs-1 and TETs-2 will only supply heat energy to the areas on the right bank of Ishim River from the year of 2010.

Up to 2010

Refer to Figure 4.5.2 Layout of Major District Heating Pipelines and Heat Centers.

Heat (Hot Water) Distribution Pipelines

- Extension of heat distribution pipelines from the existing central district heating system (supplied from TETs-1 and TETs-2) to New City Center and District No. 12
  Period of completion; by 2003
- Extension of heat distribution pipelines from the existing central district heating system to District No.17
  Period of completion; 2010
- New installation of heat distribution pipelines in New City Center
  Period of completion; by 2003 (Main)

Up to 2020

- Extension of heat distribution pipelines from the existing district heating system to District Nos. 4B, 18 and a part of Central Industrial District
  Period of completion; 2015
- New constructions of heat distribution piping networks on the left bank of Ishim River such as District Nos.15, 16 and 19
  Period of completion; 2019
- New constructions of natural gas firing six (6) heat centers (HC) as shown below:
  HC-1 (District No.13), HC-2 (District No.14), HC-3 (District No.12),
  Period of completion: At the beginning of 2011
- HC-4 (District No.15), HC-5 (District No.16) and HC-6 (District No.19)
  Period of completion: 2019

Up to 2030

- Extension of heat distribution pipelines from the existing district heating system to Northern Industrial District
  Period of completion: 2029
- New constructions of heat distribution piping networks on the left bank of Ishim River such as District Numbers 11, 14 and 16
  Period of completion: 2027
- New construction of HC-11 (District 11) and extension of heat generating facilities at six (6) heat centers (HC) such as HC-1, HC-2, HC-3, HC-4, HC-5 and HC-6
  Period of completion: 2029

(3) Electric Power and Heat Energy Generating Plants

In order to secure reliable supply of electric power and heat energy to Astana City, to make a chance to replace or modify the existing old electric power and heat energy generating facilities and to respond to the required electric power and heat energy demand in future, new electric power and heat energy generating plants will be constructed in TETs-1 and TETs-2 as the extension works.

1) Fuel to be used for electric power and heat energy generating plant

Coal will be used for 115 MW electric power and heat energy generating plant as per the existing plants with countermeasures against air pollution.

Natural gas will be used for 150 MW and 200 MW electric power and heat energy generating plants because of the following reasons:

- Natural gas is the most appropriate fuel among fossil fuels from the viewpoint of ecology because discharge amounts of SOx and dust through a flue gas stack are negligible and CO_2 discharge amount is very low comparing to that of coal fuel.
- As the existing coal used for TETs-1 and TETs-2 contains high ash (approx. 40%), it is very hard to keep the require emission standard of total suspended particles. Therefore usage of natural gas contributes not only air pollution control but also reduction of coal ash amount of Astana City.
- It is our assumption that there will be a limitation of gas usage amount at the beginning of gas supply, therefore natural gas may be applicable for electric power and heat energy generating facilities from the beginning of 2011 because a large amount of gas consumption is required for the facilities.

2) Construction Plan of Electric Power and Heat Energy Generating Plants

The followings are construction plan of electric power and heat energy generating plants.

<u>Up to 2010</u>

- New construction of conventional electric power and heat energy generating plant

Output;	Electric Power 115 MW
Heat Energy	approx. 175 Gcal/h

Fuel; Coal
Location TETs-2 as extension
Period of commissioning; at the beginning of 2006
Refer to H.1.4 Formulation of Urgent Development Project for further detail.

Up to 2020

. New construction of 150 MW natural gas firing gas turbine combined cycle electric power and heat energy generating plant at TETs-1
Refer to H.2.5 Plan of Electric Power and Heat Energy Generating Facilities.

Up to 2030

. New construction of 200 MW natural gas firing gas turbine combined cycle electric power and heat energy generating plant at TETs-2
Refer to H.2.5 Plan of Electric Power and Heat Energy Generating Facilities.

(4) Implementation Schedule relating to Electric Power and Heat Energy Generation and Supply

Implementation schedule related to electric power and heat energy generation and supply is shown in Table H.3.1.

The table shows three major items, electric power and heat energy generating plants, heat energy generation and supply facilities and 110 kV transmission of lines and 110 kV/10 kV substation and shows time period of construction of each item with a straight line.

H.4 Pre-Design Proposal for New city Center Area

New City Center consists of the whole area of District No.13 and a part of District No.14.

It is top priority to develop New City Center among the development plans of Astana City, the plans related to electricity supply and heat energy supply are shown below:

(1) Electric Power Supply Plan

Refer to Figure 4.5.3 Power Cable Network in the main report.

1) 110 kV transmission lines and 110 kV/ 10 kV substation

110 kV transmission lines from Airport switching substation to new 110 kV/ 10 kV substation in New City Center and the said new substation will be newly constructed by Astana City Mayor with the finance of the Socio-economic Development Fund.

Time period of the completion by the end of 2001

As number and the capacity of the transformers planned by the Astana City are 2 x 40 MVA, probably the capacity of the transformers will be insufficient in future taking into consideration of electric power demand of 55 MVA (Sum of District Nos. 13 and 14) of New City Center in 2010 as shown in Table H.2.28. The followings are our proposal for the substation.

Number of the transformers and selected installed capacity of 110 kV/10 kV New City Center substation are:

2 x 63 MVA

Electricity of 10 kV stepped down at the 110 kV/10 kV substation will be distributed to each 10 kV/400 V substation and the 400 V electricity is supplied to each user.

The drawing also shows a part of District No. 14 which doesn't belong to New City Center, because electricity supply to the entire area of District No.14 will not be made until new construction of 110 kV/10 kV substation in District No. 14 in 2013.

(2) Heat Energy Supply Plan

Refer to Figure 4.5.4 Heat Supply Network in the main report.

1) Heat Source

As urgent heat supply provision is required in this area, heat sources will be led from TETs-1 and TETs-2 up to the end of 2003 through extension pipelines of the existing central district heating network.

HC-1 (Heat Center No.1) with natural gas firing boilers and related ancillary equipment will be in service at the beginning of 2011 and supply heat energy to New City Center. Required capacity of HC-1 at the beginning of 2011will be 94 Gcal/h.

2) Tie Lines

The tie lines connecting right bank and the left bank of Ishim River will be isolated with two valves (Supply and Return) after HC-1 in service.

Although a part of the business area is located on District No. 14, heat supply to the area will be made from TETs-1 and TETs-2 by new construction of HC-2 for supplying heat energy to the entire area of District No.14. The scheduled commissioning time period of HC-2 is at the beginning of 2011.

TABLE

Table H.1.1 Heat Supply Volume of Astana (TETs-1 & 2) [Gcal]

		1994	1995	1996	1997	1998	1999	Total	Monthly Average	Daily Average
January	TETs-1		140,000	165,000	111,710	129,510	150,321	696,541	139,308	4,494
	TETs-2	294,402	297,758	275,488	212,163	205,069	257,798	1,542,678	257,113	8,294
	Subtotal		437,758	440,488	323,873	334,579	408,119	2,239,219	396,421	12,788
February	TETs-1		68,000	141,000	84,691	113,100	94,320	501,111	100,222	3,579
	TETs-2	287,426	408,973	249,582	208,783	200,051	236,340	1,591,155	265,193	9,471
	Subtotal		476,973	390,582	293,474	313,151	330,660	2,092,266	365,415	13,051
March	TETs-1		71,000	90,500	86,057	98,600	95,570	441,727	88,345	2,850
	TETs-2	310,214	136,350	251,872	138,011	173,529	259,457	1,269,433	211,572	6,825
	Subtotal		207,350	342,372	224,068	272,129	355,027	1,711,160	299,918	9,675
April	TETs-1		22,500	7,500	20,456	61,733	32,240	144,429	28,886	963
	TETs-2	215,000	180,903	197,683	129,143	145,985	179,640	1,048,354	174,726	5,824
	Subtotal		203,403	205,183	149,599	207,718	211,880	1,192,783	203,611	6,787
May	TETs-1		6,500	0	0	0	0	6,500	1,300	42
	TETs-2	136,632	101,263	112,360	95,942	118,634	125,229	690,060	115,010	3,710
	Subtotal		107,763	112,360	95,942	118,634	125,229	696,560	116,310	3,752
June	TETs-1		0	0	0	0	0	0	0	0
	TETs-2	97,290	98,309	76,113	73,023	87,801	115,804	548,340	91,390	3,046
	Subtotal		98,309	76,113	73,023	87,801	115,804	548,340	91,390	3,046
July	TETs-1		0	0	0	0	0	0	0	0
	TETs-2	80,517	84,851	81,224	54,102	77,819	90,785	469,298	78,216	2,523
	Subtotal		84,851	81,224	54,102	77,819	90,785	469,298	78,216	2,523
August	TETs-1		0	0	0	0	0	0	0	0
	TETs-2	71,711	50,057	54,645	47,823	23,588	57,248	305,072	50,845	1,640
	Subtotal		50,057	54,645	47,823	23,588	57,248	305,072	50,845	1,640
Septembe	TETs-1		1,750	0	0	0	0	1,750	350	12
	TETs-2	47,878	54,630	41,100	29,657	61,777	114,727	349,769	58,295	1,943
	Subtotal		56,380	41,100	29,657	61,777	114,727	351,519	58,645	1,955
October	TETs-1		27,000	18,600	10,946	18,057	16,912	91,515	18,303	590
	TETs-2	136,825	150,201	163,030	104,613	143,265	144,136	842,070	140,345	4,527
	Subtotal		177,201	181,630	115,559	161,322	161,048	933,585	158,648	5,118
November	TETs-1		80,700	80,000	123,000	97,304	90,624	471,628	94,326	3,144
	TETs-2	243,890	220,028	180,947	219,996	213,884	254,329	1,333,074	222,179	7,406
	Subtotal		300,728	260,947	342,996	311,188	344,953	1,804,702	316,505	10,550
December	TETs-1		164,000	118,000	168,349	132,630	120,445	703,424	140,685	4,538
	TETs-2	300,380	276,895	208,797	223,910	277,729	285,180	1,572,891	262,149	8,456
	Subtotal		440,895	326,797	392,259	410,359	405,625	2,276,315	402,833	12,995
Year Total	TETs-1		581,450	620,600	605,209	650,934	600,432	3,058,625	611,725	20,212
	TETs-2	2,222,165	2,060,218	1,892,841	1,537,166	1,729,131	2,120,673	11,562,194	1,927,032	63,667
	Grandtota	-	2,641,668	2,513,441	2,142,375	2,380,065	2,721,105	14,620,819	2,538,757	83,879

Table H.1.2 Typical Heat Distribution to Each Category

[Unit; Gcal/hour] January.1,2000

Kind of Building	TETs-1			TETs-2		
	Space Heating	Ventilation Heating	Living Hot Water	Space Heating	Ventilation Heating	Living Hot Water
Residents	138.0	-	58.6	147.0	-	66.3
Office building	52.5	7.7	11.7	47.5	9.5	11.6
Others	75.1	7.2	11.6	38.5	5.1	4.4
Sub Total	265.7	14.9	81.9	233.1	14.6	82.3
Total	362.5			330.0		
Grand Total	692.5					

Table H..1.3 Heat Supply Percentage of Every Category

Unit:% anuary.1,2000

Kind of building	Space Heating	Ventilation Heating	Living Hot Water	Total	Ration
Residents	41.2	0.0	18.0	59.2	3
Office building	14.5	2.5	3.4	20.3	1
Others	16.4	1.8	2.3	20.5	1
Total	72.0	4.3	23.7	100.0	

Residents : Office building : Industry = 3 : 1 : 1

Table H.1.4 Steam Generating Units of TETs-1

No.	Manufacturer	Manufacturing year	The year of operation	Steam Condition		Nominal Capacity	Operation hours
				Pressure kg/cm^2	emperatur ℃	t/h[Gcal/h	h
1	Barnaul	1999	May, 1999	39	450	65	1948
2	Barnaul	1999	Dec. 2000	39	450	65	—
3	Barnaul	1960	Jan. 1963	39	450	50	186570
4	Belogorod	1966	Dec. 1967	40	440	50	114334
5	Biysky	1966	Dec. 1966		—	[100]	120981
6	Biysky	1966	Dec. 1967		—	[100]	125944
7	Biysky	1969	Dec. 1969		—	[100]	116786
8	Gorogobuzhskiy	1970	Dec. 1971		—	[100]	63055
9	Belogorod	1973	Dec. 1973		—	[100]	49151
10	Belogorod	1977	Dec. 1977		—	[100]	39829

Table H.1.5 Steam Turbine Units of TETs-1

NO.	Type and Manufacturer	Manufacturing year	The year of operation	Turbine output kW	Steam Condition		Operation hours
					Pressure kg/cm^2	emperatur ℃	h
1	TR-4-35/1,2/0,5 Kaluzhskiy Disassembled	1959	Dec. 1961	4,000	35	435	
2	PR-4-35/5/1,2 Kaluzhskiy	1960	Sep. 1962	4,000	35	435	170876
3	R-6-35/10 Kaluzhskiy	1973	Nov. 1973	6,000	35	435	63508
4	R-12-35/5 Kaluzhskiy	1971	Dec. 1972	12,000	35	435	154289
	Total			22,000			

Abbreviation :

Barunaul ..... Barunaulskiy Boiler Plant

Belogorod ..... Belogorodskiy Boiler Plant

Biysky ..... Biysky Boiler Plant

Gorogobuzhskiy ..... Gorogobuzhskiy Boiler Plant

Kaluzhskiy ..... Kaluzhskiy turbine Plant

Table H.1.6 Steam Generating Units of TETs-2

BOILER NO.	NO.1	NO.2	NO.3	NO.4	NO.5
COMMENCEMENT OF OPERATION	1979	1981	1983	1985	1992
CAPACITY t/h	420	420	420	420	420
STEAM PRESS. AT BOILER OUTLET kg/c	140	140	140	140	140
STEAM TEMP. AT BOILER OUTLET ℃	560	560	560	560	560

The above units are all coal firing boilers manufactured by Barunaulskiy Boiler Plant.

Table H.1.7 Steam Turbine and Generator Units of TETs-2

UNIT NO.	NO.1	NO.2	NO.3
COMMENCEMENT OF OPERATION	1979	1980	1983
TURBINE OUTPUT MW	80	80	80
STEAM PRESS. AT TURBINE INLET kg/cm^2	130	130	130
STEAM TEMP. AT TURBINE INLET ℃	555	555	555
GENERATOR CAPACITY MW	120	120	120

Steam turbines ..... Manufactured by Leningradsky M. Z.

Generator ..... Manufactured by Novosibilsk

Table H.2.1 Actual Output of Electric Power Energy and Average Power Consumption per Capita

No.	Items	1997 Actual amount x 1000 kwh	1998 Actual amount x 1000 kwh	1999 Actual amount x 1000 kwh	Data to be used for Demand Forecast in 2000
1	1)Production of electric energy of TETs-2	935776	1015200	1156829	100%
	2)Power supplied by other enterprises	89847	28334		5.0%
2	Power plant consumption for heat and power production	173176	185640		17.5%
3	Total amount of released electric powe	852447	857894		
4	Technical transmission loss	232614	290126		25.0%
5	Others Item 3 – Item 4 – Item 6	118741	121913		11.5%
6	Total effective power demand	501092	445855		46.0%
7	Industrial consumers with capacity more than 750KVA	185281	170483	130900	
8	Industrial consumers with capacity up to 750KVA	94927	66073	55800	
9	Electrified city transport	8535	8249		
10	Non industrial consumers	31064	45573	45700	
11	Government office	31929	39549	43600	
12	Agricultural consumers and industries	4550	1765	600	
13	The whole population including town and village	131585	111256	118800	
14	Populated localities including town and village	13221	2907	900	
15	Sum of No. 9 + 12 + 13 + 14	157891	124177	120300	
16	Population of Astana City	275000	275000	318000	
17	Average Power Consumption per Capita Item 15 ÷ item 16 ÷ 8760	65.5 W/Capita	51.5 W/Capita	43.2 W/Capita	45.0 W/Capita

Table H.2.2 Electric Power Demand Data of Industrial Sector

Unit : x 1000 kWh

No	Item	1998 Actual demand	1999 Actual demand
1	Industrial consumers with capacity more than 750 KVA	170,483	130,900
2	Industrial consumers with capacity more up to 750 KVA	66,073	55,800
3	Total Item 1 + item 2	236,556	186,700
4	Total demand of Industrial consumers obtained from other data	250,173	207,335
5	Mean Value of Item 3 and Item 4	243,365	197,018
6	Work force of industrial sector (men)		16,000
7	Average power demand per work force Item 5 / item 6 ...kwh/work force		12,314
	Average power demand per work force	12,300 kWh/ work force = 1.40 kW / work force	

Note: For high tech. industries, 1.00 kW / work force is adopted instead of 1.40 kW / work force.

Table H.2.3 Basic Data for Microscopic Electric Power Demand Forecast

The table shows electric power consumption per unit in service, demand rate and average power consumption per unit.

Item	Unit power consumption in service	Demand rate	Average power consumption per unit
Power consumption per capita			45.0 W/ Capita in 2000 54.0 W/ Capita in 2010 62.0 W/ Capita in 2020 70.0 W/ Capita in 2030
Office floor (Gross)	48 W/ m^2	0.42	20 W/ m^2
Commercial floor (Gross)	48 W/ m^2	0.5	24 W/ m^2
Culture center floor (Gross)	45 W/ m^2	0.42	19 W/ m^2
Sports center floor (Gross)	65 W/ m^2	0.35	23 W/ m^2
University floor (Gross)	45 W/ m^2	0.35	16 W/ m^2
Average power demand of ordinary industrial sector			1.4 kW / Work Force
Average power demand of high tech. industrial sector			1.0 kW / Work Force

Table H.2.4 Average Power Demand based on Population

UNit of Average Demand : kW

District No.		2000			2000 to 2010			2010 to 2020			2020 to 2030		
		Populatio	W/capita	Average Demand	Populatio	W/capita	Average Demand	Populatio	W/capita	Average Demand	Populatio	W/capita	Average Demand
1.Central Planning Region	Residential District 3	46,300	45	2,084	46,300	54	2,500	52,300	62	8,243	58,300	70	4,081
	Residential District 4A	56,800	45	2,556	63,200	54	3,413	69,600	62	4,315	69,600	70	4,872
	Residential District 5	34,300	45	1,544	39,000	54	2,106	43,900	62	2,722	43,900	70	3,073
	Residential District 6	38,100	45	1,714	42,300	54	2,284	46,600	62	2,889	46,600	70	3,262
2. Northern Planning Region	Northern Indust. District	11,558	45	520	5,624	54	304	5,624	62	349	5,624	70	394
	Central Indust. District	4,752	45	214	3,410	54	184	3,410	62	211	3,410	70	239
	Planning District I												
	Planning District II												
	Planning District III												
	Planning District IV												
3. South-eastern Planning Region	Residential District 7	51,600	45	2,322	78,991	54	4,260	81,891	62	5,077	81,891	70	5,732
	Residential District 8	30,200	45	1,359	30,800	54	1,663	30,800	62	1,910	30,800	70	2,156
	Residential District 9	2,700	45	122	29,174	54	1,575	29,174	62	1,809	29,174	70	2,042
	Residential District 10	1,329	45	60	5,800	54	313	11,000	62	682	11,000	70	770
	Indust District-Station 40	2,512	45	113	10,062	54	543	10,062	62	624	10,062	70	704
	Residential District 17				59,131	54	3,193	69,272	62	4,295	69,272	70	4,849
	Residential District 18							28,391	62	1,760	28,391	70	1,987
	Residential District 19							17,918	62	1,111	17,918	70	1,254
	Planning District V	3,895	45	175	3,895	54	210	3,895	62	241	3,895	70	273
4. Southern Planning Region	Residential District 11	1,600	45	72	3,940	54	213	7,080	62	439	54,156	70	3,791
	Residential District 12	12,700	45	572	16,315	54	881	16,315	62	1,011	16,315	70	1,142
	Residential District 13				8,825	54	477	8,825	62	547	8,825	70	618
	Residential District 14	1,286	45	58	9,753	54	527	26,758	62	1,659	45,821	70	3,207
	Residential District 15							15,470	62	959	18,006	70	1,260
	Residential District 16	426	45	19	426	54	23	20,448	62	1,268	41,165	70	2,882
	Planning Dist VI (Air Port)												
	Planning District VII				2,500	54	135	2,500	62	155	2,500	70	175
	Planning District VIII												
5. Northwest Planning Region	Residential District 1	4,500	45	203	4,500	54	243	9,000	62	558	13,500	70	945
	Residential District 2	22,500	45	1,012	22,500	54	1,215	31,200	62	1,934	39,900	70	2,793
	West Industrial District	70	45	3	70	54	4	70	62	4	70	70	5
	Residential District 4B	3,620	45	163	3,620	54	195	45,929	62	2,848	45,929	70	3,215
	Planning District IX												
Grand Total		330,748	45	14,885	490,036	54	26,461	687,432	62	42,620	796,024	70	55,721

Table H.2.5 Average Power Demand based on Office Floor Area

Unit of Average Demand : kW
Office Gross Floor Area (Office Floor A.) in m2

District No.		2000			2000 to 2010			2010 to 2020			2020 to 2030		
		Office Floor A.	W/m^2	Average Demand	Office Floor A.	W/m^2	Average Demand	Office Floor A.	W/m^2	Average Demand	Office Floor A.	W/m^2	Average Demand
1.Central Planning Region	Residential District 3	351,157	20	7,023	276,918	20	5,538	392,875	20	7,858	470,660	20	9,413
	Residential District 4A	353,650	20	7,073	386,208	20	7,724	539,061	20	10,781	597,184	20	11,944
	Residential District 5	100,902	20	2,018	62,801	20	1,256	73,334	20	1,467	75,651	20	1,513
	Residential District 6	204,080	20	4,082	62,577	20	1,252	71,607	20	1,432	74,066	20	1,481
2. Northern Planning Region	Northern Indust. District	136,059	20	2,721	52,909	20	1,058	74,850	20	1,497	92,636	20	1,857
	Central Indust. District	198,270	20	3,966	73,762	20	1,475	107,714	20	2,154	135,532	20	2,711
	Planning District I				3,560	20	71	3,560	20	71	3,560	20	71
	Planning District II										3,560	20	71
	Planning District III							3,560	20	71	3,560	20	71
	Plan. Dist. IV Millitary Academy												
	Plan. Dist. IV Services				1,800	20	36	3,600	20	71	5,400	20	108
	Plan. Dist. IV Cargo Center				15,188	20	304	30,375	20	608	45,563	20	911
3. South-eastern Planning Region	Residential District 7	75,968	20	1,519	116,707	20	2,334	125,837	20	2,517	130,157	20	2,603
	Residential District 8	54,448	20	1,089	51,009	20	1,020	52,898	20	1,058	54,525	20	1,091
	Residential District 9				48,316	20	966	50,106	20	1,002	51,647	20	1,033
	Residential District 10				9,606	20	192	18,892	20	378	19,473	20	389
	Indust District-Station 40	4,230	20	85	28,865	20	577	35,903	20	718	42,594	20	852
	Residential District 17				97,928	20	1,959	118,973	20	2,379	122,632	20	2,453
	Residential District 18							48,761	20	975	50,261	20	1,005
	Residential District 19							30,774	20	615	31,720	20	634
	Residential District 20												
	Planning District V				5,740	20	115	5,874	20	117	5,877	20	118
4. Southern Planning Region	Residential District 11	12,345	20	247	6,525	20	131	12,160	20	243	95,872	20	1,917
	Residential District 12	27,020	20	540	27,020	20	540	28,021	20	560	28,882	20	578
	Residential District 13				1,224,735	20	24,495	1,527,408	20	30,548	1,664,672	20	33,293
	Residential District 14				524,255	20	10,485	810,461	20	16,209	1,050,785	20	21,016
	Residential District 15							26,569	20	531	31,876	20	638
	Residential District 16				706	20	14	35,119	20	702	72,874	20	1,457
	Planning Dist VI (Air Port)	17,446	20	349	28,125	20	563	28,125	20	563	28,125	20	563
	Plan. Dist. VII Sports city							5,420	23	115	4,794	23	110
	Plan. Dist. VII University							18,563	16	297	31,500	16	504
	Plan. Dist. VII Interna. Exhi	5,500	20	110	5,709	19	108	2,025	19	38	9,847	19	187
	Planning District VIII												
5. Northwest Planning Region	Residential District 1	9,723	20	194	7,453	20	149	15,457	20	309	23,899	20	478
	Residential District 2	108,753	20	2,175	37,263	20	745	53,585	20	1,072	70,635	20	1,413
	West Industrial District	3,341	20	67	10,928	20	219	15,701	20	314	20,722	20	415
	Residential District 4B				5,995	20	120	78,882	20	1,578	81,308	20	1,626
	Planning District IX												
Grand Total		1,662,892	20	33,258	3,172,605		63,446	4,446,050		88,848	5,232,300		104,524

Table H.2.6 Average Power Demand based on Commercial Floor Area

Unit of Average Demand : kW
Commercial Floor Area in m2

District No.		2000			2000 to 2010			2010 to 2020			2020 to 2030		
		Commer. Floor A.	W/m^2	Average Demand	Commer. Floor A.	W/m^2	Average Demand	Commer. Floor A.	W/m^2	Average Demand	Commer. Floor A.	W/m^2	Average Demand
1.Central Planning Region	Residential District 3	16,205	24	389	16,668	24	400	20,029	24	482	29,150	24	700
	Residential District 4A	71,146	24	1,708	77,058	24	1,850	84,696	24	2,032	96,261	24	2,310
	Residential District 5	12,005	24	288	14,040	24	337	16,846	24	404	21,950	24	527
	Residential District 6	13,335	24	320	15,228	24	365	17,882	24	429	23,300	24	559
2. Northern Planning Region	Northern Indust. District	4,045	24	97	2,025	24	49	2,158	24	52	2,812	24	67
	Central Indust. District	1,664	24	40	1,228	24	29	1,309	24	31	1,705	24	41
	Planning District I												
	Planning District II												
	Planning District III												
	Planning District IV												
3. South-eastern Planning Region	Residential District 7	18,060	24	433	28,401	24	682	31,425	24	754	40,946	24	983
	Residential District 8	10,686	24	256	11,610	24	279	12,874	24	309	16,775	24	403
	Residential District 9	945	24	23	12,836	24	308	13,216	24	317	18,478	24	443
	Residential District 10	465	24	11	1,044	24	25	2,111	24	51	2,750	24	66
	Indust District-Station 40	879	24	21	1,811	24	43	1,931	24	46	2,516	24	60
	Residential District 17				22,081	24	530	28,394	24	681	36,999	24	888
	Residential District 18							10,895	24	261	14,196	24	341
	Residential District 19							6,876	24	165	8,959	24	215
	Residential District 20												
	Planning District V	1,363	24	33	1,402	24	34	1,495	24	36	1,948	24	47
4. Southern Planning Region	Residential District 11	560	24	13	709	24	17	1,358	24	33	27,078	24	650
	Residential District 12	4,445	24	107	7,022	24	169	7,786	24	187	9,261	24	222
	Residential District 13				40,434	24	970	99,937	24	2,398	145,013	24	3,480
	Residential District 14	450	24	11	14,301	24	343	38,922	24	934	63,373	24	1,521
	Residential District 15							5,936	24	142	9,003	24	216
	Residential District 16	149	24	4	153	24	4	7,847	24	188	20,583	24	464
	Planning Dist VI (Air Port)				900	24	22	959	24	23	1,250	24	30
	Planning District VII												
	Planning District VIII												
5. Northwest Planning Region	Residential District 1	1,575	24	38	810	24	19	1,727	24	41	6,750	24	162
	Residential District 2	7,875	24	189	9,562	24	229	13,699	24	329	19,950	24	479
	West Industrial District	25	24	1	25	24	1	27	24	1	35	24	1
	Residential District 4B	1,267	24	30	652	24	16	17,625	24	423	22,965	24	551
	Planning District IX												
Grand Total		167,144	24	4,012	280,000	24	6,721	448,000	24	10,749	644,000	24	15,456

Table H.2.7 Average Power Demand based on Industrial Sector (Average Power Demand per Work Force)

Unit of Average Demand : kW

District No.		2000			2000 to 2010			2010 to 2020			2020 to 2030		
		Work Force	kw/work force	Average Demand	Work Force	kw/work force	Average Demand	Work Force	kw/work force	Average Demand	Work Force	kw/work force	Average Demand
1.Central Planning Region	Residential District 3	243	1.4	340									
	Residential District 4A	243	1.4	340									
	Residential District 5	3,679	1.4	5,151									
	Residential District 6	1,459	1.4	2,043									
2. Northern Planning Region	Northern Indust. District	2,463	1.4	3,448	7,467	1.4	10,454	10,060	1.4	14,084	9,306	1.4	13,028
	Central Indust. District	4,013	1.4	5,618	11,666	1.4	16,332	15,719	1.4	22,007	14,540	1.4	20,356
	Planning District I				3,560	1.0	3,560	3,560	1.0	3,560	3,560	1.0	3,560
	Planning District II										3,560	1.0	3,560
	Planning District III							3,560	1.0	3,560	3,560	1.0	3,560
	Planning District IV												
3. South-eastern Planning Region	Residentian District 7	486	1.4	681									
	Residentian District 8												
	Residentian District 9												
	Residentian District 10				1,377	1.0	1,377	1,410	1.0	1,410	1,630	1.0	1,630
	Indust District-Station 40												
	Residentian District 17												
	Residentian District 18												
	Residentian District 19												
	Residentian District 20												
	Planning District V												
4. Southern Planning Region	Residential District 11	1,338	1.4	1,873									
	Residential District 12	1,186	1.4	1,660									
	Residential District 13												
	Residential District 14												
	Residential District 15												
	Residential District 16												
	Planning Dist VI (Air Port)												
	Planning District VII												
	Planning District VIII												
5. Northwest Planning Region	Residential District 1												
	Residential District 2	395	1.4	553									
	West Industrial District	395	1.4	553	1,053	1.4	1,474	809	1.4	1,133	935	1.4	1,309
	Residential District 4B												
	Planning District IX												
Grand Total		15,900	1.4	22,260	25,123		33,793	35,118		45,754	37,091		47,003

Table H.2.8 Average Power Demand of Electrical Facilities proposed by Present M/P

Unit: kW

No.	Name of Facility	District No.	Year			
			2000	2010	2020	2030
1	Water Treatment Plant (Extension)	8	1,440	2,400	3,360	4,320
2	Water Treatment Plant (New)	15			1,670	1,670
3	Sewage Treatment Plant (Extension)	VIII	2,000	4,300	5,435	6,580
4	LRT	Airport		3,000	3,000	3,000
	South-North Line	4A		3,000	3,000	3,000
5	LRT	15			1,500	1,500
	East-West Line	19			1,500	1,500
6	LRT	7				3,000
	Circle Line	11				3,000

Note: 1. The data in this table were added to the category of "Industry".
2. LRT (Light railway transit)

Table H.2.9 Average Power Demand of Each Category and The Sum in 2000

Unit : kW

District No.	Name of District	Population	Office Floor	Commercial Floor	Industry	Total
1.Central Planning Region	Residential District 3	2,084	7,023	389	340	9,836
	Residential District 4A	2,556	7,073	1,708	340	11,677
	Residential District 5	1,544	2,018	288	5,151	9,001
	Residential District 6	1,714	4,082	320	2,043	8,159
2. Northern Planning Region	Northern Indust. District	520	2,721	97	3,448	6,786
	Central Indust. District	214	3,966	40	5,618	9,838
	Planning District I					
	Planning District II					
	Planning District III					
	Planning District IV					
3. South-eastern Planning Region	Residentian District 7	2,322	1,519	433	681	4,955
	Residentian District 8	1,359	1,089	256	1,440	4,144
	Residentian District 9	122		23		145
	Residentian District 10	60		11		71
	Indust District-Station 40	113	85	21		219
	Residentian District 17					
	Residentian District 18					
	Residentian District 19					
	Planning District V	175		33		208
4. Southern Planning Region	Residential District 11	72	247	13	1,873	2,205
	Residential District 12	572	540	107	1,660	2,879
	Residential District 13					
	Residential District 14	58		11		69
	Residential District 15					
	Residential District 16	19		4		23
	Planning Dist VI (Air Port)		349			349
	Planning District VII		110			110
	Planning District VIII				2,000	2,000
5. Northwest Planning Region	Residential District 1	203	194	38		435
	Residential District 2	1,012	2,175	189	553	3,929
	West Industrial District	3	67	1	553	624
	Residential District 4B	163		30		193
	Planning District IX					
Grand Total		14,885	33,258	4,012	25,700	77,855

Table H.2.10 Average Power Demand of Each Category and The Sum in 2010

Unit : kW

District No.	Name of District	Population	Office Floor	Commercial Floor	Industry	Total
1.Central Planning Region	Residential District 3	2,500	5,538	400		8,438
	Residential District 4A	3,413	7,724	1,850	3,000	15,987
	Residential District 5	2,106	1,256	337		3,699
	Residential District 6	2,284	1,252	365		3,901
2. Northern Planning Region	Northern Indust. District	304	1,058	49	10,454	11,865
	Central Indust. District	184	1,475	29	16,332	18,020
	Planning District I		71		3,560	3,631
	Planning District II					
	Planning District III					
	Planning District IV		340			340
3. South-eastern Planning Region	Residentian District 7	4,260	2,334	682		7,276
	Residentian District 8	1,663	1,020	279	2,400	5,362
	Residentian District 9	1,575	966	308		2,849
	Residentian District 10	313	192	25		530
	Indust District-Station 40	543	577	43	1,377	2,540
	Residentian District 17	3,193	1,959	530		5,682
	Residentian District 18					
	Residentian District 19					
	Residentian District 20					
	Planning District V	210	115	34		359
4. Southern Planning Region	Residential District 11	213	131	17		361
	Residential District 12	881	540	169		1,590
	Residential District 13	477	24,495	970		25,942
	Residential District 14	527	10,485	343		11,355
	Residential District 15					
	Residential District 16	23	14	4		41
	Planning Dist VI (Air Port)		563		3,000	3,563
	Planning District VII	135	108	22		265
	Planning District VIII				4,300	4,300
5. Northwest Planning Region	Residential District 1	243	149	19		411
	Residential District 2	1,215	745	229		2,189
	West Industrial District	4	219	1	1,474	1,698
	Residential District 4B	195	120	16		331
	Planning District IX					
Grand Total		26,461	63,446	6,721	45,897	142,525

Table H.2.11 Average Power Demand of Each Category and The Sum in 2020

Unit : kW

District No.	Name of District	Population	Office Floor	Commercial Floor	Industry	Total
1.Central Planning Region	Residential District 3	3,243	7,858	482		11,583
	Residential District 4A	4,315	10,781	2,032	3,000	20,128
	Residential District 5	2,722	1,467	404		4,593
	Residential District 6	2,889	1,432	429		4,750
2. Northern Planning Region	Northern Indust. District	349	1,497	52	14,084	15,982
	Central Indust. District	211	2,154	31	22,007	24,403
	Planning District I		71		3,560	3,631
	Planning District II					
	Planning District III		71		3,560	3,631
	Planning District IV		679			679
3. South-eastern Planning Region	Residentian District 7	5,077	2,517	754		8,348
	Residentian District 8	1,910	1,058	309	3,360	6,637
	Residentian District 9	1,809	1,002	317		3,128
	Residentian District 10	682	378	51		1,111
	Indust District-Station 40	624	718	46	1,410	2,798
	Residentian District 17	4,295	2,379	681		7,355
	Residentian District 18	1,760	975	261		2,996
	Residentian District 19	1,111	615	165	1,500	3,391
	Residentian District 20					
	Planning District V	241	117	36		394
4. Southern Planning Region	Residential District 11	439	243	33		715
	Residential District 12	1,011	560	187		1,758
	Residential District 13	547	30,548	2,398		33,493
	Residential District 14	1,659	16,209	934		18,802
	Residential District 15	959	531	142	3,170	4,802
	Residential District 16	1,268	702	188		2,158
	Planning Dist VI (Air Port)		563		3,000	3,563
	Planning District VII	155	450	23		628
	Planning District VIII				5,435	5,435
5. Northwest Planning Region	Residential District 1	558	309	41		908
	Residential District 2	1,934	1,072	329		3,335
	West Industrial District	4	314	1	1,133	1,452
	Residential District 4B	2,848	1,578	423		4,849
	Planning District IX					
Grand Total		42,620	88,848	10,749	65,219	207,436

Table H.2.12 Average Power Demand of Each Category and The Sum in 2030

Unit : kW

District No.	Name of District	Population	Office Floor	Commercial Floor	Industry	Total
1.Central Planning Region	Residential District 3	4,081	9,413	700		14,194
	Residential District 4A	4,872	11,944	2,310	3,000	22,126
	Residential District 5	3,073	1,513	527		5,113
	Residential District 6	3,262	1,481	559		5,302
2. Northern Planning Region	Northern Indust. District	394	1,857	67	13,028	15,346
	Central Indust. District	239	2,711	41	20,356	23,347
	Planning District I		71		3,560	3,631
	Planning District II		71		3,560	3,631
	Planning District III		71		3,560	3,631
	Planning District IV		1,019			1,019
3. South-eastern Planning Region	Residentian District 7	5,732	2,603	983	3,000	12,318
	Residentian District 8	2,156	1,091	403	4,320	7,970
	Residentian District 9	2,042	1,033	443		3,518
	Residentian District 10	770	389	66		1,225
	Indust District-Station 40	704	852	60	1,630	3,246
	Residentian District 17	4,849	2,453	888		8,190
	Residentian District 18	1,987	1,005	341		3,333
	Residentian District 19	1,254	634	215	1,500	3,603
	Planning District V	273	118	47		438
4. Southern Planning Region	Residential District 11	3,791	1,917	650	3,000	9,358
	Residential District 12	1,142	578	222		1,942
	Residential District 13	618	33,293	3,480		37,391
	Residential District 14	3,207	21,016	1,521		25,744
	Residential District 15	1,260	638	216	3,170	5,284
	Residential District 16	2,882	1,457	494		4,833
	Planning Dist VI (Air Port)		563		3,000	3,563
	Planning District VII	175	801	30		1,006
	Planning District VIII				6,580	6,580
5. Northwest Planning Region	Residential District 1	945	478	162		1,585
	Residential District 2	2,793	1,413	479		4,685
	West Industrial District	5	415	1	1,309	1,730
	Residential District 4B	3,215	1,626	551		5,392
	Planning District IX					
Grand Total		55,721	104,524	15,456	74,573	250,274

Table H.2.13 Average Power Demand at Each District

Unit : kW

District No.	Name of District	2000	2010	2020	2030	Note
1.Central Planning Region	Residential District 3	9,836	8,438	11,583	14,194	
	Residential District 4A	11,677	15,987	20,128	22,126	
	Residential District 5	9,001	3,699	4,593	5,113	
	Residential District 6	8,159	3,901	4,750	5,302	
2. Northern Planning Region	Northern Indust. District	6,786	11,865	15,982	15,346	
	Central Indust. District	9,838	18,020	24,403	23,347	
	Planning District I		3,631	3,631	3,631	
	Planning District II				3,631	
	Planning District III			3,631	3,631	
	Planning District IV		340	679	1,019	
3. South-eastern Planning Region	Residentian District 7	4,955	7,276	8,348	12,318	
	Residentian District 8	4,144	5,362	6,637	7,970	
	Residentian District 9	145	2,849	3,128	3,518	
	Residentian District 10	71	530	1,111	1,225	
	Indust District-Station 40	219	2,540	2,798	3,246	
	Residentian District 17		5,682	7,355	8,190	
	Residentian District 18			2,966	3,333	
	Residentian District 19			3,391	3,603	
	Planning District V	208	359	394	438	
4. Southern Planning Region	Residential District 11	2,205	361	715	9,358	
	Residential District 12	2,879	1,590	1,758	1,942	
	Residential District 13		25,942	33,493	37,392	
	Residential District 14	69	11,355	18,802	25,744	
	Residential District 15			4,802	5,284	
	Residential District 16	23	41	2,158	4,833	
	Planning Dist VI (Air Port)	349	3,563	3,563	3,563	
	Planning District VII	110	265	628	1,006	
	Planning District VIII	2,000	4,300	5,435	6,580	
5. Northwest Planning Region	Residential District 1	435	411	908	1,585	
	Residential District 2	3,929	2,189	3,335	4,685	
	West Industrial District	624	1,698	1,452	1,730	
	Residential District 4B	193	331	4,849	5,392	
	Planning District IX					
Grand Total		77,855	142,525	207,436	250,274	

Table H.2.14 Microscopic Electric Power Demand Forecast

Unit : MW

No.	Item	2000	2010	2020	2030
1	Average Demand Forecast at user end Total MW	77,86	142.53	207.44	250.27
2	Power Plant Consumption for Heat and Power Production %	17.50%	17.00%	15.50%	14.00%
3	Technical Loss, Non-Tech. Loss and Other Factors %	36.50%	30.50%	27.50%	27.50%
4	Item 2 + Item 3	54.00%	47.50%	43.00%	41.50%
5	Average Demand Forecast at Electric Power Generator End Item 1 ÷(1 − Item 4/100) ... MW	169.26	271.49	363.93	427.81
6	Load Factor	0.75	0.75	0.75	0.75
7	Max Power Demand Forecast ...MW Item 5 ÷ item 6	225.7	362.0	485.2	570.4

Table H.2.15 Sales Data of Heat Load to Each Consumer in 1999 Unit of Heat Load : Gcal

Item		Residence	Industry	Shop(Commercial	Office(Culture center, Sports center, University		
		Population		Non-Industry	Bujeted Organization	Private Sector	A.O.A.
1	Heat Load	878,200	72,600	262,170	351,900	14,600	630
	Subtotal	878,200	72,600	262,170	367,130		
2	Population[Person	330,748	15,900	-	-		
	Floor Area[m2]	-	-	167,144	1,662,892		
3	Item 1/Item 2	2.66 [Gcal/Capita]	4.57 cal/Person]	1.57 [Gcal/m2]	0.22 [Gcal/m2]		

A.O.A; Apartment Owners Association

Table H.2.16 Summary of the Basic Data for Microscopic Heat Demand Forecast

Item	Unit Heat Consumption in Service(Net)	Average Heat Consumption per Unit
Heat Consumption per Capita	4.57 Gcal/Capita	2.66 Gcal/Capita
Office Floor (Gross)	0.38 Gcal/m2	0.22 Gcal/m2
Commercial Floor (Gross)	2.70 Gcal/m2	1.57 Gcal/m2
Culture Center Floor (Gross)	0.38 Gcal/m2	0.22 Gcal/m2
Sports Center Floor (Gross)	0.38 Gcal/m2	0.22 Gcal/m2
University Floor (Gross)	0.38 Gcal/m2	0.22 Gcal/m2
Heat Demand of Industrial Sector per Working Population	7.86 Gcal/Working population	4.57 Gcal/Working population

Aannual heat energy supply amount from TETs-1 and TETs-2 was 2,721,105Gcal in 1999, whereas annual heat consumption by all users in 1999 was 1,580,100Gcal.
Therefore, Heat supply rate is 1.72 as shown below ;

Heat supply rate = 2,721,105Gcal / 1,580,100Gcal
= 1.72

Table H.2.17 Average Heat Demand based on Population

Unit of Anerage Demand ; Gcal/year

District No.		2000			2010			2020			2030		
		Population (person)	cal/Capit	Average Demand	Population (person)	cal/Capit	Average Demand	Population (person)	cal/Capit	Average Demand	Population (person)	cal/Capit	Average Demand
Area on the Right Bank of the Ishim River	1	4,500	2.66	11,948	4,500	2.66	11,948	9,000	2.66	23,897	13,500	2.66	35,845
	2	22,500	2.66	59,742	22,500	2.66	59,742	31,200	2.66	82,842	39,900	2.66	105,942
	West	70	2.66	186	70	2.66	186	70	2.66	186	70	2.66	186
	3	46,300	2.66	122,935	46,300	2.66	122,935	52,300	2.66	138,867	58,300	2.66	154,798
	4A	56,800	2.66	150,815	63,200	2.66	167,808	69,600	2.66	184,801	69,600	2.66	184,801
	4B			0	3,620	2.66	9,612	45,929	2.66	121,950	45,929	2.66	121,950
	5	34,300	2.66	91,073	39,000	2.66	103,553	43,900	2.66	116,563	43,900	2.66	116,563
	6	38,100	2.66	101,163	42,300	2.66	112,315	46,600	2.66	123,732	46,600	2.66	123,732
	IX-1			0	0		0	0		0	0		0
	Settlement	3,620	2.66	9,612			0			0			0
	Subtotal	206,190		547,474	221,490		588,099	298,599		792,838	317,799		843,818
	Northern	11,558	2.66	30,689	5,624	2.66	14,933	5,624	2.66	14,933	5,624	2.66	14,933
	Central	1,342	2.66	3,563	3,410	2.66	9,054	3,410	2.66	9,054	3,410	2.66	9,054
	Settlement	3,410	2.66	9,054			0			0			0
	7	51,600	2.66	137,008	78,891	2.66	209,471	81,891	2.66	217,436	81,891	2.66	217,436
	8	30,200	2.66	80,187	30,800	2.66	81,780	30,800	2.66	81,780	30,800	2.66	81,780
	9	2,700	2.66	7,169	29,174	2.66	77,463	29,174	2.66	77,463	29,174	2.66	77,463
	10	1,329	2.66	3,529	5,800	2.66	15,400	11,000	2.66	29,207	11,000	2.66	29,207
	Station 40	0		0	10,062	2.66	26,717	10,062	2.66	26,717	10,062	2.66	26,717
	12-1	1,270	2.66	3,372	1,632	2.66	4,332	1,632	2.66	4,332	1,632	2.66	4,332
	13-1			0	4,413	2.66	11,716	4,413	2.66	11,716	4,413	2.66	11,716
	15-1			0	0		0	1,547	2.66	4,108	1,801	2.66	4,781
	17			0	59,131	2.66	157,004	69,272	2.66	183,931	69,272	2.66	183,931
	18			0			0	28,391	2.66	75,384	28,391	2.66	75,384
	I			0			0			0	0		0
	II			0			0			0	0		0
	III			0			0			0	0		0
	IV			0			0			0	0		0
	V-1			0	779	2.66	2,068	779	2.66	2,068	779	2.66	2,068
	Settlement	2,512	2.66	6,670			0			0			0
	Settlement	2,470	2.66	6,558			0			0			0
	Settlement	1,107	2.66	2,939									
	Settlement	318	2.66	844			0			0			0
	Subtotal	109,816		291,583	229,715		609,938	277,994		738,128	278,248		738,801
	Total	316,006		839,057	451,205		1,198,037	576,593		1,530,966	596,047		1,582,619
Area on the Left Bank of the Ishim River	11	1,600	2.66	4,248	3,940	2.66	10,461	7,080	2.66	18,799	54,156	2.66	143,795
	12-2	11,430	2.66	30,349	14,684	2.66	38,988	14,684	2.66	38,988	14,684	2.66	38,988
	13-2			0	4,413	2.66	11,716	4,413	2.66	11,716	4,413	2.66	11,716
	14			0	9,753	2.66	25,896	26,758	2.66	71,048	45,821	2.66	121,664
	Settlement	1,286	2.66	3,415			0			0			0
	15-2			0	0		0	13,923	2.66	36,968	16,205	2.66	43,028
	16			0	426	2.66	1,131	20,448	2.66	54,293	41,165	2.66	109,301
	Settlement	426	2.66	1,131			0			0			0
	19			0			0	17,918	2.66	47,576	17,918	2.66	47,576
	V-2			0	3,116	2.66	8,274	3,116	2.66	8,274	3,116	2.66	8,274
	VI			0	0		0	0		0	0		0
	VII			0	2,500	2.66	6,638	2,500	2.66	6,638	2,500	2.66	6,638
	VIII			0	0		0	0		0	0		0
	IX-2			0	0		0	0		0	0		0
	Total	14,742		39,143	38,831		103,104	110,839		294,399	199,977		530,979
Grand Total		330,748		878,200	490,036		1,301,140	687,432		1,825,265	796,024		2,113,598

Table H.2.18 Average Heat Demand based on Industrial Sector

District No.		2000			2010			2020			2030		
		Population Industry	Gcal/Wor populatio	Average Demand	Population Industry	Gcal/Wor populatio	Average Demand	Population Industry	Gcal/Wor populatio	Average Demand	Population Industry	Gcal/Wor populatio	Average Demand
Area on the Right Bank of the Ishim River	1	0		0			0			0			0
	2	395	4.57	1,804			0			0			0
	West	243	4.57	1,110	809	4.57	3,694	809	4.57	3,694	935	4.57	4,269
	3	243	4.57	1,110			0			0			0
	4A	243	4.57	1,110			0			0			0
	4B			0			0			0			0
	5	3,679	4.57	16,798			0			0			0
	6	1,459	4.57	6,662			0			0			0
	IX-1			0			0			0			0
	Settlement	152	4.57	694			0			0			0
	Subtotal	6,414		29,287	809		3,694	809		3,694	935		4,269
	Northern	2,463	4.57	11,246	10,060	4.57	45,934	10,060	4.57	45,934	9,306	4.57	42,492
	Central	4,013	4.57	18,324	15,719	4.57	71,774	15,719	4.57	71,774	14,540	4.57	66,390
	Settlement			0			0			0			0
	7	486	4.57	2,219			0			0			0
	8			0			0			0			0
	9			0			0			0			0
	10			0			0			0			0
	Station 40			0	1,410	4.57	6,438	1,410	4.57	6,438	1,630	4.57	7,443
	12-1	119	4.57	542			0			0			0
	13-1			0			0			0			0
	15-1			0			0			0			0
	17			0			0			0			0
	18			0			0			0			0
	I			0	3,560	4.57	16,255	3,560	4.57	16,255	3,560	4.57	16,255
	II			0	0		0	0		0	3,560	4.57	16,255
	III			0	3,560	4.57	16,255	3,560	4.57	16,255	3,560	4.57	16,255
	IV			0			0			0			0
	V-1			0			0			0			0
	Settlement			0			0			0			0
	Settlement			0			0			0			0
	Settlement			0			0			0			0
	Settlement			0			0			0			0
	Subtotal	7,081		32,330	34,309		156,656	34,309		156,656	36,156		165,090
	Total	13,495		61,617	35,118		160,350	35,118		160,350	37,091		169,359
Area on the Left Bank of the Ishim River	11	1,338	4.57	6,109			0			0			0
	12-2	1,067	4.57	4,874			0			0			0
	13-2			0			0			0			0
	14			0			0			0			0
	Settlement			0			0			0			0
	15-2			0			0			0			0
	16			0			0			0			0
	Settlement			0			0			0			0
	19			0			0			0			0
	V-2			0			0			0			0
	VI			0			0			0			
	VII			0			0			0			
	VIII			0			0			0			
	IX-2			0			0			0			
	Total	2,405		10,983	0		0	0		0	0		
Grand Total		15,900		72,600	35,118		160,350	35,118		160,350	37,091		169,35

Table II.2.19 Average Heat Demand based on Commercial Floor Area

District No.		2000			2010			2020			2030		
		Floor Area Shop [m2]	Gcal/m2	Average Demand	Floor Area Shop [m2]	Gcal/m2	Average Demand	Floor Area Shop [m2]	Gcal/m2	Average Demand	Floor Area Shop [m2]	Gcal/m2	Average Demand
Area on the Right Bank of the Ishim River	1	1,575	1.57	2,470	811	1.57	1,272	1,727	1.57	2,709	6,750	1.57	10,588
	2	7,875	1.57	12,352	9,562	1.57	14,998	13,699	1.57	21,487	19,950	1.57	31,292
	West	25	1.57	39	25	1.57	39	27	1.57	42	35	1.57	55
	3	16,205	1.57	25,418	16,668	1.57	26,144	20,069	1.57	31,479	29,150	1.57	45,723
	4A	71,146	1.57	111,594	77,058	1.57	120,868	84,696	1.57	132,848	96,261	1.57	150,988
	4B			0	652	1.57	1,023	17,625	1.57	27,645	22,965	1.57	36,021
	5	12,005	1.57	18,830	14,040	1.57	22,022	16,846	1.57	26,423	21,950	1.57	34,429
	6	13,335	1.57	20,916	15,228	1.57	23,886	17,882	1.57	28,048	23,300	1.57	36,547
	IX-1			0			0	0		0	0		0
	Settlement	1,267	1.57	1,987			0			0			0
	Subtotal	123,433		193,608	134,044		210,252	172,571		270,682	220,361		345,642
	Northern	4,045	1.57	6,345	2,025	1.57	3,176	2,158	1.57	3,385	2,812	1.57	4,411
	Central	470	1.57	737	1,228	1.57	1,926	1,309	1.57	2,053	1,705	1.57	2,674
	Settlement	1,194	1.57	1,873			0			0			0
	7	18,060	1.57	28,328	28,401	1.57	44,548	31,425	1.57	49,291	40,946	1.57	64,225
	8	10,686	1.57	16,761	11,610	1.57	18,211	12,874	1.57	20,193	16,775	1.57	26,312
	9	945	1.57	1,482	12,836	1.57	20,134	13,216	1.57	20,730	18,478	1.57	28,983
	10	465	1.57	729	1,044	1.57	1,638	2,111	1.57	3,311	2,750	1.57	4,313
	Station 40	0		0	1,811	1.57	2,841	1,931	1.57	3,029	2,516	1.57	3,946
	12-1	445	1.57	697	702	1.57	1,101	779	1.57	1,221	926	1.57	1,453
	13-1			0	20,217	1.57	31,711	49,969	1.57	78,377	72,507	1.57	113,728
	15-1			0	0		0	594	1.57	931	900	1.57	1,412
	17			0	22,081	1.57	34,635	28,394	1.57	44,537	36,997	1.57	58,031
	18			0	0		0	10,894	1.57	17,088	14,196	1.57	22,267
	I			0	0		0	0		0	0		0
	II			0	0		0	0		0	0		0
	III			0	0		0	0		0	0		0
	IV			0	0		0	0		0	0		0
	V-1			0	280	1.57	440	299	1.57	469	390	1.57	611
	Settlement	879	1.57	1,379			0			0			0
	Settlement	865	1.57	1,357			0			0			0
	Settlement	387	1.57	607			0			0			0
	Settlement	111	1.57	174			0			0			0
	Subtotal	38,552		60,469	102,236		160,359	155,952		244,615	211,898		332,367
	Total	161,985		254,077	236,280		370,611	328,523		515,297	432,259		678,009
Area on the Left Bank of the Ishim River	11	560	1.57	878	709	1.57	1,112	1,358	1.57	2,130	27,078	1.57	42,473
	12-2	4,001	1.57	6,275	6,320	1.57	9,913	7,007	1.57	10,991	8,335	1.57	13,074
	13-2			0	20,217	1.57	31,711	49,969	1.57	78,377	72,507	1.57	113,728
	14			0	14,301	1.57	22,432	38,922	1.57	61,050	63,373	1.57	99,402
	Settlement	450	1.57	706			0			0			0
	15-2			0	0		0	5,342	1.57	8,380	8,103	1.57	12,709
	16			0	153	1.57	240	7,847	1.57	12,308	20,583	1.57	32,285
	Settlement	149	1.57	234			0			0			0
	19			0	0		0	6,876	1.57	10,785	8,959	1.57	14,052
	V-2			0	1,122	1.57	1,759	1,196	1.57	1,876	1,558	1.57	2,444
	VI			0	0		0	0		0	0		0
	VII			0	900	1.57	1,412	959	1.57	1,504	1,250	1.57	1,961
	VIII			0	0		0	0		0	0		0
	IX-2			0	0		0	0		0	0		0
	Total	5,160		8,093	43,721		68,578	119,476		187,402	211,746		332,129
Grand Total		167,144		262,170	280,001		439,189	447,999		702,699	644,004		1,010,138

Table H.2.20 Average Heat Demand based on Office Floor Area

District No.		2000			2010			2020			2030		
		Floor Area Office[m2]	Gcal/m2	Average Demand	Floor Area Office[m2]	Gcal/m2	Average Demand	Floor Area Office[m2]	Gcal/m2	Average Demand	Floor Area Office[m2]	Gcal/m2	Average Demand
Area on the Right Bank of the Ishim River	1	9,723	0.22	2,147	7,453	0.22	1,645	15,457	0.22	3,413	23,899	0.22	5,276
	2	108,753	0.22	24,010	37,263	0.22	8,227	53,585	0.22	11,830	70,635	0.22	15,595
	West	3,341	0.22	738	10,928	0.22	2,413	15,701	0.22	3,466	20,772	0.22	4,586
	3	351,157	0.22	77,528	276,918	0.22	61,137	392,875	0.22	86,738	470,660	0.22	103,911
	4A	353,650	0.22	78,078	386,208	0.22	85,266	539,061	0.22	119,013	597,184	0.22	131,845
	4B			0	5,995	0.22	1,324	78,882	0.22	17,415	81,308	0.22	17,951
	5	100,902	0.22	22,277	62,801	0.22	13,865	73,334	0.22	16,191	75,651	0.22	16,702
	6	204,080	0.22	45,056	62,577	0.22	13,816	71,607	0.22	15,809	74,066	0.22	16,352
	IX-1			0			0			0			0
	Settlement			0			0			0			0
	Subtotal	1,131,606		249,834	850,143		187,693	1,240,502		273,876	1,414,175		312,219
	Northern	136,059	0.22	30,039	52,909	0.22	11,681	74,850	0.22	16,525	92,836	0.22	20,496
	Central	198,270	0.22	43,774	73,762	0.22	16,285	107,714	0.22	23,781	135,532	0.22	29,922
	Settlement			0			0			0			0
	7	75,968	0.22	16,772	116,707	0.22	25,766	125,837	0.22	27,782	130,157	0.22	28,736
	8	54,448	0.22	12,021	51,009	0.22	11,262	52,898	0.22	11,679	54,525	0.22	12,038
	9	0		0	48,316	0.22	10,667	50,106	0.22	11,062	51,647	0.22	11,403
	10	0		0	9,606	0.22	2,121	18,892	0.22	4,171	19,473	0.22	4,299
	Station 40	4,230	0.22	934	28,865	0.22	6,373	35,903	0.22	7,927	42,594	0.22	9,404
	12-1	4,997	0.22	1,103	2,702	0.22	597	2,802	0.22	619	2,888	0.22	638
	13-1			0	612,368	0.22	135,197	763,704	0.22	168,609	832,336	0.22	183,761
	15-1			0	0		0	2,657	0.22	587	3,188	0.22	704
	17			0	97,928	0.22	21,620	118,973	0.22	26,267	122,632	0.22	27,074
	18			0	0		0	48,761	0.22	10,765	50,261	0.22	11,097
	I			0	3,560	0.22	786	3,560	0.22	786	3,560	0.22	786
	II			0	0		0	0		0	3,560	0.22	786
	III			0	0		0	3,560	0.22	786	3,560	0.22	786
	IV			0	16,988	0.22	3,751	33,975	0.22	7,501	50,963	0.22	11,252
	V-1			0	1,148	0.22	253	1,175	0.22	259	1,175	0.22	260
	Settlement			0			0			0			0
	Settlement			0			0			0			0
	Settlement			0			0			0			0
	Settlement			0			0			0			0
	Subtotal	473,972		104,643	1,115,868		246,359	1,445,367		319,105	1,600,887		353,441
	Total	1,605,578		354,476	1,966,011		434,052	2,685,869		592,981	3,015,062		665,659
Area on the Left Bank of the Ishim River	11	12,345	0.22	2,726	6,525	0.22	1,441	12,160	0.22	2,685	95,872	0.22	21,166
	12-2	44,969	0.22	9,928	24,318	0.22	5,369	25,219	0.22	5,568	25,994	0.22	5,739
	13-2			0	612,368	0.22	135,197	763,704	0.22	168,609	832,336	0.22	183,761
	14			0	524,255	0.22	115,744	810,464	0.22	178,933	1,050,785	0.22	231,990
	Settlement			0			0			0			0
	15-2			0	0		0	23,912	0.22	5,279	28,688	0.22	6,334
	16			0	706	0.22	156	35,119	0.22	7,754	72,874	0.22	16,089
	Settlement			0			0			0			0
	19			0	0		0	30,774	0.22	6,794	31,720	0.22	7,003
	V-2			0	4,592	0.22	1,014	4,699	0.22	1,037	4,702	0.22	1,038
	VI			0	28,125	0.22	6,209	28,125	0.22	6,209	28,125	0.22	6,209
	VII			0	5,709	0.22	1,260	26,008	0.22	5,742	46,141	0.22	10,187
	VIII			0			0	0		0	0		0
	IX-2			0			0	0		0	0		0
	Total	57,314		12,654	1,206,598		266,390	1,760,184		388,610	2,217,237		489,517
Grand Total		1,662,892		367,130	3,172,608		700,442	4,446,053		981,591	5,232,299		1,155,177

Table H.2.21 Average Heat Demand in 2000

Unit ; Gcal/year

District No.		2000					
		Population	Population Industry	Floor Area Shop	Floor Area Office	User end Total	Supply end Total
Area on the Right Bank of the Ishim River	1	11,948	0	2,470	2,147	16,565	28,527
	2	59,742	1,804	12,352	24,010	97,908	168,608
	West	186	1,110	39	738	2,072	3,569
	3	122,935	1,110	25,418	77,528	226,991	390,903
	4A	150,815	1,110	111,594	78,078	341,597	588,268
	4B	0	0	0	0	0	0
	5	91,073	16,798	18,830	22,277	148,979	256,558
	6	101,163	6,662	20,916	45,056	173,797	299,298
	IX-1	0	0	0	0	0	0
	Settlement	9,612	694	1,987	0	12,293	21,170
	Subtotal	547,474	29,287	193,608	249,834	1,020,203	1,756,901
	Northern	30,689	11,246	6,345	30,039	78,318	134,873
	Central	3,563	18,324	737	43,774	66,398	114,344
	Settlement	9,054	0	1,873	0	10,927	18,818
	7	137,008	2,219	28,328	16,772	184,327	317,431
	8	80,187	0	16,761	12,021	108,969	187,657
	9	7,169	0	1,482	0	8,651	14,898
	10	3,529	0	729	0	4,258	7,333
	Station 40	0	0	0	934	934	1,608
	12-1	3,372	542	697	1,103	5,714	9,840
	13-1	0	0	0	0	0	0
	15-1	0	0	0	0	0	0
	17	0	0	0	0	0	0
	18	0	0	0	0	0	0
	I	0	0	0	0	0	0
	II	0	0	0	0	0	0
	III	0	0	0	0	0	0
	IV	0	0	0	0	0	0
	V-1	0	0	0	0	0	0
	Settlement	6,670	0	1,379	0	8,049	13,861
	Settlement	6,558	0	1,357	0	7,915	13,631
	Settlement	2,939	0	607	0	3,546	6,107
	Settlement	844	0	174	0	1,018	1,754
	Subtotal	291,583	32,330	60,469	104,643	489,025	842,154
	Total	839,057	61,617	254,077	354,476	1,509,227	2,599,055
Area on the Left Bank of the Ishim River	11	4,248	6,109	878	2,726	13,962	24,043
	12-2	30,349	4,874	6,275	9,928	51,426	88,561
	13-2	0	0	0	0	0	0
	14	0	0	0	0	0	0
	Settlement	3,415	0	706	0	4,120	7,096
	15-2	0	0	0	0	0	0
	16	0	0	0	0	0	0
	Settlement	1,131	0	234	0	1,365	2,350
	19	0	0	0	0	0	0
	V-2	0	0	0	0	0	0
	VI	0	0	0	0	0	0
	VII	0	0	0	0	0	0
	VIII	0	0	0	0	0	0
	IX-2	0	0	0	0	0	0
	Total	39,143	10,983	8,093	12,654	70,873	122,050
Grand Total		878,200	72,600	262,170	367,130	1,580,100	2,721,105

Table H.2.22 Average Heat Demand in 2010 Unit ; Gcal/year

District No.		2010				
		Population	Population Industry	Floor Area Shop	Floor Area Office	User end Total
Area on the Right Bank of the Ishim River	1	11,948	0	1,272	1,645	14,866
	2	59,742	0	14,998	8,227	82,967
	West	186	3,694	39	2,413	6,332
	3	122,935	0	26,144	61,137	210,217
	4A	167,808	0	120,868	85,266	373,942
	4B	9,612	0	1,023	1,324	11,958
	5	103,553	0	22,022	13,865	139,440
	6	112,315	0	23,886	13,816	150,016
	IX-1	0	0	0	0	0
	Settlement	0	0	0	0	0
	Subtotal	588,099	3,694	210,252	187,693	989,737
	Northern	14,933	45,934	3,176	11,681	75,725
	Central	9,054	71,774	1,926	16,285	99,039
	Settlement	0	0	0	0	0
	7	209,471	0	44,548	25,766	279,785
	8	81,780	0	18,211	11,262	111,252
	9	77,463	0	20,134	10,667	108,263
	10	15,400	0	1,638	2,121	19,158
	Station 40	26,717	6,438	2,841	6,373	42,368
	12-1	4,332	0	1,101	597	6,030
	13-1	11,716	0	31,711	135,197	178,624
	15-1	0	0	0	0	0
	17	157,004	0	34,635	21,620	213,259
	18	0	0	0	0	0
	I	0	16,255	0	786	17,041
	II	0	0	0	0	0
	III	0	16,255	0	0	16,255
	IV	0	0	0	3,751	3,751
	V-1	2,068	0	440	253	2,762
	Settlement	0	0	0	0	0
	Settlement	0	0	0	0	0
	Settlement		0	0	0	0
	Settlement	0	0	0	0	0
	Subtotal	609,938	156,656	160,359	246,359	1,173,312
	Total	1,198,037	160,350	370,611	434,052	2,163,050
Area on the Left Bank of the Ishim River	11	10,461	0	1,112	1,441	13,014
	12-2	38,988	0	9,913	5,369	54,269
	13-2	11,716	0	31,711	135,197	178,624
	14	25,896	0	22,432	115,744	164,072
	Settlement	0	0	0	0	0
	15-2	0	0	0	0	0
	16	1,131	0	240	156	1,527
	Settlement	0	0	0	0	0
	19	0	0	0	0	0
	V-2	8,274	0	1,759	1,014	11,047
	VI	0	0	0	6,209	6,209
	VII	6,638	0	1,412	1,260	9,310
	VIII	0	0	0	0	0
	IX-2	0	0	0	0	0
	Total	103,104	0	68,578	266,390	438,072
Grand Total		1,301,140	160,350	439,189	700,442	2,601,122

Table H.2.23 Average Heat Demand in 2020 Unit ; Gcal/year

District No.		2020				
		Population	Population Industry	Floor Area Shop	Floor Area Office	User end Total
Area on the Right Bank of the Ishim River	1	23,897	0	2,709	3,413	30,018
	2	82,842	0	21,487	11,830	116,160
	West	186	3,694	42	3,466	7,389
	3	138,867	0	31,479	86,738	257,084
	4A	184,801	0	132,848	119,013	436,662
	4B	121,950	0	27,645	17,415	167,011
	5	116,563	0	26,423	16,191	159,177
	6	123,732	0	28,048	15,809	167,590
	IX-1	0	0	0	0	0
	Settlement	0	0	0	0	0
	Subtotal	792,838	3,694	270,682	273,876	1,341,090
	Northern	14,933	45,934	3,385	16,525	80,777
	Central	9,054	71,774	2,053	23,781	106,662
	Settlement	0	0	0	0	0
	7	217,436	0	49,291	27,782	294,509
	8	81,780	0	20,193	11,679	113,652
	9	77,463	0	20,730	11,062	109,255
	10	29,207	0	3,311	4,171	36,689
	Station 40	26,717	6,438	3,029	7,927	44,110
	12-1	4,332	0	1,221	619	6,172
	13-1	11,716	0	78,377	168,609	258,702
	15-1	4,108	0	931	587	5,625
	17	183,931	0	44,537	26,267	254,734
	18	75,384	0	17,088	10,765	103,237
	I	0	16,255	0	786	17,041
	II	0	0	0	0	0
	III	0	16,255	0	786	17,041
	IV	0	0	0	7,501	7,501
	V-1	2,068	0	469	259	2,797
	Settlement	0	0	0	0	0
	Settlement	0	0	0	0	0
	Settlement		0	0	0	0
	Settlement	0	0	0	0	0
	Subtotal	738,128	156,656	244,615	319,105	1,458,504
	Total	1,530,966	160,350	515,297	592,981	2,799,594
Area on the Left Bank of the Ishim River	11	18,799	0	2,130	2,685	23,613
	12-2	38,988	0	10,991	5,568	55,547
	13-2	11,716	0	78,377	168,609	258,702
	14	71,048	0	61,050	178,933	311,031
	Settlement	0	0	0	0	0
	15-2	36,968	0	8,380	5,279	50,627
	16	54,293	0	12,308	7,754	74,355
	Settlement	0	0	0	0	0
	19	47,576	0	10,785	6,794	65,155
	V-2	8,274	0	1,876	1,037	11,187
	VI	0	0	0	6,209	6,209
	VII	6,638	0	1,504	5,742	13,884
	VIII	0	0	0	0	0
	IX-2	0	0	0	0	0
	Total	294,299	0	187,402	388,610	870,311
Grand Total		1,825,265	160,350	702,699	981,591	3,669,905

Table II.2.24 Average Heat Demand in 2030 Unit ; Gcal/year

District No.		2030 Population	Population Industry	Floor Area Shop	Floor Area Office	User end Total
Area on the Right Bank of the Ishim River	1	35,845	0	10,588	5,276	51,709
	2	105,942	0	31,292	15,595	152,829
	West	186	4,269	55	4,586	9,096
	3	154,798	0	45,723	103,911	304,432
	4A	184,801	0	150,988	131,845	467,635
	4B	121,950	0	36,021	17,951	175,923
	5	116,563	0	34,429	16,702	167,694
	6	123,732	0	36,547	16,352	176,631
	IX-1	0	0	0	0	0
	Settlement	0	0	0	0	0
	Subtotal	843,818	4,269	345,642	312,219	1,505,948
	Northern	14,933	42,492	4,411	20,496	82,331
	Central	9,054	66,390	2,674	29,922	108,041
	Settlement	0	0	0	0	0
	7	217,436	0	64,225	28,736	310,397
	8	81,780	0	26,312	12,038	120,130
	9	77,463	0	28,983	11,403	117,848
	10	29,207	0	4,313	4,299	37,820
	Station 40	26,717	7,443	3,946	9,404	47,509
	12-1	4,332	0	1,453	638	6,422
	13-1	11,716	0	113,728	183,761	309,206
	15-1	4,781	0	1,412	704	6,897
	17	183,931	0	58,031	27,074	269,036
	18	75,384	0	22,267	11,097	108,747
	I	0	16,255	0	786	17,041
	II	0	16,255	0	786	17,041
	III	0	16,255	0	786	17,041
	IV	0	0	0	11,252	11,252
	V-1	2,068	0	611	260	2,939
	Settlement	0	0	0	0	0
	Settlement	0	0	0	0	0
	Settlement		0	0	0	0
	Settlement	0	0	0	0	0
	Subtotal	738,801	165,090	332,367	353,441	1,589,699
	Total	1,582,619	169,359	678,009	665,659	3,095,647
Area on the Left Bank of the Ishim River	11	143,795	0	42,473	21,166	207,434
	12-2	38,988	0	13,074	5,739	57,800
	13-2	11,716	0	113,728	183,761	309,206
	14	121,664	0	99,402	231,990	453,056
	Settlement	0	0	0	0	0
	15-2	43,028	0	12,709	6,334	62,072
	16	109,301	0	32,285	16,089	157,675
	Settlement	0	0	0	0	0
	19	47,576	0	14,052	7,003	68,631
	V-2	8,274	0	2,444	1,038	11,756
	VI	0	0	0	6,209	6,209
	VII	6,638	0	1,961	10,187	18,786
	VIII	0	0	0	0	0
	IX-2	0	0	0	0	0
	Total	530,979	0	332,129	489,517	1,352,625
Grand Total		2,113,598	169,359	1,010,138	1,155,177	4,448,272

Table H.2.25 Heat Demand Forecast at User End

Unit ; Gcal/Year

eat Sourc	District No. & Area	2000		2010		2020		2030	
		Heat Dem	Sub Total	Heat Deman	Sub Total	Heat Deman	Sub Total	Heat Deman	Sub Total
TETs-1&2	No.1-18 & Existing Area	1,020,203	1,509,227	989,737	2,472,057	1,341,090	3,199,536	1,505,948	3,537,882
		489,025		1,173,312		1,458,504		1,589,699	
	Independent Boil	0		309,007		399,942		442,235	
Total of Right Bank			1,509,227		2,472,057		3,199,536		3,537,882
HC- 1	No.13-2	0	0	178,624	229,660	258,702	332,617	309,206	397,551
	Independent Boil	0		51,036		73,915		88,345	
HC- 2	No.14	0	0	164,072	210,949	311,031	399,896	453,056	582,501
	Independent Boil	0		46,878		88,866		129,445	
HC- 3	No.12-2	51,426	51,426	54,269	69,775	55,547	71,417	57,800	74,314
	Independent Boil	0		15,505		15,870		16,514	
HC- 4	No.15-2	0	0	0	0	50,627	65,092	62,072	79,806
	Independent Boil	0		0		14,465		17,735	
HC- 5	No.16	0	0	1,527	1,963	74,355	95,599	157,675	202,725
	Independent Boil	0		436		21,244		45,050	
HC- 6	NO.19	0	0	0	0	65,155	83,771	68,631	88,240
	Independent Boil	0		0		18,616		19,609	
HC- 7	VI	0	0	6,209	7,983	6,209	7,983	6,209	7,983
	Independent Boil	0		1,774		1,774		1,774	
HC- 8	VII	0	0	4,655	5,985	4,628	5,950	6,262	8,051
	Independent Boil	0		1,330		1,322		1,789	
HC- 9	VII	0	0	4,655	5,985	4,628	5,950	6,262	8,051
	Independent Boil	0		1,330		1,322		1,789	
HC- 10	VII	0	0	0	0	4,628	5,950	6,262	8,051
	Independent Boil	0		0		1,322		1,789	
HC-11	No.11	13,962	13,962	13,014	16,732	23,613	30,360	207,434	266,700
	Independent Boil	0		3,718		6,747		59,267	
HC-12	V-2	0	0	11,047	14,203	11,187	14,383	11,756	15,115
	Independent Boil	0		3,156		3,196		3,359	
	VIII	0	5,485	0	0	0	0	0	0
	IX-2	0		0		0		0	
	Settlement Prigo.	4,120		0		0		0	
	Settlement Telma	1,365		0		0		0	
	Independent Boil	0		0		0		0	
Total of Left Bank			70,873		563,236		1,118,971		1,739,089
Grand Total			1,580,100		3,035,293		4,318,507		5,276,971

Table H.2.26 Heat Demand Forecast at Supplier End Unit ; Gcal/Year

	District No.	2000	2010	2020	2030
TETs-1&2	No.1-18 & Existing Area	2,721,105	3,970,123	4,293,777	4,670,005
Sub Total of Right Bank		2,721,105	3,970,123	4,293,777	4,670,005
Sub Total of Left Bank		0	844,854	1,678,457	2,608,633
Total		2,721,105	4,814,977	5,972,234	7,278,638

Table H.2.27 Peak Load Capacity at Heat Supply End Unit ; Gcal/hour

	District No.	2000	2010	2020	2030
TETs-1&2	No.1-18 & Existing Area	737.8	1,076.5	1,164.3	1,266.3
Sub Total of Right Bank		737.8	1,076.5	1,164.3	1,266.3
HC- 1	No.13-2	0.0	93.4	135.3	161.7
HC- 2	No.14	0.0	85.8	162.6	236.9
HC- 3	No.12-2	20.9	28.4	29.0	30.2
HC- 4	No.15-2	0.0	0.0	26.5	32.5
HC- 5	No.16	0.0	0.8	38.9	82.5
HC- 6	NO.19	0.0	0.0	34.1	35.9
HC- 7	VI	0.0	3.2	3.2	3.2
HC- 8	VII	0.0	2.4	2.4	3.3
HC- 9	VII	0.0	2.4	2.4	3.3
HC- 10	VII	0.0	0.0	2.4	3.3
HC-11	No.11	5.7	6.8	12.3	108.5
HC-12	V-2	0.0	5.8	5.9	6.1
Sub Total of Left Bank		26.6	229.1	455.1	707.3
Heat center (HC)Total		0.0	214.4	438.8	688.1
Total		764.4	1,305.6	1,619.4	1,973.6

Peak Load on Right Bank

TETs-1 and TETs-2 Peak Load = Heat Demand Forecast at Supplier End (Table E.2.26) / 8760 / 0.421

Peak Load on Left Bank

Heat Centear Peak Load = Heat Demand Forecast at User End (Table E.2.25) / 8760 / 0.421 x 1.50

Table H.2.28 Electric Power Peak Load Demand at Substation Level

Unit : MW

District No.	Name of District	2000	2010	2020	2030	Note
1.Central Planning Region	Residential District 3	14.4	12.4	17.0	20.8	
	Residential District 4A	17.1	23.5	29.5	32.5	
	Residential District 5	13.2	5.4	6.7	7.5	
	Residential District 6	12.0	5.7	7.0	7.8	
2. Northern Planning Region	Northern Indust. District	10.0	17.4	23.4	22.5	
	Central Indust. District	14.4	26.4	35.8	34.3	
	Planning District I		5.3	5.3	5.3	
	Planning District II				5.3	
	Planning District III			5.3	5.3	
	Planning District IV		0.5	1.0	1.5	
3. South-eastern Planning Region	Residentian District 7	7.3	10.7	12.2	18.1	
	Residentian District 8	6.1	7.9	9.7	11.7	
	Residentian District 9	0.2	4.2	4.6	5.2	
	Residentian District 10	0.1	0.8	1.6	1.8	
	Indust District-Station 40	0.3	3.7	4.1	4.8	
	Residentian District 17		8.3	10.8	12.0	
	Residentian District 18			4.4	4.9	
	Residentian District 19			5.0	5.3	
	Planning District V	0.3	0.5	0.6	0.6	
4. Southern Planning Region	Residential District 11	3.2	0.5	1.0	13.7	
	Residential District 12	4.2	2.3	2.6	2.8	
	Residential District 13		38.1	49.1	54.9	
	Residential District 14	0.1	16.7	27.6	37.8	
	Residential District 15			7.0	7.8	
	Residential District 16	0.1	0.1	3.2	7.1	
	Planning Dist VI (Air Port)	0.5	5.2	5.2	5.2	
	Planning District VII	0.2	0.4	0.9	1.5	
	Planning District VIII					
5. Northwest Planning Region	Residential District 1	0.6	0.6	1.3	2.3	
	Residential District 2	5.8	3.2	4.9	6.9	
	West Industrial District	0.9	2.5	2.1	2.5	
	Residential District 4B	0.3	0.5	7.1	7.9	
	Planning District IX					
Grand Total		111.3	202.8	296.0	357.6	

Note: Data of Table 4.6.12 times 1.467 (1.1 x 1/0.75)

Table H.2.29 Existing and Future Sub Stations and Their Transformer Capacities

No.	Name of Substation	2000		2010		2020		2030	
		Voltage Levels	Transformers	Voltage Levels	Transformers	Voltage Levels	Transformers	Voltage Levels	Transformers
1	Astana Tyagovaya	110kV/10kV	2 x 40						
2	Factory	110kV/10kV	2 x 40						
3	KSM	110kV/10kV	2 x 20						
4	Ceramics	110kV/10kV	2 x 16						
*5	City	110kV/10kV	2 x 40						
*6	Astana	110kV/10kV	2 x 40						
*7	Industrial zone	110kV/35/10kV	1 x 25, 1 x 40						
8	Iron Plant	110kV/10kV	2 x 40						
*9	Central	110kV/10kV	2 x 40						
*10	Spinning Factory	110kV/10kV	2 x 25						
*11	Eastern	110kV/35/10kV	2 x 10						
*12	IKI	110kV/10kV	2 x 6.3						
13	Station 40	110kV/10kV	2 x 40						
14	Krasny	110kV/10kV	2 x 6.3						
*15	Zarechinaya	110kV/10kV	1 x 6.3, 1 x 16			110kV/10kV	2 x 6.3		
*16	Pumping Sattion	110kv/6kV	2 x 6.3			110kV/10kV	2 x 6.3		
*17	Airport	110kV/35/10kV	2 x 6.3	110kV/10kV	2 x 6.3				
*18	Western	110kv/6kV	2 x 6.3					110kV/10kV	2 x 6.3
*19	Koktem	110kV/10kV	2 x 16	110kV/10kV	2 x 6.3				
*20	Southern	110kV/10kV	2 x 10					110kV/10kV	2 x 6.3
*21	Kirova	110kV/10kV	2 x 10						
*22	School	110kV/10kV	2 x 16						
*23	Arman	110kV/10kV	2 x 2.5						
24	New City Center			110kV/10kV	2 x 63				
25	District No.14					110kV/10kV	2 x 40		
26	District No.17			110kV/10kV	2 x 25				
27	Planning District I			110kV/10kV	2 x 6.3				
28	Planning District II							110kV/10kV	2 x 10
29	Planning District III					110kV/10kV	2 x 6.3		

Note: The column of transformers shows number of transformers and capacity of transformers in MVA.
Substations with mark * belong to AES in No.1 to No.23.

Table H.2.30 Installation Plan of Electric Power and Heat Energy Generating Plants

Year	Demand Forecast		Installed	Installed	New Installation	Note
	Ave Output	Max output	Rated capacit	Max. capacit	Capacity	
2000	169MW	226MW	262MW	322MW		
2005	221MW	295MW	262MW	322MW		Note: 1
2006	231MW	308MW	377MW	452MW	115MW	Beginning of 2006
2010	271MW	362MW	527MW	602MW	150MW	Beginning of 2011
2013	300MW	400MW	505MW	580MW		Note: 2
2015	319MW	425MW	505MW	580MW		
2020	364MW	485MW	705MW	780MW	200MW	Beginning of 2021
2025	398MW	530MW	625MW	700MW		Note: 3
2030	428MW	570MW	625MW	700MW		

Note: 1 At present, it is not expected to generate electric power at the rated load, lack of electric power at the peak must be compensated by KEGOC 500 kV line especialy by the commercial operation of new 115 MW plant in 2006.

Note: 2 Three sets of steam turbines and two sets of boilers of TETs-1 will be retired around 2013 because all facilites will be more than 40 years old which is the same operated years of No.1 old boiler.

Note: 3 One set of boiler and 80MW turbine of TETs-2 will be retired around 2023 because those facilities will be more than 44 years old.

Table H.3.1 Implementation schedule relating to Electric Power and Heat Energy Generation and Supply

Item	2001 to 2010	2011 to 2020	2021 to 2030
Electric Power & Heat Energy Generating Plants			
115 MW Coal Firing Conventional Thermal P.Plant	—TETs-2		
150 MW N/G Firing Combined Cycle P. Plant	——	TETs-1	
200 MW N/G Firing Combined Cycle P.Plant		——	TETs-2
Heat Energy Generation and Supply Facilities			
(1)Extension of Heat Distribution Pipelines from the existing district heating system (supplied from TETs-1 and TETs-2)			
To New City Center and Dist. No.12	—		
To District No. 17	—		
To Dist. Nos. 4B, 18 and a part of Central Industrial District		—	
To Northern Industrial District			—
(2) Heat Energy Generating Facilities in the Area on the Left Bank of Ishim River		Exten.	Exten.
HC-1, HC-2, HC-3	—	—	—
HC-4, HC-5, HC-6		—	Exten. —
HC-11			—
(3) New Installation of District Heating Pipelines in the Area on the Left Bank of Ishim River			
New City Center	—		
District No.12	—		
District Nos. 12, 14, 15, 16 and 19		—	
District Nos. 11, 14 and 16			—
110 kV Transmission Lines and 110 kV/10 kV Substation (S. S)	—		
Airport switching S.S to Dist. No.13 S.S	—		
TETs-2 to Airport switching S.S	—		
Branch of TETs-2 to Airport to Eastern Swich. S.S	—		
Eastern to District No.17 S.S	—		
500 kV Central S. S to High-Tech Park in District I	—		
Airport switching S.S to District No.14		—	
500 kV Central S.S to Western Switch. S.S		—	
Western Switch. S.S to Airport Switch. S.S		—	
Branch of TETs-2 to Airport to High-Tech Park Dis.III			—
500 kV Central S.S to TETs-2			—
Branch of 500 kV Central S.S to TETs-2 to High-Tech Park in Dist. II			—