2005 Prize of the Chairman of ECCJ

Energy Conservation Activities Worked by All Members of the Energy Center

Hoku Netsu Corporation
Central Energy Center
Energy Conservation Promotion Committee

◎ **Keywords: Prevention of energy loss due to radiation, heat transfer, etc.**
Rationalization of conversion to electricity motive power and heat (Electric power application equipment, electric heating equipment, etc.)
Rationalization of conversion to electricity motive power and heat (Lighting equipment, elevators and office equipment)

◎ Outline of Theme

Hoku Netsu Corporation, as a heat supplier, has been working on environmental improvements and effective use of energy since the launch of its heat supply business in 1971. However, having its system structure consisting of simply boilers for high-temperature water production, achievement of “reduction of energy intensity by 1% or above” was expected to be difficult. Under such circumstance, “Energy Conservation Promotion Committee” participated by all members of the Energy Center was established in FY1999 to set to activities for improvement of intensities in both heat and electricity. Our approach toward the activities was planned to firstly propose and carry out improvement measures which can be readily implemented without incurring an additional cost as a major part of the project, followed by implementation of other improvement measures requiring capital investment.

This report describes and presents details of our achievement in the energy conservation activities participated by all members of the center.

◎ Implementation Period of the Said Example

April 1999 – March 2004

- Project Planning Period — April 1999 – September 1999 — Total of 6 months
- Measures Implementation Period — October 1999 – March 2004 — Total of 54 months
- Measures Effect Verification Period — January 2005 – June 2005 — Total of 5 months

◎ Outline of the Business Establishment

- Scope of Business/Items Produced — Heat supply business/High-temperature water
- No. of Employees — 19
- Total Annual Energy Usage Amount (Actual results for fiscal year 2004)

13A	4,500,000 m^3	Kerosene	2,000 kl
Coal	27,000 t	Electricity	3,900 MWh

◎ Process Flow of Target Facility

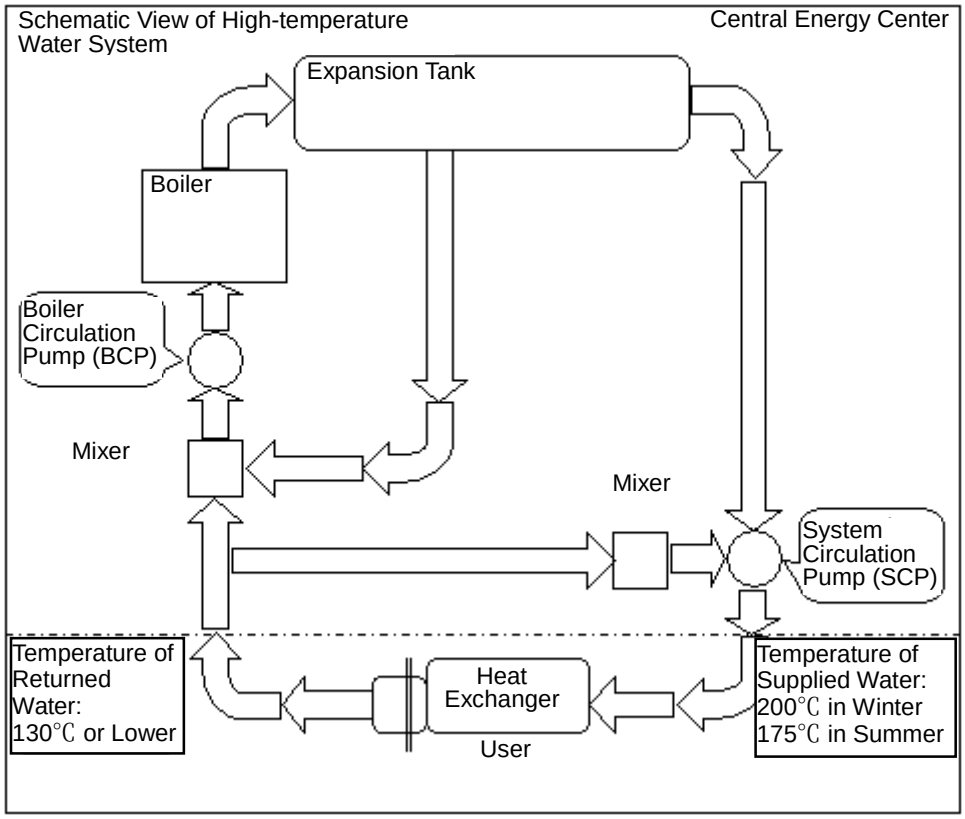

Fig. 1 Outline of the System

1. Reasons for Theme Selection

In the Revised Law concerning the Rational Use of Energy (Revised Energy Conservation Law) took effect in 1999, it was required to set a target of average energy consumption intensity improvement by 1% or above per year and to take necessary measure for achieving the target. The guideline gave a very tough numerical goal to heat providers including our company which provided “heat” itself as their product. Under the circumstance, the Central Energy Center, having a simple system for generating high-temperature water by boilers, determined to work on the promotion of energy conservation through an approach form both heat and electric aspects in order to achieve the targeted improvement of intensity by 1%.

2. Understanding and Analysis of Current Situation

Fig. 2 and 3 show heat and electric use in FY1999, when our activities for promoting the energy conservation were launched.

RDF (refused-derived fuel) was used as fuel for our production at the beginning of the improvement activities, and it was allowed not to include such recycled fuel as energy use when converted to crude oil. However, taking account of the fact that the RDF, a heat source with enough heat quantity, was generating more than 30% of total heat in the Energy Center, we determined to count it as the fuel in the same way as others so that energy conservation effect could be properly estimated and understood. (This practice was suspended in FY2003)

Breakdown of Heat Use in FY1999

The Heat Use when Converted to Crude Oil: 34,953kL

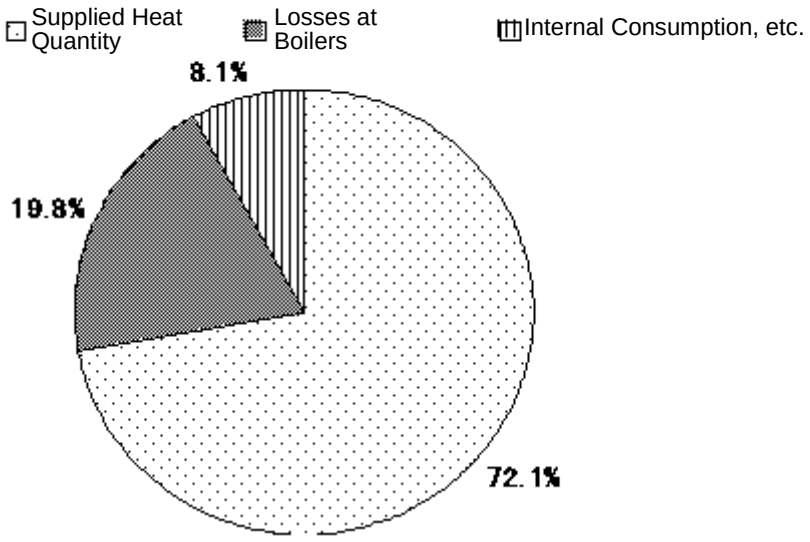

Fig. 2

Breakdown of Electricity Use in FY1999

Amount of Electricity Use 6,100Mwh

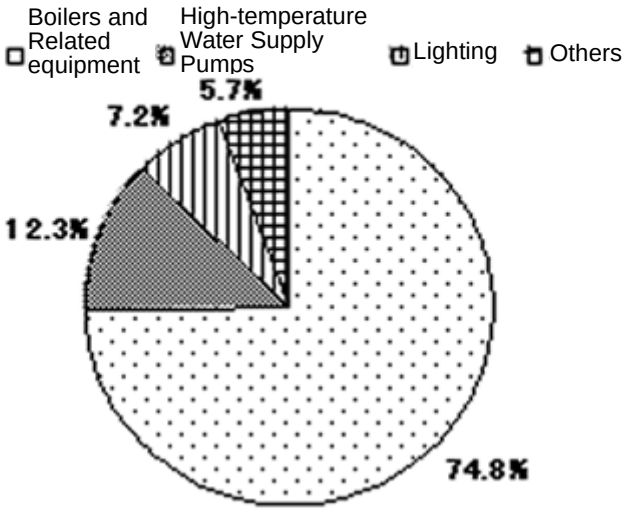

Fig. 3

3. Progress of Activities

(1) Implementation Structure

Based on some advices from a qualified person for energy management of type1 designated factory, our activities started with establishment of “playground for the activities” and announcement of “basic policy for administering the activities”.

[1] Establishment of ”Energy Conservation Promotion Committee” participated by all members of the Energy Center, specifically 16 shift workers in 4 groups working in 3 shifts and 3 daytime workers

[2] Educational activities to raise awareness in energy conservation

[3] Invitation of suggestions for improvement which can be readily implemented and requiring no additional cost

[4] Invitation of well-constructed suggestions in terms of cost-effectiveness

[5] Implementation of PDCA cycle

[6] Challenging to any activities without being afraid of failures

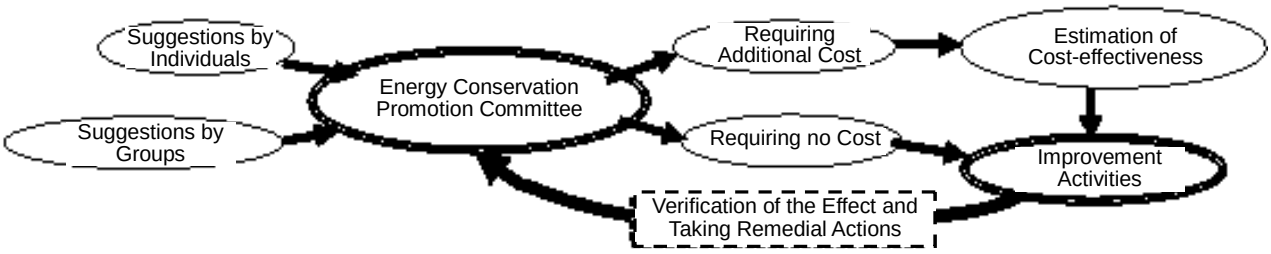

Fig. 4 Outline of the implementation Structure

(2) Target Settings

[1] Reduction of annual electric consumption

Since the center was designated as type 2 designated energy management factory in FY1999, its allowable electricity use was set to be less than 600 MWh.

[2] Improvement in fuel intensity

Improvement by 1% through improved combustion efficiency and prevention of heat losses by radiation and conduction, etc.

[3] Others

Solutions to some problems by reduced water consumption and by reduction and effective use of combustion ash

(3) Problem Points and their Investigation

[Electricity Department]		[Heat Department.]	
Motive Power for Water Delivery	... Development of standard value for management of number of pumps to be operated	Reduction of Losses in the Plant	... Improvements in warming of backup boiler
Lighting	... Reviews on number of lights and lighting equipment	Enhancement of Heat Insulation	... Improvements in boilers, pipes, pumps, etc.
Standby Electricity	... Reviews on operation method of equipment	[Others]	
Compressed Air	... Improvements in air pressure and operation method	Savings in Water Consumption	... Improvements in water used for ash discharge and cooling
Cooling Tower	... Reviews on temperature setting for anti-icing system, etc.		

4. Details of Measures

(1) Measures without Requiring Additional Cost (Reviews and changes in operation method)

[Electricity Department]

[1] Reviews on pressure setting of compressor for soot blower and number of units to be operated

A soot blower process using compressed air is applied to coal-fired and RDF-fired boilers in order to prevent lowered efficiency due to attachment of soot to flag-shaped heat-transfer tubes. In general, the lower the compressed air pressure is, the less energy consumption is required. Therefore, we made a study in power savings after lowering default pressure of the air to the level that no impact was given to effectiveness of the blower. Meanwhile, power saving effect was also examined through measurements of electric consumption when one compressor was solely operated and two compressors were operated in parallel.

Table 1 Electric Consumptions in Various Conditions of Air Pressure and Number of Units

Unit: kWh

Pressure Setting		Parallel Operation	Single Operation
OFF ON	3.10 2.65	61.96	60.79
OFF ON	2.75 2.45	59.08	**58.43**

Table 2 Annual Reduction

Reductions when Converted to Crude Oil	0.5 kL/year
Energy Conservation Ratio	6 %

[2] Reduction of motive power for water delivery through clarification of the operating standard for high-temperature water supply pumps･･･Comparison between FY2001 and FY2002

These pumps are based on direct-current (DC) motors with a flow rate of 550 m^3/h and rated output of 210 kW. Their rotation speed is controlled to adopt it to varied supply flow rates and number of units to be operated is also under control. Before we started the energy conservation activities in this project, a large energy saving effect had been already achieved by changing differential pressure at the end from 0.45 MPa to 0.35 MPa based on proper understanding of water use by customers. However, our studies on number of pumps actually operated to cover increase and decrease of supply flow rate found that the number varied greatly among the 4 groups with about 10% difference in their criteria, making us realized that further measures could improve the energy conservation. The left graph in Fig. 5 shows data of pump operations before establishing standard values, indicating start-stop operations vary greatly. After established a start-stop criteria where nearly maximum pump efficiency could be obtained, the pump operations were improved to the conditions as shown in the right graph, leading to energy conservation effect shown in Table 3.

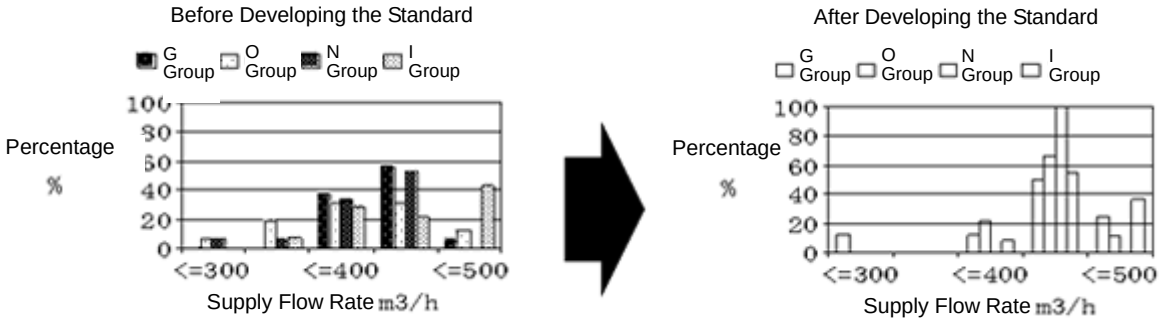

Fig. 5 Changes in Supply Flow Rate of Pumps at Parallel Off

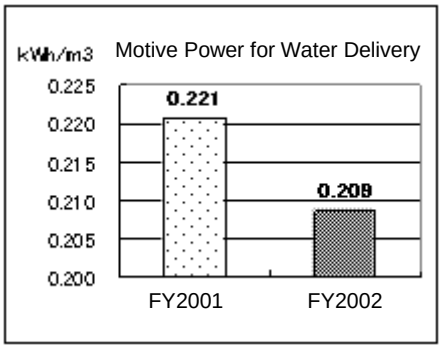

Fig. 6 Effect Obtained by Development of Standard for Stopping Operations

Table 3 Annual Reduction

Reductions when Converted to Crude Oil	9.8 kL/year
Energy Conservation Ratio	6 %

[Heat Department]

[1] Reduction of heat losses by reviewing backup boiler warming process

One to three boilers are always under warming conditions as backup units. Unlike a boiler under normal operation which serves as heating equipment, the standby boilers are there as “units under warming = heat radiators” which generate some energy loss. Taking these facts into consideration, we implemented improvement measures to reduce the loss.

Improvement measure (1):	Establishment of an order of priority in operating boilers and reduction of warming source for the units with lower priority.
Improvement measure (2):	Reduction of draft by fully opening a damper of forced draft fan (FDF), taking account of a large cooling effect by natural ventilation

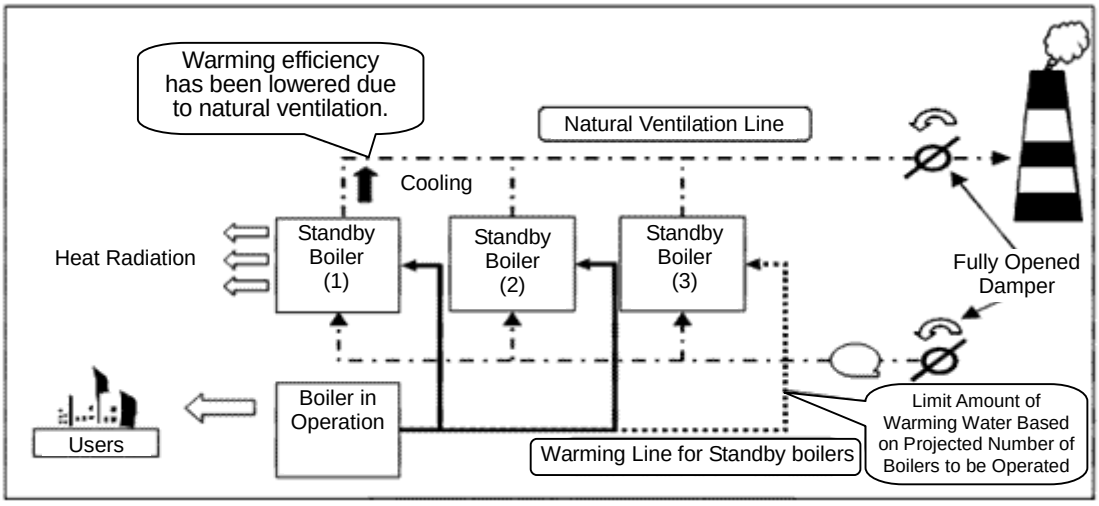

Fig. 7 outline of Boiler Warming Operations

Although we attempted to completely stop the warming process, a result of water quality analysis came back showing that boiler water satisfying the water quality management standard would not be secured. Therefore, we determined not to take such a measure.

Table 4 Annual Reduction

Reductions when Converted to Crude Oil	345 kL/year
Energy Conservation Ratio	6 %

(2) Case Study of our Measures which Led to Improvement Effect by Examining Cost-Effectiveness

[Electricity Department]

[1] Adoption of inverter-control to boiler circulation pump (BCP)

The supply water rate of boilers was previously controlled by adjusting a delivery valve in accordance with requested amount of water by customers. However, the pumps were hardly running at the rated value and electricity was almost always consumed at nearly maximum level. Considering the above, an idea of energy saving through adoption of inverter device was discussed. In the selection of a target pump aiming to obtain the maximum power-saving effect through the inverter control, we tied to determine a pump unit which had

a long operating time and served as a pump for 2 boilers, functioning as a main pump for whichever boiler under operation, as shown in Fig. 8. As a result, two circulation pumps for coal boiler and gas boiler were selected as the target of the inverter application.

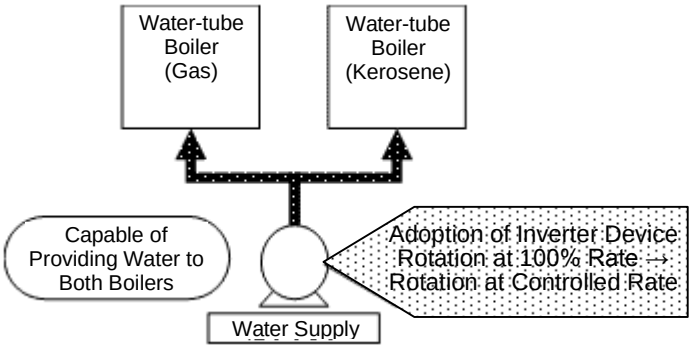

Fig. 8

Table 5 Comparison between before and after Implementing the Improvement Measure

Electricity Use before Implementing the Measure	567,719kWh
Electricity Use after Implementing the Measure	317,669kWh
Reduced Electricity	250,050kWh

Table 6 Annual Reduction

Reductions when Converted to Crude Oil	66 kL/year
Energy Conservation Ratio	44 %

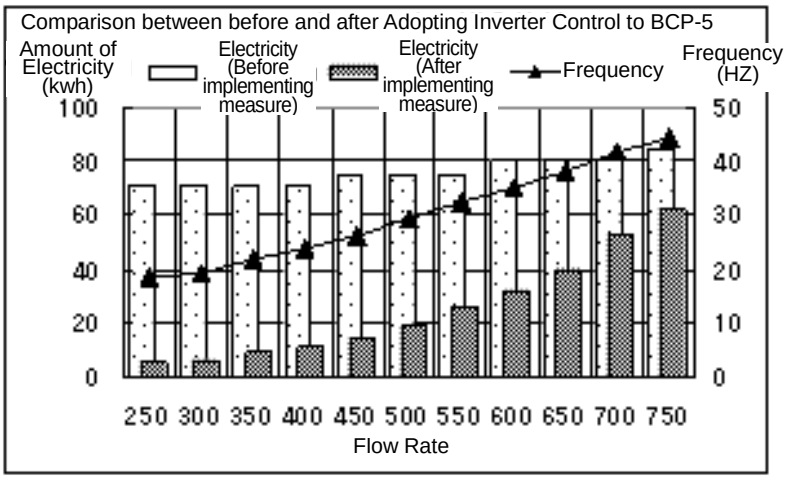

Fig. 9 Water-Supply Flow Rate and Consumed Electricity

[Heat Department]

[2]-1 Enhancement of heat insulation (boilers, pressure vessels)

Following our thermographic measurements on various facilities and installations in the plant for heat loss due to radiation, it was found that some parts of expansion tank and coal-fired boilers, the oldest installations in the plant, showed degraded heat insulation performance. In order to solve the problem, we made some modifications on the facilities through replacement of heat-insulating materials and additional work on the area without the insulation measure, such as flanges, in order to reduce the heat losses.

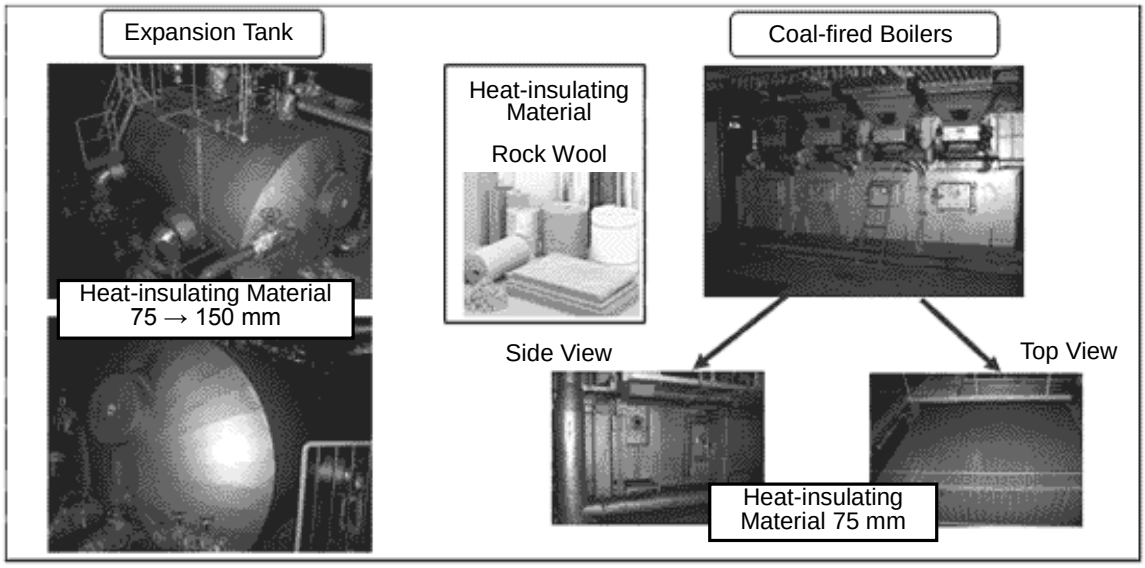

Fig. 10 Facilities to which Enforced Heat Insulation Measure was Applied

Table 7 Comparison between before and after the Modifications

	Heat Loss due to Radiation before the Modification for Better Heat Insulation	Heat Loss due to Radiation after the Modification for Better Heat Insulation
2 Expansion Tanks	2,346,278 MJ	397,353 MJ
2 Coal-fired Boilers	445,411 MJ	153,467 MJ

Reduction Effect: Annual Energy Saving of 2,240,869 MJ

Table 8 Annual Reduction

Reductions when Converted to Crude Oil	59 kL/year
Energy Conservation Ratio	20 %

[2]-2 Enhancement of heat insulation (pumps)

Since no heat-insulating measure had been applied to 6 units of high-temperature water supply pumps (SCP), they had a large amount of heat quantity loss due to radiation, which was causing raised temperature around pumps and adversely impacting on the control system. In order to solve the issue, we determined to make some additional heat-insulation work on them, following a review on the pumps to confirm that their operation would not be impacted. Similar renovation was also made on insulation flanges to which a heat-insulating measure had not been applied yet.

Table 9 Comparison between before and after the Heat Insulation Work

	[Before Heat Insulation Work]	[After Heat Insulation Work]
6 System Circulation Pumps	1,700,000MJ	62,700MJ
Insulation Flanges (Supply and return)	122,000MJ	8,900MJ

Reduction Effect: Annual Energy Saving of 1,750,400 MJ

Table 10 Annual Reduction

Reductions when Converted to Crude Oil	43 kL/year
Energy Conservation Ratio	96 %

(3) Other Case Studies

Table 11 shows a list of power and heat saving measures we implemented.

The activities we worked on during the project were mainly the measures readily implemented on our own, and included some measures requiring no additional cost, such as change in machine settings, as well as the ones requiring certain investment.

Table 11 List of Implemented Measures

Category	Additional Cost Incurred?	Description of the Measures	Amount of Energy when Converted to Crude Oil (kL)	Energy Conservation Ratio (%)
Electricity	No	Reduction of standby electricity of power supply for backup boilers and other equipment	11	50
		Power reduction through identifying areas which require lighting and replacement with more efficient lighting fixtures	28	25
		Power reduction through shortened operating hours of air fans for ventilation	17	53
		Power reduction of air fans through use of energy conserving belts	1.5	3
		Power reduction through reviews on maintenance operations	1	50
		Power reduction through changes in setup for anti-icing heater of cooling tank	2	95
	Yes	Replacement of E Feeder Tr300KVA with highly efficient 200KVA	3	33
Heat	No	Reviews on unit fan operations for air heating	3	17
		Reduction of heat losses through adjustment of valve opening level in hot-water supply for heating to be forwarded to snow-meting tanks	1	30
	Yes	Reviews on heat-insulating measures for valves with large diameter and flanges	1	20
		Renovation of some boilers	1	22

5. Effects achieved after Implementing Measures

As a result of a series of our activities to promote energy conservation started in FY1999, overall efficiency of our system when converted to primary energy was improved to 78.3% of

the starting year (Fig. 12). We understand that the figure represents a significant improvement effect, considering the fact that efficiency of boilers is around 75 to 88%. In terms of both energy intensity and electricity intensity, a large energy conservation effect was obtained (Fig. 13). Among other issues, water consumption was successfully reduced through reviews on high-temperature water discharging method at overhaul inspections and improvement in utilization of recycled wastewater into coal ash treatment. As to effective utilization of the ash, complete recycling into snow-melting agent and aggregate in cement was also achieved.

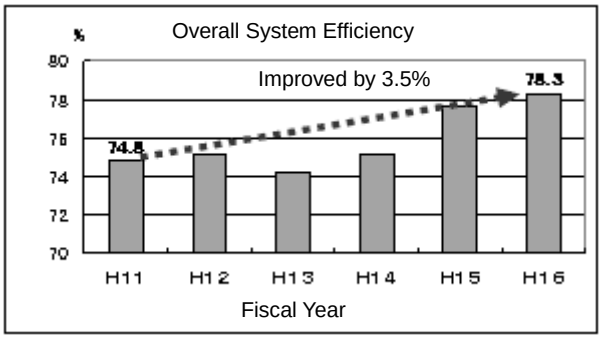

Fig. 12

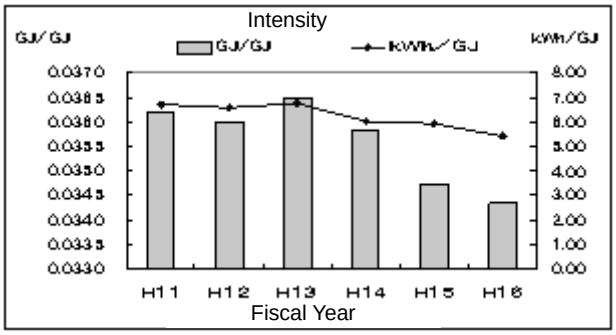

Fig. 13

Table 12 Achievement in the Energy Conservation Activities

Reduction when Converted to Crude Oil	1,143 kL/year	Improvement in Supplied Water Use	7,800 → 5,790 26%
Improvement in Energy Intensity	0.0362 → 0.0343 5%	Effective Utilization of Coal Ash	Full Recycling into: Snow-melting Agent (60%) Cement Material (40%)

6. Summary

The largest achievement in the course of the activities for promoting energy conservation in

this project was not only the energy reduction represented in the figures, but the “raised awareness in energy conservation” among all members of the Energy Center. We understand that some unique and outstanding ideas are needed for energy conservation activities; however, we also learned that small and steady steps in generally known cases could develop a stable platform of the activities and produce more continuous effectiveness. Although we had some failures during our activities, such as adoption of a high-efficiency motor resulted in no power saving, we are determined to continue our activities following a passage in our company principle, which is “giving full focus and commitment to our mission as an energy supplier”.

7. Future Plans

For further energy conservation and cost savings, we will be promoting active discussions on some issues, such as application of inverter control and waste heat recovery, etc. We will also make our efforts toward more contribution to regional and global environmental issues through effective use of energy sources in Hokkaido, including natural gas with less environmental burden and carbon-neutral woody biomass fuels.