2008 Prize of the Chairman of ECCJ

Case Study of Energy Conservation Activities by Tokyo Women's Medical University

School Corporation, Tokyo Women's Medical University
Energy Conservation Promotion Committee, Secretariat

◎ **Keywords: Energy management system for each equipment unit,**
Rationalization of heating, cooling and heat transfer (Air conditioning facilities, hot water supply facilities, etc.),
Prevention of energy loss due to radiation, heat transfer, resistance, etc.,
Rationalization of conversion to electric energy, heat, etc.

◎ Outline of the Theme

Tokyo Women's Medical University is classed as a type 1 designated energy management factory under the Energy Conservation Law as well as a business establishment designated under the environmental regulations of Tokyo Metropolitan Government to be required with reduction of CO_2 emission.

We are aware of the social role as a medical university and a big medial institute. So we started our energy conservation activities since fiscal year 2005 as one of the most important issues in our university. The activities were directed by the target that we should reduce 1% of the total consumed energy every year, compared with that of previous years.

Here, we would like to introduce the outline of our energy conservation activities which implemented from both aspects of software and hardware based on our original idea that "we should not waste energy".

◎ Implementation Period for the Said Example

- Project Planning Period — From April, 2005 still continuing
- Measures Implementation Period — From April, 2005 still continuing
- Measures Effect Confirmation Period — From April, 2005 still continuing

◎ Outline of the Business Establishment

- Type of Business　University, hospital
- Scope of Business　Education, research, medical activities
- No. of Employees　Approximately 4,800 persons (Including contract workers and temporary workers)
- No. of Students　Approximately 1,100 persons
- No. of Outpatients　Approximately 4,100/day
- Total Beds　1,423
- Type 1 designated energy management factory
- Business establishment designated by the anti-global warming plan of Tokyo Metropolitan Government.

◎ Outline of Target Facilities

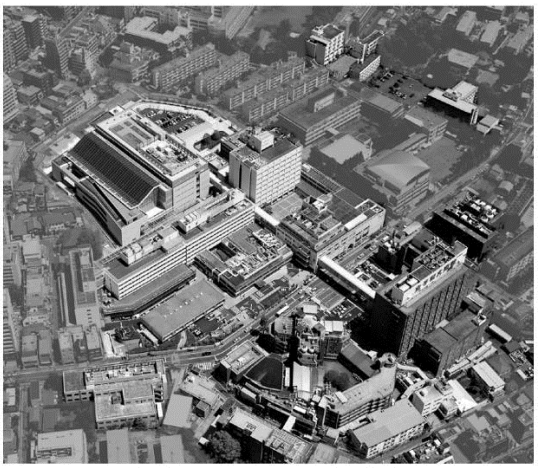


Fig. 1 Tokyo Women's Medical University (Kawada-cho campus)

Land area:	65,617 m^2
Total floor area:	167,972 m^2
No. of buildings:	27 buildings
Electric equipment:	
・Loop input electricity	66 kV
・Contracted electricity	9,200 kW
・Transformers	17,000 kVA x 2
Heat equipment:	
・Steam boiler	x 10 units
・Hot water boiler	x 4 units
・Absorption chiller	x 2 units
・Absorption water chiller-heater	x 14 units
・Turbo chiller	x 8 units
・Various chiller	x 10 units, etc.

1. Reasons for Theme Selection

There are a hospital, school facilities and research facilities in our university campus, and they are linked to each other complicatedly. Therefore, the energy conservation would hardly make progress if we made big plans from the beginning. Rather, it is very important that we should start from things we can easily do without thinking too seriously and gradually

expand the scope of our activities.

So we focused on the operational improvement of energy consumption. In the hardware aspect of the energy conservation, based on the measures for aged equipment and the cost performance, we conducted the effective activities.

2. Progress of Activities

(1) Implementation Structure

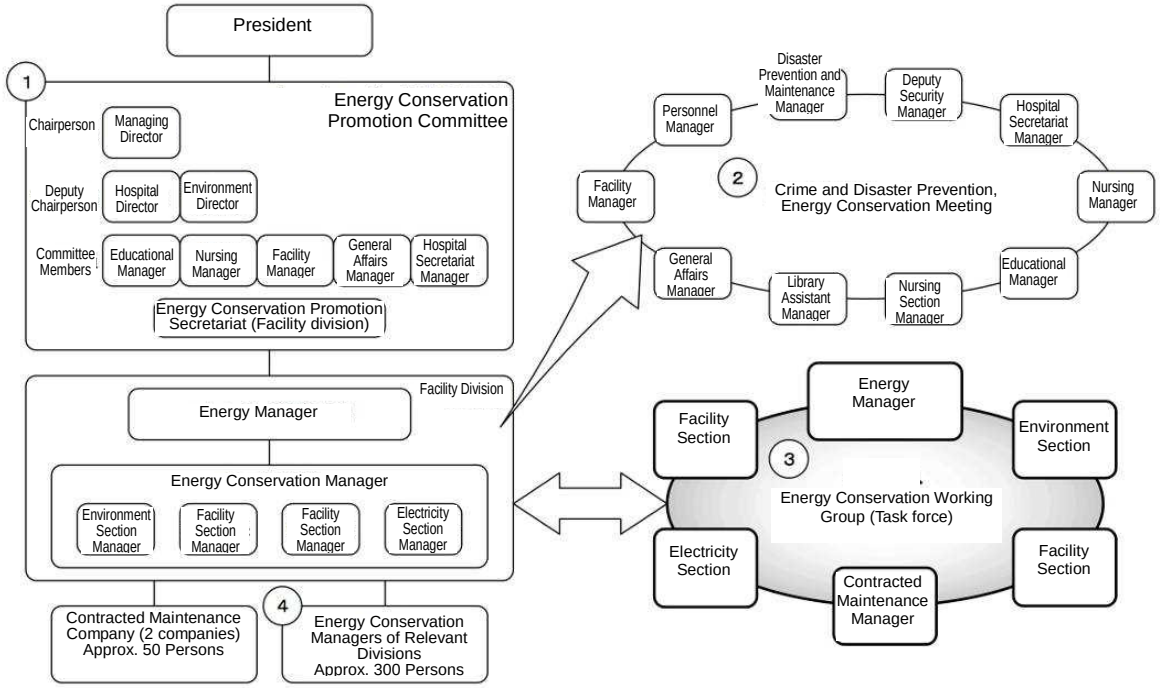


Fig. 2 Implementation Chart

① Energy conservation promotion committee

We organized the Energy Conservation Promotion Committee (Chairperson, managing director) in 2004 for the purpose of effectively promoting the energy conservation of our university. The Facility Division in charge of energy management works as the committee's secretariat to make proposals of related matters including the activity reports of of the current year, the activity policy of the next year, the state of utility cost and energy use, the cost performance and so on. The Committee deliberates and makes decision over those proposals.

② Crime-prevention, disaster-prevention and energy conservation meeting

A monthly meeting for crime-prevention, disaster-prevention and energy conservation is held in attendance of the managers of the Nursing Division and the Secretariat Division, in

which the energy conservation manager reports various issues concerning energy and asks for cooperation from the related organizations and people.

③ Energy conservation working group

Under the initiative of the energy manager, the Energy Conservation Working Group of the task force plays the central role for implementing the energy conservation activities as follows.

- Collection of energy data, comparison of actual energy use with the target and study of problems and measures
- Planning, proposal, implementation and verification of energy conservation measures
- Review of management manual and study of other issues concerning energy conservation

④ Roles of energy managers of each division (Approximately 300 persons)

- Supply of information necessary for the enhancement of energy conservation awareness of the employees.
- Appropriate management of lighting, air conditioners, etc. (Set of appropriate room temperature and switch off when leaving)
- Switch off the PCs, copying machines, etc. when leaving
- Appropriate management of city water, water heaters, etc. (bathrooms, showers)
- To transfer opinions and/or proposals concerning energy conservation to relevant divisions, and to implement proposals of the Promotion Committee at each work site
  We held the energy conservation seminars for the energy conservation managers of related divisions in FY2006 and FY2007.

(2) Understanding of Current Situation

The ratios of the electricity and the utility gas used in our university are 77% and 23% respectively at calorie equivalent. The energy consumption of the air conditioners for heating and cooling accounts for almost 60% of total consumption, which is easily affected by the weather of each year.

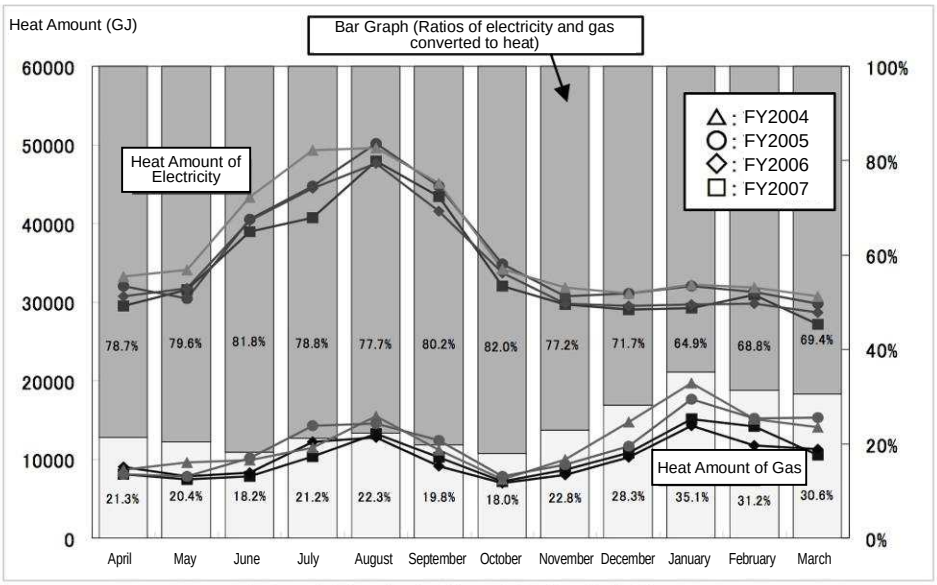


Fig. 3 Electricity and Utility Gas, Monthly Load Curve

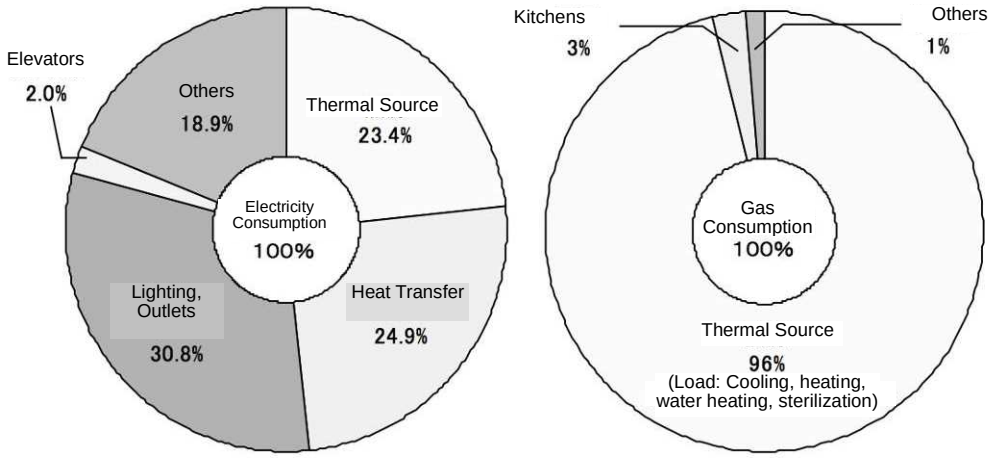


Fig. 4 Breakdown of Electricity and Gas Consumption

(3) Analysis of Current Situation

① Electricity

As shown in Fig. 3, the monthly load curve of the electricity consumption has a peak in the period between June and September every year and does not change much in other months. It is noticeable that the electricity consumption does not increase even if the outside temperature decreases in winter.

Therefore, the key point of focus is the electricity consumption in the period between June and September, in which a lot of OA equipment, medical testing equipment, freezers, etc. are operated in the hospital which has been wholly high-tech due to enhancing high-quality specialized medical treatment.Thus, the heat generated by those equipment is thought to increase the electricity consumed for cooling in summer and to warm the buildings in winter.

② **Utility gas**

96% of the utility gas is consumed by thermal equipment such as boilers and water chiller-heaters,etc. and the load of those equipment undergoes a significant variation according to the weather of the year (hot or cold) since those equipment is used for heating, cooling, water heating, sterilization, etc. Especially in the heating season of winter, its consumption increases to the peak.

(4) Target Settings

Our university is classed as a type 1 designated energy management factory under the Energy Conservation Law as well as a business establishment designated under the environmental regulation of the Tokyo Metropolitan Government. In order to perform our obligations under those regulatory requirements, we decided to develop active efforts of achieving our target to reduce our total energy consumption of 1% every year from that of previous years.

(5) Details of Measures

1) Improvement measures for software aspect

① **Operational improvement which we can start immediately!**

The advantage of this activity is that there are no risks. The effect of each activity may be small, but a firm effect can be expected by implementing various measures as follows.

- We patrolled the buildings and thinned out a too bright lighting while obtaining the consent of the on-site employees.
- We changed wholly the candescent lighting to fluorescent lighting and also changed existing FLR40W fluorescent lamps to 36W type. (12800 lamps)
- We changed the temperature setting of unmanned transformation rooms from 25℃ to 29℃.
- We changed the way to use the lights of the transformation rooms and machine rooms, shifting to turning on them only when they are used.
- When patrolling the buildings at night (9p.m., 11a.m.), we checked that the lights and air conditioners of the meeting rooms, corridors, stairs, halls, bathrooms, etc. have been turned off.
- As regards the lighting of the outpatient center, we changed its program to shorten the lighting time on the lighting operation panel in the disaster prevention center.
- We shortened the operating time of the air conditioners and fan coil units.

- We reviewed the flow rate of the once-through boilers and reduced the fuel used.
- We changed the outlet temperature of the chilled water and hot water supplied from the thermal equipment (changed according to the season).
- We changed the belts, replacing with the energy conservation type one by one. (340 locations)

Fig. 5 Thinning out a Lighting in the Corridor

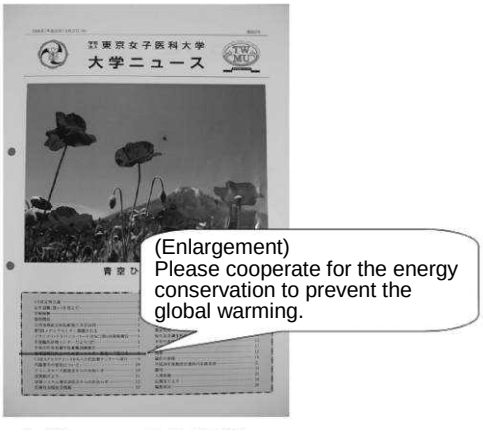


Fig. 6 The Front Page of the Campus Newspaper

②Active awareness campaigns

It is difficult to achieve our target without cooperation of the employees using energy, so we actively ran awareness campaigns for the energy conservation to the employees as follows.

- Posting of energy conservation articles in the monthly university magazine "Campus Newspaper" (four times a year). (See Fig. 6)
  - Transition of the energy use
  - Outline of the revised Energy Conservation Law
  - Outline of the anti-global warming measures planning system of the Tokyo Metropolitan Government
  - Publication of the state and achievement of the energy conservation measures
  - Request of cooperation to the employees
- Posting of energy conservation posters (at conspicuous locations in the campus)
- Attachment of energy conservation stickers (to the switches of the lights and air conditioners and at the entrance and exit of rooms)
- Registration of the energy managers of each division (approximately 300 people)
  - Promotion of the energy conservation activities at each work place to enhance the energy-saving awareness of employees
- Implementation of energy conservation patrol by the working group
  - We patrol each building mainly in the afternoon of the summer when the energy is most, used to check so that the setting daytime temperature of the air

conditioners is appropriate and no wasteful light is used.

③Energy conservation patrol at night

- We started the patrol from 2002, once in every 2 months, and done 30 times so far.
- Employees of each division participate in the patrol in turn. Approximately 20 employees at a time patrol all the buildings in 2 hours between 9p.m. and 11p.m.
- Turn off the lights and air conditioners in unmanned rooms! Set PCs to the energy conservation mode
- We recommend improvement to the energy managers of each division to fully implement the energy conservation.

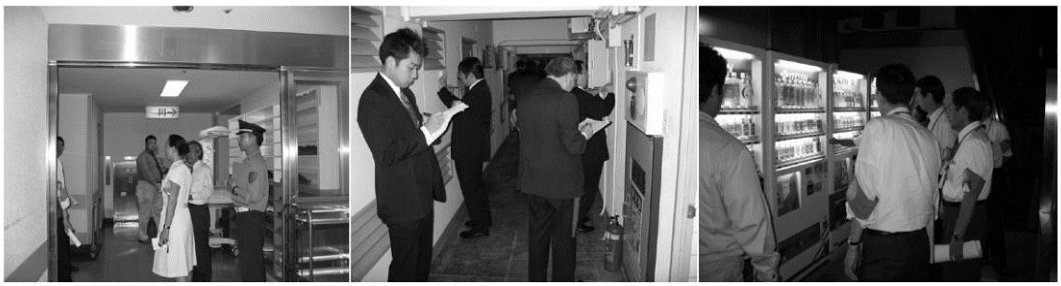


Fig. 7 Doing Energy Conservation Patrol at Night

④Reduction of contracted electricity

Fiscal year 2004: 10,500 [kW]
Fiscal year 2005: 10,100 [kW]
Fiscal year 2006: 9,700 [kW]
Fiscal year 2007: 9,500 [kW]
This fiscal year: 9,200 [kW]

Due to the energy conservation effect, reduction of 1,300 [kW] in 4 years was achieved.

<2> Improvement measures for hardware aspect

The followings are the list of the engineering works completed in our energy conservation 5 year project which started in 2005.

○ 2005 Renewal of building multi type air conditioners
○ 2005 Renewal of the guiding lights ting to the energy conservation high luminance type
2006 Retrofit of the inverter control on ventilation operation at the parking lots
2006 Retrofit of the inverter control on rotation frequency of chilled/hot water pumps
○ 2006 Retrofit for preventing the heat loss of the steam pipes and valves
2006 Retrofit of imitation sound system for women's rest rooms
2006 Retrofit of the inverter control on rotation frequency of air conditioners 2007 Retrofit of the inverter control on variable flow of the cooling water pumps
○ 2007 Retrofit of the inverter control on variable flow of the chilled water secondary

pumps

2007 Retrofit of the inverter control on of variable flow of the hot water primary pumps

As we cannot describe the details of all of the above-mentioned engineering works due to the limitation of the pages, we only describe more over the above encircled works as follows.

①Renewal to building multi type air conditioners

- Outline of the renewal

At the second building, the central cooling and heating equipment was renewed to the building multi type air conditioners.

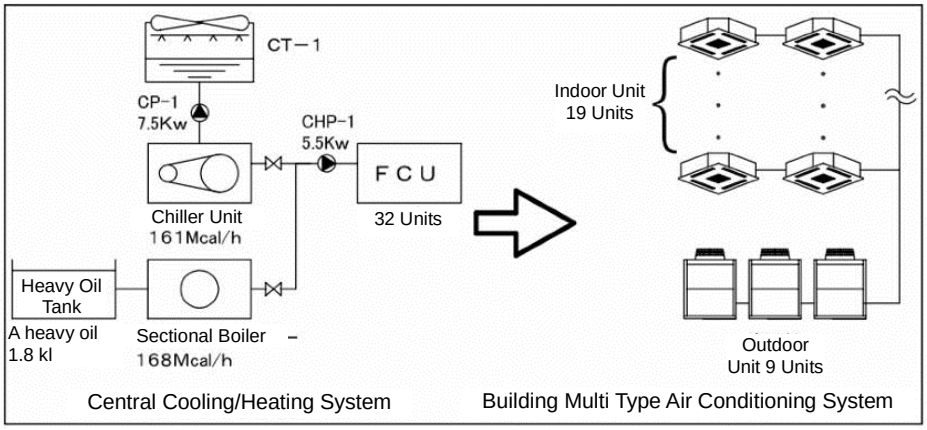


Fig. 8 Renewal Construction of Building Multi Type Air Conditioning System

- Purpose of the renewal
  - 36 years have passed since the current cooling/heating air conditioning system had been installed, so it became old and inefficient.
  - Wasteful energy was consumed in spite of the fact that the utilization rate of the entire building was low.

Due to this renewal, it became possible to use individually the system only in the room when using it, it and it is expected to reduce significantly energy consumption.

- Effect of the renewal
  - The consumption of Bunker A oil for boiler fuel l became Zero !!: 8,027[ℓ]/year
  - The consumption of the cooling water for the cooling tower became Zero !! 764[m^3]/year
  - The consumption of electricity was also so much reduced to lead to a large energy conservation effect.: 54,323[kWh]/year

② Renewal of the guiding lights to the energy conservation high luminance type.

- Outline of the renewal

  721 units of the existing fluorescent type lights were newly replaced with high luminance energy-saving type lights.

- Purpose of the renewal

  The existing lights became so old to require frequent repairs resulting in a large expenditure.

  - Repeating of repairs every year was not the fundamental solution.
  - The guiding lights were lit 24 hours, accordingly a large effect can be expected by replacing them with the energy conservation type.

- Effect of the renewal
  - The repair cost became almost zero0!
  - Reduction of electricity: 108,481 [kWh] /year

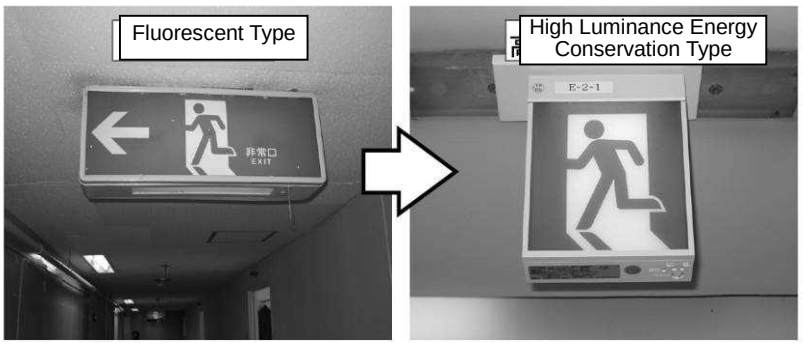


Fig. 9 Renewal of Guiding Lights

③ Retrofit for preventing the heat loss of f the steam pipes and valves.

- Outline of the repair works

Thermal insulation treatment applied to the steam pipes and valves installed in all of the boiler rooms and machine rooms in the university.

- Purpose of the repair works
  - The heat discharged from the pipes and valves in the boiler rooms, etc. causes to make the room temperature very high.
  - The heat thus discharged is also the wasted energy.

- Effect of the repair works
  - Lowering the increase of the room temperature
  - Improvement of heat transfer efficiency

  } Reduction of city gas as fuel!! 62,226 [m^3]/year

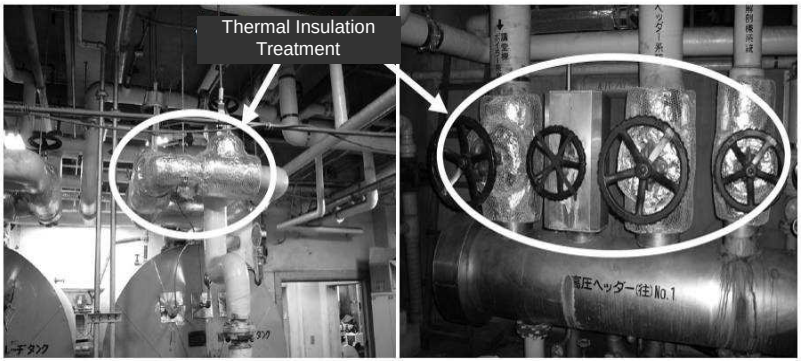


Fig. 10 Thermal Insulation of Pipes and Valves

④ Retrofit of the inverter control on variable flow of the chilled water secondary pumps.

- Outline of the repair works

Change from the control system comprising 1 inverter and l 3 units by the unit sequence control (1 unit by the fixed pump head and 3 units by the proportional unit sequence control) to the entire inverter control system (by variable pump head control) (SeeFig.11).

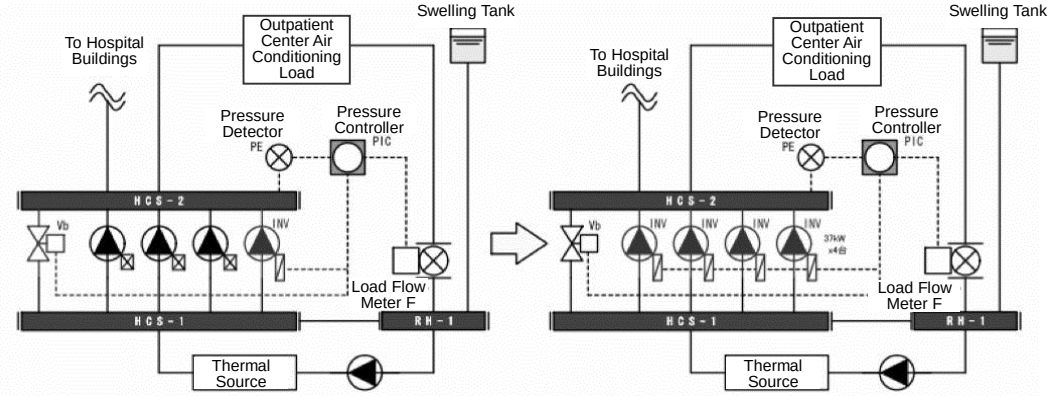


Fig. 11 Outline of Retrofit of the inverter control on Variable Flow of the Chilled Water Secondary Pumps

- Purpose of the repair works
  - In the system before the repair works, only 1 pump out of the 4 chilled water secondary pumps was equipped with the inverter.
  - When the load increased, the pumps were operated by the unit sequence control. As a result, the wasteful energy was consumed because it made impossible to control exactly the flow.
- Effect of the repair works

From the result of the simulation shown in Fig.12, the electricity in the area marked by the diagonal lines would be reduced. This reduction is equivalent to the energy conservation effect of 62% compared with the use before the repair work.

In a year ⇒ Electricity Reduction of 249 [MWh]

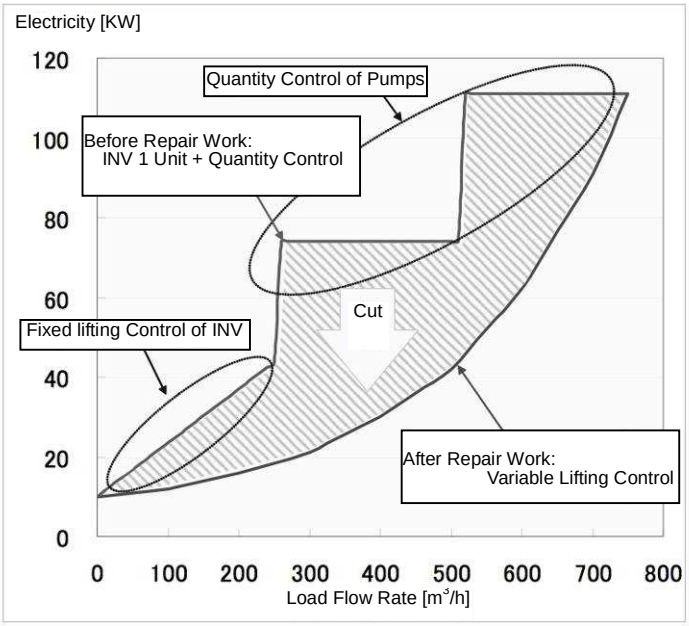


Fig. 12 Pump's Energy Characteristics against Load Flow Rate

Besides, we implemented repair works for aging equipment as follows.

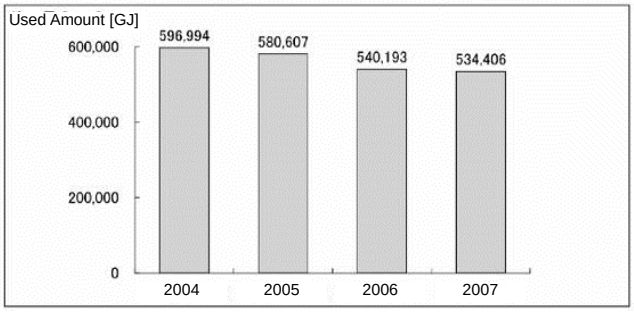
- We installed 5 inverter controlled elevators in the west hospital building A and B and in the south hospital building.
- We renewed the fluorescent lights FLR40W replacing with the HF32W inverter type.

We implement these measures, in mind that they could contribute to the energy conservation.

(6) Effects Achieved after Implementing Measures

Fiscal Year	2004	2005	2006	2007	Total Cut Amount
Used Amount [GJ]	596,994	580,607	540,193	534,406	−62,588
Compared with 2004	–	−2.74%	−9.51%	−10.48%	–

Fiscal Year	2004	2005	2006	2007	Total Cut Amount
CO_2 Emission [t]	25,610	25,047	23,132	22,920	−2,690
Compared with 2004	–	−2.20%	−9.68%	−10.50%	–



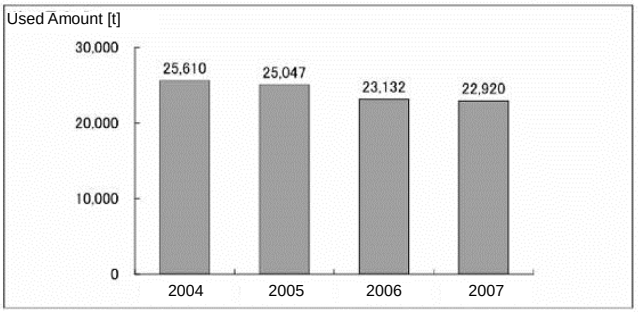


Fig. 13 Transition of Energy Consumption and CO_2 Emission

Result of the activities in 3 years from fiscal year 2005.

⇒ We could reduce CO_2 emission by 10.5%, greatly exceeding the target, i.e. 3%.

3. Summary

As a result of the energy conservation activities started in fiscal year 2005, we could reduce the energy consumption by almost 11%, compared with that of fiscal year 2004. 75% of this reduction depends on the effect of the operational improvement, which we could implement without spending a lot of money. In other words, we had been wasting energy so much.

Now we feel that the energy conservation awareness of our employees was greatly enhanced, compared with the awareness at the time when we did the patrol for the first time.

4. Future Plans

To implement the energy conservation measures, it is inevitable to have cooperation of our employees who use the energy. So we focused on the energy conservation campaign and the enhancement of the awareness of our employees. However, those activities take time and the effect does not come out immediately. Eventually by continuing those activities, we can obtain big increasing effects after half a year or one year. We actually think that it is important to keep going those activities. As regards the measures for the hardware aspect, it is a key point to clear the problems concerning cost performance. However in fact, since there are also managerial problems of the university for that, we will keep in mind to have to study them together with the problems of aging equipment.