2006 Prize of Director General of Agency for Natural Resources and Energy

Energy Conservation with No Facility Investment for 5% Annual Reduction over Eight Consecutive Years

Toyo Building Maintenance Inc.
Facility Management for Fukuoka City Public Library

◎ **Keywords:** **Rationalization of heating, cooling and heat transmission (heating facilities, etc.)**
Rationalization of electric energy conversion into motive power and heat, etc., (electromotive power application equipments, electric heating equipments, etc.)
Rationalization of electric energy conversion into motive power and heat, etc., (lighting facilities, elevators, clerical equipment and consumer appliances)

◎ Outline of Theme

This is the eighth year since energy conservation with no facility investment was started in FY1999, with figures of FY1998 used as the benchmark.
The annual reduction by 5% for eight consecutive years refers to the average annual reduction in comparison with the previous year and the details include energy consumption, carbon dioxide emissions and utility expenses. Details of the energy conservation methods include energy management, PDCA control and energy conservation measures.

◎ Implementation Period

Implementation started from April 1999 and continues to the present time

◎ Summary of Building

- Total floor area: 24,120 m^2
- Building area: 8,384 m^2

- Land area: 19,818 m^2
- Scale of building: RC, five stories above ground
- Number of air conditioning operating days: 357 days per year
- Air conditioning heat source: Supply of district heating and cooling
- Number operating days: 287 days per year
- Number of visitors: One million or more per year
- Number of loan books: An average of approximately 7,000 books per day

◎ Target Facility

- Air conditioners x 17 units (large x 11 units; individual space x 6 units)
- Circulating pumps 30 kW x 3 units
- Air supply fans x 5 units
- Packaged air conditioners x 24 units (mainly for storage)
- Fan coil units x 100 units
- Exhaust fans x 45 units

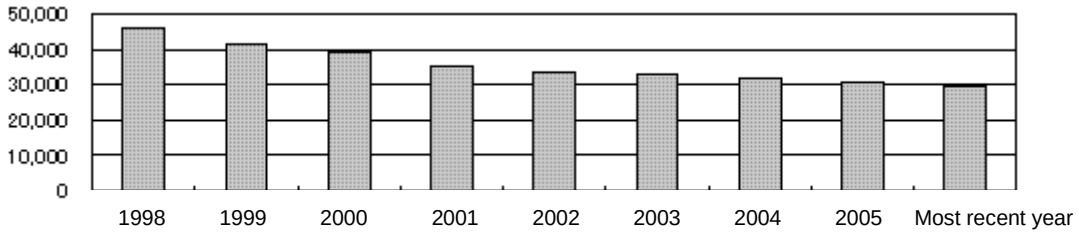
1. Reasons for Theme Selection

A reduction of the annual energy consumption by 5% in comparison with the previous year was attained seven consecutive years up to FY2005. It has been four years since the Energy Conservation Case Example Presentations were conducted in FY2001 and FY2002. How the energy conservation strategies have thus far been implemented, evolved, together with the effects of energy conservation strategies implemented and energy management conducted since then, as well as details relating to reduction of energy consumption in comparison with the previous year for eight consecutive years, are the themes for this project.

Although the objective is to reduce energy consumption, carbon dioxide emissions and utility expenses, it would be unreasonable to expect a library building to conserve energy by reducing the intensity of the illumination below a required level. Still, we do not want to settle for simply changing the set temperatures for cooling and heating, requiring users to stand. We also do not want to consider conserving energy by reducing the amount of external air introduced into the building, thereby deteriorating the air environment. Energy conservation sought by the Fukuoka City Public Library is the sustained conservation of energy with a no facility investment through the fine tuning of energy conservation for the facilities, to result in building internal environments that are sustained at even better conditions than before.

2. Understanding and Analysis of Current Situation

FY2005 marked the time when the notion of a conscious effort to reduce energy consumption over consecutive years was conceived. It was also at this time that we begun to experience the difficulty involved in reducing energy consumption over consecutive years. No matter how effective the implemented energy conservation measures were the reduction attained in terms of comparison with the previous year limited the effects to one year only. If we were to merely do the same thing over and over again, the most we would be able to do is sustain reductions at the same level. In order to continue reductions over consecutive years it was necessary to implement new energy conservation measures each year, implemented in coordination with other energy conservation measures that were put in place to achieve progress. Currently we are not conducting individual energy conservation strategies, but rather, we are bringing out increased energy conservation effects through the synergistic effects attained through efficient overall coordination. Since the reduction rate fluctuates due to climactic influences, a reduction in the energy consumption by 5%, compared with the previous year, over eight consecutive years, is difficult to maintain and in some years it is not possible to reduce the energy consumption by 5% in comparison with the previous year. Instead, we hope to have an average annual reduction of 5% and in order to do so by FY2006, it was necessary to reduce the energy consumption by 33.7% in comparison with FY1998. The annual energy consumption in the most recent year was a 35.3% reduction and utility expenses were down by 44.1%, thereby already attaining the targets, however the conversion value for carbon dioxide emissions arising from electric power increased significantly, resulting in a reduction by 33.0%, which is short of the targeted figure. The four-month period from April to July brought about a reduction by 7.4% in comparison with the previous year, providing the prospect of achieving the 5% reduction over eight consecutive years.



Graph -1: Energy consumption by fiscal years

3. Progress of Activities

(1) Energy Management (Heat Intensity), Table 1

Table 1: Heat intensity (MJ/m^2-year) by fiscal years: (Note) Using conversion figures amended in 2006

1998	1999	2000	2001	2002	2003	2004	2005	Most recent year
1,898	1,719	1,613	1,467	1,396	1,350	1,326	1,262	1,229

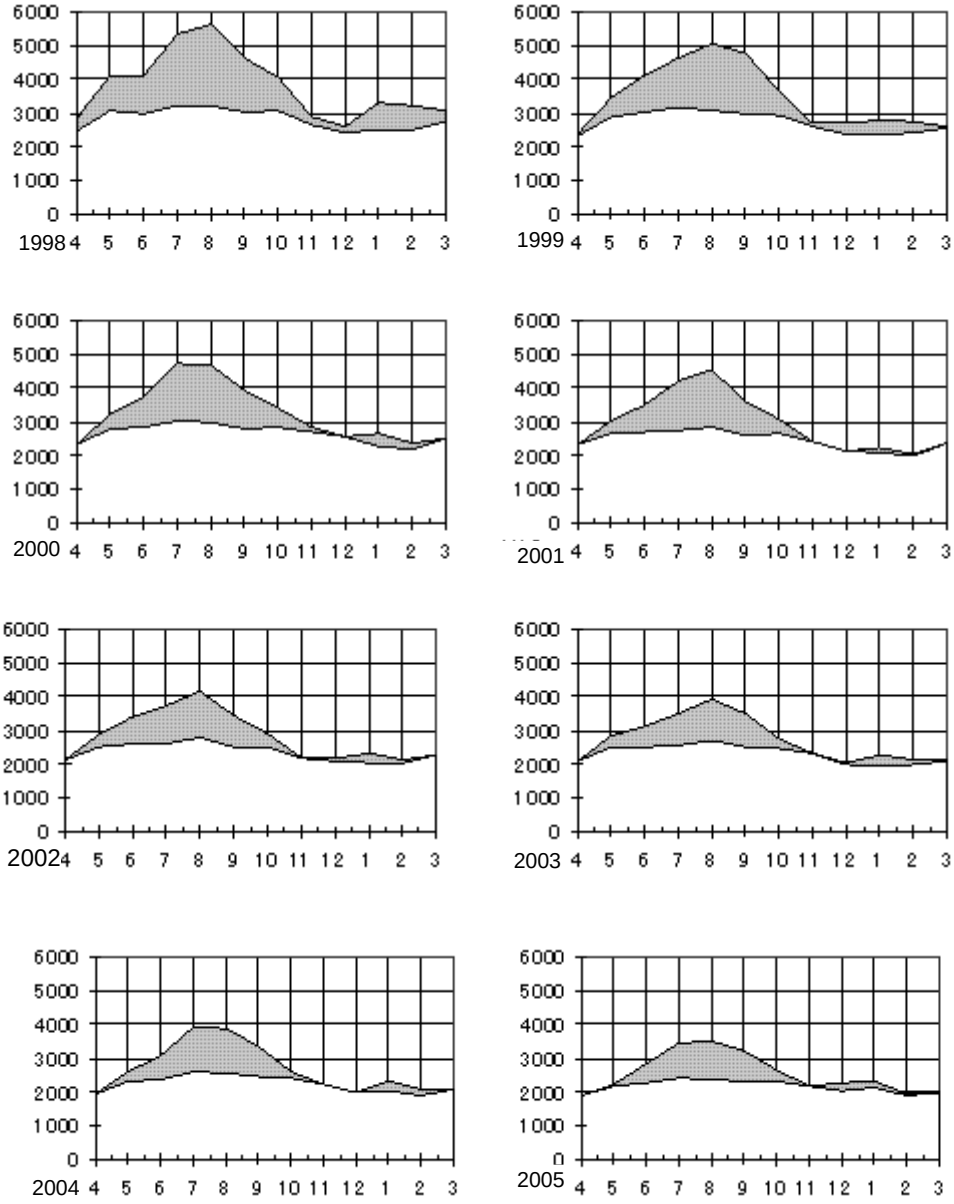
The heat intensity was calculated for each individual fiscal year at the Fukuoka City Public Library, from the time of its opening in 1996 to 2005, with the “Latest Annual Energy Consumption Status” table used by the Energy Conservation Center, Japan (ECCJ) for energy conservation diagnosis. It is important to compare heat intensity in order to understand the status of energy consumption and the progress of energy conservation. It has become possible to make accurate comparisons at all times, by recalculating the heat intensity for the past ten years using a new conversion value, whenever changes occur in the conversion coefficient of calorific value. At the present time, starting from April 2006, the latest annual heat intensity is calculated by overwriting the energy consumption status table for FY2005 with electric power, heat and water consumption amounts. Energy conservation is being promoted to achieve the target of 1,200 MJ/m^2-year. Systematic energy conservation can never be hoped for if thermal unit consumption is calculated at the end of each fiscal year.

Facilities subject to conserving energy are merely equipped with inverters on circulating pumps for cooling and heating water. The air conditioners do not even have bypasses for cooling using external air. Since the opening of windows is not permitted, cooling is performed from April to November. The heat intensity of 1,898 MJ/m2-year for 1998 would have been a good figure for the Fukuoka City Public Library, where air conditioners are in operation 357 days per year. The thermal unit consumption has been reduced to 1,229 MJ/m^2-year as of the latest year at end of July 2006, through the continuous fine tuning of energy conservation measures for the facilities. This was started just with an idea that can be easily applied to any building, with the objective of further improving the favorable figure by reducing air conditioning loads that increase year after year.

(2) Energy Management (Consumption Management)

Emphasis is placed on managing the daily energy consumption with conscious efforts made for each individual day, since the monthly consumption or annual consumption cannot be reduced without a reduction in the daily consumption. Consumption of electric power, heat for cooling and heat for heating are being managed through a comparison of these amounts against the daily consumption, monthly consumption and annual consumption of the previous year. This is done using tables effective for comparing the figures for individual days, months and years for the past ten years, as well as by converting the figures into graphs that are effective for visually comparing the figures in terms of individual months and years. The daily consumption of district heating and cooling supplies for air conditioning varies from day to day, depending on the external air temperature. Comparisons, therefore, are being made against the average daily consumption for the same month of the previous year, which is set as a daily target value. Thus comparisons are made against cumulative daily consumption for the same month of the previous year, as well as the cumulative monthly consumption. Since no significant changes are evident for the daily consumption of electric power, it is important to compare daily consumption with it of the same period in the previous year. Tables that make it possible to compare monthly average daily consumption and cumulative monthly consumption with the same period of the previous year are prepared by making monthly entries on a spread sheet of monthly average daily consumption over a one year period for each year. This table is used to manage energy consumption. The extension of such accumulated daily consumption management details are used for monthly consumption management and yearly consumption management. These are used to verify the effects of newly implemented energy measures for the purpose of energy management with the intention of achieving sustained reductions.

(3) Energy Management (Energy Consumption Graph), Graph 2



Graph 2: Graph of energy consumption (GJ) by fiscal years

The upper layer depicted in gray represents heat, whereas the lower layer depicted in white represent electric power converted into GJ units. This graph is also an “energy consumption graph” that is viable for comparing the annual figures and it is used for energy conservation diagnosis of building. It has been useful for understanding the overall energy consumption for the entire Fukuoka City Public Library, and in order to seek out potential locations where energy conservation can be implemented and to formulate energy conservation measures.

The effects of conserved energy for heat are significant when the graphs over an eight year period are compared. Energy conservation for heat is effective in the graph for 1998, whereas energy conservation for heat is in the proximity of the limits shown in the graph for 2001. It is for this reason that a decision was made to place an emphasis on energy conservation for electric power starting from 2002. Since the source of heat for air conditioning is supplied by district heating and cooling and because packaged air conditioners are used for the storage of documents and films, the settings are made for constant temperatures and changes must not be made to that aspect throughout the year. For this reason, not a lot could be expected from conserving the energy of electric power used for air conditioning but by focusing on energy conservation measures that emphasizes lighting, which is effective throughout the year, we were able to reduce significantly more electric power than heat since FY2002.

(4) PDCA Management

In order to nurture the growth of energy conservation, starting small and evolving into something much bigger, a decision was made not to spend too much time on planning (“P” for plan) but implement ideas into action immediately (“D” for do). Since energy conservation that sustains lighting, air conditioning temperature and air environment at favorable levels without facility investments, improvements in operations only is energy conservation that presented no demerits to anyone and a lot of time was not required for the planning (P) or implementing (D). Verifications (“C” for check), on the other hand, were a critical aspect for the fine tuning of energy conservation for facilities and a considerable amount of time was spent for that purpose before action was immediately implemented (“A” for act) in the smaller cycles of the PDCA management. The addition of such PDCA management cycles along the same concentric circle year after year was effective in obtaining energy conservation effects in the short term and sustaining energy conservation with long terms effects.

4. Details of Measures (Energy Conservation Measures)

(1) Minimum Frequency Setting Change of Inverters of Circulating Pumps for Cooling and Heating Water (Announced FY2001)

The 18 Hz frequency settings are still unchanged at the present time. The operating frequency for cooling, based on the control of the number of units with three 30 kW units was two units of 31 Hz, even during peak periods. The surface temperature of the motors at

high temperature sections was 48 degrees Celsius. There have been no failures and no problems in any way up to the present time.

(2) Expulsion of Air without Operating Exhaust Fans (Announced FY2002)

Exhaust air was kept to small amounts, since expelling the air at room temperature while the rooms were being cooled or heated was a waste of heat. Starting from FY2005, air has been expelled through the smoke vent at the main entrance hall, even during July and August. This entrance hall has a stairwell that reaches the second floor, with the side fitted with glass facing the outside, which receives insolation, much like the roof, causing heated air to accumulate in the upper section of the hall. This is therefore an effective location for expelling the air naturally. The amount of air pulled in from the outside by air conditioners increases, but since only air that has been heated higher than the outside temperature is expelled, the exhausting air provides better energy conservation in terms of temperature and also facilitates a better air environment. Since the air in the library is induced to move towards the main entrance hall by this strategy, it has become possible to reduce the operating time of air conditioners for the hall, which provides yet more energy conservation.

(3) Discomfort Index Cooling (Announced FY2002)

It is possible to lower the discomfort index further with the same amount of cooling heat used, by using the cooling heat to reduce the temperature rather than using cooling heat to reduce the humidity. Humidity inside the library was maintained at 60% in FY2005, and since cooling became possible with the temperature of circulating cold water 15 degrees Celsius or higher, it reduced the amount of dehumidification. The environment becomes hot and humid once the humidity exceeds 60%, but no problems arise as long as the humidity level is maintained up to 60%.

(4) External Units of Packaged Air Conditioners Cleaned with High-pressure Cleaners before Summer Season (Measure Implemented in FY2000)

The external units of all packaged air conditioners are cleaned each year in April using high-pressure cleaners.
Cleaning prior to the start of the full-scale cooling season contributes toward the improvement of the cooling efficiency and energy conservation.

(5) Blinds (Measure Implemented in FY2000)

The blinds are down with the slats in a horizontal position all year round, regardless of the season, whether or not any insolation is present. Since the temperature of the glass panes of the windows is close to the temperature of the external air and the glass panes of the windows are considered to be heat exchangers, simply by keeping the blinds up promoted heat exchange by the flow of air along the internal glass pane surface of the windows, while care was taken to ensure that the supply of air for the fan coils, particularly those located near the windows, was not drawn from the direction of the glass panes of the windows. Although it was not possible to change the external temperature and air current, which is the principal side, it was possible to reduce the heat exchange on the glass pane of the windows, by inhibiting the air flow along the glass surface of on the window panes inside, keeping the lighting unchanged by using horizontal slats.

(6) Air Recirculation Method through Closed-access Book Vault on Fourth Floor (Measure Implemented in FY2003)

The book vault with a closed access that spans 80 meters east to west is an air conditioning sector with air conditioners located in the machine room on the east side. An air recirculation vent is located at one area on the east and west sides respectively, with the large east side air recirculation vent located in the proximity of the air conditioners on the east side and the small west side air recirculation vent located far from the air conditioners. Recirculation ducts are located above the ceiling on the fourth floor, where additional construction of the fifth floor is planned, but at the moment no floors or ceilings exist, which makes this space hot in summer and cold in winter. An uncovered recirculation duct spans 70 meters from the recirculation air vent on the west side. The recirculation of air performs heat exchange inside the recirculation duct, creating a load on the air conditioning, thereby deteriorating the cooling and heating efficiency for the closed-access book vault on the fourth floor. A decision was made to use the closed-access book vault as an air recirculation route, by sealing off the west side of the air recirculation vent thereby directing all recirculation of air to the air conditioners from the east side air recirculation vent, as a strategy to eliminate wasteful heat exchange taking place in the air recirculation ducts above the ceiling.

It is better to perform air recirculation and have heat exchange take place in the closed-access book vault with people inside, rather than have heat exchange taking place in ducts above the ceiling, where no people are present.

(7) Air Recirculation Duct through Compact Stack Book Vault on Fourth Floor (Measure Implemented in FY2003)

Similar to the closed-access book vault, the area above the ceiling is a large space. This area is divided into sectors of the document vault and compact stack book vault. Since only one air recirculation vent exists at each of these sectors, they could not be sealed off. For this reason, thermal insulation was conducted for the air recirculation duct. It was simple construction work consisting of merely laying down the thermal insulation materials over the air recirculation duct, and it has been possible to verify that the cooling and heating capacities have improved since the work was done. It appears that such an energy conservation strategy provides effective results for air recirculation ducts that are not thermally insulated. Since we were only able to use a small amount of thermal insulation material that was given free of charge, it was not possible to thermally insulate the entire span of the air recirculation duct, however, we intend to continue with the thermal insulation of the air recirculation duct to reduce the amount of heat lost inside the duct.

(8) Automatic Doors for Wind Shielding Space (Measure Implemented in FY2003)

The wind shielding space is placed to prevent the intrusion of external air when the building is being cooled or heated and to prevent the discharge of internal air from the building.
More than one million users visit the library annually and each time a person enters and leaves the premises the automatic door opens and closes four times, resulting in the opening and closing of these doors more than four million times throughout the year. Since it is better to allow the internal air to flow out of the building during intermediate periods, when cooling effects by external air is promoted, there is no need for the wind shielding space during such periods. If the automatic door on the inner side of the wind shielding space is locked open, it becomes possible to exhaust air when the door on the outer side opens, reducing the unnecessary wind shielding effect. This is a simple energy conservation measure involving the flick of a switch to turn OFF the inner side automatic door, but contributes to an increased external air cooling effect and, by keeping a door open for six months, it provides a saving of electric power used to open and close an automatic door approximately one million times. This has been implemented with automatic doors at three locations since 2003.

(9) Fan Coils (Measure Implemented in FY2004)

Fan coils in the general user section of the library are locked to ensure that users do not operate them on their own. Since FY2005, the coils in the sections intended only for library personnel have also been either locked or steps have been taken to ensure that the temperature settings are not able to be adjusted. The locking of the fan coils is an effective method, since randomly changed temperature settings by people results in wasteful cooling and heating. Since the air pressure inside the building is increased at the Fukuoka City Public Library, air can be discharged through gaps around the windows but there are no intrusions of external air. Temperature conditions around the windows, therefore, are not particularly bad as long as there is no insolation. Fan coils therefore are manipulated only in circumstances when cooling or heating is difficult, relying on air conditioners alone.

(10) Air Supply Vents for Air Conditioners (Measure Implemented in FY2004)

Air supply vents located on the ceiling of the reading rooms have been positioned in a diagonal angle to ensure that cold air does not strike the people directly underneath these vents. When these were adjusted to face straight down, however, the amount of supplied air increased from when they were positioned at an angle, resulting in increased air flow, and through this it was discovered that it actually felt physically cooler this way. Since the temperature of circulating cold water is 17 degrees Celsius or higher, the temperature of supplied air is also high at 20 degrees Celsius or higher, so there appears to be no problem with cold air striking people.

(11) Light Control Panel (Measure Implemented in FY2004)

The light control panel located at the central surveillance room is comprised of 700 switches, which are used to turn on and off almost all the lights in the library. With so many switches it was not possible to determine any wasteful lighting. For this reason colored stickers were applied to these switches to indicate the lights to be turned on and off by timers, which ones were to be turned on only when needed and which ones were to be turned off immediately once the library was closed to the public. By making it easy to distinguish these switches, it became possible to detect and turn off any wasteful lighting. The necessary lighting only needs to be turned on during the time it is required.

(12) Lighting switches (measure implemented in FY2005)

There were four to eight switches at each location on the walls of corridors, making it difficult to determine just at a glance as to which switches needed to be turned on, often resulting in the wasteful turning on of lights. By attaching colored stickers to the switches that need to be turned on, it was possible to ensure that only those switches were used to turn lights on. Although we merely took the liberty of placing stickers, it appears to have triggered psychological inducing effects.

(13) Changing Areas of Lighting (Measure Implemented in FY2005)

Energy conservation for lighting provides energy conservation throughout the year, and although planning (P) had been conducted in the past, because it had been taking so much time for the investigation leading up to the implementation (D), it was an energy conservation measure that had not been implemented. Wall switches located at various locations are individually assigned with blocks of multiple light switches on the light control panel, and light switches included in these blocks can be changed freely at will. All switches on the light control panel, which are individually assigned to these blocks, were investigated. Indirect lights, brackets and lighting along the windows, which did not need to be turned on when books were cleaned or sorted, were removed from such blocks and were set by timers to turn on and off. A detailed review of these blocks was conducted in order to make it possible to turn on only those lights at the necessary locations, using wall switches that have more available switches. The saving of annual electric power exceeded 60,000 kWh. Although the same number of lights as before remained turned on during the business hours of the library, the electric power for lighting during the closed hours was reduced by 60 kW. In the summer season this meant that the cooling loads for the mornings were reduced and resulted in the conservation of energy for cooling heat, as well as shorter operating hours for air conditioners.

(14) Angle of Humidifier Spray Heads Adjusted (Measure Implemented in FY2005)

Water sprayed onto the heat exchangers of air conditioners by pressurized pumps while the heating is turned on and water that does not evaporate was warmed and discharged, results in the waste of heat. Scale also attaches to the heat exchangers themselves, resulting in a deterioration of the efficiency as well. For this reason, the angle of the spray heads was adjusted so that no more water is sprayed onto the heat exchangers. This resulted in a

lower drain temperature than previously, even though no changes were observed with the humidifying capacity. During intermediate periods, humidification is performed in conjunction with cooling heat for cooling purposes as well, contributing towards the conservation of energy for cooling heat.

(15) Dampers of New Air Conditioners Adjusted (Measure Implemented in FY2005)

In the past, the external air dampers of air conditioners were fully opened, with adjustments made by closing the dampers on the exhaust side of the air supply fans. This was reversed and the dampers of the exhaust side of the air supply fans were fully opened, with the external air dampers adjusted to the same angle as the angle to which the exhaust side dampers were previously set to. This resulted in a reduction of electric current for air supply fans from 22 A to 18 A during the summer season. Since the effectiveness of the air conditioners that have air supply dampers on the intake side of the air supply fan is non-existent, it is believed that there must have been some pressure loss of air due to the air supply damper on the side of the exhaust. Reducing the resistance on the side of the exhaust, rather than the side of the intake of the air supply fan appears to be the air conditioner damper adjustment method that brings about energy conservation.

(16) Morning Cleaning (Measure Implemented in FY2005)

Cooperation was obtained from the cleaning staff to change their time for starting in the morning from 6:00 to 6:30. As a result of delaying the time for starting the use of lighting by 30 minutes, it was possible not only to save electric power for lighting before opening hour of the library but it also led to a saving in terms of the cooling and heating loads.

(17) Beverage Vending Machines (Measure Implemented in FY2005)

The daily electric power consumption was recorded over a five year period for the four vending machines situated in the library. Since the machines were replaced by more current models three years ago, noticeable changes were evident in the consumption of electric power between the winter season and the summer as well as the intermediate seasons. By setting the daily electric power consumption in August 2004 as 100%, a comparison of the monthly data indicates that the amount is 124% for January and 147% for November, which demonstrates a significant increase. The installed models are comprised of three-chamber

structures, with the left chamber comprised of two to three rows dedicated for cold drinks, a central chamber consisting of one row only that can be switched between cold and hot, and the right chamber containing two rows, also for switching between cold and hot. During the summer seasons all the chambers are set for cold drinks, but during the intermediate seasons warm drinks are loaded in the single row of the central chamber. This resulted in the sandwiching of the warm chamber between the cold chambers, apparently creating an increase in heat loss due to the borders with the cold chambers. In the winter season the warm drinks are shifted to the two rows of the right chamber, resulting in a split of hot and cold drinks into two parts at the left and the right. Even then, since there is one less border between the hot and cold temperatures, the electric power consumption decreases in comparison with the intermediate season, during which the machine is split into three temperature sections. By delaying the loading of warm drinks during the intermediate seasons slightly, or by loading them into the two rows in the right chamber to make them available, changes the level of consumption during the season when normally it is 147% down to 100% or perhaps 124%. Furthermore, it has been discovered that there is hardly any difference in the electric power consumption on the days when almost no drinks are sold, the days on which the library is closed and the days on which 800 drinks are sold, such as during the summer school holidays. This means that about the same amount of electric power is consumed during the night as during the day, indicating that if power was shut off during the night, when there is no one around, it is potentially possible to reduce the electric power consumption by 50%.

(18) Heat Generated in Electric Room Utilized for Heating (Measure Implemented for FY2006, in Trial Implementation since Late February 2005)

The concept of using the heat generated in the electric room located on the fourth floor, where the room temperature rises to 30 degrees Celsius or more without cooling even during winter season, for heating the book vault on the fourth floor, in which the temperature increases were difficult to set due to a lack of lighting and people, had been in the works for several years. Even though they are both located on the same floor, the distance from the electric room to the book vault is substantial. It has therefore not been possible to perform duct construction work, as that would require some expenditure. In February 2005, however, a method for guiding air from the electric room to the air recirculation vent of the air conditioners on the fourth floor using the corridors was discovered. This method was quickly put into practice and it was found that the temperature of the electric room was sustained at

25 degrees Celsius or higher, even with the induction of external air. It was possible to verify that with a large amount of electric power consumption during business hours this temperature level could be used for heating. Since heating with the external air via the electric room became possible, the temperature was maintained in the book vault in combination with the existing heating, with a higher temperature than before. The sending of the air to the book vault from the electric room, which is cooled even during the winter season due to the uninterruptible power supply units installed there, resulted in the introduction of external air into the electric room, which was then cooled by external air, which saved electric power for cooling and heating. The increased amount of external air through the electric room contributes towards the maintenance of the entire library under positive pressure. This also makes it possible to reduce the amount of external air introduced through other air conditioners, thereby reducing the external air load on those air conditioners as well. After taking measurements of air quality it was possible to verify that the concentration of carbon dioxide reduced on other floors also, indicating that this measure killed four birds with a single stone.

5. Effects achieved after Implementing Measures

(1) Electric Power Consumption and Maximum Electric Power

Table 2: Electric power consumption ratio for individual years in comparison with FY1998

1998	1999	2000	2001	2002	2003	2004	2005	Most recent year
100%	96.2%	93.7%	86.9%	83.1%	81.6%	79.0%	76.7%	75.2%

During the most recent year a reduction by 24.8% was evident in comparison with the figure in FY1998, indicating that the attainment of the targeted 25% is at hand.

Table 3: Maximum electric power (kW) for individual years

1998	1999	2000	2001	2002	2003	2004	2005	2006
882	853	866	806	801	774	761	736	715

The contract was changed to one with a higher basic unit price. The maximum electric power was then controlled to save more usage charges than the increased amount in basic charges.

(2) Consumption of Cooling Heat and Heating Heat

Table 4: Cooling heat and heating heat total consumption ratio for individual years in comparison with FY1998

	1998	1999	2000	2001	2002	2003	2004	2005	Most recent year
Cooling heat	100%	77.6%	67.1%	58.5%	51.2%	44.9%	47.8%	40.6%	37.5%
Heating heat	100%	60.1%	26.2%	8.0%	23.6%	24.7%	25.1%	22.3%	22.3%
Total	100%	74.6%	60.1%	49.8%	46.4%	41.4%	43.9%	37.4%	34.9%

Due to a delay in responding to the heat wave, FY2004 was the first year during which the cooling heat consumption increased over the previous year.
Figures for the consumption and maximum load were the lowest ever for FY2005. Only a tiny bit more is required before the targeted reduction by 66.6% is attained.

(3) Carbon Dioxide Emission [Tons of Carbon Dioxide]

Figure 5: Carbon dioxide emissions for individual years (tons of carbon dioxide)

1998	1999	2000	2001	2002	2003	2004	2005	Most recent year
2423	2224	2104	1922	1832	1777	1740	1664	1623

During the most recent year, a reduction by 33.0% was reached in comparison with the figure in FY1998, indicating that the average reduction by 5% in comparison with the previous year was not attained.

(4) Utility Expenses

Table 6: Utility expenses ratio for individual years in comparison with FY1998

1998	1999	2000	2001	2002	2003	2004	2005	Most recent year
100%	93.0%	87.3%	79.0%	71.5%	64.9%	63.2%	57.0%	55.95

The reduction rate was the highest due to a reduction in demand, resulting in a saving of JPY67 million in comparison with FY1998 figures during the most recent year.

6. Summary

The conservation of energy at the Fukuoka City Public Library is not assigned energy conservation, but rather, something that is hand-made. The numerous energy conservation measures conceived and implementation of them also resulted in the fine tuning of such implementations for the purpose of energy conservation at the same time. Air conditioning needs to be fine tuned at all times, in accordance with the load. Other fine tuning work is also coordinated and expanded, resulting in an annually increasing amount of work and continual fine tuning day after day. By the time the eighth year is reached following such continuous fine tuning, the sections where energy conservation are no longer possible through fine tuning alone, are now becoming known. Facility investments can be implemented in such sections, starting from the sections where efficient investment effects can be expected, in accordance with the available budget. If facility investments were made from the start in order to conserve energy, it would have been somewhat doubtful whether or not effective facility investments were possible and hand-made energy conservation would have not been implemented either. Although energy conservation implemented by the power of machines may be effective, the awareness and technological improvements relating to energy conservation are increased through starting the conservation of energy from relying on our abilities alone.

7. Future Plans (Targets)

Individual targets have been set for heat intensity, electric power, heat and utility expenses. The targeted annual reduction by 5% for eight consecutive years has already been attained in the most recent year for both energy consumption and utility expenses, whereas the target for carbon dioxide emission is also expected to be attained. The heat intensity of 1,200 MJ/m^2-year, was attained in June. Since the figure was increased by 41 MJ/m^2-year due to the change in the conversion rates for the district heating and cooling supply in the current fiscal year, however, efforts must once again be made to reach the target. An electric power consumption reduction by 25% and heat consumption reduction by 66.6% are both just a verge of attainment. A maximum electric power reduction by 20% and maximum cooling heat load reduction by 35%, in comparison with figures in FY1998, have been attained as of August 25. The most difficult target to attain, the utility expense savings by 50%, has also been set. Setting multiple targets in this manner, ensuring that at least one of these are attained each year, brings about a drive to attain the next target.