

2008 Prize of Director General of Regional Bureau of Economy, Trade and Industry

Activities for Reducing CO₂ by 22% at a Tenant Building

Kokuryudo Co., Ltd.
Building Rental Department

Keywords: Rationalization of heating, cooling and heat transfer (Air conditioning facilities)

Rationalization in conversion of electricity into motive power and heat, etc. (Electrically powered equipment)

Rationalization in conversion of electricity into motive power and heat, etc. (Lighting equipment)

Outline of Theme

Kokuryu Shiba-Koen Building is not the factory designated by the Energy Conservation Law, but we implemented energy conservation activities there as one of the efforts to improve our business competitiveness. As a result, we could reduce CO₂ emitted there by 22% compared with the period prior to the activities, although it is said that tenant buildings are difficult to do energy conservation.

Implementation Period for the Said Example

- Project Planning Period June 1995 – May 1996 (12 months)
- Measures Implementation Period
 April 1997 – March 1999 (I and II periods) (24 months)
 September 2003 – March 2006 (III period) (19 months)
 April 2006 up to now (Performance verification period)
- Measures Effect Verification Period April, 2006 up to now

Outline of the Business Establishment

- Scope of Business Office building (Tenant building)
- No. of Employees 400 persons (Employees working indoor, as of April, 2008)
- Designated factory or not Non-designated plant

Outline of Target Building

- Name Kokuryu Shiba-Koen Building
- Construction completed
1970 (West building),
1978 additional construction
(East building)
- Land area 1,151 m²
- Total floor area 9,497 m²
- Stories Underground 1 story, above
ground 9 stories, rooftop 1 story



Equipment Installed after Implementing Measures

- Air cooling heat pump chillers 80 HP x 2 units
- Gas-fired water heater 240 RT x 1 unit
- Air conditioners AHU x 6 units (Inverter control, VAV x 142 units)
- Fan coils FCU x 90 units
- Lighting equipment 32W・2 x Approximately 1,000 units (For dedicated areas)

1. Reasons for Theme Selection

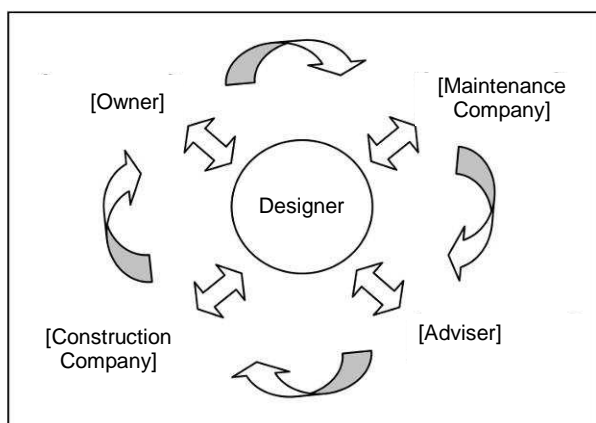
It is said that energy conservation activities in tenant buildings are relatively difficult compared with those in factories or buildings owned by a single user. In this building which is used as offices, 80% of the energy used there is consumed by the tenants. This energy is needed by the tenants to do their business and to satisfy the people working there (comfort, etc.). Therefore, it is difficult for the building lender (owner) to restrict the use of the energy without thinking of the convenience of the tenants.

Despite these circumstances, we could achieve the energy conservation in the building without sacrificing the satisfaction of the tenants, resulting in the 22% reduction of CO₂ emitted there. So we decided to present the achievement as our theme to be verified in light of the management of the energy conservation promotion method, as well as in light of the organization system and process.

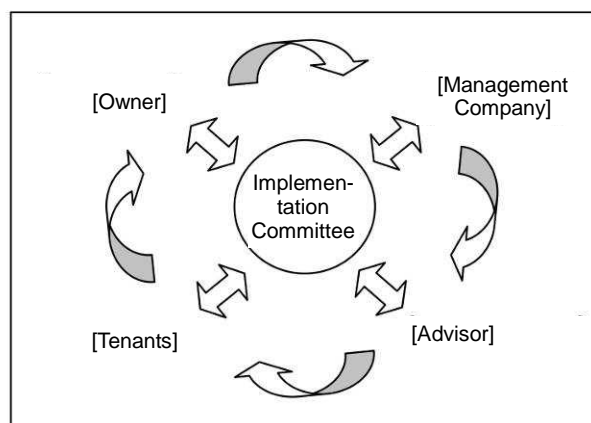
2. Progress of Activities

(1) Implementation Structure

The activities are implemented by 2 organizations which were organized according to the purpose and period of the activities linked together in a way that promote the activities. The one is the “Verification committee” (Fig. 1) consisting of the owner, maintenance company, adviser (consultant), designer and constructor of the building. It takes charge of practical aspects of the energy conservation activities, covering from planning and proposal of the activities up to the evaluation and verification of the implementation. The other is the “Committee to Promote Measures for the Global Warming” (Fig. 2) which monitors the continuity of the activities and in which the owner, maintenance company, adviser of the building work together to share the concept of the energy conservation activities of this building and its value.



(Fig. 1)



(Fig. 2)

(2) Understanding of Current Situation

1) Social deterioration, functional deterioration

When we planned the repair work for the building in 1995, so-called social deterioration was noticeable with the building, meaning that it no longer met the requirements of the tenants which had been diversified due to the development of information/IT technologies and globalization of business. Especially, it could not catch up with the functional requirements enhanced by the emergence of intelligent buildings. The building was losing marketability.

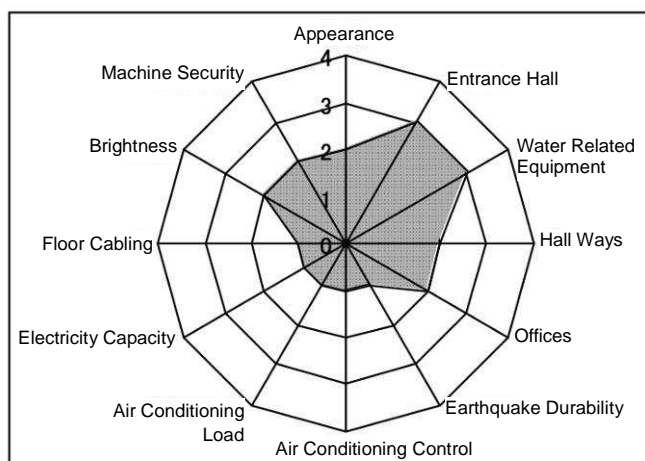
2) Aging deterioration

In 25 years after the completion, physical deterioration became noticeable with the

equipment of the building. It was time to renew.

(3) Analysis of Current Situation

In light of the needs in the market, we evaluated this building by scoring it and comparing the result with other buildings built recently, where the standard specifications of other buildings were made 4 points as a perfect score, and it turned out that a lot of parts and equipment of this building were scored 1 to 2 (Fig. 3). Meanwhile, we analyzed the air conditioning equipment of this building, which greatly affected the energy conservation and for which there were the most claims when the building was planned, and obtained the result as described in Table 1.



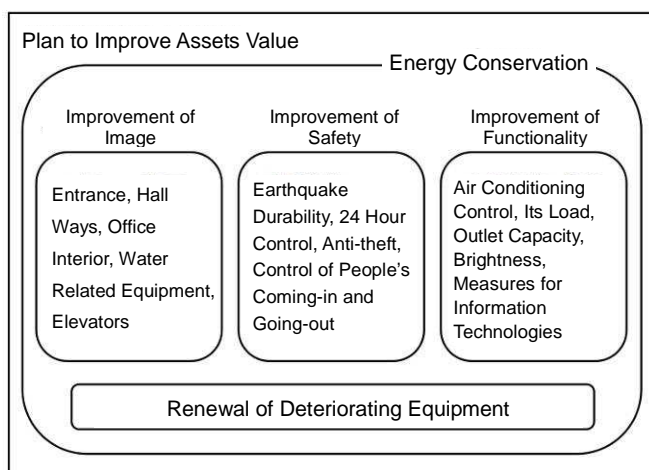
(Fig. 3)

Measures to be Taken	Purpose (Self Analysis)
Renewal of Thermal Equipment	Renewal of Deteriorating Equipment, Having Two Sources of Energy
	Increase of Equipment Capacity, Energy Conservation by Introducing High Efficiency Equipment
Change of Secondary Piping of Chilled/Hot Water, Change of Its Flow Rate	Renewal of Deteriorating Equipment, Improvement of Air Conditioning Flexibility
	Energy Conservation by Adopting Variable Flow Rate System
Renewal of Air Conditioners	Renewal of Deteriorating Units and Piping, Enhancement of Air Conditioning Capacity
	Energy Conservation by Variable Air Flow System

(Table 1)

(4) Target Settings

Based on the analysis above, we planned the repair work dividing the period into I to III phases. The I and II periods were for the repair work done between 1997 and 1998, in which we renewed thermal equipment, air conditioning equipment, etc. and aimed to achieve 5% energy conservation. As regards the III period, we re-planned the repair work and made the “Plan for improving the assets value (Fig. 4)”, based on the achievement of previous two periods, to ensure the competitiveness of this building in the market in the future, and the repair work was done during the period from 2003 to 2005. We studied how much energy we could save according to the five themes described in Fig. 4 below (improvement of image, improvement of safety, improvement of functionality, renewal of deteriorating equipment and energy conservation), and we came to have the target that was to achieve 12% energy conservation, including operational saving, during the III period (Table 2).



Implementation Period	Target Reduction Rate
I and II Periods	5%
III Period and Operational Saving	12%

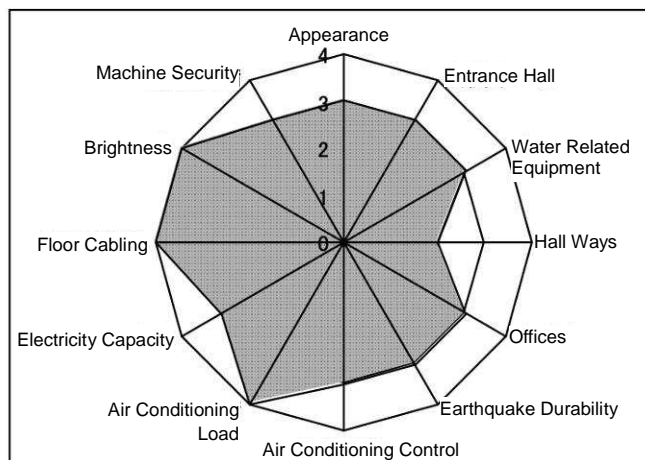
(Table 2)

(Fig. 4)

(5) Problem Points and Their Investigation

The overall evaluation of the building after the measures are implemented is shown in Fig. 5 below. Of them, the measures implemented for the items which specifically concern the energy conservation are shown in Table 3. The problems found in light of energy conservation when this repair work was finished are the following 4 points.

- 1) It is necessary to verify the effect of the repair work.
- 2) It is necessary to convey the design intention to the operator (maintenance company).
- 3) It is important to have the tenants involved.
- 4) It is necessary to build a system which makes the parties concerned continuously involved.



(Fig. 5)

Equipment		Content of Repair Work	Period	Period	Period
Air Conditioning Equipment	Thermal Source	Renewal of Chilled/Hot Water Generators			
		Renewal of Air Cooling Heat Pump Chillers			
		Renewal of Cooling Tower			
		Renewal of Chilled/Hot Water Pumps			
		Renewal of Cooling Water Pumps			
	Air Conditioners	Renewal of AHU			
	Piping	Renewal of Chilled/Hot Water Piping (AHU System)			
	Duct	New Installation of VAV with Fan			
	Automatic Control	Renewal of Automatic Control around Thermal Source			
		Renewal of Automatic Control around Air Conditioners			
New Installation of Central Monitoring System					
Lighting Equipment	Renewal of Lighting Equipment to Hf Type (High Efficiency)				

Remarks/ : Implemented : Partially Implemented

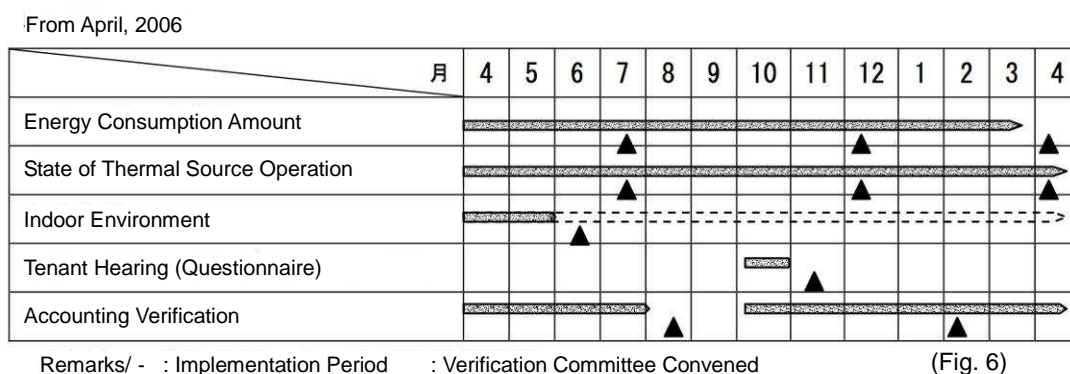
(Table 3)

(6) Details of Measures (“Problems” “Measures”)

1) Verification of effectiveness of repair work Verification of performance

We thought that the repair work was not complete unless the equipment works as per the design intention. So the owner, maintenance company, adviser, constructor gathered around the designer to evaluate and verify the performance of the equipment repaired, and the result was reflected on the management of the equipment operation. (Establishment of systematic learning, management and operation. Designing values Measurement of values at the time of operation → Verification → Improvement of operation method → Re-verification → Systematization) After the repair work, the performance verification was conducted as follows.

1. As the I and II periods were for the repair work of the thermal equipment, air conditioners, etc., the improvement of the air conditioning capacity and the progress of the energy conservation were mainly verified.
2. In the III period, total verification including precedent two periods was made under the following schedule. (Fig. 6)



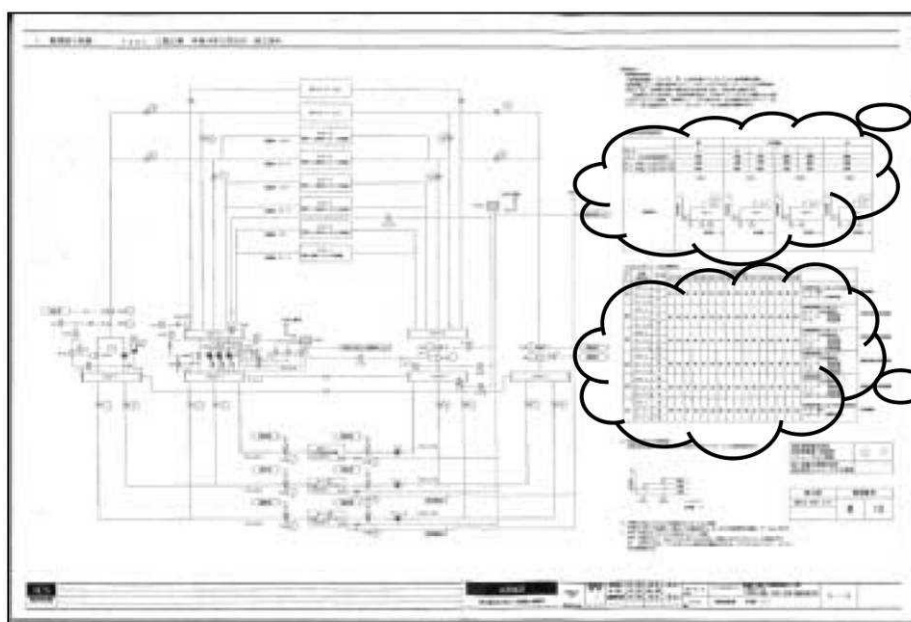
(Fig. 6)

2) Conveyance of design intention to the operator (maintenance company) Improvement of the design documents (construction drawings)

To maximize the effect of the repair work for the air conditioners, we made a construction drawing (Fig. 7) which clearly reflected the design intention to support the equipment manager doing the operation based on the management of what they learned. To be more specific, it described the operational parameters which change as the season changes, besides the initial setting values, valve's switching state in six operation patterns of air conditioners and the description of the maintenance indices, etc. (Table 4)

Target Items	Measures (To be Described)
Optimal Operation of Thermal Equipment	Optimal operation of the thermal equipment was described according to the season and time zone
Switching of Thermal Piping, etc.	Clearly described the switching method for doing the cooling and heating mixed operation with the fan coil and air conditioning system
Air Conditioner Operation Flow	Clearly described the conditions and method for interlocking VAV, air conditioners and thermal equipment
Various Setting Values	Clearly described the setting values for the temperature of water as thermal source and for the temperature and humidity set for air conditioners
Maintenance Items	Clearly described the maintenance items and maintenance frequency required for the equipment

(Table 4)



Description of switching parameters used for automatic control operation

Table describing opening and closing of valves, 6 patterns consisting of summer, winter and middle seasons (x 4)

(Fig. 7)

3) Involvement of tenants Operation of the “Committee to Promote Measures for the Global Warming”, hearing from the tenants

The Committee to Promote Measures for the Global Warming was organized for all of the tenants to achieve energy conservation, where the value and information concerning energy conservation were shared by them. Besides, hearing (questionnaire) from each tenant was conducted to know how their satisfaction about the indoor environment has changed because of the energy conservation.

4) System which makes the parties concerned continuously involved Introduction of an incentive system

To make the energy conservation achieved by the repair work during to periods last, we thought that the most important thing is to motivate the parties involved to do it, so we introduced the incentive system. This system was intended to distribute the energy cost lowered by the energy conservation between the parties involved (owner, tenants, maintenance company) (in other words, we return the benefit to the parties concerned), where the return (incentive) was set as follows (Table 5).

Party Involved	Main Activities	Return (Benefit/Incentive)
Owner	Proposal and introduction of systems	Enhancement of tenant satisfaction High occupancy rate, reasonable rent
Tenants	Participation in the Committee Individual energy conservation (meticulous turning off of lights, etc.)	Reduction of utility cost
Maintenance Company	Continuous implementation of efficient management	Bonus according to the conservation rate.

(Table 5)

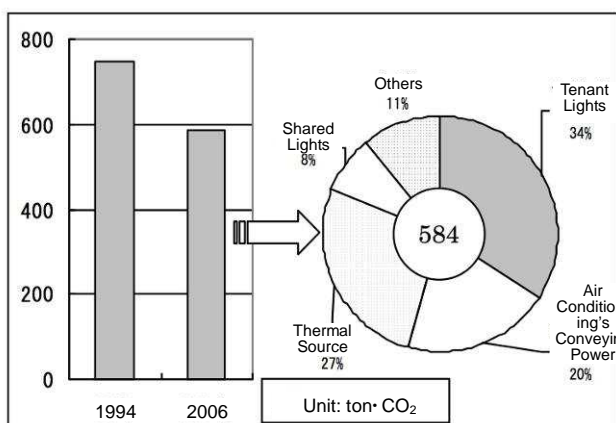
(7) Effects Achieved after Implementing Measures

The summary of the effect is shown in Table 6.

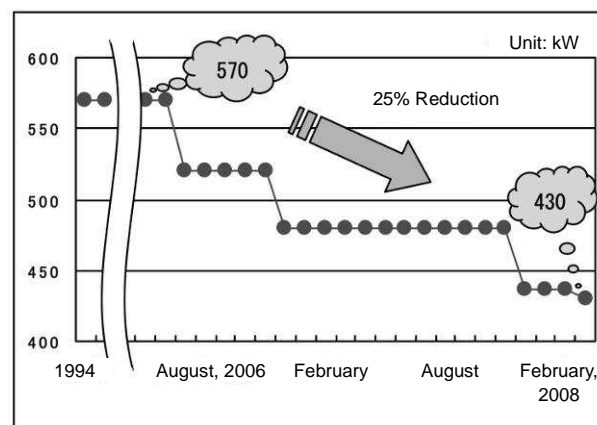
We could realize both investment to the equipment (hardware aspect) and involvement of the parties concerned (software aspect). As a result, improvement was made compared with the time prior to the investment as shown in Fig. 8. (indicated by CO₂) There was synergetic effect generated by combining the hardware aspect and the software aspect, which contributed to the saving of the total amount. Also, by introducing the incentive system, the efforts to make the operation more efficient (operation based on the management of what has been learned) were made by the maintenance company, leading to the reduction (leveling) of contracted electricity (Fig. 9).

	1994	2006	Reduction Rate
Energy Conservation Rate	1,920 MJ/year·m ²	1,465 MJ/year·m ²	24%
Energy Conservation Amount	749 ton·CO ₂	584 ton·CO ₂	22%

(Table 6)



* The breakdown of the circle graph is expressed by %.
 (Fig. 8)



(Fig. 9)

3. Summary

(1) To Promote the Energy Conservation While Keeping the Tenant Building in Use, It Is Important to Make Repair Work Plans Which Can Be Carried out Phase by Phase.

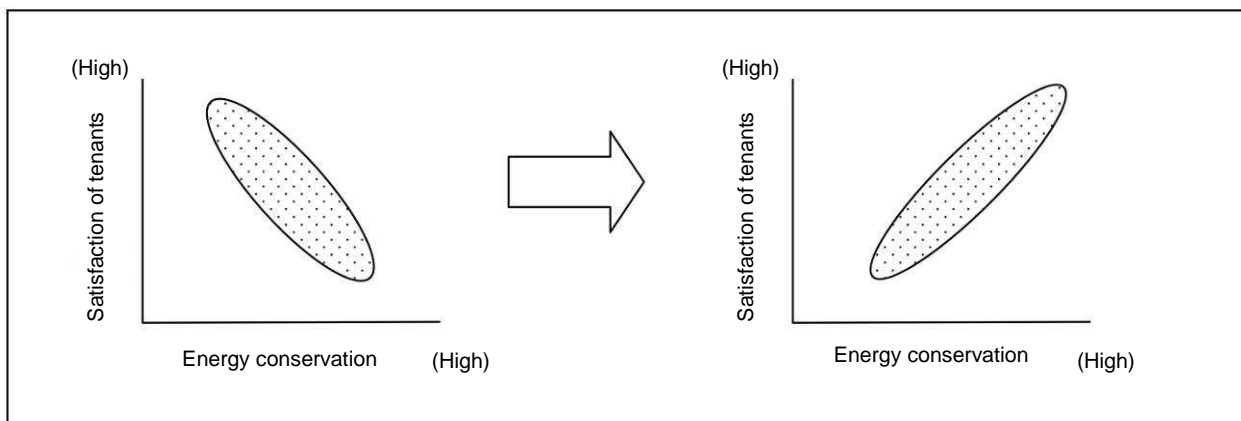
In order to promote the energy conservation without making the investment uneven and without disturbing the office work of the tenants, it is important to do the repair work phase by phase. In this building, the repair work was done first for the conveying systems such as thermal source equipment, air conditioners, pumps during periods I and II, then for the individual air conditioning equipment (VAV) and lighting equipment during the period III to further promote the energy conservation. In other words, we first repaired the background equipment, then repaired the equipment which is in contact with the tenants. Although it took a long time, the work was done relatively smoothly. We think that the most important thing in repairing the building kept in use is to first make a good entire plan, then to implement the contents one by one. The success of the repair work depends on the quality of the entire plan, so it is important to make it using the knowledge of external experts.

(2) To Promote the Energy Conservation, the Management After Repair Work Is Very Important and It Is Necessary to Make Preparation in the Early Stage.

Some people may think that the energy conservation is achieved when repair work is completed. But renewed equipment cannot perform its full function, and we cannot achieve the energy conservation with such thought, because the management of operation based on the full understanding of the design intention cannot be expected there. Meanwhile, it is important to make tenants jointly work, because 80% of the energy used in tenant building is affected by tenants. The subjects entitled “Verification of the effectiveness of the repair work”, “conveyance of the design intention to the operator (maintenance company)”, “Involvement of tenants” and “System which makes parties concerned involved” described in “2. Background of Activities, (5) Problem Points and those Investigations” are all focused on the operation of the building after the construction is completed, suggesting that the building should be constructed considering the use after the completion from the beginning when it is planned. Especially, “Involvement of tenants” and “System which makes parties concerned involved” are very important for tenant buildings.

(3) To Be Interlocked with the Behavior of Tenants According to the Change of the External Environment.

The reason of being said that the energy conservation of tenant buildings is difficult is that the satisfaction of tenants concerning the comfort of their offices is thought to be contradictory to the energy conservation. However, as the measures for the global warming become global requirements, the energy conservation has become one of the operational issues which tenant companies cannot ignore. Besides, the requirements of consumers, i.e. clients, are expected to become stricter for the environmental measures of companies, so the tenants themselves may have to change the definition of the comfort in their offices. In other words, it can be said that the best office environment desired by tenants is changing in light of energy conservation (Fig. 10). Based on this viewpoint, it is important to talk with tenants and implement appropriate measures for the global warming based on their understanding.



(Fig. 10)

4. Future Plans

(1) The Incentive for Tenants Is Enhanced Phase by Phase as Follows.

The first step is the phase where we make the tenants understand that the energy conservation is the activities taken up by the whole of this building and make them actively involved in the activities. It is kind of the phase where we make a peer group. Participation in the Committee to Promote Measures for the Global Warming and simple energy conservation activities in each office (meticulous turning off of lights, cutting of power supply to computers during lunch time, etc.) are the examples of the activities of this phase. The energy cost saved by these activities in the entire building was returned fairly to all of the tenants by reducing their utility cost (still being implemented).

The second step is the phase where we expand the coverage of the incentive to encourage the tenants to further become involved. The tenants who have become familiar with the energy conservation activities through the Committee become more interested in their use of energy through the return of their energy cost. In response, the building side helps the tenants understand the use of energy through provision of information and proposes the way to use their offices which contributes to the energy conservation. For example, in case of air conditioners which affect the comfort of the office work, we ask them to add some small actions to their routine work, such as to meticulously start and stop them according to the indoor load (to stop it when people are out or rooms are not used, etc.). The building side is studying to introduce a billing system that supports the activities of the tenants (expansion of the metered rate system, etc.). The room temperature is set by the tenants according to their judgment, so the amount of the cost return varies among the tenants depending on their strength of their activities. These details of the activities were introduced at the Committee to Promote Measures for the Global Warming to make other tenants share

the information. The tenants are still introducing their energy conservation activities at the Committee.

The third step is the phase where the building itself becomes the incentive for the tenants if it continues to be the building actively promoting the energy conservation. As informed by recent newspapers, etc., consumers know the attitude of companies toward environment through their activities and they decide their consumption activities based on that. In the era when company activities are evaluated from the viewpoint of energy conservation, companies which are doing business in the building which is actively promoting energy conservation are deemed to be the company continuously paying attention to the environment and so they are supported (evaluated) by consumers. This fact becomes the incentive that is much more attractive for the tenants than the monetary return because, by doing this, the companies can expect much wider appeal such as increase of company value or enhancement of their brand. For the tenants, the building they are in becomes more important than the monetary return, because it becomes the partner doing good for the environment. This is what we aim at.

(2) The Effectiveness of the Incentive must be Verified.

We will verify the correlation between the effect of the energy conservation and the incentive to prove the effectiveness of the incentive.