2005 Achievement Report

International Project for the Efficient Use of Energy
International Project for Establishment of Infrastructure for the Efficient Use of Energy
(Promotion of Energy Efficiency and Conservation for Buildings in ASEAN Countries)

Report on the Results

March, 2006

The Energy Conservation Center, Japan

Preface

Now we are faced with the demand for two contradicting achievements. Preventing global warming is a common problem to be solved for the entire human race and continued economic growth is also required at the same time. In addition, recent high crude oil price leads to high energy price, greatly affecting the world economic.

To cope with these difficult situations, we need technologies that allow the effective use of energy, technologies that enable us to use energy without causing great damage to the environment, and technological innovations including developing a type of energy that does not cause damage to the environment.

To balance the economic growth and the environmental preservation in developing countries, we need to acknowledge the facts about the energy use and the environment preservation measures in each target country, investigate the status of each country such as infrastructures and customs, and provide adequate support that is well received in each target country.

To perform these tasks, as the 1st phase, we supported the ASEAN energy conservation award system for buildings for business use, performed energy conservation audits in target buildings, and transferred energy audit measures in ten ASEAN countries in four years from 2000. Recently, we were also active in creating the systems and the base before officially starting the creation of databases, benchmarks and guidelines for promoting energy conservation in buildings in ASEAN countries in the future. We completed the first phase of activities in ten ASEAN countries in 2003fy. Based on the results of these activities, we started a new phase of this project last year by performing energy audits and improvement measures, and enhancing the base for promoting energy conservation. As a valid measure for this purpose, we officially started to create the technical directory and create databases, benchmarks and guidelines for the buildings in each country.

To enhance the base for performing and promoting energy conservation, we performed follow-up investigations for the buildings for which we conducted energy audits in the past to check the performance status of improvements we suggested and we also performed quick energy audits in new buildings to transfer the energy audit technologies to the engineers in each ASEAN country. This year, we performed quick energy audits in Myanmar, Malaysia, Laos, and Viet Nam. We also held a seminar/workshop in each of these countries, invited people from the buildings implementing excellent energy conservation measures in ASEAN countries other than the host country, and had them present the successful energy conservation examples in order to share information in the ASEAN area and use those activities as the base for promoting energy conservation. In the seminar/workshops, we discussed the ideas and policies for creating the technical directory as well as the databases, benchmarks and guidelines for each country like the last year. We also introduced the advanced building assessment system in the building industry in Japan, which is the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) and the energy management tool (Energy Efficiency Index management tool).

This year is the second year of phase two. We were able to achieve the above goals, provide the direction for performing energy conservation in the new phase, and secure the base for further energy conservation promotion activities. We are proud of these achievements.

We hope that this project contributes to energy conservation and environment protection in the building industry in ASEAN country and that each country will grow economically in an environment-friendly and sustainable manner. We hope this project will become the bridge between Japan and ASEAN countries in enhancing technological exchange and friendship.

March 2006

The Energy Conservation Center, Japan

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Ⅰ. Overview

The ASEAN countries have continued rapid economic development. In near future, this will lead to a rapid increase in energy consumption which will require energy to be used more efficiently and measures to be taken against global warming.

This project has been implemented for six years since it started. The ASEAN Center for Energy (ACE) as a partner, and relevant organizations in the ASEAN countries have deployed more active and concrete activities. Being triggered by the energy price increase caused by the rapid oil price increase and by the enforcement of the Kyoto protocol on February 16, 2005, the ASEAN countries have enhanced their awareness for a reduction of energy consumption,

This year is the second year of phase Ⅱ, where ASEAN should promote and disseminate by their further self-help efforts the results we have achieved before. Our main goal is to continue the activities of the last year and clearly identify the tangible results of the project. In other words, we perform energy audits in various buildings in ASEAN countries, and hold seminar/workshop to share and propagate energy conservation information as we did last year. We also advise the ASEAN Center of Energy (ACE) to hire engineers to continue creating the technical directory, databases, benchmarks, and guidelines which we started last year and have those engineers perform actual preparation work.

We have deployed the following specific activities in Myanmar, Malaysia, Laos, and Viet Nam:

- ♦ Follow-up survey for the buildings we audited in the past and quick energy audits for new buildings

  The purpose of these activities is to understand the problems in performing and propagating improvement measures and to determine improvement measures.
- ♦ Preparation of the technical directory

  The purpose of this activity is to enhance the possibility of application and dissemination of these technologies by sharing the information obtained through the introduction of the successful cases and the technologies applicable to the ASEAN countries.
- ♦ Establishment of databases, benchmarks and guidelines

  The purpose of this activity is to provide the numerical targets and the guidelines for promoting energy conservation to attain those objectives. The establishment of databases and so fourth is to be linked with ASEAN benchmarking activities deployed in the whole ASEAN region. National University of Singapore (NUS) is at the center of ASEAN benchmarking activities to implement systems applicable to each of the ASEAN countries.

In addition, this project includes the activities for advising support on evaluation criteria in the energy conservation best practice building award system implemented in the ASEAN countries from years ago.

We conducted investigations including energy audits, and held workshops in the above-mentioned countries. Through those investigations, we (Japanese experts) checked the learning extent of the energy audit technologies which we had transferred in the past, and gave advice and instructions to the local staff again if needed to ensure the transfer of the technologies and enhance the promotion of energy conservation.

In the workshops held in the ASEAN countries, we discussed the activities mentioned above. We invited the people involved in the building sector in host country as well as the people who had worked or worked for energy conservation best practice buildings in other ASEAN countries, and asked them to present the details about their activities, and actual examples of improvement measures. Many people participated in those workshops which played a great role in sharing and spreading information of the energy conservation in building sector.

This year, the major activities of this project started with the inception workshop (common to both projects for the major industry and for the energy management) in late June 2005 and those activities ended with the summary workshop/post-workshop (common to both projects of the major industry and the energy management) in late January 2006. Before the inception workshop, we participated in the ASEAN energy conservation best practice building evaluation meeting held in late May and gave some advice on the evaluation standard.

In the inception workshop, in order to enable the smooth start of the project, we explained the details about the plans to be implemented in 2005 and determined the specific action plans for each activity, and also confirmed the preparatory step for the field jobs. Then we conducted the energy audits and held workshops in four countries successfully by November 2005.

From this year, the ACE hired mechanical a engineer and a system engineer to build the systems for preparation of the technical directory as well as establishment of the database for each country and actually had those engineers engaged in such work.

The summary workshop and post-workshop were attended by the representatives (focal points) of the ASEAN countries. They reported the results and achievements of activities in the four countries and discussed the preparation of the technical directory and the establishment of national databases, benchmarks and guidelines that the ACE had been carrying out. At the end, they discussed a project policy for the next and subsequent years.

The followings explain the actual project activities this year.

May 31 to June 3, 2005 (dispatched the experts between May 30 and June 4)

We attended the following meetings held in Phnom Penh (Cambodia) as observers:

I. 11th Evaluation Meeting of the Board of Judges

(ASEAN Energy Efficiency and Conservation (EE&C) Best Practices Competition for Energy Efficient Buildings, ASEAN Energy Awards 2005) (May 31 to June 1)

This is the meeting for evaluating the EE&C best practice buildings in ASEAN countries. This EE&C building contest is supported by PROMEEC.

II. ASEAN EE&C-SSN (Energy Efficiency and Conservation Sub-sector Network) meeting (June 2 to 3)

The ASEAN EE&C best practice building evaluation meeting was attended by the judges from ASEAN countries and selected the energy conservation best practice buildings in the following four categories:

Category 1: New and Existing Building: For buildings that are five years old or younger

Winner: National Institute of Education (NIE) Campus (Singapore)

Category 2: Tropical Building: For buildings with air conditioning in 50% or less of the total floor area and those that are 15 years old or younger

Winner: Singapore Botanic Garden Visitor Center (Singapore)
Popa Mountain Resort (Myanmar)

Category 3: Retrofitted Building: For buildings that are reformed for energy conservation and those that are five years old or younger

Winner: Plaza BII Building (Indonesia)

Category 4: Special Submission: For special energy conservation activities in buildings and latest energy conservation technologies

Winner: Environmental Friendly Solar Hydrogen Eco-House (Malaysia)

Two members of ECCJ attended this evaluation meeting as observers, and evaluated the applied buildings and projects as the judges from ASEAN countries did. The evaluation result of ECCJ members was almost the same as that of ASEAN judges. For the purpose of the expansion of this information even in Japan, the report of National Institute of Education (NIE) Campus (Singapore), which was the winner of the Award in Category 1, was published on the January 2006 issue of the Japanese Energy Conservation magazine issued by the Energy Conservation Center. It was also published on the Energy Conservation Technology Handbook (for Business Buildings) issued by Tokyo Anti-Global Warming Network (March 2006) as a successful example in school buildings.

We also attended the annual meeting of the ASEAN Energy Efficiency and Conservation Sub-sector Network as observers and were able to acquire the information of the energy conservation activities which were promoted by ASEAN countries.

June 30 to July 1, 2005 (dispatched between June 29 and July 2)

“Inception Workshop of on Promotion of Energy Efficiency and Conservation (PROMEEC) (Major Industry, Building and Energy Management), SOME – METI Work Program 2004–2005”

Place: Manila, Philippines. (This workshop is common to both projects for the major industry and for the energy management)

The representative of Myanmar was absent. Thirteen people, including the representatives of the ASEAN countries and the members of the ACE and the Energy Conservation Center, Japan (ECCJ) attended the workshop for discussion.

Opening statements (by the representatives of the host and relevant countries)

Session 1: Results of the PROMEEC project, descriptions, confirmation and discussions of activity policies in phase 2

Explanation of the Japanese efforts for promoting sustainable buildings and energy conservation buildings by ECCJ members

Session 2: Presentation by the representatives of the ASEAN countries on what they learned from the PROMEEC project and what they expected in the phase 2 of the project

Session 3: Explanation of the energy conservation successful case award systems in Japan and discussions (ECCJ)

Session 4: Final confirmation through the explanations and discussions of the program to be undertaken in 2005 and 2006 (ECCJ)

Session 5: Presentation of Japanese international cooperation for EE&C (ECCJ)

Session 6: Explanation of the multi-country training for ASEAN countries which starts this year (ECCJ)

Session 7: Efforts of different countries for creating the energy management systems (representatives of ASEAN countries)

August 8 to 19, 2005 (dispatched between August 7 and 20): Field job in Myanmar and Malaysia (primary)

1. Follow-up surveys of the buildings where the energy audit was performed in the past (only in Myanmar), and simplified energy audits for the new buildings

   We investigated two buildings in Myanmar and one building in Malaysia and reported the results of the investigation in each building.

2. Workshop held in each country

   The workshop in Myanmar was attended by 60 people and the workshop in Malaysia was attended by 130 people. They exchanged opinions and information very actively. The policies proposed by Japan on preparing the technical directory and the policies for the activities to establish databases, benchmarks, and guidelines were basically accepted. The workshop ended successfully.

   (1) Energy conservation policies and programs (presented by the ASEAN countries and Japan)

   We introduced the "Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)" as the latest energy conservation activity in the building field in Japan.

(2) Presentation of the energy conservation successful case studies of the buildings by the representatives of the host country and the other ASEAN countries

The cases of the buildings that won the prizes in the ASEAN EE&C best practice competition for buildings (ASEAN Award) mentioned above were mainly presented.

(3) Discussion of the policy for preparation of the technical directory

To enrich the contents of the technical directory, we proposed the use of the energy conservation successful example award system in ASEAN countries.

(4) Discussion of the policies of the activities for establishing databases, benchmarks, and guidelines in each host country

We introduced "the Energy Efficiency Index Management Tool for Buildings" ECCJ had developed and emphasized the importance of databases, and explained the ideas for benchmarks.

November 7 to 18, 2005 (dispatched between November 6 and 19): Field job in Laos and Viet Nam (secondary)

1. Follow-up investigation of the buildings surveyed in the past and quick energy audits of new buildings

   We conducted simplified audits on two new buildings in Laos and one new building in Vietnam, performed follow-up energy audits on two buildings in Vietnam and reported the results of the investigations in each building.

2. Workshop held in each country

   The workshop in Laos was attended by 54 people and the workshop in Viet Nam was attended by 39 people. They exchanged the opinions and information very actively. The policies proposed by Japan on preparing the technical directory and the policies for the activities to establish databases, benchmarks, and guidelines were basically accepted. The workshop ended successfully.

   (1) Energy conservation policies and programs (presented by the ASEAN countries and Japan)

   We introduced the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) as the latest energy conservation activity in the building field in Japan.

   (2) Presentation of energy conservation successful case studies of buildings by the representatives of each host country and the other ASEAN countries

   The cases of the buildings that won the prizes in the ASEAN EE&C best practice competition for buildings (ASEAN Award) mentioned above were mainly presented.

(3) Discussion of the policy for the technical directory

To enrich the contents of the technical directory, we proposed the use of the energy conservation successful example award system in ASEAN countries.

(4) Discussion of the policies for the activities for establishing databases, benchmarks, and guidelines in each host country

We introduced “the Energy Efficiency Index Management Tool for Buildings” which ECCJ had developed, and emphasized the importance of databases, and explained the ideas for benchmarks.

January 26 and 27, 2006: Summary workshop and post-workshop (dispatched between January 25 and 29)
“Summary Workshop and Post Workshop on Promotion of Energy Efficiency and Conservation (PROMEEC) (Major Industries, Building and Energy management), SOME – METI Work Program 2005 – 2006”
Place: Bandung, Indonesia. (These workshops are common to both projects for the major industry and for the energy management.)
The representatives of Singapore, Myanmar, and Vietnam were absent. These workshops were attended by 22 people including the representatives of the ASEAN countries (seven from the host country, Indonesia, including observers and one from each of other countries), five people from the ASEAN Center for Energy (ACE) and four people from the Energy Conservation Center, Japan (ECCJ) for summarization and discussion. The ECCJ members reported the results of the simplified energy audits and follow-up energy audits conducted in the visited four countries. Among those four countries, the representatives of Laos and Malaysia explained their activities in the PROMEEC project and submitted proposals to the PROMEEC project. The ACE people reported the working status of the technical directory and the systems for the databases for buildings and we had lots of discussion about their report. Especially, the discussions on establishing the databases, benchmarks, and guidelines took much time and it was confirmed that the ASEAN countries need to understand the specific procedures to actually proceed with these tasks in the future and that this issue should be resolved in the next workshop. We highly appreciated the achievements of this year's activities in the ASEAN countries. The policies on how to conduct the project in the next and subsequent years was basically accepted by those countries.

<u>Opening statements (by the representatives of the host and relevant countries)</u>

<u>Summary Workshop</u>

Session 1: Major industries

Session 2: Buildings

- Results and achievements of this year and evaluations
- Status of energy conservation activities in Laos and Malaysia

- Creation status of the technical directory and the systems for creating databases for energy conservation
- Policies on how to conduct the project in the next and subsequent years

Session 3: Energy management

<u>Post-Workshop</u>

Session 1: Summary of discussions in the summary workshop for each project

Session 2: Basic activity plans for the next and subsequent years

This year, as the second year of phase 2, in order to support the construction of the infrastructure for the sustainable EE&C activities in the ASEAN countries, we deployed higher-level activities by requesting the ASEAN countries to make further self-help efforts and consequently had a great success this year. On the other hand, the existence of the gap between ASEAN countries in the constitutional systems, policies, technical levels, etc is an unavoidable problem. This problem needs to be taken into consideration for the future activity plans of the project. We believe that the ACE should continuously play the important role for the communications among the ASEAN countries and Japan to make them more deeply understand each other and ASEAN should establish an appropriate system for each country to be able to cooperate with each other. Through the meeting we realized that the issues to be tackled in future are clear. and understood that this was because this project is now well known in the ASEAN countries and because the governments of the ASEAN countries became aware of the importance of EE&C due to the rise of energy prices. Finally, we all confirmed that this project has stepped up for successful development.

Lastly, we would like to express our deepest gratitude to the ACE, the organizations involved in each country, and the building managers of the buildings we investigated for full cooperation in this project.

II. Myanmar

1. Activity Overview

In Myanmar, we carried out follow-up energy audits at FMI Building and Pansea Hotel. We also investigated two buildings (office buildings) and held a workshop.

Participants from the International Engineering Department of the Energy Conservation Center, Japan (ECCJ):

Yoshitaka Ushio (General Manager)

Akira Kobayashi (Technical Expert)

Hisashi Amano (Technical Expert)

Date	Schedule	Remarks
August 7 (Sunday)	(JL717）Narita 11:00 → Bangkok 15:30, (TG305) Bangkok 18:00 → Yangon 18:50	Traders Hotel In Yangon
August 8 (Monday)	Energy audit (FMI Center : Follow-up Survey) (9:00 – 16:30)	
August 9 (Tuesday)	Energy audit (Pansea Hotel : Follow-up Survey) (9:00 – 11:30)	
August 10 (Wednesday)	Building investigation, small workshop (MCEA headquarters building) (9:00 – 12:00) Building investigation (Kanbawza Bank headquarters building) (13:30 – 16:30)	
August 11 (Thursday)	Preparation for the seminar & workshop	
August 12 (Friday)	Seminar & workshop (9:00 – 17:00)	

We conducted follow-up surveys in FMI Center and Pansea Hotel (now called Governor's Residence since the owner changed) for which we performed energy audits in January and February 2003.

For a follow-up survey, we send a questionnaire beforehand, and ask the performance status of the energy conservation measures recommended by Japanese experts in the past and the voluntary improvement measures taken by the local people as well as the current energy use status. Then we investigated the actual site.

The energy audit conducted in FMI Center was an on-the-job training (OJT) to educate the engineers and government officials that were involved in local energy conservation, which had been conducted from earlier times. For this energy audit, 15 people from the following organizations in Myanmar participated:

Five people from the Ministry of Industry (including Mr. Aung Kyi of Focal Point), one person from the Ministry of Energy, three people from the Ministry of Construction, one person from the Ministry of Science and Technology (professor at Yangon Technological University), one person from the Ministry of Electric Power, one person from the Yangon City Government, and three people from FMI Building (total of 15)

An ex-professor (about 70 years old) of Yangon Technological University who was hired as a consultant for this building and his subordinate (Maintenance Manager) were in charge of maintaining the building and they said they were working on energy conservation. However, they were reluctant to make costly improvements such as installing measurement devices and adding ducts. Their main method seemed to improve the efficiency of existing facilities through human management. This is mainly due to the cheap energy price and labor expenses supported by the subsidy provided by the government. The unit price of the electricity contract for this building was as cheap as 25 Kyt (2.5 yen)/kWh (reference: the unit price of gasoline was 0.04 US dollars/gallon). They said the owner would not permit installing a power meter for measuring electricity consumption of chillers since it was expensive.

Pansea Hotel was a high-class resort hotel situated in a quiet neighborhood close to embassies. The hotel was colonial style and beautifully built (48 rooms). Since the owner changed recently, the hotel was planned to be reformed. The reform will start next April. The reform plan incorporated the suggestions we made two years ago. They were planning to discard a 50-liter storage type electric water heater installed in each room and install a hot water supply system for all rooms (we recommended a heat pump water heater with CO_2 refrigerant two years ago during the energy audit). They replaced 110 lamps used in yards and corridors (310 lamps were used in total when including guest rooms and restaurants) from 40-W lamps to 7-W high-efficiency lamps and lighting fixtures. They seemed to be eager in conducting energy conservation activities.

We visited Myanmar Construction Entrepreneurs Association (MCEA) Headquarter Building, which was nominated for the Special Submission category of the ASEAN energy conservation best practice building award (award activity supported by this project) and Kambowza Bank Headquarter Building (won a prize in 2002), and obtained information from the staff. MCEA Headquarter Building incorporated passive design and we discussed energy conservation in buildings in Myanmar in a workshop manner. Kambowza Bank Headquarter Building's winning of the ASEAN energy conservation best practice building award played a great role in promoting energy conservation activities in buildings in Myanmar. We received reports indicating that this building was a good example for questions like "What is an energy conservation building?" or "What is a sustainable building?".

On August 12 (Friday), we held a workshop. Sixty nine people participated including four presenters invited from four other ASEAN countries. The workshop was successful with many questions and discussions.

2. Follow-up audit of FMI Centre

2.1 Outline of FMI Centre

(1) Name of building: FMI Centre

(2) Usage: Offices and stores

(3) Scale: 1 floor underground and 11 floors above ground
Total floor area … 10,953 m^2

(4) Age: 10 years old

(5) Electric equipment: Receiving voltage … 6.6 kV
Transformer capacity … 1,600 kVA
Generator (emergency) … 750 kVA
Elevator … 11 kW × 2 units
20 kW × 1 unit

(6) Air conditioning equipment: Store section … Chiller 210RT (231 kW) × 1 unit
Fan coil unit (174 units)
Office section … Split type (135 units)

(7) Plumbing equipment: Storage pump … 11 kW × 2 units
Elevated tank … 29.5 m^3

2.2 Outline of the Results of the Energy Audit in 2002

(1) Date of audit: 1st Survey … January 14 and 16, 2003
2nd Survey … February 25, 2003

(2) Audit Specialists: The Energy Conservation Center, Japan
Technical specialists: Akira Ueda and Akira Kobayashi

(3) Outline of the results of audit

FMI Center is a complex building of offices and stores, and the energy consumption per unit area is 1,915 MJ/m^2, which is approx. 86% (2,222 MJ/m^2) of the average of Japanese office buildings.

Assuming the electric energy in the year 2000 as 100, that in 2001 and 2002 is 110 and 119, respectively, indicating an annual increase of approx. 10%.

In terms of the ratios of respective purposes of energy consumption, the ratio of energy consumption for the heat source in Japanese office buildings is approx. 28%, while that of FMI Center is approx. 43%, indicating that the ratio of the hear source is high.

We proposed the following three items that should be improved to save energy consumption.

1) Increase in chilled water temperature
The temperature of chilled water at the outlet of the chiller is low even during low-load seasons. We proposed increasing the chilled water temperature during the light-load seasons to permit high-efficiency operation of the chiller. The reduction in the electric energy will be 18,992 kWh, and the ratio of reduction will be 0.9% of the total electric energy of the building as a whole.

2) Effective use of indoor ventilation (Improvement of the efficiency of separate type package)
The outdoor unit of the split-type air conditioner is installed in the indoor void space with high-temperature air intake, which seems to be the cause of low efficiency. The efficiency of the outdoor unit should be improved by blowing down the indoor air from above the outdoor unit toward the outdoor unit in order to suck the low-temperature air.

The reduction in the electric energy will be 13,214 kWh, and the ratio of reduction will be 0.6% of the total electric energy of the building as a whole.

3) Study of the possibility of installation of total heat exchanger
Intake and exhaust of air from and into the shopping zone are independent respectively, and the cold exhausted air is not used effectively for air conditioning. Therefore, when a total heat exchanger is installed for heat recovery, the reduction in the electric energy will be 36,749 kWh, and the ratio of reduction will be 1.8%.

2.3 Follow-up of the Previous Proposals

Some of the aforementioned improvements proposed in 2002 have been studied and implemented, and the result of the follow-up audit on the respective items are shown below.

(1) Increase in chilled water temperature

Based on the improvements proposed in February 2003, the temperature setting of the chilled water at the outlet has been changed from 48F (8.9°C) to 50F (10°C).

The effect of improvement was not clarified because the power consumption of the chiller is not measured independently. Since the power consumption of the chiller is substantial in comparison with the power consumption in the building as a whole, it is important to understand the power consumption also for future energy management.

Since local engineers also wanted clamp-type wattmeters and recorders, we felt it necessary to study the possibility of providing measuring instruments that can clearly help their improvement in energy efficiency, as part of the energy-conservation technical support.

In order to find the degree of effect in the operation log, the data in April 2001 is compared with that in April 2005 after improvement. The major part of the operation log is shown below.

		2005-Apr-22			2001-Apr-30			
		10:20	11:55	15:05	12:13	14:02	15:44	
Amb.tem 01	°C				38.1	40.2	36.6	
Amb.tem 05	°C	35.3	38.3	40.1				
LWT 01	°C				3.3	4	3.9	
LWT 05	°C	12.3	11.6	12.2				
RWT 01	°C				13.5	13.6	12.3	
RWT 05	°C	13.2	12.4	13.4				
RWT-LWT	°C	0.9	0.8	1.2	10.2	9.6	8.4	
#1 % 01	%				91	90	90	
#1 % 05	%	85	86	88				
#2 % 01	%				80	80	79	
#2 % 05	%	51	52	89				
Com	kW		138		171			100kW*2
Pump								25l/s*2

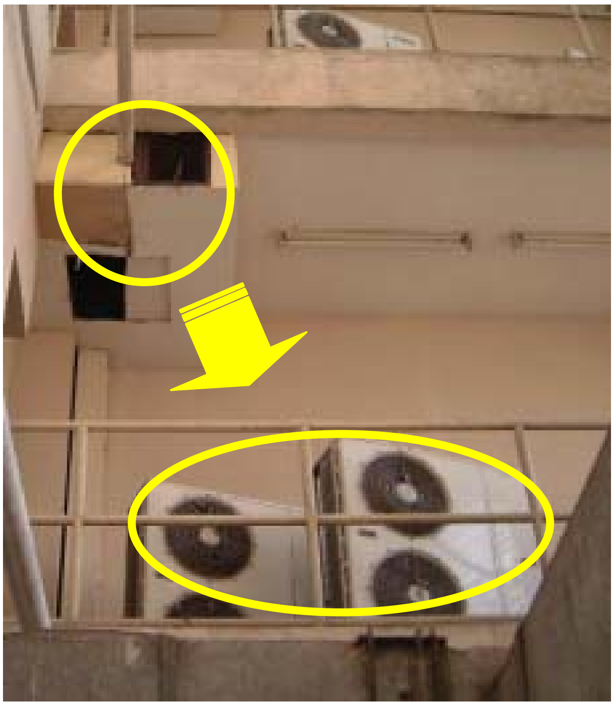
April is the hottest season in Myanmar, and days on which the outside temperature exceeded 40°C are picked out in both data. While the chilled water temperature at the outlet (LWT01) before improvement is 3.3-4.0°C, that after improvement (LWT05) is 11.6-12.3°C during operation, indicating that the aim of the proposal has been understood.

However, the temperature of the returning chilled water before improvement (RWT01) is 12.3-13.6°C, and the difference between the temperatures of going and returning chilled water (RWT-LWT) is as big as 8.4-10.2°C. While the temperature of returning chilled water after improvement (RWT05) is 12.4-13.4°C, and the difference between the temperatures of going and returning chilled water is as small as 0.8-1.2°C. Since the outside temperature is considered to be the same, the cooling load is judged to be the same and the chilled water pump is operated with the same quantity of water, which do not justify the actual temperature difference. Since the measured temperature may not necessarily be appropriate, we asked the engineers to check the temperature again.

We asked the engineers whether customers made complaints after the chilled water temperature was raised, and we understood that there was no specific complaint.

(2) Effective use of indoor ventilation (Improvement of the efficiency of separate type package)

In the office zone from the 5th to the 11th floors have outdoor units installed in the void sections of respective floors, and the exhaust air from the room is discharged into the space above the outdoor units. We proposed two years ago to blow the exhaust air from the upper section of the room to the outdoor units as shown in the photo.



We confirmed this time that a new duct was installed for the outdoor units on the uppermost floor as we proposed. We were told that the improvement was made because the high temperature did not permit the package on the top floor to deliver its expected performance, preventing sufficient cooling in the rooms. The effect of our proposal was confirmed on the top floor, but the improvement work was not applied to the other floors because of the high construction cost.

(3) Examination of the possibility of installation of total heat exchanger

Intake and exhaust of air from and into the shopping zone are independent respectively, and we calculated the effect of a total heat exchanger to be used for heat recovery from the heat and cold of the exhaust air. However, since the location of air exhaust is far away from the location of air intake and simple work cannot cope with the situation, no measures have been taken.

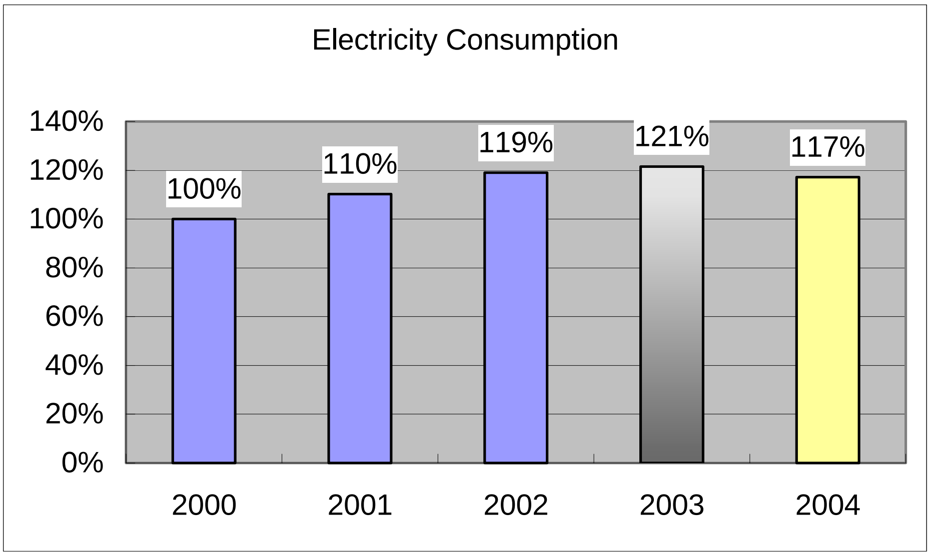
It is necessary to adopt this idea when constructing a new building, but implementation of the idea for retrofit work will be physically very difficult. However, we introduced it as a technology adopted usually in Japan.

2.4 Result of Folloe-up Audit

(1) Change in electric energy

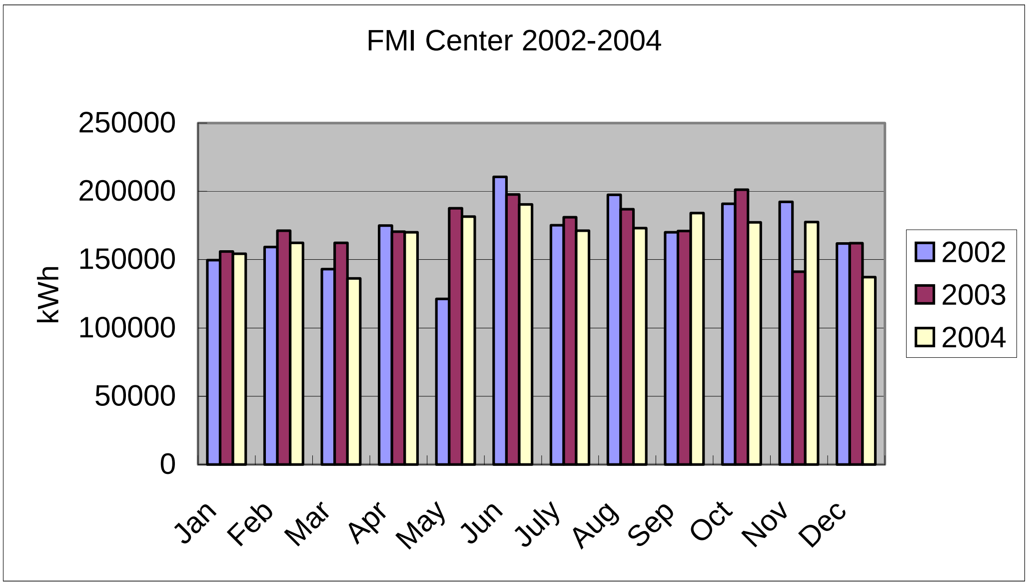
The change in electric energy from 2000 to 2004 is shown in the graph below. The previous audit and proposal of improvement were made in 2003, and the electric energy was reduced by 4% in 2004 as compared with that in 2003. We cannot assert that the reduction is attributable to the decrease in the temperature of chilled water at the outlet of the chiller because of the absence of detailed data.

However, we can understand that the tendency of increasing energy was stopped in 2004.



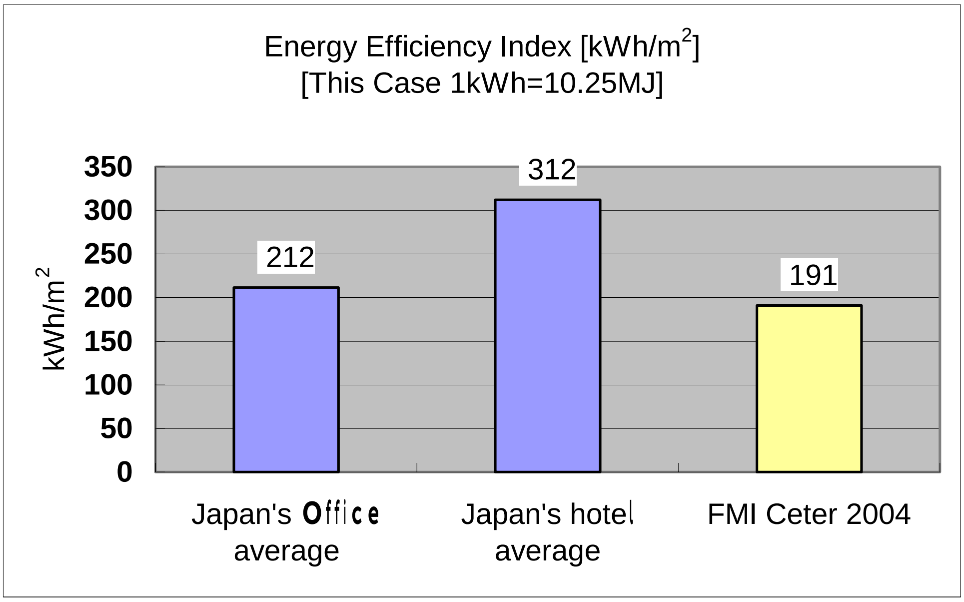
(2) Monthly electric energy for three years

The monthly electric energy from 2002 to 2004 is shown below. There are abnormal values in May and June 2002, which seems to be the problem of data collection. However, we can understand that there is no substantial difference between each month throughout the year.



(3) Evaluation of energy amount

The graph below shows the difference in the energy consumption per unit area in comparison with that in Japanese office buildings and hotels. The electric energy in 2004 is used as the value of FMI Centre, and the values of Japanese cases are converted into kWh by converting the data collected by The Energy Conservation Center, Japan using the ratio of "10.25MJ/kWh." In comparison with Japanese office buildings, the value is approx. 10% lower than that of Japanese office buildings, which is understandable because the overtime work is less and OA equipment density is low.



(4) Difficulty in promotion of energy conservation in tenant building

The chief engineer pointed out the following as the factor of heavy power consumption. Many 50W halogen lamps are used in the store zone, and they are turned on and off by respective stores. The building management cannot control them. Furthermore, the lighting apparatuses and air conditioners are turned on and off freely by tenants, which is out of control as well.

The situation is the same in Japan as well, indicating the difficulty in promoting energy conservation in tenant buildings.

2.5 Further Improvement and Provision of Information

In addition to the follow-up audit, we proposed further improvement and offered information that seemed to be useful.

(1) Detailed chilled water temperature control and confirmation of the accuracy of temperature measurement

We proposed increasing the temperature of chilled water at the outlet of the chiller two years ago, and they are making efforts in that direction. However, the temperature setting is the same throughout the year, and the detailed operation control is not conducted. Temperature setting for every month and according to the outside temperature is desired.

The indicated temperature of the chiller is recorded in the log, but there still remains a question about the recorded values as we pointed out before. It is necessary to confirm the accuracy of the present temperature measurement.

(2) Detailed measurement

The electric energy of the building as a whole is measured at the power receiving point, but detailed measurement thereafter is not conducted. It is necessary to understand the power consumption of the chiller, which is the biggest energy consuming equipment in this building, and appropriate measurement is indispensable for promotion of energy conservation.

The engineers of the building management also want such detailed measurement, but instruments for the measurement are not available. In order to allow the Japanese energy conservation technical assistance to take root in respective countries, not only promotion of improvement methods but also provision of measuring instruments that clearly show the effect are desired.

(3) CO_2 concentration measuring technique for introduction of appropriate amount of outside air

All the countries in ASEAN are located in the tropical zone, and their cooling load is very high. Of all types of air conditioning equipment, the chiller consumes a large quantity of energy, and the ratio of the outside air load to all the cooling load is very large. Appropriate quantity of outside air intake is the biggest point of energy conservation, but control of the quantity of outside air is poorly implemented in the countries in ASEAN.

We had the engineers master the method of measuring the CO_2 concentration, which is an index to get the optimum quantity of outside air intake, through practice. Optimization of the quantity of outside air and the technique to measure the CO_2 concentration are important element techniques for energy conservation for air conditioning, and they are useful methods as well for respective countries in ASEAN.

The scene of measurement at FMI Centre is shown below.

2.6 The Barrier for the Promotion of Energy Conservation and Measures against Those Problems

(1) Energy cost

The electricity pricing system in Myanmar is classified into several categories according to consumers. At FMI Centre, the rate is approx. 25K/kWh, which is approx. ¥2.5/kWh. When the average unit price of electricity for Japanese office buildings is from ¥15/kWh to ¥20/kWh, the rate is approx. 1/6 or 1/8. The price of gasoline is 150K/L, which is approx. ¥15/L.

The control of the unit cost of energy in conformity with the national subsidies policy is hindering the promotion of energy conservation, and adoption of an appropriate price is effective in reduction of energy consumption.

(2) Problem of tenants

FMI Centre is a tenant building, and air conditioners are controlled and the lighting is turned on and off individually by respective tenants. Only the action taken by the building management will be insufficient for promotion of energy conservation, and understanding and cooperation of tenets are indispensable.

The situation is the same in Japan, and enlightenment and awareness of the people in the building and their cooperation are indispensable.

(3) Physical hindrance

Heat recovery by introduction of a total heat exchanger is difficult because of the physical factors of the existing building, but the understanding of the technology and its incorporation into the design of a new building will lead to further energy conservation.

Introduction of the energy conservation methods in various ways will be instrumental in spreading the technology, and we expect that heat recovery by total heat exchangers will be realized in Myanmar in future.

3. Follow-up Energy Audit of Pansea Orient-Express Hotel (Pansea Hotel)

3.1 Outline of Pansea Hotel

(1) Name of the building: Pansea Orient-Express Hotel

(2) Use: Hotel (resort)

(3) Size: Two floors below the ground and three floors above the ground, total floor area: 7,111.1 m2
: Number of guest rooms: 50

(4) Age: 80 years old

(5) Outline of electrical systems: Service voltage: 6.6 kV × 50 Hz, Transformer capacity: 500 kVA
Emergency generator: 315 kVA, 3-phase 4-line 230 V

(6) Outline of air-conditioning systems: Split-type air conditioners (62 units)

(7) Sanitary facilities: Well pumps: 1.1 kW × 1 pump, 0.56 kW × 1 pump, underground water receiving tank: 36.4 m3,
Booster pumps: 4.1 kW × 2 pumps, 1.9 kW × 2 pumps
Storage type electric water heaters in guest rooms: 50-liter × 1.8 kW × 50 units

3.2 Outlined Results of the Audit in 2002

(1) The energy audit was carried out on January 15 and 16 in 2002.

(2) Audited by: Akira Ueda (technical expert) and Akira Kobayashi (technical expert) from the Energy Conservation Center, Japan

(3) Outlined results of the audit

1) Outlined results of the audit

The energy consumption per unit area in Pansea Hotel was 1196 MJ/m^2, which is about one third of the average of Japanese hotels, 3278 MJ/m^2. The reasons for such low energy consumption are probably the superior design of the building and the use of passive design that incorporates the elements of nature to maximum for creating a comfortable environment without using air conditioning.

2) Proposals for improvement

We explained four proposals for improvement and the CO2 water heating system as a recommended technology.

① Switching to high-efficiency lamps and lighting fixtures

The following conventional incandescent lamps were used in guest rooms and at the entry of guest rooms. We proposed switching these 40-W incandescent lamps to 7-W energy saving high-efficiency lamps. The expected effect was 23608 kWh/year.

Guest rooms: Four 40-W lighting fixtures x 50 rooms
Entry of guest rooms: Two 40-W lighting fixtures x 50 rooms
Corridors: Ten 40-W lighting fixtures

② Introducing a water heating system

A 50-liter storage type electric water heater was installed in each guest room to provide hot water. However, the temperature of hot water decreased when hot water was poured to a bathtub. To maintain the comfortable temperature, we proposed the employment of a larger hot water storage tank and the introduction of a central water heating system.

③ Improving power factor

Power factor was 85%. We proposed the installation of a capacitor for improving power factor to nearly 100%.

④ Managing water consumption

The water used in the hotel was drawn up by using two well pumps. However, the amount of water was not measured and the water consumption was unknown. We proposed the installation of a water meter to measure and record the amount of water. By doing so, the operation of the well pumps and the booster bumps can be managed and the water leakage from pipes and pools can be detected in early stages.

3.3 Follow-up of the Previous Proposals

The proposals for improvement made in 2002 described above were all taken into consideration.

Currently, the hotel is planned to be reformed. We were told that our proposals were considered as precious advice and might be incorporated in the reform plan. The reform construction is planned to begin in April in the next year after the coming high season.

The results of the follow-up of the previous proposals are as follows:

(1) Switching to high-efficiency lamps and lighting fixtures

The 40-W lighting fixtures at the entry of guest rooms and in corridors were replaced by compact fluorescent lamps (7 W).

The 40-W lighting fixtures in guest rooms were not changed since aesthetic values were more important in guest rooms.

(2) Introducing a water heating system

They were discussing whether to replace the water heaters in guest rooms to a central electric water heating system.

(3) Improving power factor

Our proposal was not carried out yet. However, they were discussing the installation of a capacity bank to improve power factor.

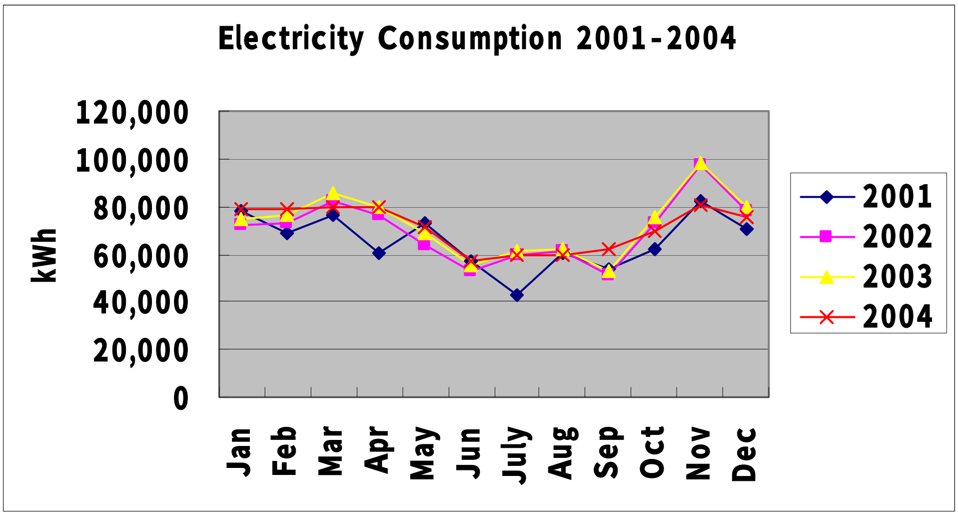
(4) Managing water consumption

No water meter was installed yet. However, they were checking the size of a required water meter and planning to propose the installation of a water meter to the owner.

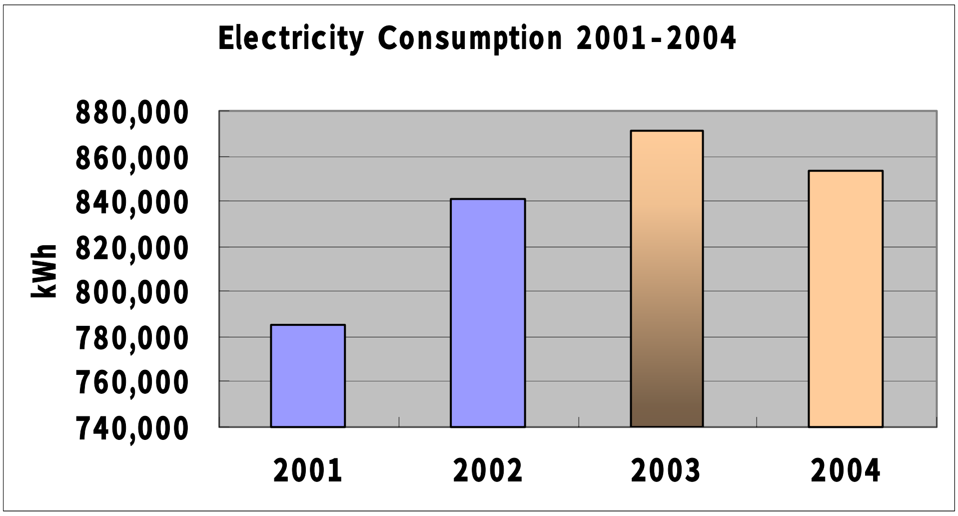
3.4 Results of Follow-up Energy Audit

(1) Historical development of energy consumption

The following graph shows the monthly energy consumption in five years from 2001 to 2004. Energy is consumed most in November. Since the best season for taking trips in Myanmar is November to February, the energy consumption is high in that season.



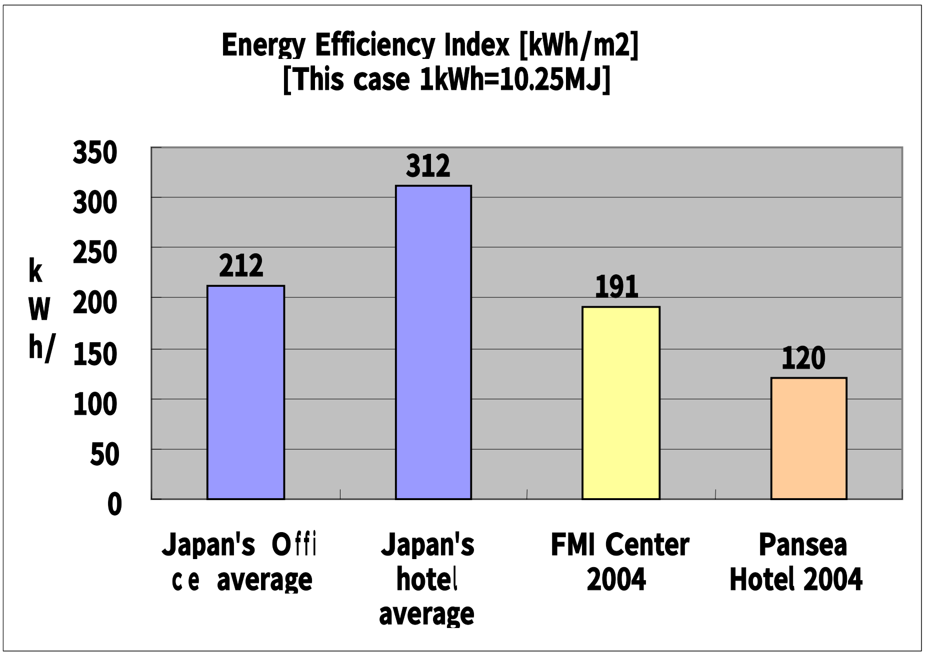
The following graph shows the changes of energy consumption in five years. The last energy audit was conducted at the beginning of 2003. The yearly energy consumption is highest in 2003 and is lower in 2004.



(2) Evaluations of energy consumption

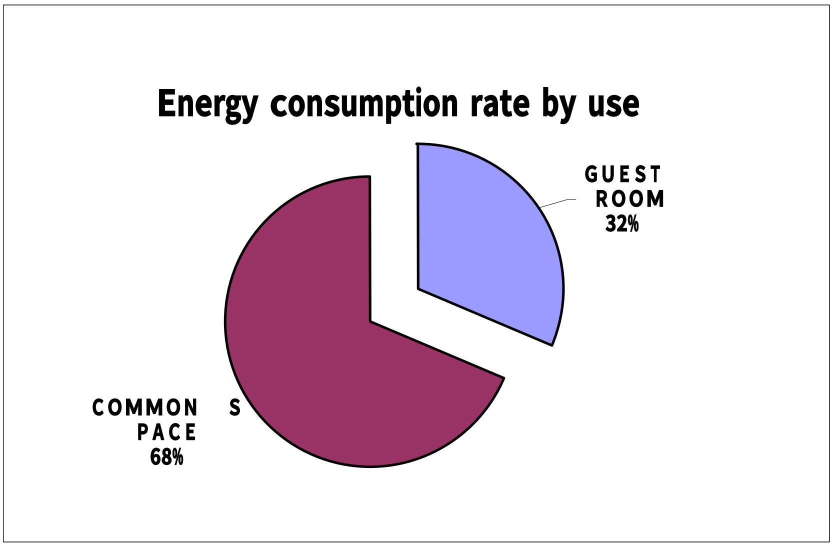
The following graph shows the energy consumption per unit area in 2004 in units of kWh. The graph also shows the comparison with other buildings. A coefficient is used to convert the MJ unit used in Japan to kWh which indicates electric energy. The coefficient is 1 kWh ＝ 10.25 MJ.

The energy consumption of Pansea Hotel is about one third of that of Japanese hotels. The energy consumption of FMI Center, which is an office building in Yangon, is about 60% of that of Japanese hotels. This low energy consumption is probably due to the passive design incorporating the features of climate in ASEAN countries.



(3) Energy consumption rates by use

Since the energy consumption rates by use in the hotel are probably not so different from the rates of the last energy audit, the values of the last energy audit are shown here. The percentage of energy consumption in guest rooms is about 32% and the percentage of energy consumption in common areas is about 68%. In guest rooms,

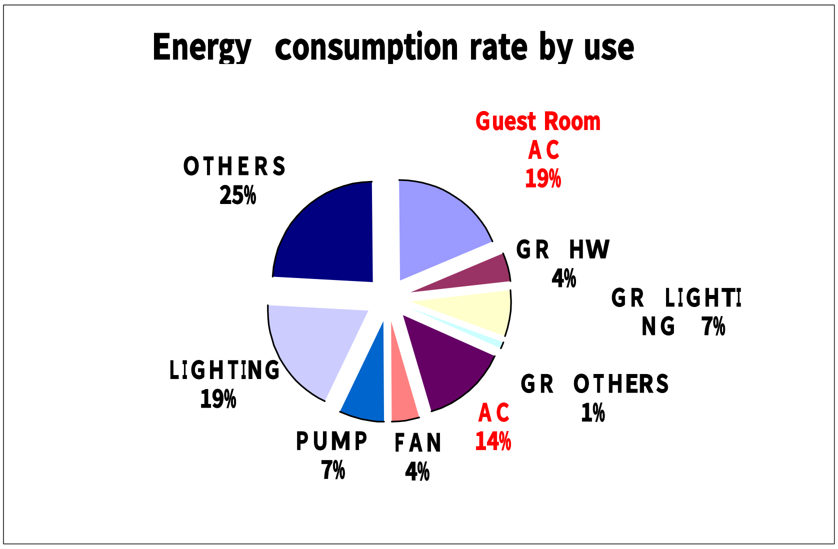


air conditioning takes about 19% (largest) of the entire energy consumption, lighting takes 7%, and water heating takes 4%.

3.5 The Barriers for the Promotion of Energy Conservation and Measures Against Those Problems

Due to our previous proposals, the lamps at the entry of guest rooms and in corridors were changed from incandescent lamps to energy saving fluorescent lamps. However, the lamps in guest rooms were not changed since aesthetic values were more important. Although some types of energy saving fluorescent lamps can provide the kind of color that is normally provided by incandescent lamps, the people at the hotel probably did not want to change the shapes of lamps.

The balance between aesthetic values and energy conservation is required. We need the building owner and designers to understand the importance of energy conservation and we need to continue promotional activities.



4. About the Result of the Workshop

4.1 Outline

Mr. Zamora from the ACE was the moderator. From Myanmar, the following high-ranking officials from the related ministries participated as guests:

Gen. Than Htay: (deputy minister of the Ministry of Energy (MOE))

Lt. Col. Khin Maung Kyaw: (deputy minister of the Ministry of Industry Ⅱ)

Mr. Soe Myint: Director General of the Energy Planning Department in the Ministry of Energy (also a member of ASEAM SOE)

Sixty people participated in the workshop including Mr. Than Myint who was the President of the Myanmar Engineering Society as well as high-ranking personnel from the architect association and the construction association. Three of us from Japan, Dr. Weerawat and Mr. Zamora from the ACE, and four presenters from other ASEAN countries also participated in the workshop and 69 people were present in total. We could tell how much the Myanmar government expects of the PROMEEC project from the people in this workshop.

4.2 Details about the Workshop

The workshop began with Gen. Than Htay's welcome remarks and proceeded based on the following program schedule. From ASEAN, Mr. Ayi Kyaw who was the Director of MOE in Myanmar explained the current energy situations and energy conservation activities in Myanmar. Successful examples of the buildings that won ASEAN EE&C best practice building awards (facilities) were presented (Myanmar: two cases, invited ASEAN countries (Singapore, Philippines, Indonesia (two cases): four cases).

- Kambawza Bank (Myanmar: Special Submission Category, Winner in 2002)
- Popa Mountain Resort Building (Myanmar: Tropical Building Category, Winner in 2005)
- Plaza BII Building (Indonesia：Retrofitted Building Category, Winner in 2005)
- Bayer House Building (Philippines：New & Existing Building Category, Runner-up in 2005)
- Alexander Hospital Building (Singapore: Retrofitted Building Category, Runner-up in 2002)
- Air-conditioning Unit Equipped with Heat Pipe (Indonesia: Special Submission Category, winner in 2004)

The presentations were very specific and interesting. We thought that energy conservation activities for buildings in ASEAN countries partially reached a rather high level. The presentations by the invited guests from ASEAN countries were a great inspiration to the Myanmar people who were about to start building the infrastructures for rationalized use of energy.

We gave a presentation titled "Concept and Activity Towards Sustainable Building in

Japan" to introduce the CASBEE method for evaluating buildings based on environmental performance, the energy efficiency index management tool for buildings developed by the Energy Conservation Center, and the energy conservation best practice award system. We also stressed the importance of creating databases and technical directory. Since there were many participants from the architect association, the construction association and the engineering association, we were told that our presentations were very valuable. Questions and answers, and discussions were frequently exchanged in each presentation and the workshop was a success. In addition, the workshop was featured in a local newspaper.

We realized again that through energy audits and workshops, the PROMEEC project was a great influence on the promotion of energy conservation activities in Myanmar.

The detailed program of the workshop is as follows:

PROGRAMME OF SEMINAR ON ENERGY EFFICIENCY AND CONSERVATION FOR BUILDING BEST PRACTICES IN SOUTH EAST ASIA

Traders Hotel, Yangon, Myanmar 1２th August 2005

8:30 AM	-	9:00 AM	**Registration**
9:00 AM	-	9:10 AM	**Welcoming Remarks** H.E. General Than Htay Deputy Minister, Ministry of Energy
9:10 AM	-	9:20 AM	**Opening Statement** Mr. Yoshitaka Ushio, Energy Conservation Centre, Japan (ECCJ)
9:20 AM	-	9:30 AM	**Opening Statement** Dr. Weerawat Chantanakome Executive Director, ASEAN Centre for Energy (ACE)
9:30 AM		10:00 AM	**Photo Session and Coffee Break**
Session 1 **Moderator: ACE**			
10:00 AM	-	10:15 AM	**Introduction to PROMEEC Programme** **Mr. Yoshitaka Ushio,** General Manager, ECCJ
10:15 AM	-	10:40 AM	**Overview of EE&C Initiatives and Activities in Myanmar** Mr. Aye Kyaw, Ministry of Energy
10:40 AM	-	11:05 AM	**Concept and Activity Towards Sustainable Building in Japan** Mr. Yoshitaka Ushio, General Manager, ECCJ
11:05 AM	-	11:30 AM	**Energy Conservation Approach for Myanmar Building Industries (Kambawza Bank)** Mr. Yin Htwe Thet, M.D. Central Engineering and Construction Co.,

			Ltd.
11:30 AM	-	11:55 AM	**Energy Efficiency & Conservation(EE&C) Best Practices of Popa Mountain Resort Building** Mr. Win Aung, Chairman, Group of Woodland Companies
11:55 AM	-	12:20 PM	**Energy Audit Findings at FMI Building and Pansea Hotel Building** Mr. Akira Kobayashi, Expert, ECCJ
12:20 PM	-	12:40 PM	**Q & A Session**
12:40 PM	-	2:00 PM	**Lunch**
Session 2 **Moderator: PTM**			
2:00 PM	-	2:25 PM	**EE&C Best Practices of Plaza BII Building, Indonesia** Ms. Vincentia Ari Mutiawati
2:25 PM	-	2:45 PM	**EE&C Best Practices of Bayer House Building, Philippines** **Mr. Irwin Angkico, Facilities Engineer**
2:45 PM	-	3:15 PM	**EE&C Best Practices of Alexander Hospital Building, Singapore** Mr. Steward Tai, Building Energy Manager
3:15 PM	-	3:45 PM	**Innovation on Energy Efficient Technologies: Air-conditioning Unit Equipped with Heat Pipe (Indonesia)** **Mr. John Budi Haryanto**
3:45 PM	-	4:00 PM	**Coffee Break**
4:00 PM	-	4:15 PM	**The Development of a Technical Directory (Concept and Methodology)** Mr. Hisashi Amano, Expert, ECCJ
4:15 PM	-	4:30 PM	**The Development of a Database/ Benchmarking/ Guideline for Buildings Concept and Methodology)** Mr. Akira Kobayashi, Expert, ECCJ
4:30 PM	-	4:45 PM	**Q & A Session**
4:45 PM	-	5:00 PM	**Closing Remarks** Dr. Weerawat Chantanakome Executive Director, ASEAN Centre for Energy (ACE)

III. Malaysia

1. Activity Overview

In Malaysia, we carried out rather detailed energy audits at Wisma Sime Darby Building. We also held a workshop as in Myanmar.

Participants from the International Engineering Department of the Energy Conservation Center, Japan (ECCJ):

Yoshitaka Ushio (General Manager)

Hisashi Amano (Technical Expert)

Date	Activity	Remarks
August 13 (Saturday)	Amano and Ushio: (MH741) Yangon 12:15→ Kuala Lumpur 16:25 Kobayashi: (8M 331) Yangon 8:15 → Bangkok (TG 640） → Narita 19:30	Pan Pacific Kuala Lunpur
August 14 (Sunday)	Day-off	
August 15 (Monday)	Energy audit (Wisma Sime Darby Building) (10:00 – 16:30)	
August 16 (Tuesday)	Energy audit (Wisma Sime Darby Building) (9:30 – 16:30)	
August 17 (Wednesday)	Preparation for the seminar & workshop and meeting with PTM people (15：00 – 17:00)	
August 18 (Thursday)	Seminar & workshop (9:00 – 16:30)	
August 19 (Friday)	Reporting the results of the energy audit for PTM people and management staff of Wisma Sime Barby Building (15:00 – 17:30) Amano: Left for Phnom Penh on the morning of the 21st. Ushio: Left for Japan. Kuala Lumpur 22 :35 (JL724) →	Flew overnight. Ushio: Arrived at Narita at 6:35 on the 20th

When we arrived at the Kuala Lumpur airport, we were amazed by the scale and the ingenious design of the terminal building. This airport was designed by a Japanese architect, Kisho Kurokawa and built by the joint venture of Takenaka Corporation and Taisei Corporation (opened in 1998). The features of the terminal building are the large-span foundation using a space truss as the roof structure, high ceilings, and external glass walls. The terminal building consists of the passive design with lots of sunlight and the active design with a large-scale air conditioner. The building won the second prize (runner-up) of the ASEAN energy conservation best practice building award in 2004. We also saw the city filled with novel buildings including KLCC building which is second highest in the world. We felt a big difference from Yangon where we were three to four hours before. We also realized the importance of filling the gaps between ASEAN countries in conducting the ASEAN PROMEEC project and also the importance to do so.

We performed an energy audit on a 22-story office building that was built 20 years ago (Wisma Sime Darby Office Building). Three engineers from PTM (Pusat Tenaga Malaysia: Malaysia Energy Center) participated in the energy audit. Before the energy audit, we asked PTM to conduct an energy audit. However, the PTM people were rather passive and the audit was not conducted as scheduled. In addition, the answers to our questionnaire were unprepared, the communication between PTM and the people at the target building was insufficient, and the cooperation from the people at the target building for the energy audit was less than satisfactory due to miscommunication. Therefore, it took some time for us to explain the purpose of the energy audit to the building staff. We explained the activities of ECCJ and the PROMEEC project using Power Point and the building staff finally understood it. After that incident, the building staff cooperated with us very nicely. We collected information using the questionnaire that we previously handed out, checked all air conditioners, lifts, lightings and electric facilities in the building, and received detailed explanations about the air conditioning facilities.

The building staff did not prepare sufficient data and the Building Automation System (BAS) was out of order. However, we used the installed measurement devices (such as a WH meter) and the measurement devices brought by the PTM people to measure the daily electricity consumption, temperatures and luminance. Although the meters and the BAS were installed in the building, they were scarcely used. The building management team seemed keener on running the air conditioning systems to satisfy the needs of tenants to maximum. It seemed that the owner's policy was to minimize the maintenance cost rather than pursuing energy conservation. This is probably the reality in ordinary buildings in Malaysia. We felt that the cheap electricity charge hindered the promotion of energy conservation in Malaysia as well.

On the last day (19th), we held the energy audit result reporting meeting. Seven people attended the meeting. From PTM, three people participated including Ms. Azah (focal point in the project) and four people participated from the target building including two building managers. Before this meeting, we had a meeting with PTM engineers and created an energy conservation improvement plan incorporating their opinions. We explained this plan at the meeting on the 19th.

On August 18 (Thursday), we held a workshop. About 130 people participated including four presenters invited from four ASEAN countries. Many questions and answers, and discussions were exchanged in the workshop and the workshop was a success.

Again in Malaysia, we clearly realized that the PROMEEC project had a great influence on the energy conservation activities in Malaysia through the energy audit, the seminar, and the workshop.

2. Energy audit of Wisma Sime Darby Building

2.1 Outline of Wisma Sime Darby Building

Photo 2.1-1
Wisma Sime Darby building

1) Name of building:
   Wisma Sime Darby Building
2) Address:
   JALAN RAJA LAUT, 50350
   KUALA LUMPUR, MALAYSIA
3) Usage:
   Office (tenant building)
4) Scale:
   1 floor underground and 22 floors above ground
   Reference: Fig.2.1-1 Configuration of standard floor
   Total floor area … 54,856.09 m^2
   Working area … 44,546.54 m^2
   (Parking lot: 1-6 floors in west building)
5) Age: 20 years old
6) Central monitoring/control system of the building:
   Building Automation System (BAS)
7) Electric equipment:
   Receiving voltage … 11 kV
   Transformer capacity … 1,500 kVA × 5 units; 1,250 kVA × 1 unit
   Distribution system … 3-phase, 4-wire (400/230 V)
   Reference: Fig.2.1-2 Receiving/distributing system diagram
   Elevators: For people … 33.7 kW × 4 units
   22.17 kW × 6 units
   For car park … 22.5 kW × 2 units
   For baggage … 33.7 kW × 1 unit
   For firefighting … 22.5 kW × 1 unit
   Lighting apparatus … 40 W × 3 tubes/unit (integral with air conditioning port) × approx. 5,300 units
   Reference: Photo 2.1-3 Lighting apparatus and air conditioner jet exhaust
8) Air conditioning equipment:
   Water cooling package unit (WCPU) (with 10 Hp fan) …
   26.1 kW × 39 units, 29.8 kW × 3 units, 37.3 kW × 1 unit
   Cooling tower × 4 units
   Cooling water pump … 37.3 kW × 6 units
   Reference: Fig.2.1-3 Air conditioning (WCPU) system diagram
   Air cooling package unit … 41 kW × 2 units, 14.9 kW × 5 units, 7.5 kW × 2 units
   Air cooling chiller … 37.5 kW × 2 units
9) Hygienic equipment:
   Service water pump … 14.9 kW × 2 units

Lavatory ventilation fan … 44.8 kW, 29.8 kW, 26.1 kW × 1 unit each

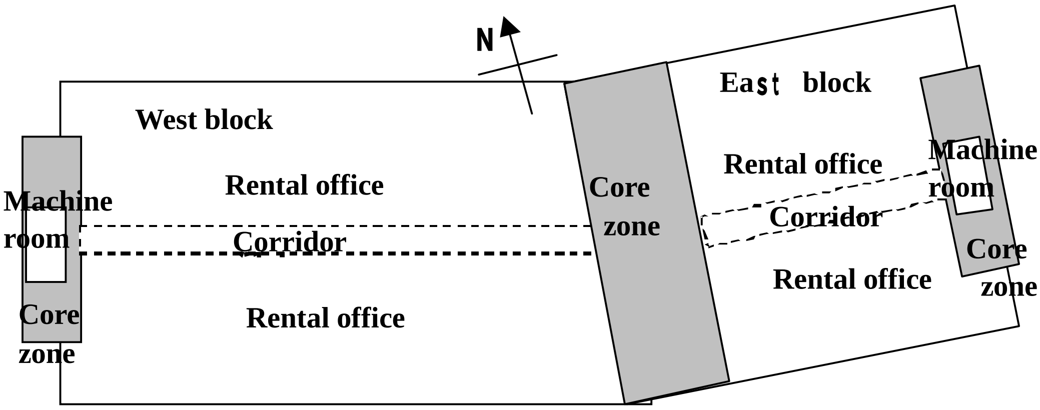


Fig.2.1-1 Configuration of standard floor

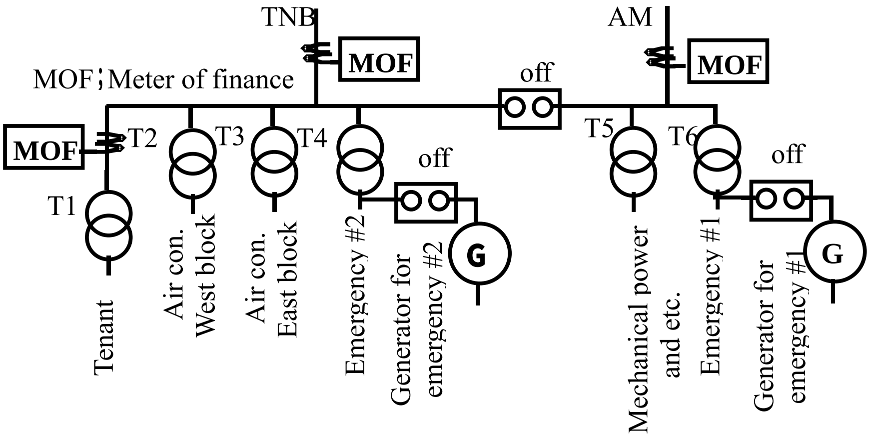


Fig.2.1-2 Receiving/distributing system diagram

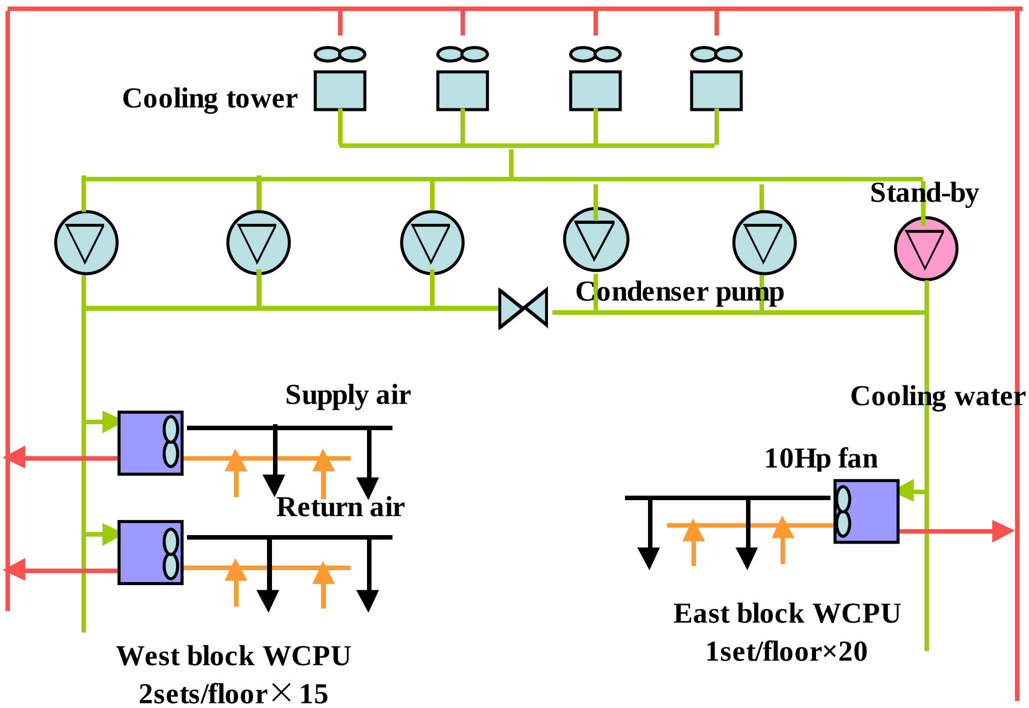


Fig.2.1-3 Air conditioning (WCPU) system diagram

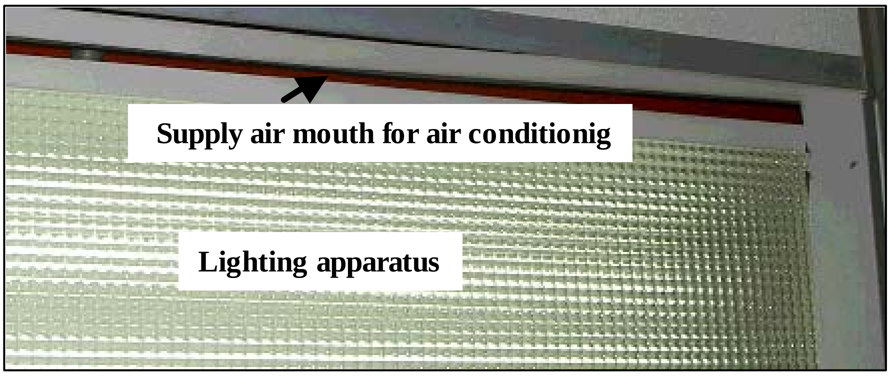


Photo 2.1-3 Lighting apparatus and air conditioner supply air mouth

2.2 Outline of the Audit

1) Date of audit: August 15 (Mon.)-16 (Tue.), 2005

2) Persons in charge of building: Amiruddin Haja Abu, Building Executive
Amiruddin Mohd Nadzri, Building Executive

3) Joint audit specialists: Ptm (Malaysia Energy Center)
Muhd, Muhtzam Moor Din
Technical Assistant, Energy Industry & Sustainable Development Division
Two other people

4) Steps of audit
(1) Delivery of advance questionnaire
(2) Interview (contents of questionnaire and ancillary matters)
(3) Survey of building facilities
(4) Collection and analysis of data

(5) Report of simple audit
(6) Audit report

3.3 Analysis of Current Situation

(1) Power consumption

1) Monthly consumption (2002-2005)

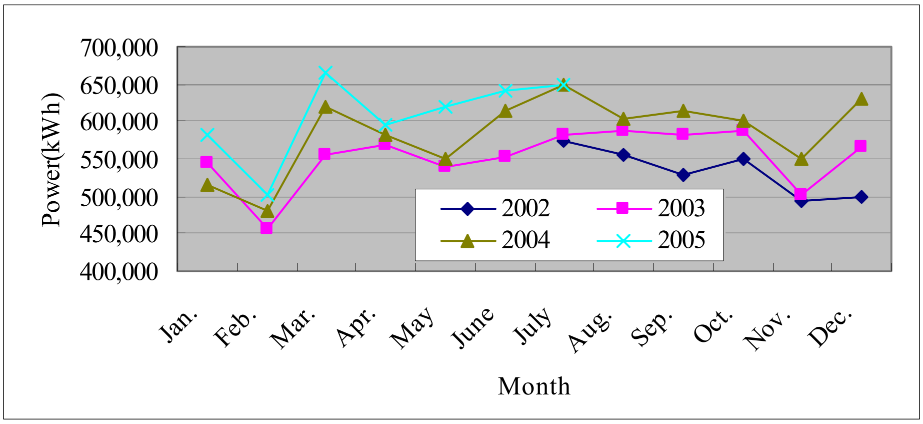


Fig.2.3-1 Monthly power consumption

Similar patterns are repeated every year, and the power consumption minimum in February, while a large quantity of power is consumed from July to October. Since the annual temperature in KUALA LUMPUR is almost constant, other elements (the number of working days and so on) seem to be the cause of the change.

2) Change in annual base
The annual power consumption is shown graphically by showing the average of monthly consumption.

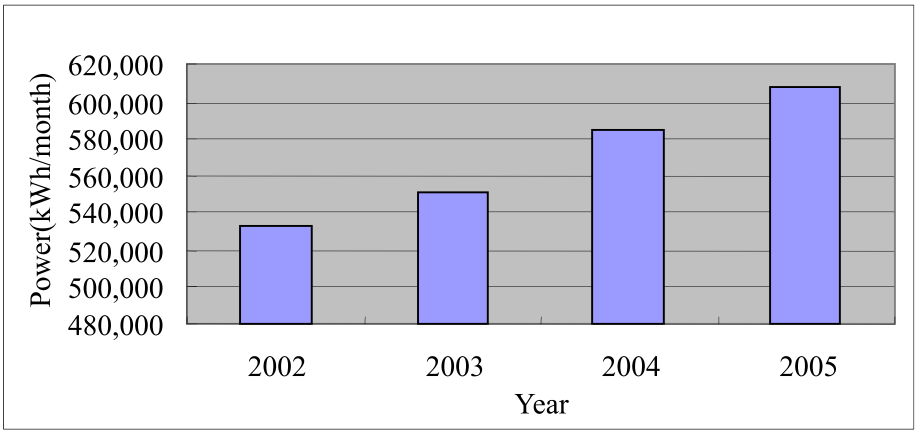


Fig.2.3-2 Change in monthly power consumption

According to the graph, the power consumption is increasing every year by 3.4-6%.

The graph below shows the correlation between the tenant occupation rate (2002-2005) and power consumption.

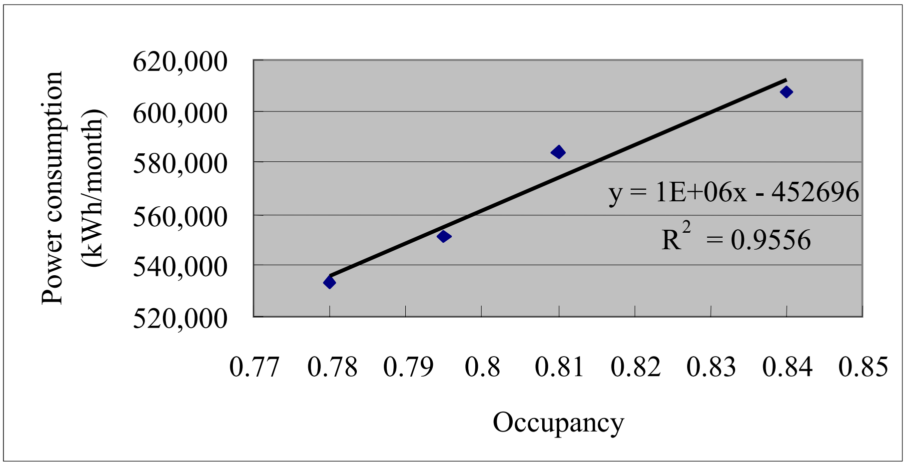


Fig.2.3-3 Correlation between power consumption and tenant occupation rate

According to the graph, power consumption has a correlation with the tenant occupation rate. However, the constant term of the approximation formula is negative, which means that the tenant occupation rate is one of the factors but there exist some other factors that are attributable to the increase of power consumption. Although those factors were not revealed in this audit, these factors should be pursued as the power consumption management elements.

3) Comparison with other buildings in Malaysia

The figure below shows the scatter diagram of total floor area and power consumption of 59 buildings in Malaysia, to which the data of the Darby building (7,013,356 kWh in 2004) is added. (the Darby building is plotted in a red mark.)

This building is almost on the average line, and the energy consumption of the building is an average. The average value is 124.9 kWh/m^2, while the value of the Darby building is 127.8 kWh/m^2, and the ratio is 1.023.

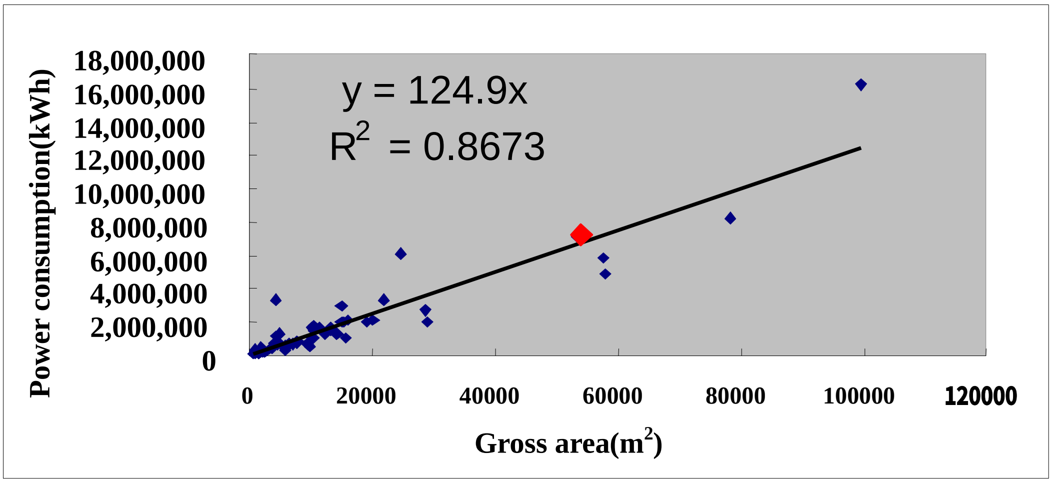


Fig.2.3-4 Power consumption per unit total floor area

(Comparison with data on 59 buildings in Malaysia)

The figure below shows the scatter diagram of net floor area (air-conditioned area) and power consumption of the 47 buildings and the Darby building. The average value per net floor area of the 47 buildings is 169.31 kWh/m^2, while that of the Darby building is 157.4 kWh/m^2, which is 93% of the average.

According to these data as well, the energy consumption of the Darby building is almost an average.

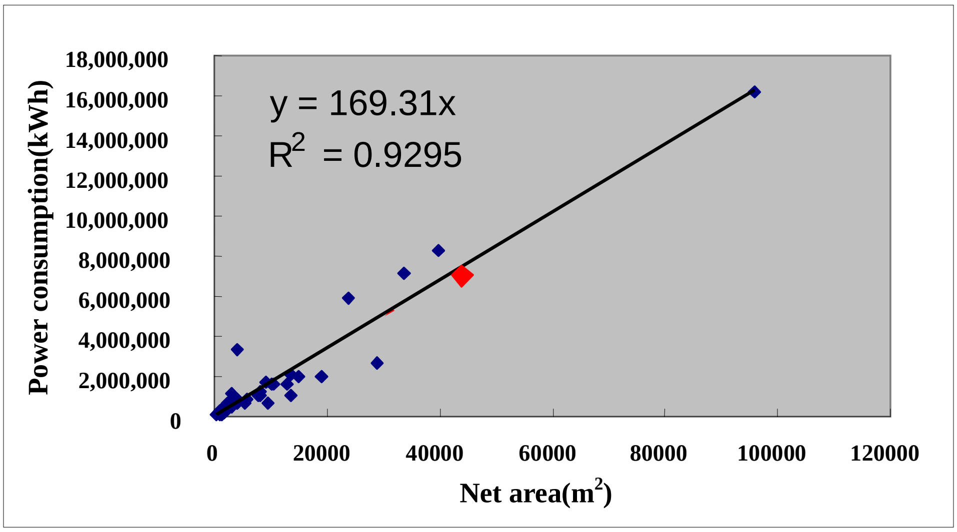


Fig.2.3-5 Power consumption per unit working floor area

(Comparison with data on 47 buildings in Malaysia)

4) Estimation of power consumption of respective equipments

The energy consumption of respective equipments is calculated based on the mechanical drawings of the Darby building and the operating condition of respective equipments. Empirical values are used for part of estimation, and the values shown below are approximate.

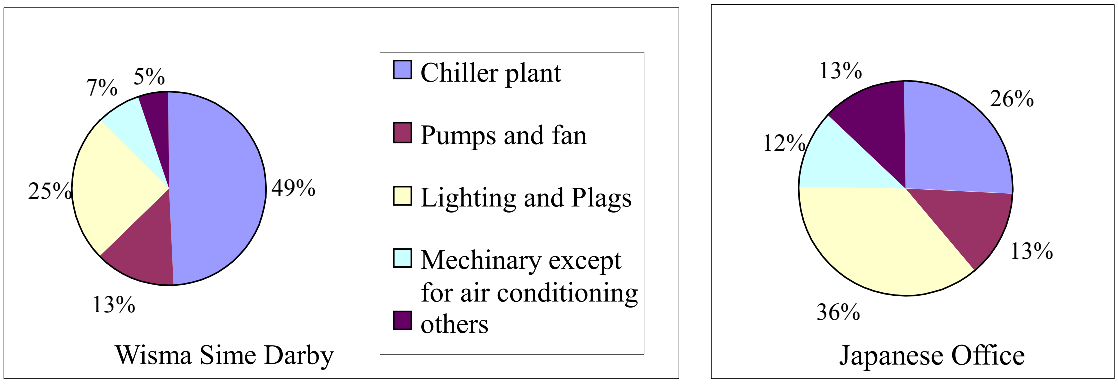


Fig.2.3-6 Power consumption of respective equipments

The circle graph shows the 49% and 25% of power is consumed for heating/cooling and lighting respectively in this building and these are the target equipment for the energy conservation.

(2) Water consumption

1) Trends of consumption

The monthly averages of water consumption from 2000 are shown graphically below.

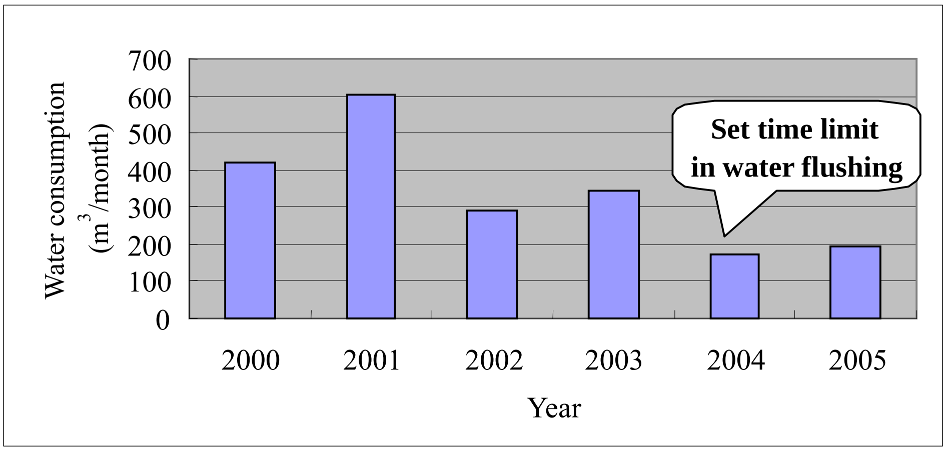


Fig.2.3-7 Change in water consumption

Water consumption has been reduced recently. Reduction in consumption was realized by setting the flushing time in the toilets in 2004.

2) Correlation between power consumption and water consumption

The water consumption is originally dependent on the tenant occupation rate. The power consumption is also dependent on the tenant occupation rate. Therefore, there must be some correlation between them. The correlation diagram is shown below.

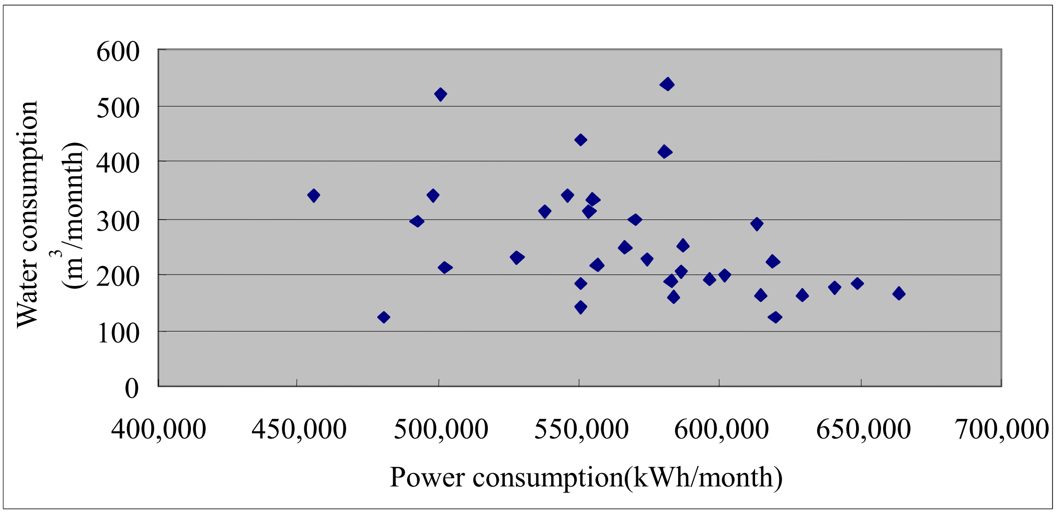


Fig.2.3-8 Correlation between power consumption and water consumption

As shown above, however, there was no correlation between the two. Since there is a correlation between the power consumption and the occupation rate, the water consumption is not dependent on the occupation rate. There was no correlation in the data collected after the improvement of the water flushing system in the toilets.

In other words, water is used irrespective of the tenants, indicating that the water is used for some purposes other than the original purpose. We requested the investigation of the reasons and the improvement of water consumption control based on the result.

2.4 Points for Improvement and Expected Effects

Measures have been taken for energy conservation for the Darby building unlike other buildings that are also 20 years old. Some examples of the measures are shown below.

(1) Air conditioning system
- Special window glass, in which a plastic is sandwiched, is adopted to reduce the solar radiation.
- The cold air supply system is simple and the loss is small.
- The cooling tower is clean and maintained well.
- The building automation system (BAS) is installed.

(2) Power distribution system
- A watt-hour meter is installed for each transformer.
- The power factor is improved by the capacitor bank on the secondary side of the transformer.

(3) Others
- The recent energy conservation techniques such as computer control of elevators, improvement of lavatory flushing, etc. are adopted.

However, for further energy conservation we propose the following improvement measures.

(1) Improvement of air conditioning operation (improvement of water cooling package unit (WCPU) operation)

The air conditioners are constantly operated according to the set rating irrespective of the season, weather or tenant occupation rate, which causes the waste of electricity shown below.

Capacity of equipment in general has many inevitable margins, including design margin, the difference between the necessary capacity and the planned, excessive estimation of various losses.

In addition, there is supply surplus caused by load fluctuation. The situation is shown schematically. The initial adjustment of the installed capacity is for minimizing the capacity margin, while the load control of the equipment following the load fluctuation is for minimizing the supply surplus. The latter needs a costly complicated system in general, and the former is comparatively easy.

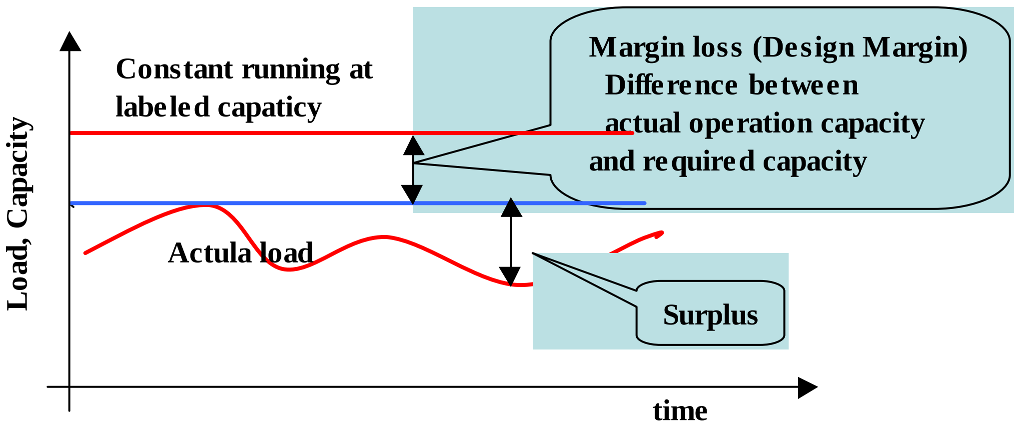


Fig.2.4-1 Structure of waste generation

1) Control of equipment capacity of WCPU
When the 25 Hp WCPU is taken as an example, the combination of the three operation units (5 Hp, 10 Hp, and 10 Hp) shown below can change the cooling capacity of WCPU.

Table 2.4-1 Control of WCPU capacity

	Unit1 5hp	Unit 2 10hp	Unit 3 10hp	adjusted capacity
case1	on	off	off	5hp
case2	on	on	off	15hp
case3	off	on	on	20hp
case4	on	on	on	25hp

In other words, it is possible to operate by setting the appropriate cooling capacity according to the degree of the load. The figure shown below is the conceptual figure which explains that the proposed operation can be realized by the system which combines the indoor temperature and the control system of BAS.

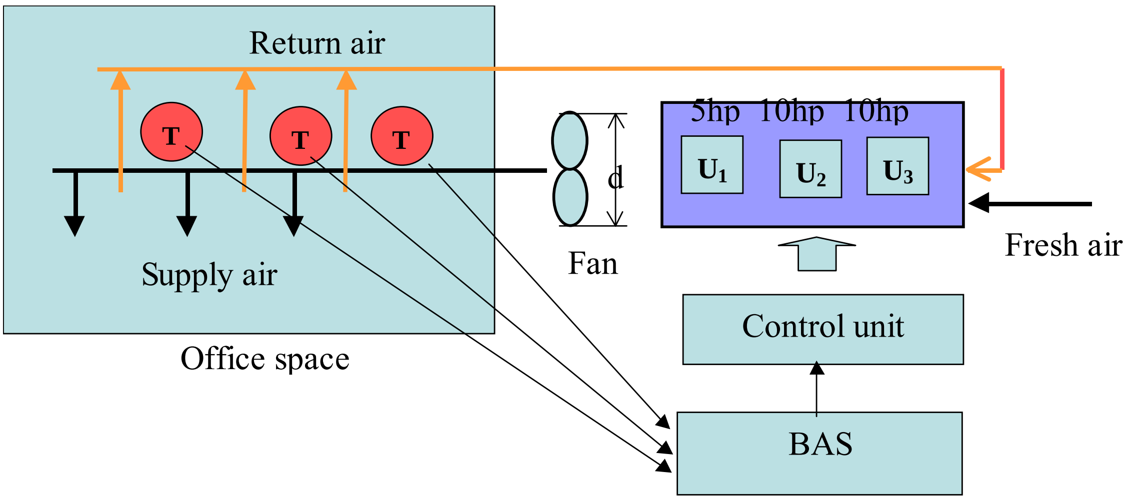


Fig.2.4-2 Control of WCPU capacity

The capacity of the WCPU is planned to be increased to 40 Hp. However, the WCPU will not need 40 Hp at all times. Capacity control will become more important for further energy conservation.

2) Control of fan capacity
The air volume of fans is controlled by the damper. As shown in the figure, the damper control is not efficient. Even if the air volume is reduced to 80%, the shaft power of the motor will be reduced only by 2%.

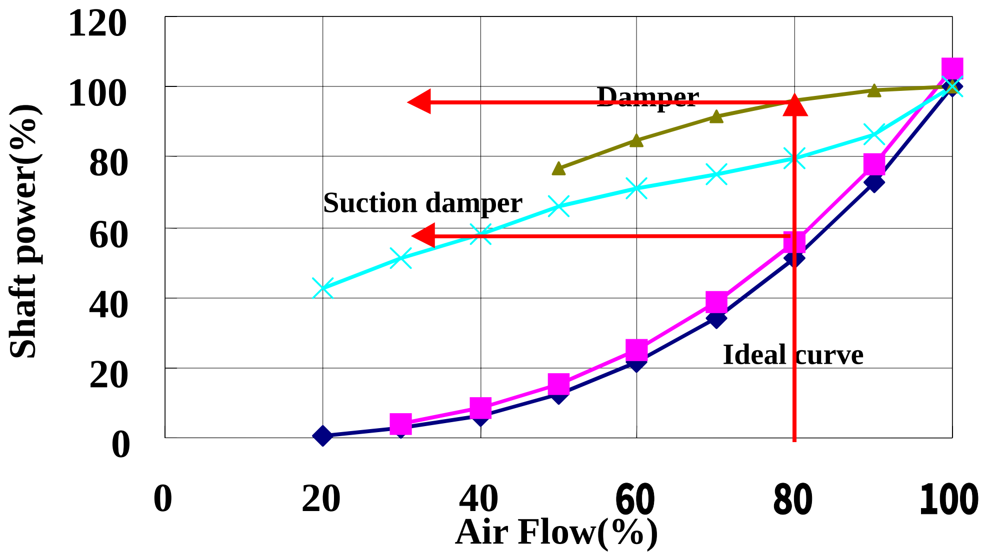
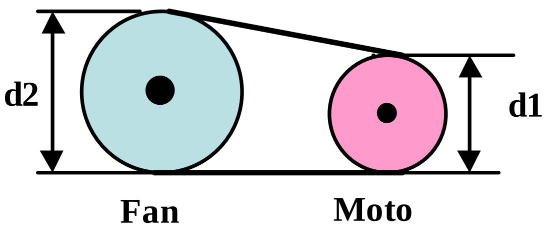


Fig.2.4-3 Comparison of various air volume control methods

Adoption of the following methods to control the capacity can ensure energy conservation.

a. Reduction of diameter of fan impeller
It is effective in controlling the surplus capacity up to 80%. Based on "affinity law" of fans, the air volume is proportional to the third power of the diameter of impeller, while the necessary shaft power is proportional to the fifth power of the diameter of impeller. Therefore, the energy conservation effect will be approx. 1.5th power the reduction in the air volume.

b. Change of pulley ratio (in the case of belt drive type)
The number of revolutions of fans is controlled by changing the pulley ratio.



$$\text{Pulley ratio} = \frac{d1}{d2} \qquad \text{Power} = \left(\frac{d1}{d2}\right)^3$$

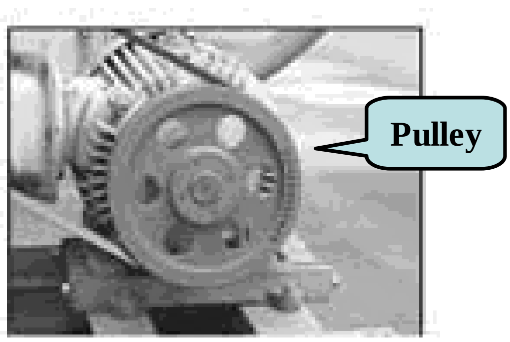


Fig.2.4-4 Air volume control by changing pulley ratio

When the number of revolutions is controlled, the power consumption changes at the rate of the third power of the number of fan revolutions. Therefore, the power consumption is proportional to the third power of the pulley ratio. This method is less expensive for investment cost than controlling the number of revolutions by an inverter. Adoption of this method should be taken into consideration for inverter control.

c. Control of the number of revolutions by inverter control
In this method, the power frequency of the motor is changed to control the number of revolutions. Since continuous control is possible, this method permits easy management. However, the pay-back period of the investment of the inverter is a problem for the owner's decision.

3) Trial computation of energy conservation effect
The equivalent annual working days used for trial computation of the effect is set at 280 days/year, assuming the weekly working days is 5.5 days/week and taking holidays into consideration as well. This value is also applied to the trail computation of other items mentioned later.

a. Control of equipment capacity of WCPU
Estimation condition: The 25 Hp WCPU is operated at the capacity rate of 20 Hp for 2h/d within the low-load time zone. In other words, the 5 Hp unit is stopped.

Annual power saving:
5 Hp (= 3.73 kW) × 39 units × 2 h/d × 280 days/year = 81,354 kWh/y

b. Control of fan capacity
Estimation condition: The air volume is supposed to be reduced to 80% by damper control in one system (14 units) in the West block, which is to be changed to the control of the number of revolutions by the inverter.

The rate of power consumption with an 80% load factor is shown in Fig.3.4-3 when the damper control is 98% and the inverter control is 58%. The operation hour is 10 h/d.

Table 2.4-2 Energy conservation by fan capacity control

Flow control	Power rate	Power kW	Applicable units	Power consumption	
Damper control	98%	7.301	14	286,199	kWh/year
Speed control by INV	58%	4.321	14	169,383	kWh/year
Improvement	40%	2.98		116,816	kWh/year

Power rate to labeled value is at 80% load factor

The pay-back after introduction of inverters is calculated on a trial basis.

Supposing the unit cost of a 7.5 kW inverter for the 10 Hp fan is approx. 10 kRM ($3k) and the unit cost of power is 0.272 MR/kWh according to the actual data obtained from the Darby building, the amount of money per fan after power saving will be as follows:

2.98 kW × 10 h/d × 280 d/y × 0.272 MR/kWh = 8,344 kWh/y × 0.272 MR/kWh
= 2,270 MR/y

Number of pay-back years = Investment/Saved power = 10 kRM/2.27 kMR = 4.4 y

c. Summary of the effects of proposals
The above calculations are summarized in the table below.

Table 2.4-3 Result of trial computation of energy conservation by improvement of air conditioner operation

Item	Energy saving	Cutting down of bills
WCPU's unit control	81,354 kWh/year	22,128 RM/year
Fan's speed control	116,816 kWh/year	31,774 RM/year
total	198,170 kWh/year	53,902 RM/year

(2) Reduction in the number of units in operation by improvement of transformer load factor

1) Survey of load factor and reduction of the number of transformers in operation
The primary side of the transformer for power distribution is provided with the voltmeter, ammeter, and integrating wattmeter. The load factor of the transformer is obtained from the readings of those meters. The load factors of T4-T6 are as low as approx. 10%, and the combination rearrangement of these transformer loads is possible.

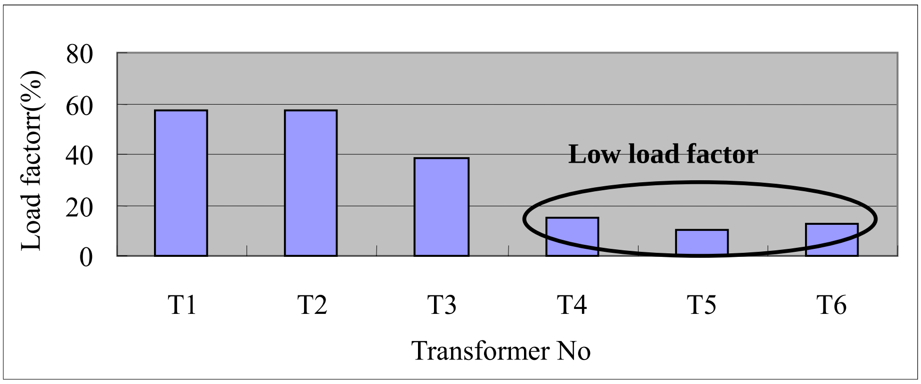


Fig.2.4-5 Load factor of transformer

Since T4 and T6 are provided for emergency, they are grouped as emergency transformers, and the load on T5 is shifted to T3 whose load factor is comparatively small. The six transformers can be reduced to four transformers in this way.

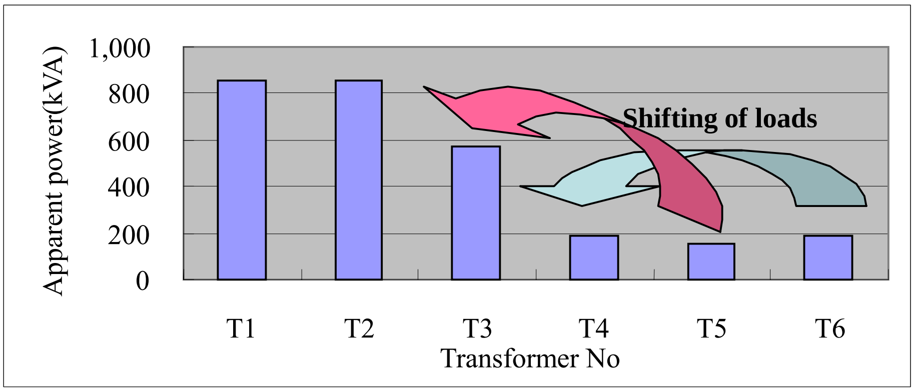


Fig.2.4-6 Use of four transformers by load shifting

By the load shifting shown above, the load factor will be improved as shown in the table below.

Table 2.4-4 Result of calculation of transformer loss

	6-transformer system(as it is)				4-transformer system(Proposal)		
Transformer	Capacity kVA	Current A	App. power kVA	L. facter %	Current A	App. power kVA	L. facter %
T1	**1,500**	45	857	57	45	857	57
T2	**1,500**	45	857	57	45	857	57
T3	**1,500**	30	572	38	38	724	48
T4	**1,250**	10	191	15	20	381	30
T5	**1,500**	8	152	10			
T6	**1,500**	10	191	13			

App. Power: Apparent power
L. Facter: Load factor

Combination of transformer loads can reduce the loss of the group of transformers as a whole.

2) Trial consumption of effect
The progress of improvement for reduction in the transformer loss is remarkable, and the present transformer loss is 30% of the products made 30 years ago as shown below (in the case of 50% load factor).

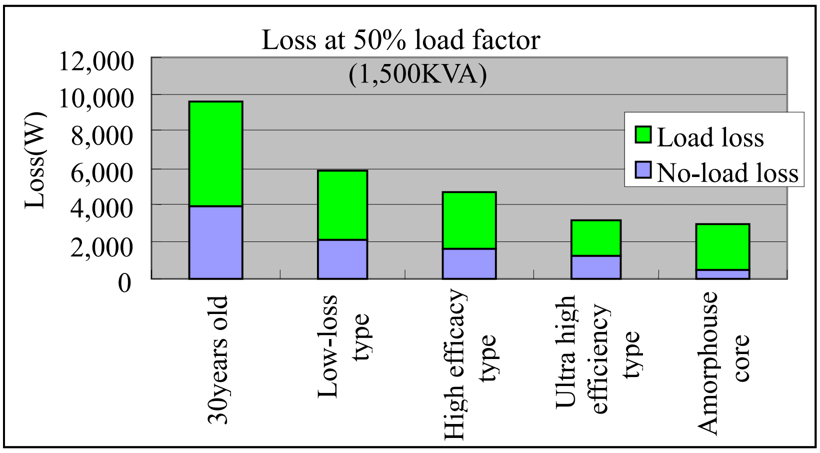


Fig.2.4-7 Change of transformer loss

The Darby building was established 20 years ago, and it is considered that the low-loss type transformers were adopted. The loss data used for trial computation is shown below.

Table 2.4-5 Load loss and no-load loss of low-loss type transformer

Capacity of transformer		No-load loss(W)	Load loss (W)
1500kVA	T1～3,5,6	2,380	15,910
1250kVA	**T4**	2,130	13,900

Respective losses are calculated from the formulae shown below.

No-load loss = No-load loss × 24h/d × 365days/year
Load loss = Load loss × (Load factor)^2 × 10h/d × 280days/year
Total loss = No-load loss + Load loss

The result of trial computation is shown below.

Table 2.4-6 Reduction in transformer loss

System	No load loss kWh/y	Load loss kWh/y	Total loss kWh/y	Improve kWh/y
6 trans.	122,903	37,657	160,559	Base
4 trans.	81,205	43,100	124,305	36,254

The annual reduction in transformer loss is 36,254 kWh/year (9,861 kRM/year).

(3) Lighting apparatus

1) Proposal for change in lighting apparatus and use of Hf

The intensity of illumination in the passageway is as low as 150-200 LX. The lighting apparatus are composed of 40 W × 3 tubes with covers. The beam of light from the equipment is scattered, which is desirable for ensuring uniform intensity of illumination of the lighting space as a whole. However, it is disadvantageous to ensure required intensity of illumination on the working surface of a desk.

In terms of energy conservation, we propose the two-tube illumination method with a reflection plate without covers.

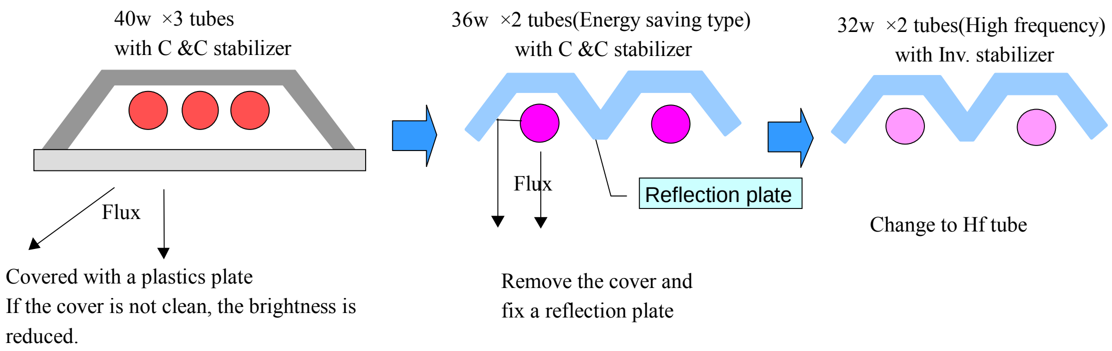


Fig.2.4-8 Sketch drawing of proposed improvement of lighting method

In that case, the number of tubes can be reduced from three to two by improving the Lighting apparatus efficiency (= lumen output from lighting apparatus/ lumen output of lighting source) by elimination of the transmission loss of the cover and improving the utilization factor (lumen of light cast on the working surface/lumen of light of light source). However, consideration is necessary because the intensity of vertical illumination decreases. The table below compares the characteristics of respective fluorescent lamps.

Table 2.4-7 Characteristics of respective fluorescent lamps

Category	Lamp power [W]	Input power [W]	Flux of light [lm]	Efficenecy [lm/W]	Colar renderig	Life [h]
Fluorecent lamp						
General	40	43	3,000	69.8	61	12,000
Energy saving type	36	39	3,000	76.9	61	12,000
High frequency	32	35	3,200	91.4	88	12,000

The Hf (high frequency operation lamps) will permit further energy conservation. Furthermore, use of the INV. stabilizer permits addition of various luminance control functions (daylight utilization control, initial luminance control, presence-in-room detection control, and so on).

2) Trial computation of effect
Trail computation is carried out with respect to Proposal 1: Change to 36 W × 2 tubes (energy-conservation lamp) and Proposal 2: 32 W × 2 tubes (Hf lamp).

The changeable lighting apparatus are assumed to be approx. 80% of the whole lighting apparatus, and the number of apparatuses is assumed to be 4,000.

The lighting hour is 10 hours × 280 days/year.
The power consumption by lighting apparatuses is calculated according to the values shown in Table 3.4-7.

The result of trail computation carried out under the above conditions is shown in the table below.

Table 2.4-8 Result of trial computation after improvement

Lighting apparatus		Power/apparatus	Power consumption
As it is.	40W*3tubes, C&C stabilizer	129 W	1,444,800 kWh/y
Proposal 1	36W*2tubes(Energy saving type)	78 W	873,600 kWh/y
Proposal 2	32W*2tubes(Hf tube)	70 W	784,000 kWh/y

The cost reduction effect is shown below.

Proposal 1: 571,200 kWh/y (155,360 RM/y)
Proposal 2: 660,800 kWh/y (179,738 RM/y)

(4) Utilization of building automation system

1) BAS and PDCA cycle

The BAS is considered to be a control system. In addition, its use as a data collection system is also desired. The first step for promotion of energy conservation is to understand the present situation of energy consumption. The flow of energy from the generation, through the conveyance, to the consumption should be understood quantitatively, and the utilization conditions of the applicable building should be understood simultaneously. Furthermore, it is desirable to understand respective elements separately for each year, month, time and usage (heat source, air conditioner, lighting plug outlet, elevator, and so on). If we can understand the actual condition of the use, such as the quantity, location, and method of use of energy, we can make improvements by establishing a goal of reducing energy consumption. Furthermore, analysis of the increase and decrease in energy consumption with respect to the change in utilization conditions will be able to establish an optimum operation condition and a heat-source optimizing operation plan for energy conservation. The following two points are necessary for that purpose.

① Installation of flow-meters, thermometers, ammeters, voltmeters, watt-hour meters, power-factor meters, and various other meters.
② Arrangement and graphical expression of obtained values

After the above efforts, the present situation of energy consumption will be clearly understood for the first time and you will be able to obtain the judgment data for know how to promote energy conservation activities. The BAS has all the functions necessary for the above, and the BAS should be used sufficiently. Once the data were provided by the BAS, next the energy management should be implemented. The key of energy management is to control a smooth PDCA management cycle as shown below.

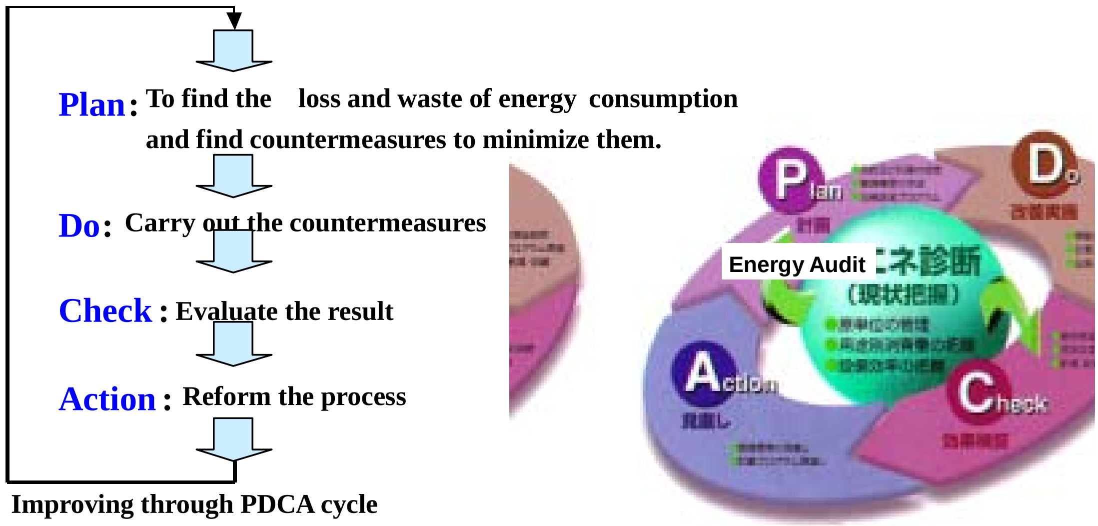


Fig.2.4-9 PDCA cycle

What is important here is to understand the situation of progress, and the BAS data system is to be used effectively here as well.

2) Trial computation of effect
According to the statistical data collected in Japan, approx. 5% energy conservation was achieved by systematic energy conservation activities based on the data. The value is considered to be the result of effective use of the BAS.

Annual power consumption × 5% = 7,013,356 kWh/y × 5%
= 350,668 kWh/y (95,362 RM/y)

2.5 Other Items to be Discussed

(1) In-house distribution loss (voltage drop and distribution loss)

The distribution loss W in the environment of in-house distribution system (small inductance of distribution system and comparatively large power factor) is represented by the formula shown below. (Refer to data 1.)

$W = \Delta V/V \times P/\cos\Phi$ = Voltage drop rate × Apparent power

Where ΔV: voltage drop, V: line voltage, P: load power, $\cos\Phi$: power factor.
Since $\Delta V/V$ shows the voltage drop rate and $P/\cos\Phi$ shows the apparent power, the distribution loss is the product of the voltage drop rate and apparent power (subject to the power factor).

According to the reading of the voltmeter, the outgoing voltage of the transformer is 450 V, and the reading of the voltmeter of the motor control panel, a load end, was 400 V.

Since incorrect calibration of the voltmeter is conceivable, the voltmeter should be checked first.

If this voltage drop is correct, the following will hold:

Voltage drop rate = $\Delta V/V$ = 50 V/400 = 12.5%

The above equation shows that slightly more than 10% of the power supplied to the load is lost in the distribution section, which cannot be ignored. Therefore, measures should be taken first to reduce the voltage drop. The goal is to reduce the voltage drop to approx. 5%.

It is also recommended to renew the WCPU and examine the possibility of installing a capacitor for power factor improvement. The power factor improvement for loads is to be conducted as an additional work when loads are renewed.

(2) Installation of water saving disk

The water saving disc is recommended by the Waterworks Department (Japan). When installed in a faucet of a built-in disk type, the water saving disk can save a maximum of approx. 6 liters of water per minutes.

As shown in the figure below, the lower section of the water saving disk is bigger than that of an ordinary disk.

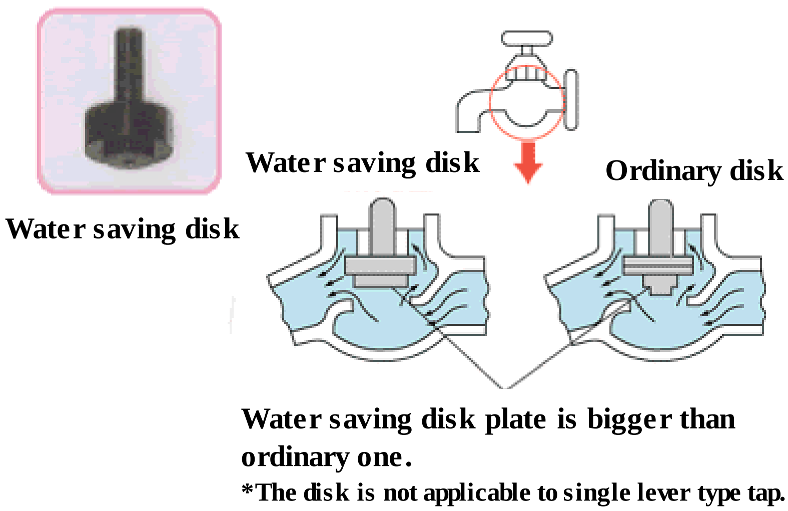


Fig.2.5-1 Structure of water saving disk

The effect of the water saving disk according to the opening of the faucet is shown in the graph below. As shown there, the performance is the same as that of an ordinary disk when the faucet is fully open, but the water saving disk exhibits its effect when the opening is 180 degrees or less.

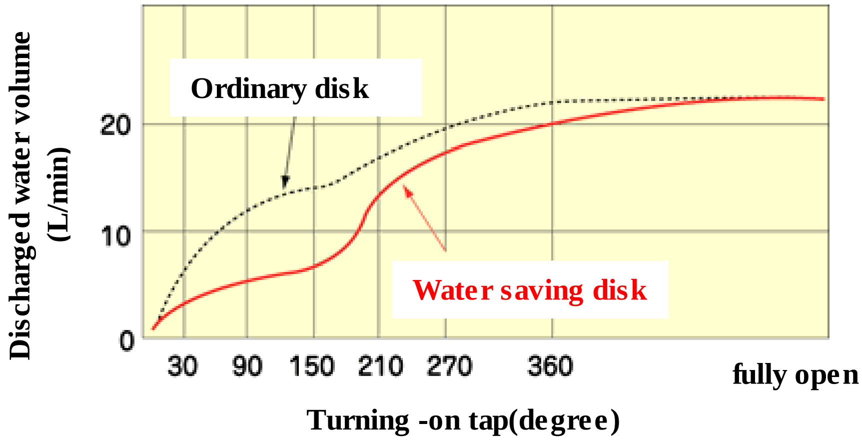


Fig.2.5-2　Characteristics of water saving disk

(3) Improvement of electric energy measuring instruments

Watt-hour meters are necessary for more detailed examination of energy conservation by specifying the equipment. You should study the possibility of introduction of commercial watt-hour meters with a recording function sold by some measuring instrument manufacturers. Recent watt-hour meters are equipped with functions that enable the measurement of higher harmonics, distortion factor and other various electric data, and that also enable analysis by direct input of the data to a personal computer. The photo below shows a watt-hour meter of Company H, priced at approx. ¥400,000 and provided with functions that are used in general. Other measuring instrument manufacturers also provide with the models with similar functions.

You can purchase and use jointly with some cooperative companies. It should be borne in mind that such an instrument is essential for energy conservation activities.

Fig.2.5-3　Watt-hour meter with recording function

2.6 Summary

(1) Proposed improvement items and result of trial computation of effect

The contents of “3.4 Proposed improvement items and effect of improvement” are summarized in the table below.

Table 2.6-1 Proposed items and result of trial computation of effect

No	Recommendation	Energy conservation kWh/year	Ratio %	Maney saving RM/year
1	Improvement of operation of Air conditioning	198,170	2.8	53,902
2	Improvement of load factor of tansformer	36,254	0.5	9,861
3	Improvement of lighting system	571,200	8.1	155,360
Subtotal		805,624	11.4	219,123
4	Further improvement by the effective usage of "BAS"	350,668	5.0	95,361
Total		1,156,292	16.4	314,484

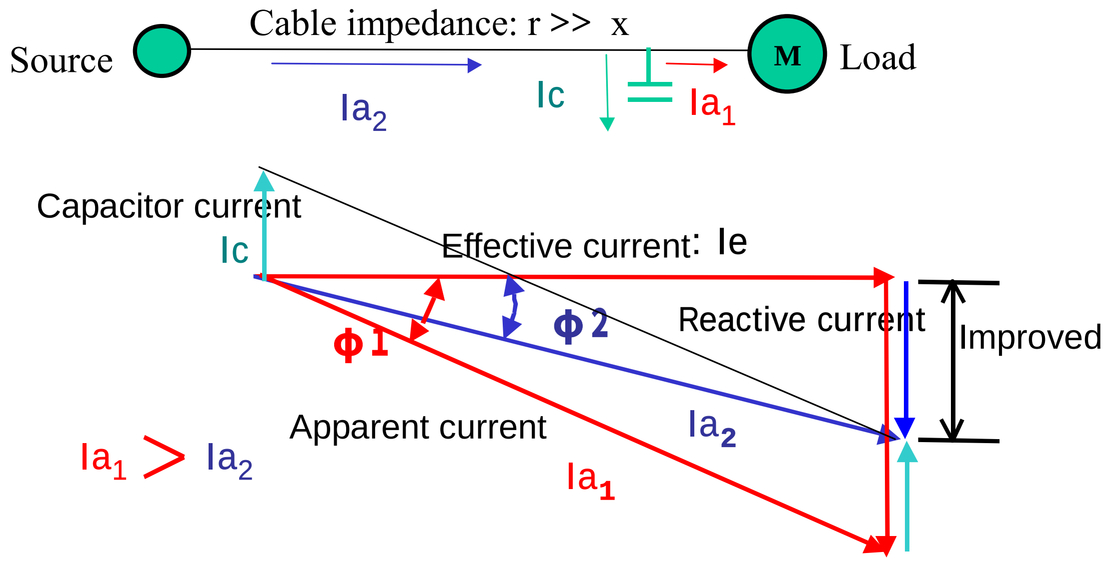
(2) Other comments (advice)

“3.5 Other matters to examine” are itemized. These matters should be examined simultaneously with the above-mentioned proposed improvement items.

① Investigation of voltage drop in trunk line and corrective measures
② Examination of the possibility of adoption of water saving disk
③ Improvement of metering system
Recommendation of watt-hour meter with recording function
Replacement and calibration of defective meters

Data 1 Power loss in distribution system

The figure below shows the case where a capacitor for improvement of the power factor of the distribution system. The red lines show the condition before improvement of the power factor, and the blue lines show the condition after improvement of the power factor.



The current (green) of the capacitor for improvement of power factor compensates the reactive power component of the current component of the load. The current in the cable changes from Ia_1 to Ia_2 in this way, reducing the value. From another point of view, the power factor changes from $\cos\Phi_1$ to $\cos\Phi_2$, showing improvement.

Since Ia_2 is smaller than Ia_1, the voltage drop in the cable reduces accordingly. When the inductance (x component) of the cable can be ignored, the voltage effect in the distribution system will be as shown below.

$$\Delta V = r \times Ia$$

Therefore, the voltage drop reduces because of the improvement of the power factor.

The relationship between the voltage drop and loss W in the distribution system is represented by the formula shown below , which can be obtained after simple calculation.

$$W = \frac{\Delta V}{V} \times \frac{P}{\cos\Phi}$$

where ΔV: voltage drop, V: line voltage, P: load power, and $\cos\Phi$: power factor.

3. About the Result of the Workshop

3.1 Outline

The workshop started at 9 a.m at Hotel Pan Pacific Kuala Lunpur. Ms. Azah of PTM was the moderator. The following VIPs participated as the guests of Malaysia side:

Mr. Teo Yen Hua (Deputy Secretary General, Ministry of Energy, Water and Communications)

Dr. Syed Hamzah Syed Othman (Chairman, PTM)

Dr. Anua Abdl Rahman (CEO, PTM)

In addition to the above guests, we had 130 participants including the people from government agencies, universities, architect offices, and the building industry. Two of us from Japan, Dr. Weerawat and Mr. Zamora from the ACE, and four presenters from other ASEAN countries also attended the seminar and the workshop.

3.2 Details about the Workshop

The workshop began with Dr. Weerawat's welcoming remarks from the ACE, the speech of the representative of the ECCJ, and Mr. Teo Yen Hua's opening remarks. The workshop proceeded according to the following program schedule. The guests left the workshop before its end. However, most of other participants stayed all day. Dr. Hassan Ibrahim (ex-Executive Director of the ACE) of the Energy Commission gave the first presentation on "EE Regulation and Incentive". Two people from Malaysia and four invited guests from other ASEAN countries presented the successful examples of energy conservation buildings (The buildings that won ASEAN energy conservation best practice building awards). All the presentations were specific and easy to understand.

- Telekom HQ (Malaysia: New and Existing Building Category, Runner-up in 2005)
- Low Energy Office Building: Min. of Energy, Water & Communications
- National Institute of Education Building (Singapore: New and Existing Building Category, Winner in 2005)
- Plaza BII Building (Indonesia: Retrofitted Building Category, Winner in 2005)
- 6750 Office Tower Building (Philippines: Retrofitted Building Category, 1st Runner-up in 2004)
- EGCO Tower (Thailand: New and Existing Building Category, 1stRunner-up in 2000)

Same as presented before in Myanmar, ECCJ gave presentations to introduce the Japan’s advance systems technologies such as the CASBEE method for evaluating buildings based on environmental efficiency, the energy Efficiency management tool for buildings developed by the Energy Conservation Center, and the award system for the excellent energy conservation practice. We also stressed the importance of creating databases and technical directory.

All the presentations were very valuable and so many questions and answers were exchanged that the moderator had to put an end to them. Many questions regarding CASBEE were made even after the workshop by the people of universities and architect offices. That was probably because Malaysia was planning to develop similar systems. We were highly praised in regard to the energy consumption rate tool for buildings by the engineers who designed facilities. Through these questions and answers, we felt that the energy conservation activities in building sector in Malaysia have already reached quite high level.

IV. Laos

1. Activity Overview

In Laos (Vientiane), we carried out energy audits at two hotels which were Lane Xang Hotel and Don Chan Palace. We also held a workshop.

The following gives the ECCJ participants and task records.

Participants from the International Engineering Department of the Energy Conservation Center, Japan (ECCJ):

Yoshitaka Ushio (General Manager)

Akira Kobayashi (Technical Expert)

Hisashi Amano (Technical Expert)

Task records

Date	Description	ECCJ staffs
November 6 (Sunday)	Traveling: Narita (11:00)→Hanoi→Vientiane (19:35)	Ushio and Amano
November 7 (Monday)	Energy conservation audit at Lane Xang Hotel	Ushio and Amano
November 8 (Tuesday)	Energy conservation audit at Lane Xang Hotel	
November 9 (Wednesday)	Energy conservation audit at Don Chan Palace	
November 10 (Thursday)	Gathering audit results and reporting to the people involved	
November 11 (Friday)	Seminar and workshop	Ushio, Amano, and Kobayashi
November 12 (Saturday)	Traveling: Vientiane (20:20)→Hanoi (21:25)	Ushio, Amano, and Kobayashi

The energy audit at Lane Xang Hotel was an OJT. From Laos, 15 people participated the energy audits including Mr. Khamso Kouphskham (Ministry of Industry and Handcrafts (MIH)), people from government agencies such as EDL (Electricity du Laos) under MIH, the Ministry of Education, the Ministry of Finance, the Ministry of Security, the Prime Minister Office, people from National University of Lao, and the staffs of the hotels where we were going to perform an energy audit. The energy audit began with greetings from Mr. Khamso who was a focal point in Laos for the PROMEEC project. We (ECCJ) briefly explained the procedure for the energy audit and stressed on the importance of collecting data and information. Then we checked the answers to the questionnaire we handed out in advance. Since the energy audit was also an OJT, we explained the purpose of each question in detail as much as possible.

The hotel was built 43 years ago and was very old. We asked the hotel staff to explain the details about energy consumption in the building as well as the details about the reforms that were done before.

After the confirmation of the answers of the questionnaire, the hotel manager showed us the facilities and we thoroughly investigated the situations of the electricity room, air conditioners, pumps and lightings. There were no special facilities since the hotel was rather old. We noticed some problems in regard to maintenance of the instruments such as a failed ammeter at the output side of a transformer. Staying this hotel, we were also able to check the quality of the environments such as air ventilation in meeting rooms, air conditioning environment, and indoor lighting environment, etc. The participants exchanged questions and answers regarding the energy audit and we ended the first day. All the participants were very enthusiastic and the OJT was performed as planned.

Next day, we conducted an energy audit at Don Chan Palace with almost the same members that participated in the energy audit at Lane Xang Hotel. At Don Chan Palace, the engineer, who always participated in the PROMEEC project activities in Laos, mainly responded to the audit. The energy audit was conducted based on the prepared questionnaire and the engineer's detailed explanation. However, since the engineer only started working in this hotel two months before, energy conservation activities just began including the creation of the maintenance system for facilities and the collection of energy data. Therefore, the submitted energy data were insufficient. The engineer showed us part of the manual he was creating for promoting energy conservation. The manual was being prepared based on the experiences and knowledge he gathered through developed countries' supporting activities such as the PROMEEC project, etc. After that, we surveyed the air conditioning facilities, the heat supply facilities, and the electric facilities such as transformers, and studied the details about the facilities and the status how the facilities were used. This building is an international meeting place with the largest hotel facility in Laos. Although there were no high-tech facilities, air conditioning and water heating facilities were superb. In this building, the floor area for exhibition halls and conference halls was larger than that of guest rooms. Only 30 to 40% of the facilities were used since the hotel opened only a year ago. Therefore, we felt that a large issue in terms of energy conservation was how to manage the energy use based on the usage rate of each department. After we checked the facilities, we exchanged questions and answers. Then the energy audit of the building as well as an OJT in Laos ended. Lastly, one of the participants commented that more engineers in Laos needed to experience energy audits like this one.

On November 10, we held a meeting to report the results of energy audits (two hotels). Thirteen people from Laos attended including the building managers and engineers of both hotels and the government officials who attended the OJT. We tried to let them learn the methods of energy audits as much as possible and explained analysis methods such as how to calculate the amount of saved energy in detail rather than the details about the proposals for improvement. For details about the results of the energy audits, see the next chapter.

We also held a workshop to promote and propagate energy conservation activities in the buildings in Laos and 64 people participated. It was a good opportunity for us since we could exchange views and information in regard to promoting energy conservation in the buildings in Laos.

2. Energy Audit of Lane Xang Hotel

2.1 Outline of Lane Xang Hotel

1) Name of the building: Lane Xang Hotel
2) Location: Fa Ngum Road, Vientiane Lao PDR. P.O. Box: 280
3) Use: Hotel, conference hall
4) Size: Five floors above the ground

   Number of guest rooms: 72 (see Figure 4.1－1 "Structure Outline" and Figure 4.1－2 "Rates of Floor Areas by Use" for reference)

   Total floor area: 9,852 m^2 (hotel building)
   The floor area of bars and pools is unknown since the building drawing was not available.

   Air-conditioned area: 7,823 m^2
5) Age: 43 years old

Photograph 2.1－1 Lane Xang Hotel

6) Outline of electrical systems

   Service voltage: 11 ｋV, Transformer capacity: 1,000 kVA (hotel facility)
   400-V low voltage power reception (bars and pools)
   （see Figure 4.1－2 "Outline of the Power Receiving and Distribution System" for reference)

   Elevators: 4

   Lighting load: 24.978 kW (2.54 W/m^2)
7) Outline of air-conditioning systems

   Air cooled room air conditioners (split type)

   2.6 kW: 6 units, 5.3 kW: 145 units, 7.0 kW: 6 units, 9.7 kW: 19 units, 12.9 kW: 2 units
9) Sanitary facilities

Lift pumps: 2.6 kW × 5 units, Water supply pumps: 2.6 kW × 4 units
Water heating facilities: Electric heaters and boilers (for guest rooms): 3 kW
Laundry facility

10) Overall status of the hotel

Although this hotel was run by the government, it was managed by the private company.

The five-story hotel was old and it was built 43 years ago. Some of the facilities were reformed during that time. The second and third floors were guest rooms, and the first and fifth floors were equipped with restraints, halls and meeting rooms. The fourth floor was not available since it was under modification (guest rooms and reception rooms).

In the ball room on the first floor, the seminar and workshop of the PROMEEC project (Main industry) were held last year (2004).

11) Energy management

Four electricians and nine people including mechanical engineers are engaged in the control and maintenance of the equipment and facilities. However, energy management was not yet implemented to the overall organization level.

The following improvement measures were implemented so far:

① Incandescent lamps were replaced by energy saving compact fluorescent lamps.
② The water heaters in guest rooms were renewed (changed to electric heaters and boilers).
③ The air conditioners were changed from the window type to the split type and the capacity of the air conditioners was reduced from 24,000 Btu to 18,000 Btu.
④ The daily energy consumption was now recorded (from two years ago).

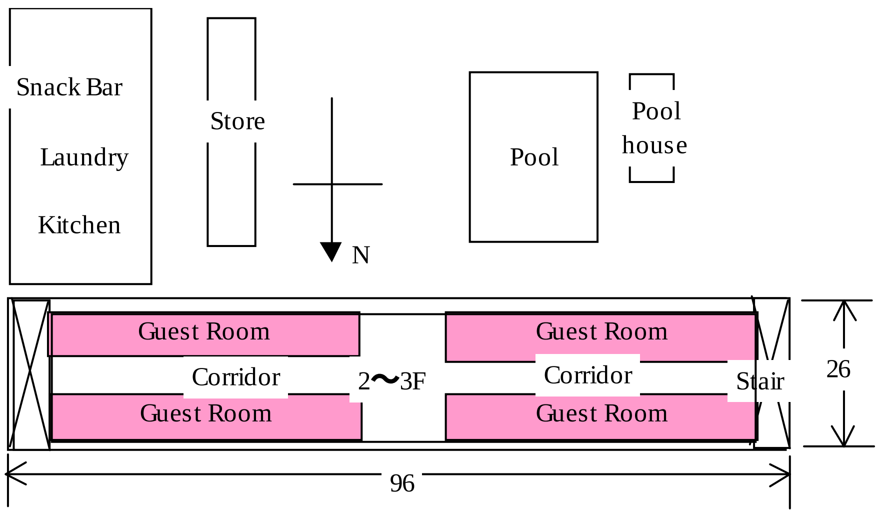


Figure 2.1－1　Structure Outline

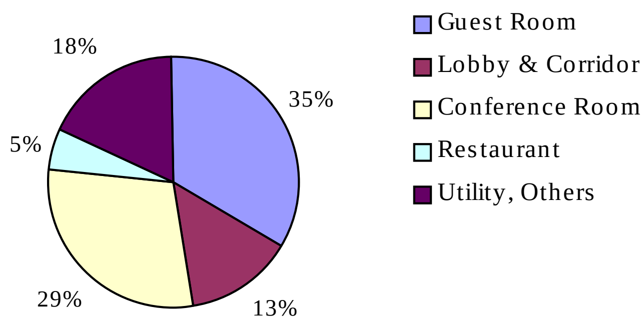


Figure 2.1－3　Rates of Floor Areas by Use

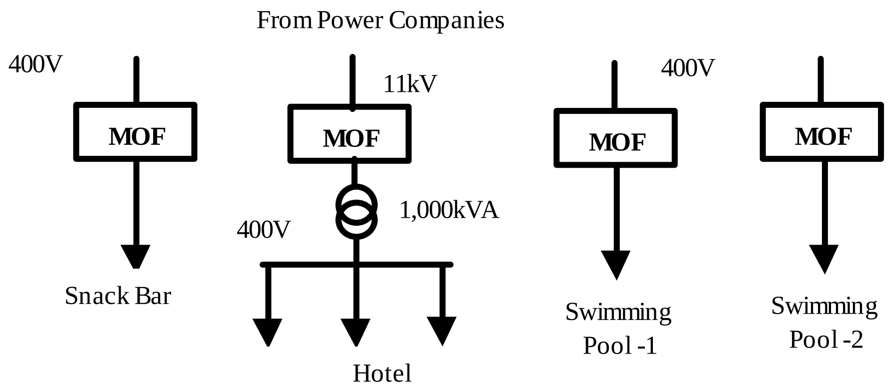


Figure 2.1－3　Outline of the Power Receiving and Distribution System

2.2 Outline of the Audit

1) Date of audit: November 7 (Monday), 2005
2) Building staff: Names unknown
3) Audit steps
   ① Transmission of a questionnaire in advance
   ② Interview (based on the questionnaire and in regard to other related items)
   ③ Checking of the facilities in the building
   ④ Collection and analysis of data
   ⑤ Brief reporting of the audit
   ⑥ Audit report (document)

Photograph 2.2－1　Snap photo During the Audit

2.3 Details about Energy Consumption and Analysis

(1) Electric Energy Consumption

1) Monthly Electric Energy Consumption (2003 and 2004)

We calculate the monthly electric energy consumption of two years and create a bar graph.

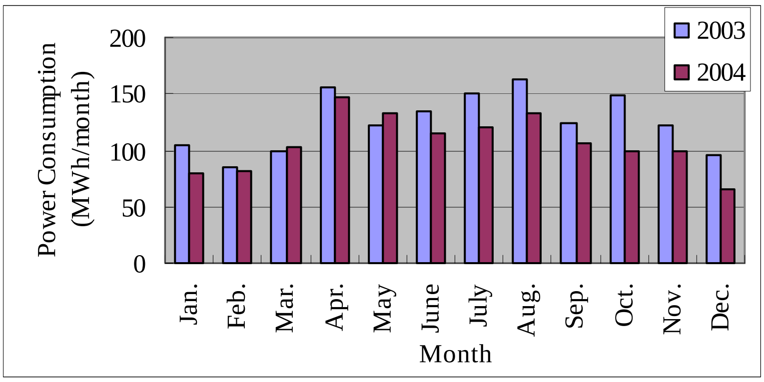


Figure 2.3－1 Monthly Electric Energy Consumption

2) Yearly changes of the electric energy intensity

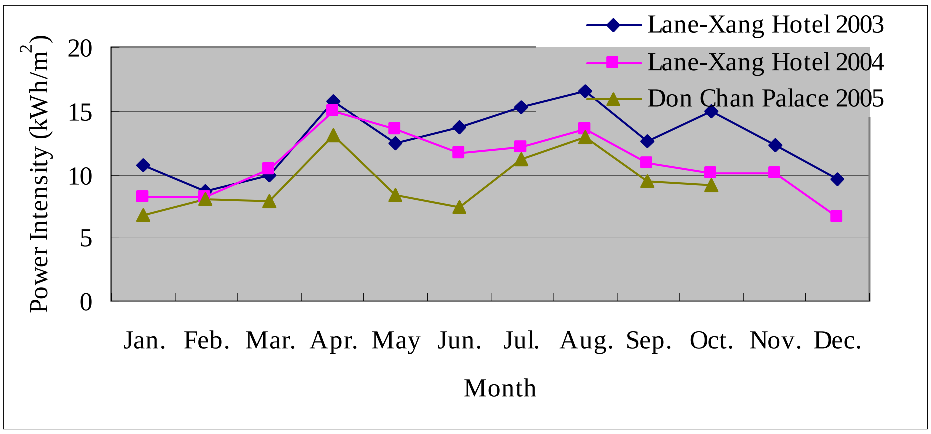


Figure 2.3－2 Yearly Changes of the Monthly Electric Energy Consumption

The above graph shows the monthly electric power consumption of Lane Xang Hotel and that of Don Chan Palace Hotel we also audited. Since the monthly changes of both hotels are almost the same, the electricity was consumed mainly for air conditioning based on temperature changes. Compared with the one in 2003, the electric energy intensity apparently decreases from June in 2004. This is probably due to the decrease in usage rate mainly caused by the reform of the fourth floor.

3) Comparison of the Power consumption among the Hotels in Laos

We compare the electric energy intensity of the hotels in the city of Vientiane including Lao Plaza Hotel we audited in 2003.

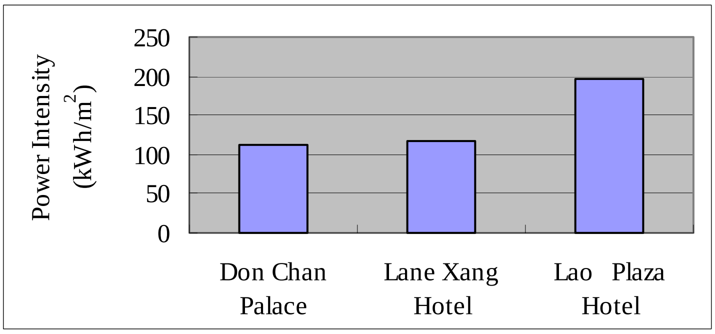
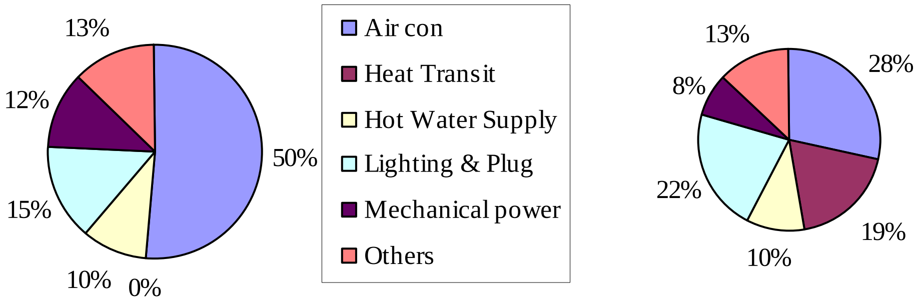


Figure 2.3－4 Comparison of Electric Energy Consumption Rates (in Vientiane City)

The energy intensity of Lane Xang Hotel and the one of Don Chan Palace are lower than the rate of Lao Plaza Hotel. This is probably because the fourth and fifth floors of Lane Xang Hotel were being reformed and the occupancy rate of the facilities in Don Chan Palace was low since the hotel was new.

4) Estimated electric energy consumption by user

We calculate the rate of energy consumed by each use based on drawings and the operation status of facilities. The calculated values should be used only for reference since some of the data is derived from experiences.



a) Electricity Use in Lane Xang Hotel b) Energy Use in a Japanese Hotel

Figure 2.3－5 Electric Energy Consumption by Use

Since this hotel is equipped with room air conditioners, there is no facility of heat conveyance. When we include this facility as part of the air conditioning system, the rate of energy used for air conditioning is almost the same as in Japan. Other elements also do not differ from the rates of Japan except for the rate of energy used for lightings which is smaller than that of Japan.

As the pie chart describes that the hotel uses 50% of electric energy for cold heat source and 15% for lightings. These areas are the first target of energy conservation.

5) Analysis of electric energy consumption

Fig.2.3-6 shows the relationship between the energy consumption by air conditioning and the outdoor air temperature since the amount of energy consumed by air conditioning is much higher than the others.

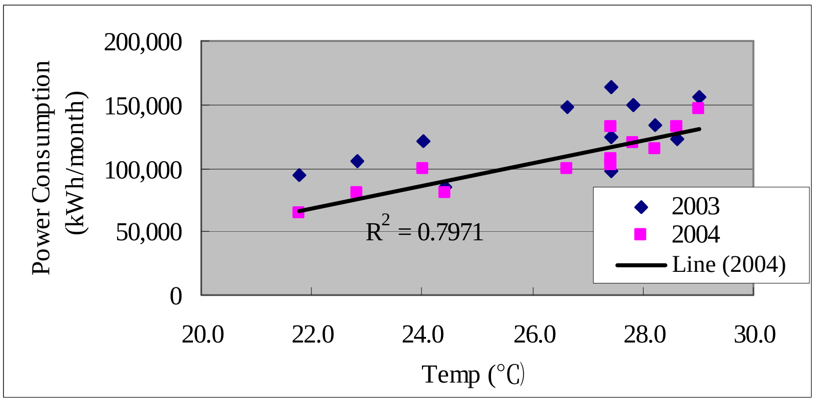


Figure 2.3－6 Relationship Between the Electric Energy Consumption and the Outdoor Air Temperature

In the data of 2004, the correlation coefficient of the temperature and the electric energy consumption is very high, R^2 = 0.7971. We may need to investigate further what this high correlation coefficient means.

(2) Water consumption

1) Trend of consumption

The amount of supplied water is measured for each purpose (hotel building (guest rooms), swimming pools, and cooking and snack bar). The following table shows the total water supply of the year 2004.

Table 2.3－1 Tap Water Supply Amount

Usage	Supply	Ratio
Hotel Building	33,477	86%
Swimming Pool	2,190	6%
Cooking & Snackbar	3,094	8%
Total	38,761	100%

Eighty six percent of water was used for the hotel building. The water was probably used for baths and toilets in guest rooms. The water used for cooking was rather small, 8%. The graphs show the monthly water supply in 2004 by use.

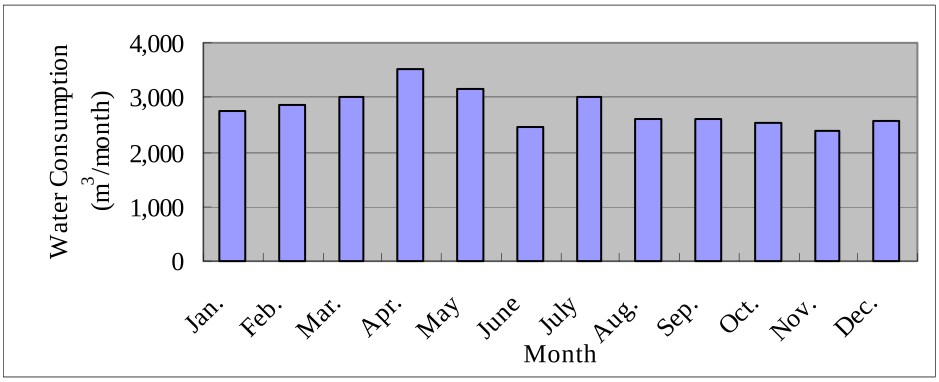


Figure 2.3－7　Water Supply Amount (Hotel Building) (2004)

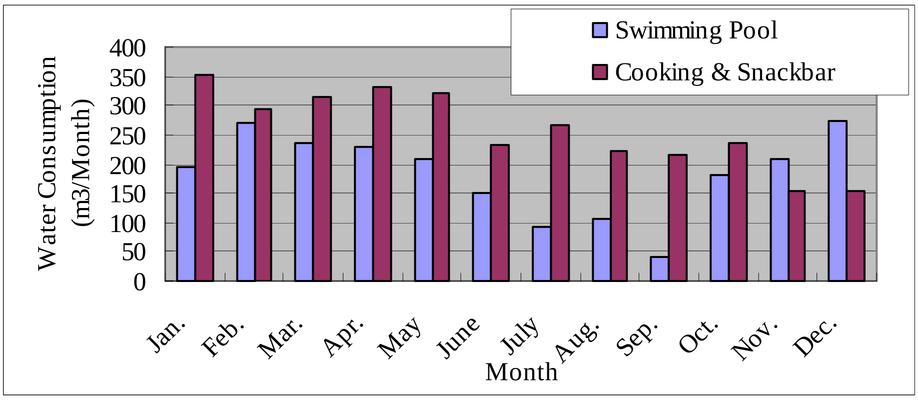


Figure 2.3－8　Water Supply Amount (Swimming Pools, and Cooking and Snack Bar) (2004)

(3) Gas consumption

The gas supply amount between January and October in 2005 is as follows:

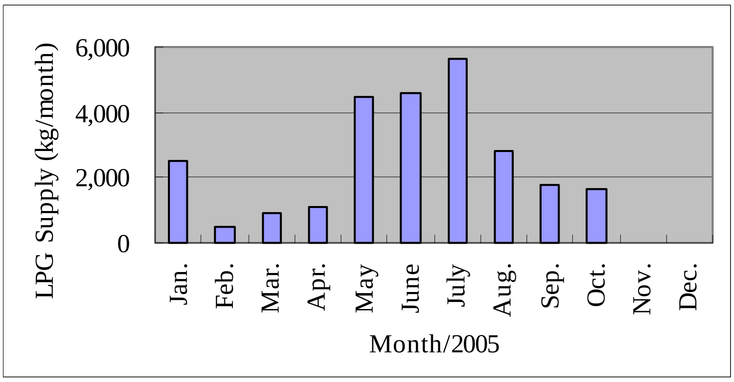


Figure 2.3－9 Gas Supply Amount

Gas was most used between May and August.

(4) Correlation between different types of energy consumption

The following table consists of the data we acquired and the temperature data. The table shows the correlation coefficients of different elements of monthly consumption.

Table 2.3－2 Correlation Between Different Types of Energy Consumption

		power			Water			LPG	Temp.
		Hotel Buil.	Pool-1	Pool-2	Hotel Buil.	Pool	Cooking		
power	Hotel Buil.	1							
	Pool-1	0.64	1						
	Pool-2	-0.10	0.62	1					
Water	Hotel Buil.	0.52	0.10	-0.34	1				
	Pool	-0.40	-0.48	-0.09	0.25	1			
	Cooking	0.29	-0.23	-0.71	0.76	0.17	1		
	LPG	-0.20	-0.51	-0.65	0.55	0.99	0.81	1	
	Temp.	0.89	0.60	-0.21	0.46	-0.46	0.33	-0.28	1

Correlation coefficients are marked with colors when an absolute value is greater than 0.5.

We detected some characteristics based on the above correlation coefficients.

① The electric energy consumption of the hotel building is closely correlated with the temperature and it is also correlated with the electric energy consumption of pool 1 and the supplied water consumption for the hotel building, which is probably due to the water consumption in baths and toilets in guest rooms.

② The supplied water consumption for the hotel is correlated with the supplied water consumption and LPG consumption for cooking, and the electric energy consumption for the hotel.

③ The gas (LPG) consumption is correlated with the supplied water consumption of pools and inversely correlated with the electric energy consumption.

④ The gas and supplied water consumption is not affected by the temperature unlike the electric energy consumption.

The conclusions are as follows:

The factors that may be strongly related with each type of energy consumption are as follows:

Electric energy:	Air conditioning in the public space in the hotel
Water:	Use of baths and toilets in guest rooms
Gas (LPG):	Use of pools and cooking

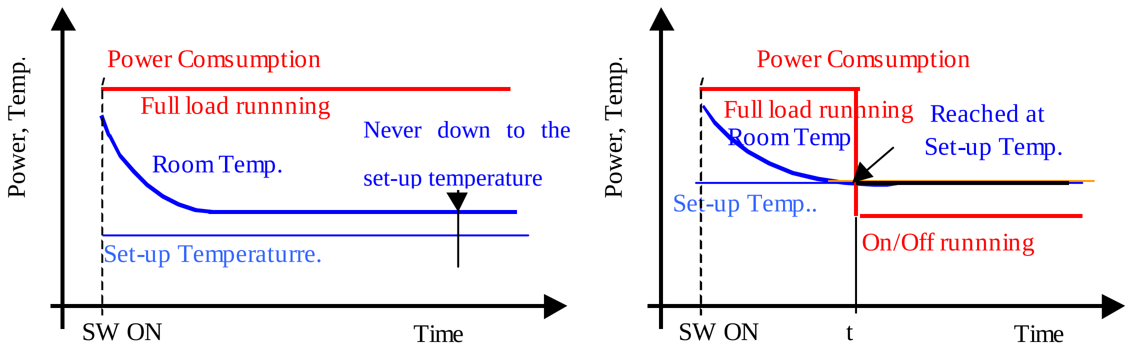
2.4 Points for Improvement and Calculated Effects

(1) Optimizing the temperature settings of air conditioners

1) Set room temperatures and consumed electric power

The initial temperature setting for air conditioners was 16°C which was too low. This is probably because the room-service staffs tend to set the temperature of air conditioners to too low temperature to satisfy guests.

However, 16°C is too low and the room temperature does not usually stay at 16°C. The following graphs show the operating status of air conditioners depending on the temperature settings:



a) When the setting is 16°C   b) When the setting is 25°C

Figure 2.4－1 Operating Status of Air Conditioners Depending on Temperature Settings

When the temperature setting is 16°C, the air conditioner runs with the maximum capacity to reach the set-up temperature. However, the room temperature stays at a certain level because the heat invaded from doors and windows become more than the cooling capacity of the air conditioner. Since the set temperature is never reached, the air conditioner continues to run fully.

When the temperature setting is 25°C, the room temperature reaches 25°C in some time. After that, the air conditioner will continue on/off operation according to the room temperature. This means the consumed electric energy is reduced.

When we assume the cooling capacity of an air conditioner in a guest room is 18,000 Btu and the COP is 2.5, the rated electric energy consumption is as follows:

18,000 Btu × 2.9307 × 10-4 kWh/ Btu / 2.5＝ 2.11 kW

When we assume the air conditioner runs seven hours continuously per day (expected run time), the electric power consumption for both temperature settings is calculated as follows:

When the temperature setting is 16°C: 2.11 kW × 7 h ＝ 14.77 kWh/d

When the temperature setting is 25°C: 2.11 kW × 0.5 h ＋ 1.05 kW × 6.5 h ＝ 7.91 kWh/d

(We assume the room temperature reaches the set temperature in 30 minutes and the air conditioner is automatically turned on and off every 30 minutes.)

This is the effect that can be obtained by standardizing the temperature setting of air conditioners as a rule of room make service in guest rooms.

2) Calculation of effects

We calculate the yearly effects assuming air conditioners are run with the initial temperature setting in 15 rooms (30% of the occupied rooms when the average occupancy rate of guest rooms is 70%).

To calculate the amount of energy conservation, we use the value calculated above.

Improvement per guest room: 14.77 kWh/d－7.91 kWh/d ＝ 6.86 kWh/d

We assume 15 rooms are not improved: 6.86 kWh/d × 15 rooms = 109.7 kWh/d

Yearly energy conservation: 109.7 kWh/d × 365 d ＝ 40,050 kWh/year

The ratio of energy conservation to the total electric energy consumption is as follows:

40,050 kWh/year / 1,280,200 = 0.031

(2) Lighting control using human body sensors

1) Outline of the operation

The purpose of lighting is to illuminate the areas where people work and to ease the working except for special cases such as crime prevention. Therefore, energy conservation is achieved by turning off or dimming lights when there are no people. Human body sensors automatically perform this function. The figure shows how a human body sensor works.

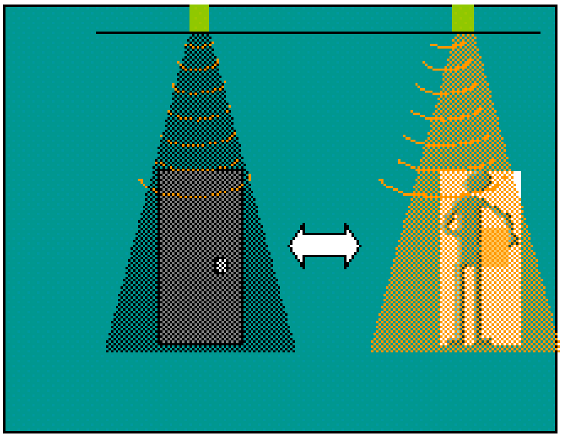


Figure 2.4－2 Lighting Control Using a Human Body Sensor

When the door opens, the sensor detects a human being and turns on the light. Main applications for human body sensors are in toilets and staircases. One example is to turn on half number of the lamps at regular time and turn on all the lamps when a human body is detected. You can install a human body sensor in a working area to prevent missing of turn-off lights, for example. This kind of light turn-on/off system with a human body sensor is also installed in kitchens in some cases for hygiene reasons.

2) Calculation of effects

We calculate the effects of controlling the lights in toilets as an example.

Let's assume we want to install human body sensors in four toilets. Fifty percent of the lamps (5 W, 8 lamps) should be turned off when there are no people. We assume half of the lamps are turned off for 50% of the time.

Amount of energy conservation per day: 5 W × 8 lamps × 12 hours/day × 4 toilets ＝ 1,920 W/d

Yearly energy conservation: 1,920 W/d × 365 d/year ＝ 700.8 kWh/year

The ratio of the yearly energy conservation to the total electric energy consumption is as follows:

700.8 kWh/year / 1,280,200 = 0.005

(3) Decreasing the solar heat gain load

1) Solar heat gain load

In the regions at low latitude, the sun is high and the direct sunlight from south windows is easily prevented using eaves and sleeve walls. However, some measures must be taken to prevent the sunlight to the roof and the direct sunlight when the sun is low in position in early mornings or early evenings.

The following graph shows the design solar gain in summer in Naha city which is located at the lowest latitude in Japan (close to the latitude of Vientiane) (referring to "Calculation method for the Maximum Design Heat Load" by The Society of Heating, Air-Conditioning and Hygienic Engineers of Japan).

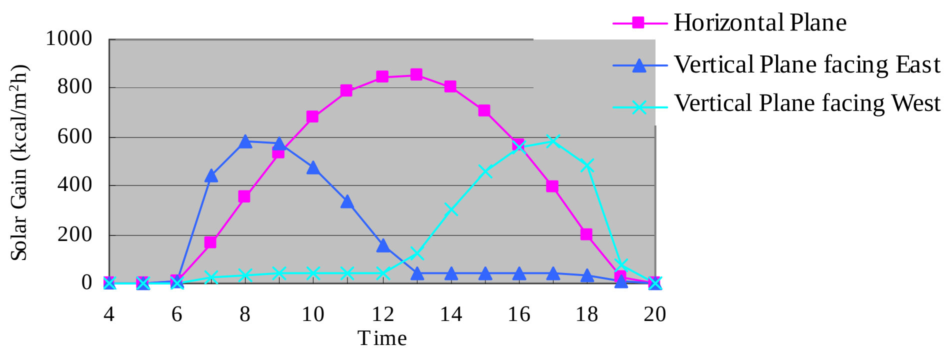


Figure 2.4－3 Solar heat gain Status in Summer (in Naha City)

The maximum horizontal solar heat gain is about 800 kcal/m^{2}h and the maximum vertical solar heat gain due to the morning sun or the evening sun is about 600 kcal/m^{2}h. To minimize the solar heat gain due to the morning sun and the evening sun, buildings should be built by avoiding the openings and windows in the east and west. The hotel was built in this way.

Here, we discuss the heat load from the roof, which is the main heat load for the fifth floor.

We have data regarding the temperature rise on the ground surface caused by solar heat gain in relation to the temperature rise on the roof.

The following graph shows the changes of the temperature rise caused by solar heat gain depending on the status of the ground.

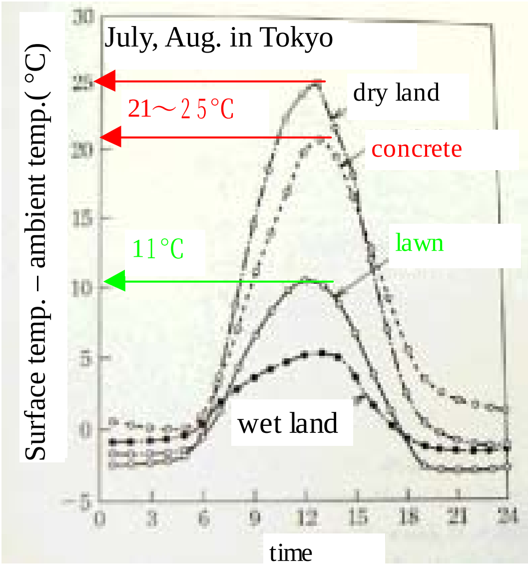


Figure 2.4－4　Temperature Rise on the Ground Surface Caused by Solar heat radiation

The condition of the roof is similar to concrete or dry soil. Therefore, the temperature of the roof is raised up to the ambient temperature plus 20 to 25°C. When we assume the daytime temperature of Vientiane is 35°C, the temperature of roof tiles is 60°C. The heat transferred to the inside of the building through the ceiling of the fifth floor as transfer heat.

To reduce the amount of transfer heat, the roof system should be improved to reduce the temperature rise (growing plants on the roof, applying heat-resisting paint, etc.) or the heat insulation of the roof should be improved The first option is recently tested in many cities of Japan. Now, we consider the second option of enhancing the heat resistance of the roof.

The following figure shows a sample structure designed to calculate the heat load of the roof and the ceilings. Although this roof system might differ from the actual one of this building, it is shown as the example to calculate the effect of heat resistance.

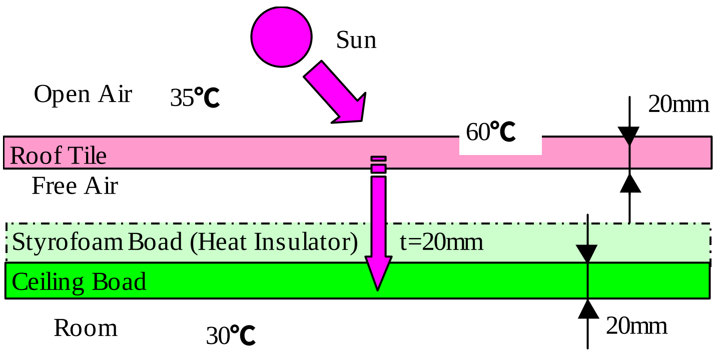


Figure 2.4－5　Structure Model for Calculating the Heat Resistance of

the Roof and the Ceiling

The solar heat entering the roof goes through the roof and the ceiling materials, and reaches the ceiling surface. After that, the heat raises the indoor temperature by convection.

We assume the temperature of the roof is To, the temperature of the ceiling surface is Tc, the indoor temperature is Tr, the overall heat transfer coefficient is K (kcal/m^{2}h°C), and the heat transfer rate from the ceiling surface through natural convection is αi (kcal/m^{2}h°C). The following formula is established in regard to the heat flow:

$$K \times (To - Tc) = \alpha i \times (Tc - Tr)$$

The overall heat transfer coefficient is a constant that is determined from the materials and the structure of the ceiling. The following table shows the related constants used for the calculation.

Table 2.4－1　Constants for Calculating the Heat Load

Thermal Conductivity	mh°C/kcal
Roof Tile	0.86
Styrofoam Boad	0.032
Laminated Wood	0.16

Heat Transfer Coeffcient		kcal/m^{2}h°C
Roof	αo	20
Ceiling	αi	5.3

When we use the model, the overall heat transfer coefficient K_1 is as follows when there is no heat insulation material:

$$K_1 = 1 / (1 / \alpha o + tr / \lambda r + Ra + tc / \lambda c)$$

$$= 1 / (1 / 20 + 0.02 / 0.86 + 0.08 + 0.02 / 0.16) = 3.594$$

Here, tr is the thickness of the roof and tc is the thickness of the ceiling. λr and λc are thermal conductivity coefficients. Ra is the thermal resistance of air and we assume it to be 0.08 m^{2}h/ kcal. Other values are mentioned in the above table.

When the temperature of the roof is 60°C and the heat transfer rate of the ceiling surface is $\alpha i = 5.3$ kcal/m^{2}h°C, the temperature of the ceiling surface is about 42°C and the amount of transfer heat is 64 kcal/m^{2}h.

When we insert polystyrene foam heat insulation, the overall heat transfer coefficient K_2 is as follows:

$$K_2 = 1 / (1 / 20 + 0.02 / 0.86 + 0.08 + 0.020 / 0.032 + 0.02 / 0.16) = 0.944$$

The temperature of the ceiling surface is about 35°C and the amount of transfer heat is 27 kcal/m^{2}h.

By inserting a heat insulation material, the transfer heat is reduced to 27 / 64 = 0.42 (42%). This value is the amount of energy conservation for air conditioning systems.

2) Calculation of effects

In this section, we think about controlling the room temperature to 30°C with the above conditions (To ＝ 60°C).

For the room temperature, we assume 30°C (in average), which is rather high, in the consideration that the fifth floor is used only about five times a month. First, we assume the roof temperature is 60°C and the applicable hours are five hours to make it simple to calculate the daily heat load.

Since the amount of transfer heat without heat insulation materials is 64 $kcal/m^2h$ and the amount of transfer heat with heat insulation materials is 27 $kcal/m^2h$, the amount of energy conservation is 37 $kcal/m^2h$. Since the roof area of the fifth floor is 1,512 m^2:

Improvement per hour: 37 $kcal/m^2h$ × 1,512 m^2 ＝ 55,944 kcal/h

Assuming COP =2.5 for air conditioning, the electric energy to be reduced (Es) is as follows:

Es = 55,944 kcal/h × 1.163 Wh/kcal / 2.5 / 1,000 = 18.92 kW

We multiply this value by (5 hours × 365 days) as the length of equivalent solar heat gain of one year.

Amount of yearly energy conservation: 18.92 kW × 5 h × 365 d ＝ 34,522 kWh/year

The ratio of the energy conservation to the total electric energy consumption is 34,522 kWh / 1,280200 kWh ＝ 0.0270.

(3) Organizing the power receiving system

At the time of the audit, the hotel received power through multiple power lines (one system of 11 kV and three systems of 400 V). Two measures for efficient supply of electric power are as follows:

① Power should be sent in high voltage up to the point close to the required load.

② Invalid power should be reduced by increasing the power factor.

The purpose of these measures is to reduce the current that runs through the power lines and reduce the ohm loss (I2R) generated there. From this point of view, the 400-V power receiving systems are inefficient. It is more energy saving to provide electricity from the secondary transformer for receiving power in the building. In addition, the loss in the transformers for power distribution and the power lines can be reduced by installing a low voltage capacitor for improving the power factor.

The following figure shows an improved single-line diagram.

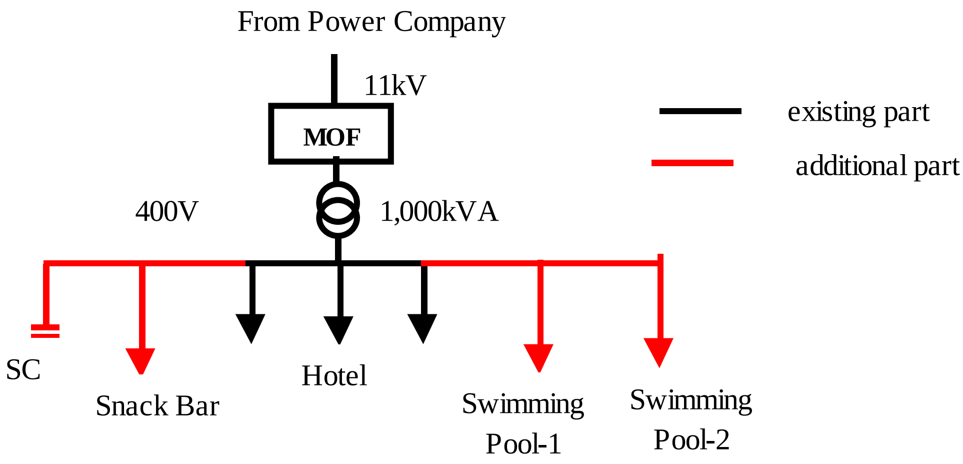


Figure 2.4－6 Proposed Single-Line Diagram

Here, we describe the load status of the 1000-kVA transformer for receiving power. We need to estimate the daily load curve since it is not available. We assume the load factor (＝ maximum electric power/average electric power) is 2. Based on the received electric energy in 2004, the maximum received electric power is 409 kW. We assume the power factor is 80%. The apparent electric power transformed by the transformer is 500 kVA and the demand factor (maximum electric power/transformer rating) is 50%. Since the demand factor is rather low, the transformer can take the electric power from the 400-V power receiving systems without problems. Note that improving the power factor to reduce the power distribution loss or the loss in transformers is an inexpensive and easy way to save energy.

We cannot calculate the effect of this measure. However, the measure can be applied without problems and we hope the hotel takes this measure as part of the energy conservation activities.

(4) About energy management

The first step for the energy conservation is measuring. For this step, the hotel collected and managed daily data and monthly data. The next step is to use (analyze) the collected data and utilize these data for the energy conservation to expand the activity. We have some comments on this.

1) Acquiring the daily load curve and points for improvement

Every activity has the proper timing to execute it. To determine the timing, you need the daily load curve which indicates the timing when the related electric power is required.

Basically, you can create a daily load curve by recording the indications of a watt-hour meter every hour. However, the indications may be rough and include errors.

A watt-hour meter is the best measuring equipment to get the daily load. However, you can also check the rotation speed of the disk of a watt-hour meter and estimate the daily load curve based on the current values as an alternative method (see the appendix for details).

The following graph is an example daily load curve of the hotel.

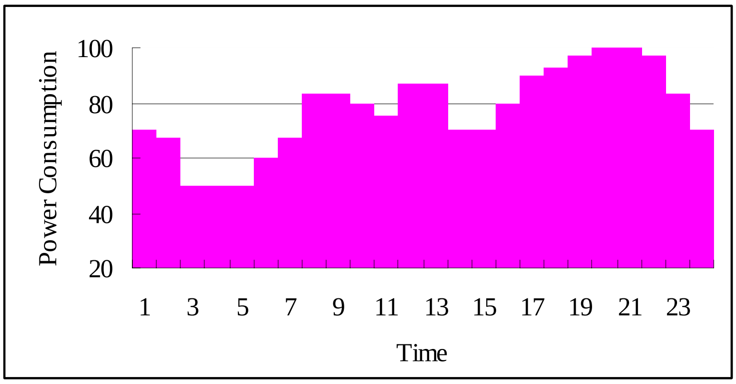


Figure 2.4－7　Example Daily Load Curve

From this daily load curve, you can consider cutting back the peak electric power, optimizing the electric power consumption in the nighttime and the daytime, reducing the preparation and clean-up time for banquets, etc. as the issues to be addressed for energy conservation.

2) Analyzing energy

You determine the energy consumption and water consumption by use, and analyze the relationship between the consumption and the results of particular use and the relationship with other types of energy consumption.

For example, you can investigate the relationship between the electric power consumption in guest rooms and the number of guests or the relationship between the electric power consumption and the water consumption.

By this analysis, you can determine the optimal values to be kept, set up the standards, and build an energy management system.

3) Expanding the energy management activities to all the groups in the hotel

The energy consumption in conference halls greatly differs from that of guest rooms. The energy consumption in kitchens and laundries is also special. Therefore, to achieve a highly accurate energy management, the energy consumption information in each department is required. In another hotel, the electric energy of guest rooms on each floor is measured and managed.

The all-group-involved energy conservation activity is achieved through the cooperation from the staffs of each applicable department. To enable this activity, decision making and policies set by the top management may be required since each department must cooperate with each other.

In addition, results may need to be presented in concrete manner. That is why the measurement system is important.

When the effects are realized, the PDCA cycle works efficiently, which is a barometer for the promotion of activities. The PDCA cycle is an essential process for enhancement of the activities. The PDCA cycle is shown below.

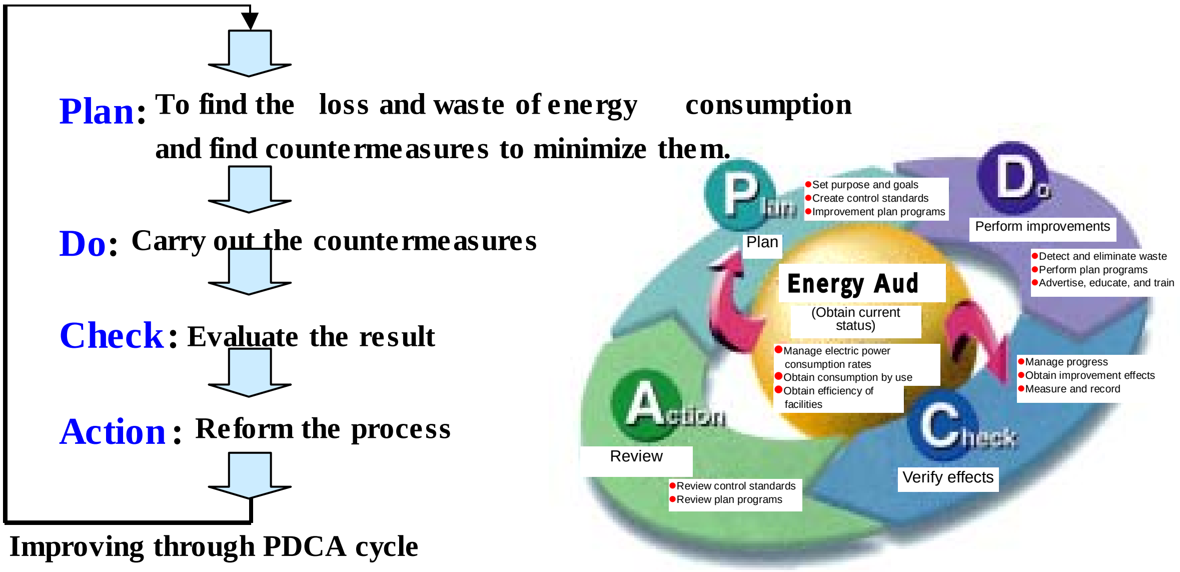


Figure 2.4－8　PDCA Cycle

3) Calculation of effects

According to the Japanese statistics, approx. 5% energy conservation in average is achieved by performing organized energy conservation activities based on data. We use this value as the effect of the improved energy management.

Annual electric energy consumption × 5% ＝ 1,280,200 kWh/year × 5% ＝ 64,010 kWh/year

2.5 Other Related Points

1) Installing a watt-hour meter

In order to pursue further energy conservation with specific devices, an energy manager requires measurement devices for investigations. We recommend a watt-hour meter with a recording feature.

The suitable watt-hour meters are available from measurement manufacturers and the devices allow you to enter data directly into a personal computer and analyze the data. The watt-hour meters are equipped with features to make different kinds of measurements such as higher harmonics and distortion rates. The following figure shows the watt-hour meter manufactured by H company and it costs about 400,000 yen.

Figure 2.5－1　Watt-hour meter with a Recording Feature

2) Ventilation in the meeting rooms (air ventilation performance and energy conservation)

Intake of excess external air increases the heat load of air conditioning and it must be optimized. To evaluate the external air intake, there is a general method of measuring the CO2 concentration in energy conservation audits. We performed this measure as an OJT.

After about two hours since the beginning of a meeting, we measured the CO_2 concentration in the meeting room. The result was 1,400 ppm. The CO_2 concentration with adequate external air intake is about 800 ppm. The measured value exceeds this value. The standard CO_2 concentration set for the building management laws of Japan is 1000 ppm. The measured value exceeds this value as well. However, 1000 ppm is not an absolute limit. The CO_2 concentration should follow the indoor environment standards and judgments in Laos. If Lane Xang Hotel employs the Japanese standard, they need to take in more external air and improvements are required. More air ventilation means increased energy when passive air conditioning is not available. This is a problem from the view point of energy conservation.

The important thing is to clarify your purpose. Energy cut by ignoring the purpose is not energy conservation. Energy conservation should be performed after fulfilling the standards for the set purpose. The indoor environment standard to be satisfied in this hotel should be based on the management policy of the hotel. Energy conservation is not just about reducing energy consumption.

2.6 Summary

(1) Points for improvement and the results of calculated effects

The following table summarizes the contents of Section 2.4, "Points for Improvement and Calculated Effects".

Table 2.6－1 Points for Improvement and the Results of Calculated Effects

No	Recommendation	Energy conservation kWh/year	Ratio %	Money saving k Kips/year
1	Raising Set-up Temperature of Room A.C	40,050	3.1	33,081
2	Installing of Human Sensor (Example: on Toilet)	701	0.05	579
3	Reducing of Solar Gain through Roof	34,522	2.70	28,515
Subtotal		75,273	5.9	62,175
4	Further improvement by the effective Energy Management	64,010	5.0	52,872
Total		139,283	10.9	115,048

Note: Conversion is made assuming 826 Kips/kWh.

In addition to the items in the above table, we also proposed the following:

① Unify the receiving power systems to the high voltage receiving system and install a low voltage capacitor.

(2) Other comments (advice)

The summary of Section 4.5, "Other Related Points" is as follows. We hope you will

consider them as well as the above points for improvement.

① We recommend a full system of measurements and the preparation of watt-hour meters with a recording feature.

② The air ventilation in meeting rooms may need to be improved.

Appendix　Measuring the Electric Power Using a Watt-Hour Meter

Here, we explain how to measure electric power using a watt-hour meter for supplied electric power.

The photograph shows a watt-hour meter for supplied electric power for measuring the electric power for pools.

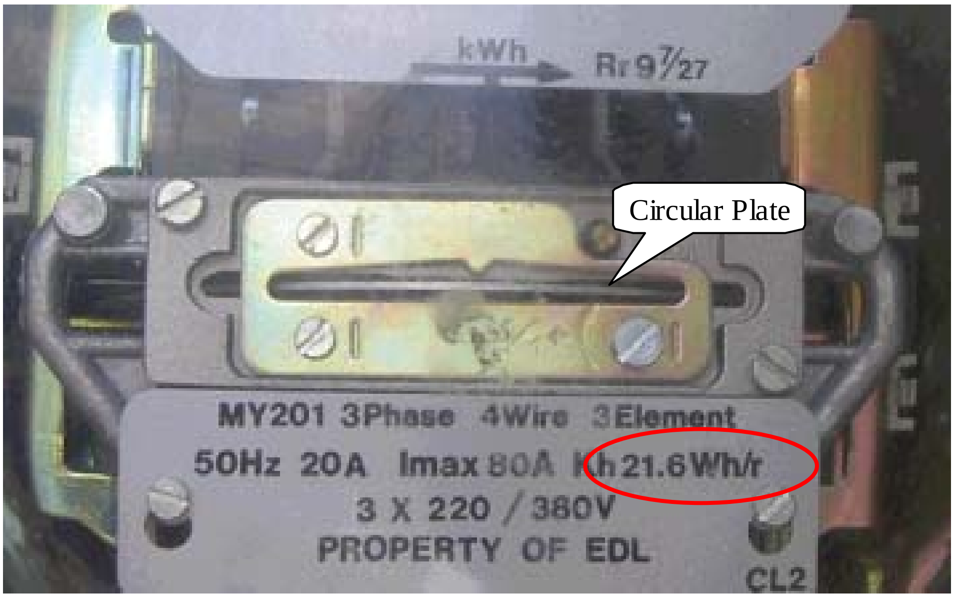


Figure 2.A－1　Watt-Hour Meter for Supplied Electric Power

Usually, there is a disk with a black mark rotating near the display which shows electric energy. The specifications of the meter are written near the disk.

In the specifications of the watt-hour meter, check "21.6 Wh/r" (circled). This indicates the disk needs 21.6 Wh of electric energy to make a full turn. Therefore, you measure the rotation speed of the disk to measure the electric power at that time.

To measure the rotation speed of the disk, use the black mark on the disk. You can use any kind of method to measure the speed. For example, you can measure the length of time taken before the disk turns ten times. If the time is 90 seconds, you convert the length of time to the rotation count per hour as follows:

10 turns × 60 seconds × 60 minutes / 90 seconds (measured value) ＝400 turns/hour

In this case, the electric energy consumption is calculated as follows:

21.6 Wh/r × 400 r/h ＝ 8.64 kW

You can find a similar indication on other watt-hour meters. Use the found value. In some cases, the unit is reversed like "1.5 r/kWh". In this case, you need to use a reciprocal number like "1/1.5 r/kWh ＝ 667 Wh/r" and calculate in the same manner for the rest.

3. Energy Audit of Don Chan Palace Hotel

3.1 Outline of Don Chan Palace Hotel

1) Name of the building: Don Chan Palace
2) Owner: Sum Holding Co., Ltd. Malaysia
3) Location: Unit 6, Piawat Village, Sisattanak District, Vientiane Lao PDR
4) Use: Hotel and conference hall
5) Size: Fourteen floors above the ground
   Number of guest rooms: 218 (see Figure 3.1－1 "Structure Outline" for reference)
   : Total floor area: 33,000 m^2
   : Air-conditioned area: 29,700 m^2（The parking lot was outside the building and not air-conditioned.)
6) Age: One year old (opened in January 2005)

Photograph 3.1－1 Don Chan Palace

7) Outline of electrical systems: Service voltage: 22 kV, Transformer capacity: 1,000 kVA × 2 units, 800 kVA × 2 units, Power distribution method: 3-phase, 4-line (380 V/230 V)(see Figure 3.1－2 "Outline of the Power Receiving and Distribution System" for reference)
   Elevators: 5
   Escalators: 11 kW × 2 units
   Lighting load: 218.7 kW (6.63 W/m2)
   Emergency generator: 890 kW
8) Outline of air-conditioning systems (see Figure 3.1－3 "Outline of the Air Conditioning System" for reference)
   Water-cooled chillers: 315 kW × 3 units, Cooling towers: 15 kW × 3 units,
   Cooling water pumps: 45 kW × 4 units, Cooled water pumps: 45 kW × 4 units
   AHUs: 40 units (193.7 kW), FCUs: 558 units (52.8 kW)
   Hot water pumps: 3 kW × 4 units, 2.2 kW × 4 units, 1.5 kW × 4 units

9) Sanitary facilities: Lift pumps: 15 kW × 4 units, 4 kW × 2 units
Water heating boilers (diesel oil): 2 units
Laundry facility

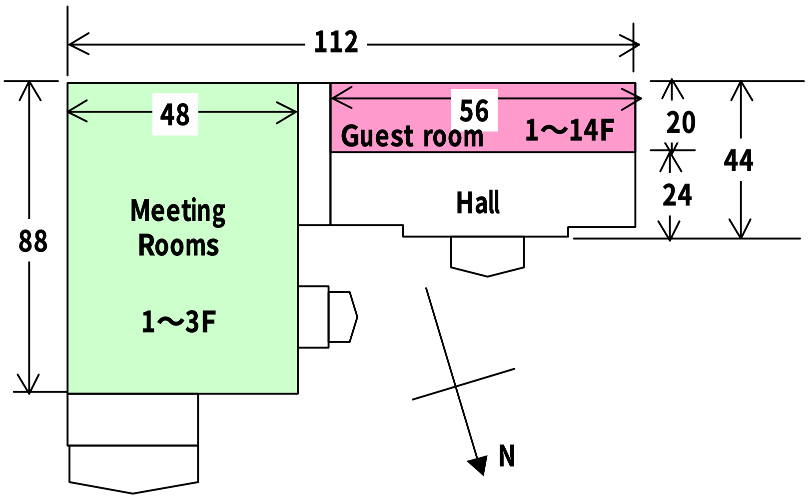


Figure 3.1－1 Structure Outline

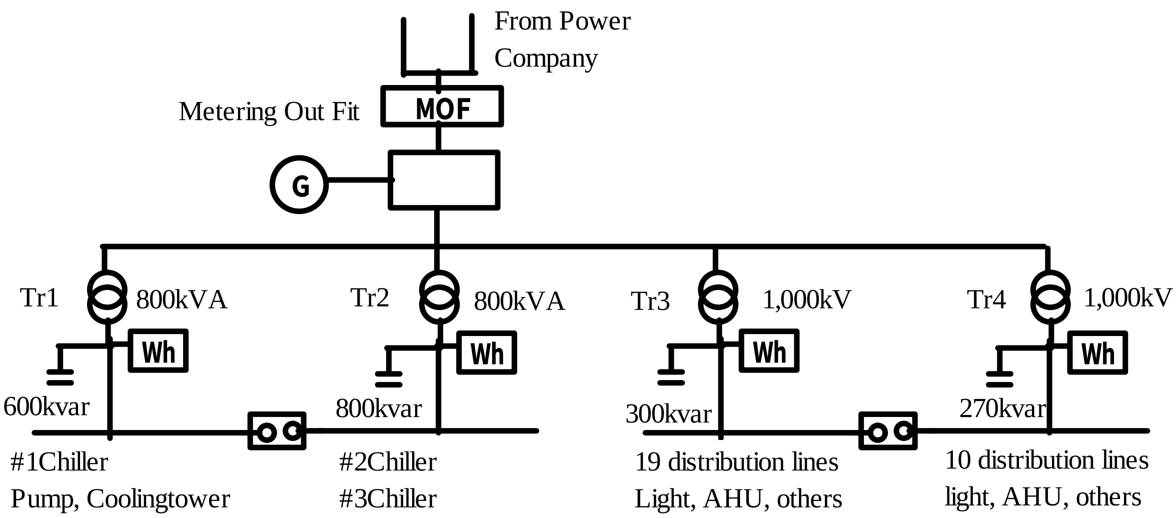


Figure 3.1－2 Outline of the Power Receiving and Distribution System

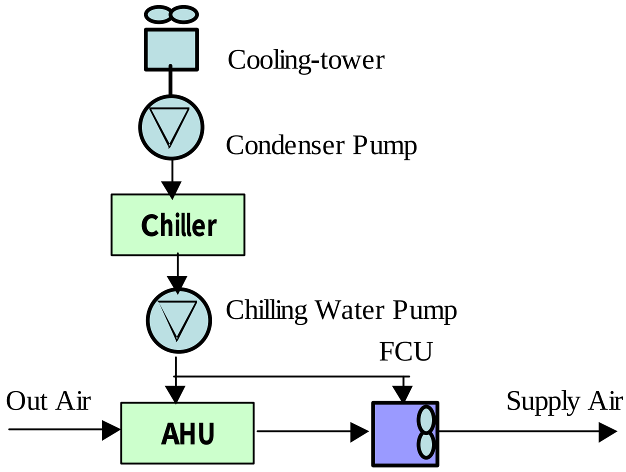


Figure 3.1－3　Outline of the Air Conditioning System

3.2 Outline of the Audit

1) Date of audit: November 9 (Thursday), 2005
2) Building staff: Mr. Bounthong Keovongsa (Chief of the Engineering Department)
3) Audit steps
   ① Transmission of a questionnaire in advance
   ② Interview (based on the questionnaire and in regard to other related items)
   ③ Checking of the facilities in the building
   ④ Collection and analysis of data
   ⑤ Brief reporting of the audit
   ⑥ Audit report (document)

3.3 Energy Management System

1) Outline

Mr. Bounthong, the Chief Engineer, was a leading person in the field of energy conservation for buildings and he always participated in the PROMEEC project in Laos.

He started to work in this hotel only two months ago and he was still working on creating the maintenance system for facilities and the system for collecting energy data. Therefore, the submitted energy data was insufficient.

At the seminar which was held two days after the audit, Mr. Bounthong presented a specific guideline for the energy conservation activities to be conducted at Don Chan Palace Hotel. Part of the guideline is shown below. The guideline shows the control values for the illuminance of lightings.

Typical Recommended Footcandle Values

Auditorium (Variable on dimmers)
Assembly only .... 0 to 50
Exhibitions .... 30 to 80
Dancing .... 2 to 10

Bars and Cocktail Lounges
(Intimate) .... under 4

Bathrooms
Mirror 40
General 15

Bedrooms
Reading (Books, magazines, newspapers) 50
Writing 50
Make-up* 30
General 10

Corridors and stairs .... 5 to 20

Dining areas
Cashier 50
Intimate type - -
Light environment .... over 10
Subdued environment .... Under 3
For cleaning 30
Leisure type - -
Light environment .... over 30
Subdued environment .... Under 15

Dining areas
Quick service type - -
Bright surroundings 100
Normal surroundings 50

Entrance Foyer 30

Front office 50
Kitchen : Work station areas .... 30 to 50
Inspecting, checking, pricing 70
General, non-work station .... 10 to 30

Figure 3.3－1　Part of the Guideline (Control Standard for Lightings)

In addition to managing lightings, Mr. Bounthong created action plans for energy conservation activities and specific management activities for guest rooms, the kitchen and the laundry.
The building was an international meeting place with the largest hotel facility in Laos. Although the building had no high-tech facilities, it was fully equipped with air conditioning and water heating facilities. The floor area for exhibition halls and conference halls was especially large. The following graph shows the rates of floor areas by use.

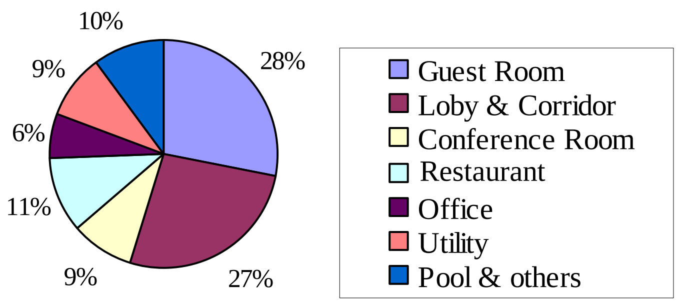


Figure 3.3－2　Rates of Floor Areas by Use

2) Organization chart

The hotel had sufficient staff and an adequate organization as shown below.

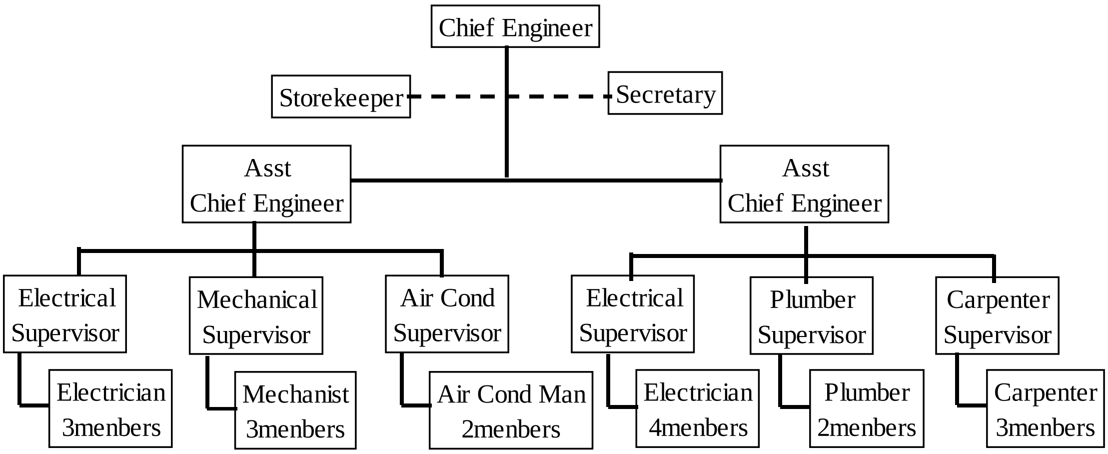


Figure 3.3－2　Organization Chart for Managing Facilities

3.4 Details about Energy Consumption and Analysis

(1) Electric energy consumption

1) Monthly changes (January to October in 2005)

We calculate the monthly averages of the yearly electric energy consumption and create a bar graph.

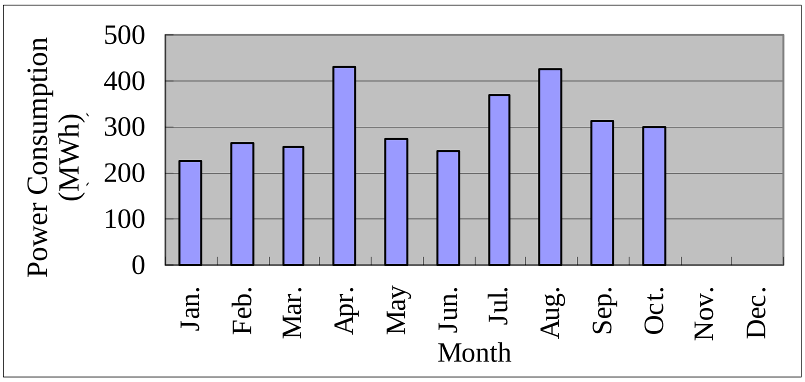


Figure 3.4－1　Changes of Monthly Electric Energy Consumption

2) Yearly changes of the electric power consumption rate

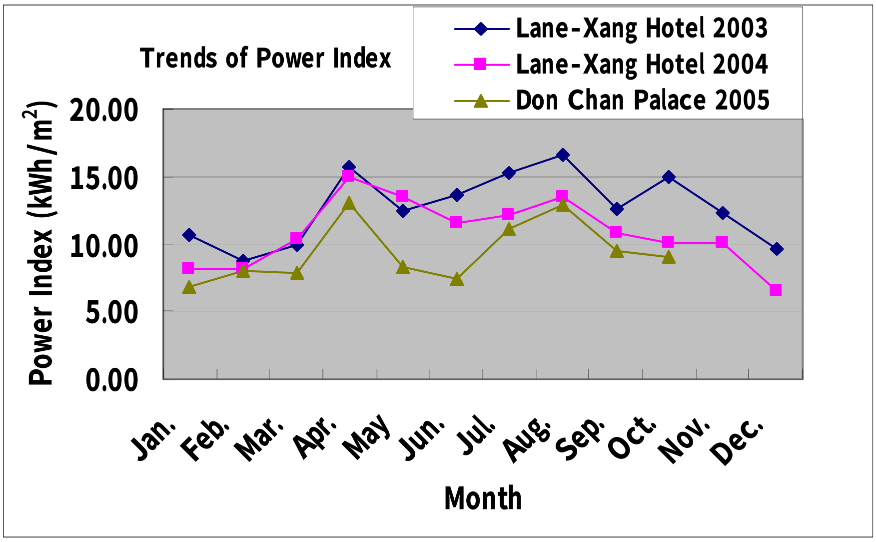


Figure 3.4－2 Yearly Changes of the Electric Power Consumption Rate

We divide the electric energy consumed each month by the total floor area and determine the electric power consumption rate.

We present the rate of Don Chan Palace Hotel along with the rate of Lane Xang Hotel we audited at the same time. Since the monthly changes of electric power consumption of both hotels almost match, the electric energy was consumed mainly for air conditioning based on temperature changes. However, the rate of Don Chan Palace drops greatly in May and June.

3) Comparison of Hotels in Laos

We compare the electric power consumption rate (divided by total floor area) of Don Chan Palace Hotel, Lane Xang Hotel, and Lao Plaza Hotel we audited in 2003.

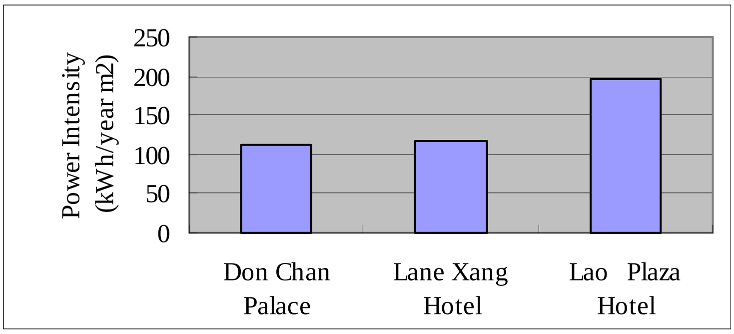
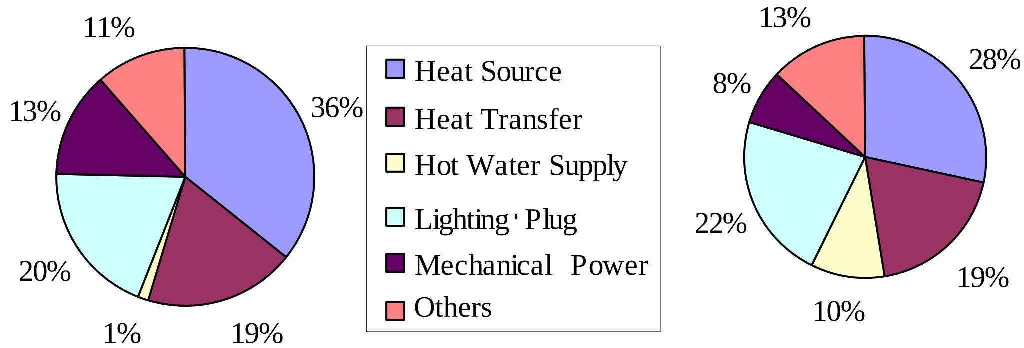


Figure 3.4－4　Electric Energy Consumed per Unit Floor Area

The intensity of Don Chan Palace and Lane Xang Hotel are lower than that of Lao Plaza Hotel. This is probably due to the fact that the facilities of the hotels were underused (the fourth and fifth floors of Lane Xang Hotel were being reformed).

4) Estimated electric energy consumption by user

We calculate the rate of energy consumed by each user based on drawings and the operation status of facilities. The calculated values should be used only for reference since some of the data is derived from experiences.



a) Electricity Users in Don Chan Palace　　b) Energy Users in a Japanese Hotel

Figure 3.4－4　Electric Energy Consumption by User

The left pie chart shows that 49% of electricity is used for cold heat source and 25% is used for lightings in Don Chan Palace. These areas are the target of energy conservation.

The energy for water heating is rather small since Don Chan Palace used an oil-fired water heating system. We could not obtain the amount of energy derived from fuel since the amount of fuel was not measured at the time.

5) Analysis of electric energy consumption

We create a graph showing the relationship between the energy consumption by air conditioning and the outdoor air temperature since the amount of energy consumed by air conditioning is excessively high.

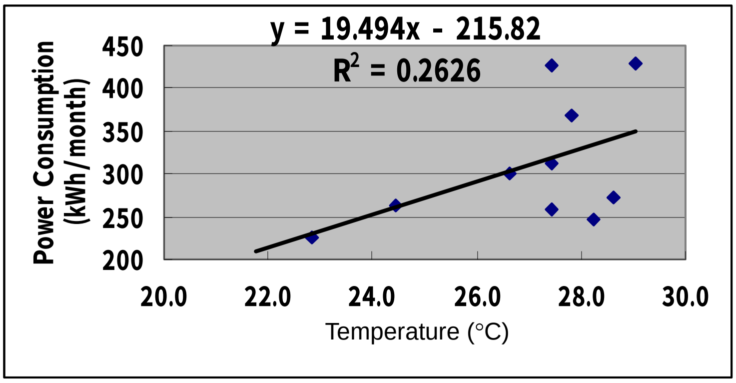


Figure 3.4—5 Relationship Between the Electric Energy Consumption and the Outdoor Air Temperature

Although the correlation coefficient (R^2) is still low, it indicates the energy consumption depends on the outdoor air temperature.
We investigated other elements as well. We checked the correlation between the water consumption or the number of banquets and the energy consumption, and both correlation coefficients are low. We performed a multiple regression analysis by adding the number of banquets to the outdoor air temperature. The correlation coefficient is R^2=0.2365 and correlation is not improved. We need more data to obtain a full analysis.

(2) Water consumption

1) Trend of consumption

We chart the monthly averages of water consumption in 2005.

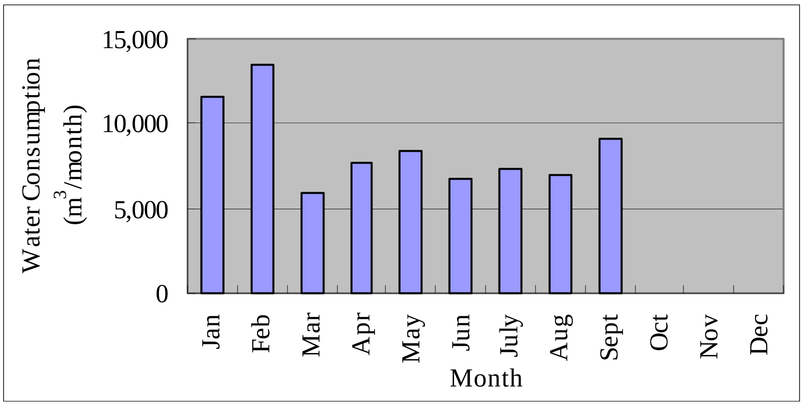


Figure 3.4－6　Changes of Water Consumption

2) Correlation between electric energy consumption and water consumption

Generally, water consumption depends on the number of guests and the number of events. We acquired the number of banquets and checked the correlation with the water consumption.

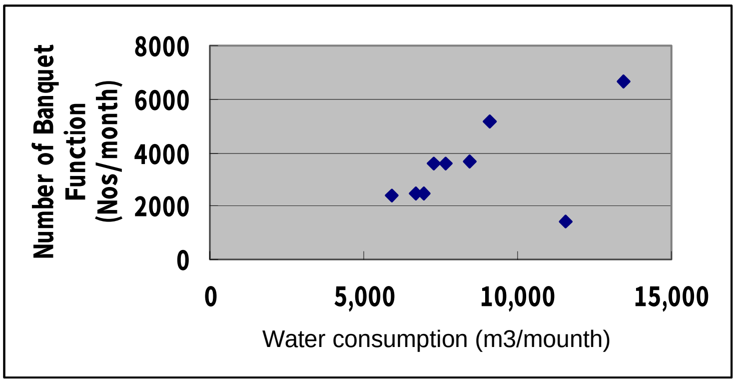


Figure 3.4－7　Correlation Between the Number of Banquets and the Water Consumption

The dots that are not in correlation, come from the data of January when the hotel began operation. Those dots can be eliminated as irregularities. Since we can see a clear correlation, the number of banquets can be used as an index to indirectly show the water consumption.

3.5　Points for Improvement and Calculated Effects

(1) Cooling water temperature setting for turbo chillers

Although the hotel probably expected future expansions, the existing facilities were excessive and only one chiller was running currently. On the day of the audit, the load of air conditioning was small. Judging from the consumed electric power, even one chiller was excessive and the chiller was needed only partially. From this incident, we thought the partial operation of facilities was a key to energy conservation.

As shown in the following graph, in Laos, the summer temperature and the winter temperature differs about 7°C. Therefore, the operation of turbo chillers should take the variance in the load of air conditioning into consideration for different seasons.

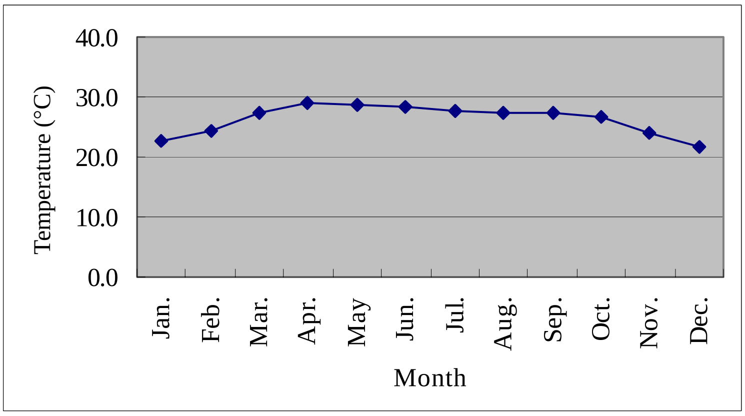


Figure 3.5－1 Yearly Temperature Changes in Vientiane

The following conditions are required to increase the COP during the operation of turbo chillers:

・ The load factor (= performance rate) must be large.
・ The temperature of cooling water must be low.
・ The temperature of chilled water must be high as much as possible.

The reduction in consumed electric power is determined as follows:

Total power ＝ power of cooling water pumps ＋ power of cooling towers ＋ power of chillers

Therefore, all the devices must be taken into consideration. Generally, turbo chillers with speed control produce less total power if no cooling tower is controlled. However, the total power is smaller by controlling the number of cooling towers if turbo chillers are equipped only with suction vane control.

1) Energy conservation by increasing the temperature of chilled water

The following graph shows the relationship among the temperature of cooling water, the temperature of chilled water, and the required motor power (equivalent to consumed electric power).

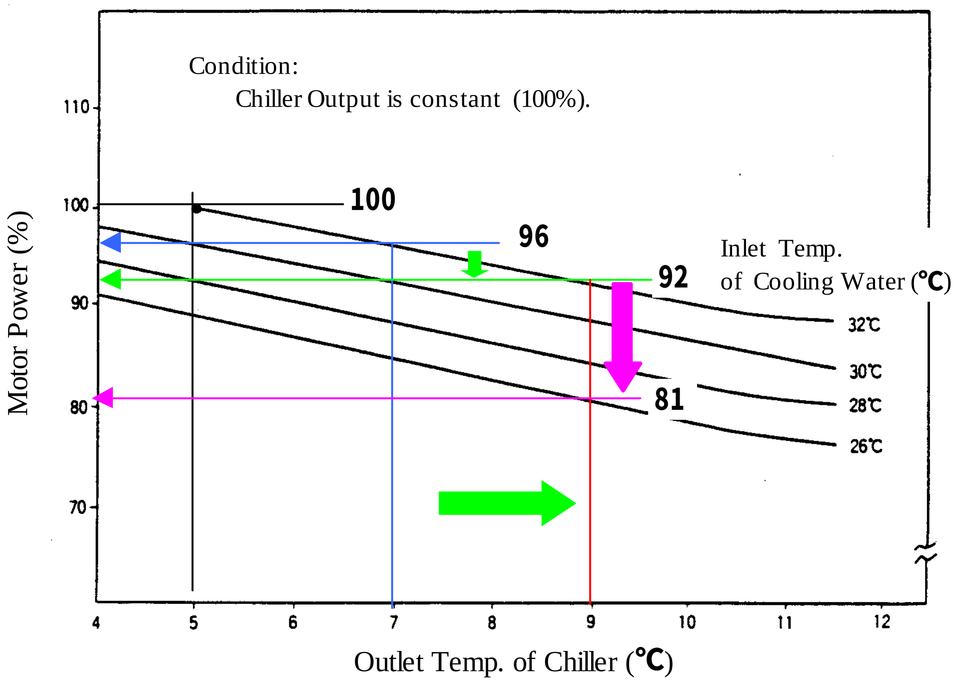
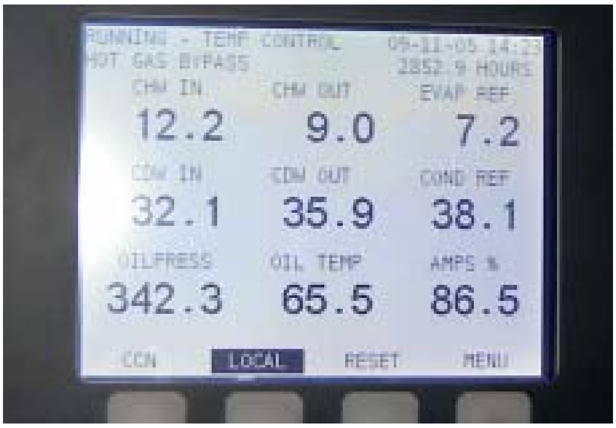


Figure 3.5－2 Relationship Among the Temperature of Cooling Water, the Temperature of chilled Water, and the Motor Output (Turbo Chiller)

You can see that the electric power consumption can be reduced by increasing the temperature of chilled water when the load is small.

The following photograph shows the panel display indicating the operation status of a turbo chiller.



Photograph 3.5－1 Chiller Panel Display

The panel display indicates that the inlet temperature of chilled water is 12.2°C and the outlet temperature is 9.0°C. The outlet temperature is set rather high to enable an energy saved operation when the load is small. When the outlet temperature is changed from 7°C to 9°C, energy is saved by about 4%.

2) Energy conservation by changing the temperature of cooling water

The performance of a cooling tower greatly changes depending on the wet bulb temperature.

We do not have data on the wet bulb temperature. However, the wet bulb temperature is as follows when we assume the humidity is 80% in summer and 60% in winter:

Table 3.5－1 Dry Bulb Temperature and Wet Bulb Temperature

	D.B	R.H	W.B
Summer	29°C	80%	26°C
Winter	22°C	60%	17°C

The following graph shows the relationship between the wet bulb temperature and the temperature of cooling water in a cooling tower:

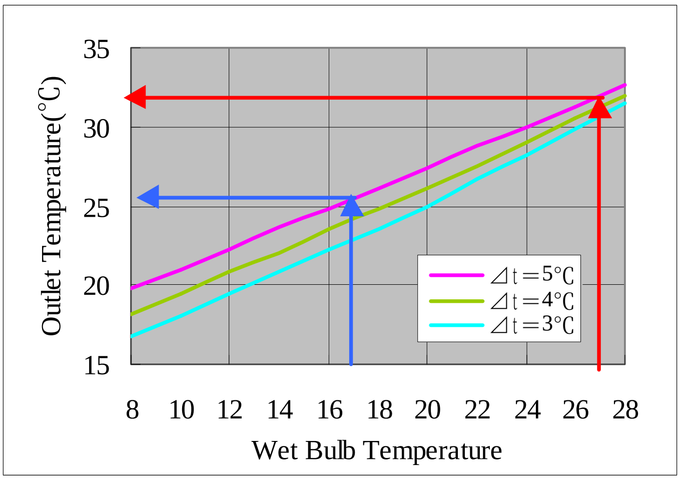


Figure 3.5－3 Relationship Between the Wet Bulb Temperature and the Cooling Water Temperature in a Cooling Tower

As the graph shows, cooling water of about 26°C can be obtained when the wet bulb temperature is 17°C in a cooling tower with the same performance. This way, the cooling performance increases by about 12% (= 1－81%/92%) and the motor output can be reduced.

You can specify different temperature settings for cooling water for summer and winter. The efficiency of chillers can be improved in winter when the load is small by specifying the winter pattern that sets the outlet temperature for chillers to a rather high temperature.

2) Calculation of effects

We calculate the effect of decreasing the temperature of cooling water from 32°C to 26°C in the winter mode operation. When we assume the consumed electric power is rated 315 kW when the temperature of chilled water is 7°C, saved energy is as follows when Figure 3.5－2 is applied:

Energy is saved by 4% by setting the chiller outlet temperature to 9°C.

Energy is saved by 12% by changing the cooling water temperature from 32°C to 26°C.

When the chillers are run in the winter mode for four months, the amount of saved energy is as follows:

315 kW × (1－4%) × 12% ＝ 36.29 kW

Assuming the equivalent operation period per day is 8 hours, the amount of saved energy in four months is as follows:

36.29 kW × 8 h/d × 30 d/month × 4 m ＝ 34,836 kWh

The ratio of saved energy to total electric energy consumption is 34,836 kWh/3,722,400 kWh = 0.0093.

(2) Improving the low load operation of transformers

1) Improving the load factor of transformers (reducing the number of running transformers)

The load of transformers is low in the current operation.

Since the received electric energy is about 310 MWh/month, the average electric energy consumption per day is 10 MWh/d.

The maximum electric energy is as follows when we assume the load factor (＝ average electric energy/maximum electric energy) is 0.5:

10 MWh / (24 h × 0.5) = 833 kW

The total capacity of transformers is 3,600 kVA with two transformers of 1,000 kVA and two transformers of 800 kVA.

Since the distribution system is equipped with a low voltage capacitor, the apparent power of transformers is about 850 kVA when the power factor is improved. Therefore, the demand factor of transformers is probably as follows in average:

850 kVA/3,600 kVA ＝ 24%

Transformers can be reduced without load loss by using one transformer of 1,000 kVA and one transformer of 800 kVA, and saving other transformers as standby transformers.

2) Calculation of effects

Assuming the transformers in the hotel are equivalent to high-efficiency transformers, the loss characteristics of the transformers are as follows based on the catalog of Mitsubishi Electric. Since the catalog does not contain data on 800-kVA transformers, the data on 750-kVA transformers is shown here.

Table 3.5－2 Loss Characteristics of Transformers (Load Loss and No Load Loss)

Tr. Capacity	750kVA	1,000kVA
No load loss (W)	1,030	7,564
Load loss (W)	1,245	8,795

In the following graphs, the daily load of each transformer is simplified. We assume the load is constant between 6:00 to 22:00 and the load is zero in the rest. Since the average daily electric energy consumption is 10 MWh/d, the consumed electric power in the set time period is 625 kW. One transformer takes 300 kVA and the other transformer takes 400 kVA since the capacity of the transformers differs. See the following graphs. In the improved example, Tr2 and Tr4 are removed from the system.

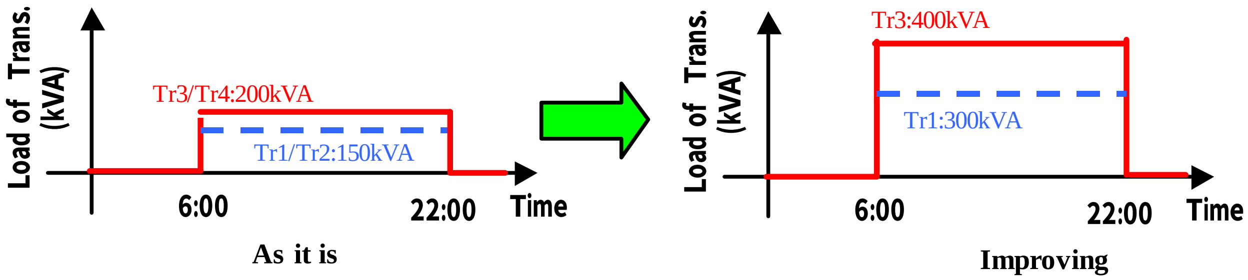


Figure 3.5－4 Daily Load Status of Transformers

Each loss is calculated as follows:

No load loss ＝ No load loss × 24 h/d × 365 d/year

Load loss ＝ Load loss × (Load factor)2 × 10 h/d × 280 days/year

Total loss ＝ No load loss ＋ load loss

The result of the calculated loss reduction per day is shown below:

Table 3.5－4 Amount of Reduced Transformer Loss

	No load loss kWh/d	Load loss kWh/d	Total loss kWh/d	Improving kWh/d
As it is	412.512	12.6582	425.2	Base
Improved	206.256	25.3165	231.6	193.6

The yearly reduced loss is as follows:

193.6 kWh × 365 d ＝ 70,663 kWh/year (58,368k kips/year)

The ratio of the reduced loss to the consumed electric energy is as follows:

70,663 kWh/3,722,400 kWh = 0.0190

(3) Decreasing the solar radiation load

1) Solar radiation load

Some part of solar radiation coming through glass windows is reflected by the glass, some part is absorbed by the glass, and the rest enters inside. The absorbed solar radiation increases the temperature of the glass and some of the heat enters inside through radiation and convection and becomes solar radiation load. Solar radiation also enters the ground and the reflected element indirectly enters inside. The solar radiation also increases the ambient temperature and enters inside as transfer heat load.

Now we consider cooling load. Generally, the solar radiation load is large and the transfer heat load is small during the day. However, in the regions at low latitude like Vientiane, the solar radiation load is smaller compared to Japan.

Let's assume the solar radiation load from a window located in the southwest which is in the length of a building. When we calculate the solar radiation load per day based on the latitude and the position of the sun, the solar radiation load is about 2,000 kcal/m^2 in winter, 1,000 kcal/m^2 in seasons other than winter and summer, and negligible in summer since the sun is at the top.

The transfer heat load is proportional to the difference between the outdoor air temperature and the indoor temperature. When we take Naha in Japan, which is closest to Vientiane in terms of climate conditions (the highest temperature in the day is 32°C), as a replacement of Vientiane, the transfer heat load is 300 to 400 kcal/m2 in a room with 26°C room temperature through a white curtain. As you can see, the solar radiation load through glass windows is 2,300 kcal/m^2 in winter and 1,000 kcal/m^2 in summer, which is unexpectedly small because the solar radiation is small since the sun is high in summer.

Another element is the ground which receives global solar radiation. The sunlight that enters the surface of the ground is about 7,000 kcal/m^2 and it increases the temperature of the surface. When the sunlight is reflected, it enters inside.

To prevent the increase of the temperature, place lawn and create ponds to reduce the ascension of heat from the surface.

The following graph shows the rise of the temperature caused by solar radiation depending on the condition of the ground.

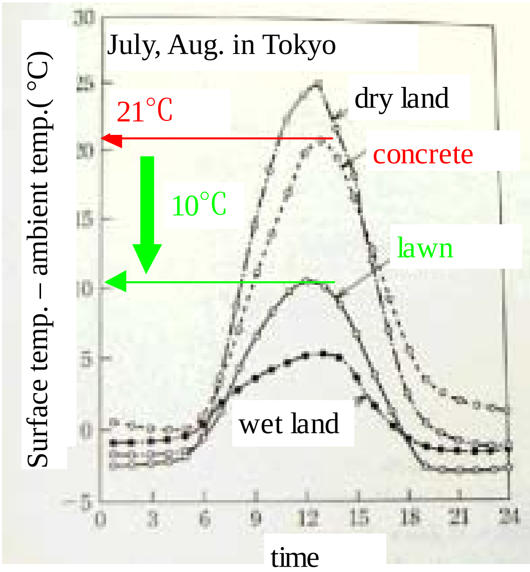


Figure 3.5－5　Effects of Lawn and Ponds

By using lawn to prevent the reflection of sunlight, the temperature of external walls (at the peak) is decreased by about 10°C and the temperature is decreased by 15°C on the wet ground.

The exterior of the conference building on the corridor side was a parking lot with concrete floor. Therefore, the heat caused by the reflection of sunlight must have been very high. The temperature of concrete floor is the atmospheric temperature plus 21°C. This is the data in Tokyo. The temperature of concrete floor must be much higher in Vientiane. When we assume the temperature in the day time is 35°C and the temperature of glass windows rises by 25°C due to solar radiation, the actual temperature of glass windows is 60°C. When we touched a window on the day of the audit, it felt like 50 to 60°C.

When we assume the temperature of glass is 60°C, the indoor temperature is 26°C, and the heat transfer rate of the internal side of the glass (αi) is 10 kcal/m^2 h°C, the entered heat due to convection is as follows:

$$Qc = \alpha i \times (Tg - Tr) = 10 \times (60 - 26) = 340 \text{ kcal/m}^2 \text{ h}$$

2) Countermeasures

To reduce solar radiation, lawn can be placed or ponds can be created to reduce the temperature of the surface that is raised by absorbing heat as shown in the graph. The above graph indicates that the temperature can be reduced to 11°C (lawn) or 5°C (wet ground).

Another method that can be applied to all types of radiation load is external blinds. External blinds are more effective in reducing heat load compared to indoor blinds. The following table shows the effects in terms of irradiation invasion rates.

Table 3.5－5　Irradiation Invasion Rates of Windows

	Nothing	Lace Curtain	Inner Shades	Outer Shades
Sigle-plate Glass(3mm)	0.88	0.56	0.46	0.19

Shades that are as effective as blinds (such as bamboo blinds) installed outside windows are also very helpful. By using shades, the amount of entered solar radiation is reduced to one fourth.

3) Calculation of effects

We calculate the reduction in heat load and electric power for air conditioning in the corridors of the conference building when we place lawn and install bamboo shades to cut heat and reduce the temperature rise by 15°C. Since the temperature of glass reaches 45°C, the heat capacity of convection is as follows:

$$Qc = 10 \times (45 - 26) = 190 \text{ kcal/m}^2\text{h}$$

This indicates the reduction of 340－190 ＝ 150 kcal/m^{2}h.

We assume the applicable hours per day is 8 hours and the total applicable days per year is 200 days. When we take the windows on the first floor in the conference building, the yearly reduction in cooling load is as follows:

$$Qd = 150 \text{ kcal/m}^2\text{h} \times 8 \text{ h} \times 200 \text{ d} \times 68 \text{ m} \times 2 \text{ m}$$
$$= 32{,}640.4 \text{ Mcal/year } (= 37{,}960 \text{ kWh/year})$$

When we assume air conditioning using an air conditioning system of COP = 4, the saved energy is as follows:

$$Qd = 37{,}960 \text{ kWh}/4 = 9{,}490 \text{ kWh/year } (7{,}839\text{k kips/year})$$

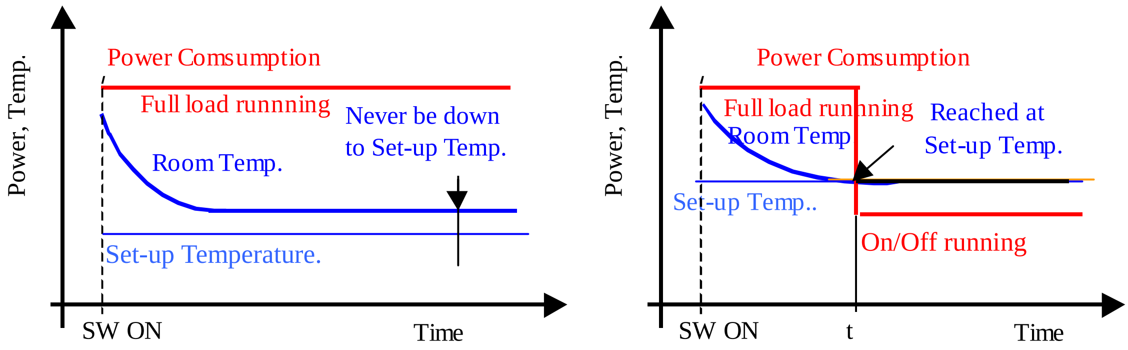
(4) Optimizing the temperature settings of air conditioners

We often saw this problem during the audits of other hotels. Since the problem may be related to this hotel as well, we mention it here.

1) Set room temperatures and consumed electric power

The initial temperature setting for air conditioners was 16°C which was the lowest. This is probably the room make service staff set the temperature of air conditioners to the lowest to please guests.

However, 16°C is too low and the room temperature does not usually stay at 16°C. The following graphs show the operating status of air conditioners depending on the temperature settings:



a) When the setting is 16°C　　　　　　b) When the setting is 25°C

Figure 3.5－6　Operating Status of Air Conditioners Depending on Temperature Settings

When the temperature setting is 16°C, the air conditioner runs with the maximum output to reach the set temperature. However, the room temperature stays at a certain level because the heat coming from doors and windows increases in relation to the capacity of the air conditioner. Since the set temperature is never reached, the air conditioner continues to run fully.

When the temperature setting is 25°C, the room temperature reaches 25°C after a while. After that, the air conditioner runs according to the room temperature. This means the output of air conditioning is reduced. Let's assume that the air conditioner runs with 50% output to make the matter simple.

When the capacity of an air conditioner in a guest room is 18,000 Btu and we assume the air conditioner runs seven hours continuously per day (expected run time), the electric power consumption for both temperature settings is calculated as follows:

When the temperature setting is 16°C:　18,000 Btu × 7 h ＝ 126,000 Btu/d

When the temperature setting is 25°C:　18,000 Btu × 0.5 h＋9,000 Btu × 6.5 h ＝ 67,500 Btu/d

(We assume the room temperature reaches the set temperature in 30 minutes and the air conditioner is automatically turned on and off after that as needed.)

This is the effect that can be obtained by standardizing the temperature setting of air conditioners as a rule of room make service in guest rooms.

2) Calculation of effects

We calculate the yearly effects assuming air conditioners are run with the initial temperature setting in 25 rooms (30% when the average occupancy rate of guest rooms is 40%).

As mentioned above, the reduction in the air conditioner output is as follows:

Reduction per guest room:　126,000 Btu－67,500 Btu/d ＝ 58,500 Btu/d

Electric power consumption in 25 rooms:　58,500 Btu/d × 25 rooms ＝ 1,426,500 Btu /d

We convert the above value to saved electric power Es assuming the total performance coefficient (COP) of chillers as 4.

Es = 1,426,500 Btu/d × 2.930711 × 10-4 kWh/Btu/4/1,000 ＝ 107.2 kWh/d

Yearly: 107.2 kWh/d × 365 d ＝ 39,111 kWh/year

The ratio of the saved electric energy to the total electric energy consumption is as follows:

39,111 kWh/year / 3,722,400 kWh/year = 0.0105

(5) About energy management

To perform energy management, many measurement tools with integrating meters must be installed to measure the amount of used electricity, gas, heavy oil, and kerosene. For this purpose, the Building Energy Management System (BEMS) is available. Advanced buildings employ this system.

1) Measuring and managing electric power, and introducing the BEMS

We thought a hotel as large as Don Chan Palace had a system like BEMS. However, we could not see it. We hope the hotel considers introducing the BEMS to enable integrated energy management.

In the BEMS, measurement tools are installed on the distribution board in the electricity room, turbo chillers, boilers, and other devices.

The collected data is sent to the central system and managed there. See the following example.

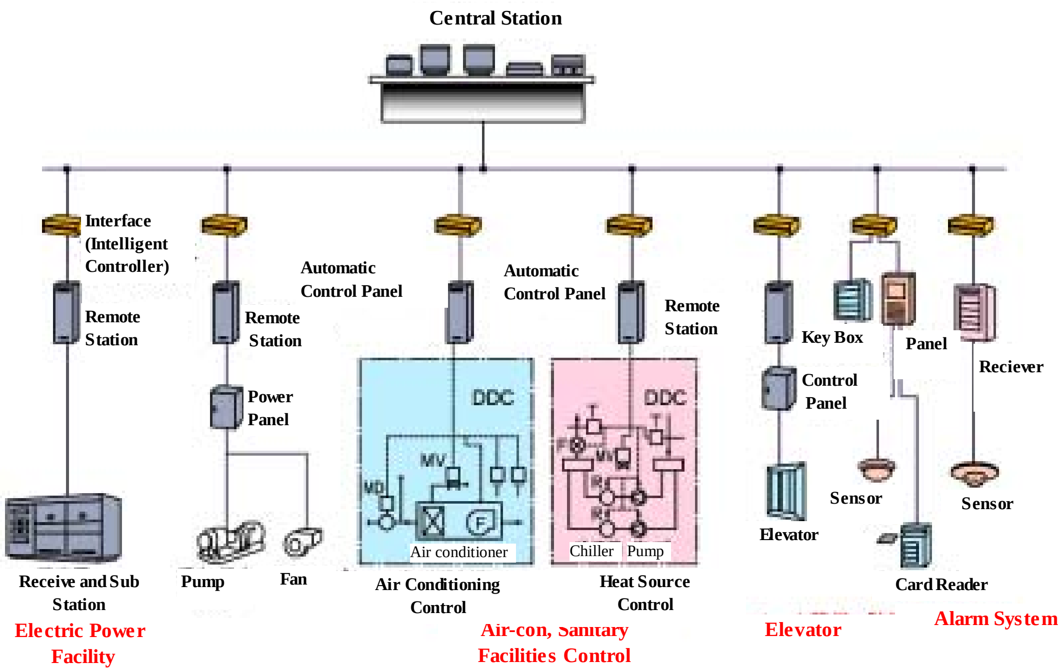


Figure 3.5－7 Example BEMS

By identifying where and how energy is used and how much of it is used, you can set a goal for reduction in energy consumption and make improvements. You can also set the conditions for the optimized operation for energy conservation and the plans for the optimized operation of heat sources by analyzing the increase and decrease of energy consumption depending on the changes in usage status.

For this purpose, the following two points are required:

① Installation of measurement devices such as flow meters, thermometers, ammeters, voltmeters, watt-hour meters, and power factor meters

② Organizing and charting the obtained measurements

The BEMS is an integrated management system with the above features.

2) Developing energy management activities

The floor rate of conference halls is rather large in Don Chan Palace. The energy consumption of conference halls is quite different from that of guest rooms. In addition, kitchens and laundries have different energy consumption as well. Therefore, to achieve a highly accurate energy management, the energy consumption information in each department is required. In another hotel, the electric energy of guest rooms on each floor is measured and managed. The electric energy consumption should be obtained in the energy management system (BEMS) mentioned before. The obtained data can be used as the base for the hotel-wide activities and the effects of energy management promoted by Mr. Bounthong will be put into figures. When the effects are realized, the PDCA cycle works efficiently, which is a barometer for the promotion of activities.

The PDCA cycle is a mandatory process for powerful activities. The PDCA cycle is shown below.

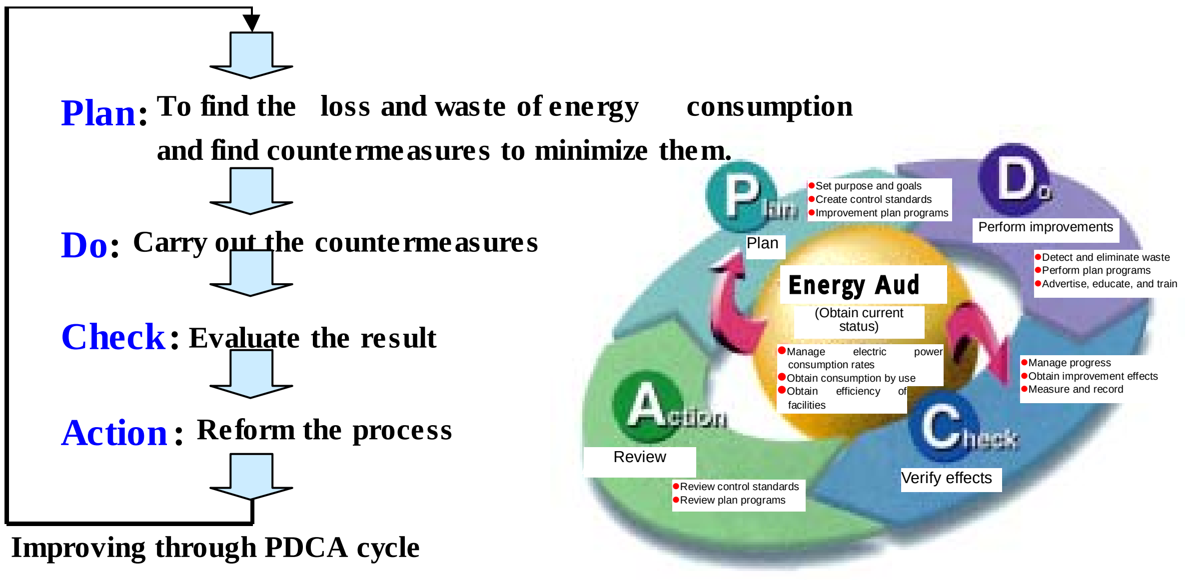


Figure 3.5—8 PDCA Cycle

3) Calculation of effects

According to the Japanese statistics, 5% energy conservation is possible by performing organized energy conservation activities based on data. We use this value as the effect of creating the BEMS.

Annual electric energy consumption × 5% ＝ 3,722,400 kWh/year × 5% ＝ 186,120 kWh/year (153,735k kips/year)

3.6 Other Related Points

1) Installing a watt-hour meter

To detect devices with problems and pursue further energy conservation, an energy manager requires measurement devices for investigations. We recommend a watt-hour meter with a recording feature.

Commercial watt-hour meters are available from measurement manufacturers and the devices allow you to enter data directly into a personal computer and analyze the data. Watt-hour meters are equipped with features to make different kinds of measurements such as higher harmonics and distortion rates. The following figure shows a watt-hour meter manufactured by H company and it costs about 400,000 yen.

Figure 3.5－9　Watt-hour meter with a Recording Feature

2) Managing chillers through managing trends

We noticed some slime in the water at the bottom of a cooling tower. It could be a problem.

General problems that occur in a cooling water circulation system are: ① Corrosion, ② Scale, and ③ Slime. Since the facility was new (less than one year old), the problem may not be apparent. However, slime may be generated in the cooling water pipes. So care must be taken. We recommend slime control agents and anti-corrosion agents as well as controlling the water quality by checking PH, conductivity, and chloride ions.

To detect deterioration in early stages, the hotel should set control values for the outlet temperature and the inlet temperature of cooling water and cooled water displayed on the turbo chiller panel and check the measurements continuously.

3) Ventilating air in meeting rooms (air ventilation performance and energy conservation)

Taking in excess external air increases the heat load of air conditioning and it must be optimized. To evaluate the external air intake, there is a general method of measuring the CO2 concentration.

After about two hours since the beginning of a meeting, we measured the CO_2 concentration in the meeting room. The result was 1,200 ppm. The CO_2 concentration with adequate external air intake is about 800 ppm. The measured value exceeds this value. The standard CO_2 concentration set for the building management laws of Japan is 1000 ppm. The measured value exceeds this value as well. However, 1000 ppm is not an absolute limit. The CO_2 concentration should follow the indoor environment standards and judgments in Laos. If Don Chan Palace employs the Japanese standard, they need to take in more external air and improvements are required. More air ventilation means increased energy when passive air conditioning is not available. This is a problem from the view point of energy conservation.

The important thing is to clarify your purpose. Energy cut by ignoring the purpose is not energy conservation. Energy conservation should be performed after fulfilling the standards for the set purpose. The indoor environment standard to be satisfied in this hotel should be based on the management policy of the hotel. Energy conservation is not just about reducing energy consumption. Energy conservation is not just about reducing energy consumption.

3.7 Summary

(1) Points for improvement and the results of calculated effects

The following table summarizes the contents of Section 3.5, "Points for Improvement and Calculated Effects".

Table 3.7－1 Points for Improvement and the Results of Calculated Effects

No	Recommendation	Energy conservation kWh/year	Ratio %	Maney saving k Kips/year
1	Lowering of condensing water temp. in light load season	32,569	0.9	26,976
2	Improvement of load factor of tansformers	70,663	1.9	58,368
3	Decreasing of solar gain with lawn and/or shades	9,490	0.3	7,839
4	Raising set-uptemparature of room A.C unit	39,111	1.1	32,306
Subtotal		119,264	3.2	98,512
4	Further improvement by the effective usage of "BEMS"	186,120	5.0	153,735
Total		305,384	8.2	252,248

Note: Conversion is made assuming 826 Kips/kWh.

(2) Other comments (advice)

The summary of Section 3.6, "Other Related Points" is as follows. We hope you consider them as well as the above points for improvement.

① We recommend a full system of measurements and the preparation of watt-hour meters with a recording feature.

② The status of facilities should be monitored through checking the chronological changes.

③ The air ventilation in meeting rooms may need to be improved.

4. About the Result of the Workshop

4.1 Outline

The workshop was held at the hall of Don Chan Palace. The agenda is as described below. Mr. Zamora of ACE served as the moderator and a total of 54 people participated from the government and the private sector of Lao PDR including Mr. Houmphone Bulyaphol (Director-General of Ministry of Industry and Handcraft (MIH) and ASEAN SOE Leader for Lao PDR) and Mr. Khamso Kouphokham (Deputy Chief of Electricity Management Division of MIH). It was a big seminar/workshop having, in addition, 3 participants from Japan (Ushio, Amano and Kobayashi,), another 3 from Ace (Dr. Weerawat Chantanakome, Mr. Christopher G. Zamora and Mr. Ivan Ismed) and 4 presenters from ASEAN countries (Mr. Reynaldo Baura (BII Building, Indonesia), Mr. Faizul Ramdan (Pusat Tenaga Malaysia), Mr. Jose Hilario (ENMAP, Philippines) and Mr. Steward Tai (Alexander Hospital, Singapore)).

4.2 Details about the Workshop

At the beginning of the seminar/workshop, Mr. Houmphone Bulyaphol (Director-General of MIH and also the leader of ASEAN SOE) gave welcome remarks. In the remarks, he mentioned that the promotion of energy conservation was very important for Laos heavily depending on the import of oil and that this PROMEEC project provided the country with very effective means of leaning advanced energy conservation technologies of Japan and other ASEAN countries and therefore they were very grateful for the cooperation of the government of Japan (METI).

This was followed by opening statements by Dr. Weerawat of ACE and the representative of ECCJ and then, the workshop proceeded in accordance with the following program.

The titles of the respective presentations (presenters in the parentheses) are given below. Please see the attached material for details.

(1) Overview of ASEAN energy efficiency and conservation programs and activities (Dr. Weerawat Chantanakome)

(2) Energy efficiency and conservation initiatives and activities in Lao PDR (Mr. Khamoso Kouphokham)

(3) Concept of and initiatives for Sustainable Buildings in Japan (Ushio)

(4) Activities for promotion of energy efficiency and conservation in Don Chan Palace Hotel, an energy efficient building recognized as a best practice building in Laos (Mr. Bounthong Keovongsa: Chief of Engineering Dept.)

(5) Energy conservation best practice building in Indonesia: Plaza BII Building (Mr. Reynaldo Baura, Manager of Plaza BII)

(6) Energy conservation best practice buildings in Malaysia (Mr. Faizul Ramdan, Exert of Pusat Tenaga Malaysia (PTM))

Introduction of energy conservation efforts and measures implemented in 3 buildings in Malaysia that won an energy conservation best practice building award in the past.

(7) Energy conservation best practice buildings in Philippines (Mr. Jose Hilario, Energy Management Association of Philippines)

Introduction of energy conservation efforts and measures implemented in 3 buildings in Philippines that won an energy conservation best practice building award in the past.

(8) Energy conservation best practice building in Singapore ; Alexandra Hospital Building (Mr. Steward Tai, Building Facility Manager)

(9) Proposal for preparation of Energy Conservation Technical Directory (TD) (Amano, technical expert and Mr. Ivan Ismed)

(10) Development of unit energy consumption management tools in Japan (Kobayashi, technical expert)

In the presentation by Japanese delegates, titled "Concept and initiatives for Sustainable Buildings in Japan", as in the Workshop held in Myanmar and Malaysia, CASBEE (the comprehensive assessment system for building environmental efficiency), a system of labeling buildings in terms of environmental performance, advanced management tools of unit energy consumption for buildings that are being developed in the Energy Conservation Center and the system of recognizing energy conservation good practice buildings were introduced and the importance of development of database and technical directory (TD) was emphasized. In the current seminar, a sample of Technical Directory for Energy Efficiency and Conservation (TD) that is in the process of preparation at ACE was shown and the progress status in preparation was explained.

All presentations were very meaningful and most of the participants stayed until the end of the program to listen attentively to all presentations. Many questions and answers were actively exchanged and the enthusiastic and positive attitude on the part of the government was apparent. It appears that in the country earning foreign currencies by export of electric power and importing fossil energy, the rising energy prices has a significant impact on the government policy. For the presentation in English, a simultaneous interpreter for Laotian language was employed so that participants could understand the presentation very well and it actually contributed to the smooth proceeding of the program.

SEMINAR ON PROMOTION OF ENERGY EFFICIENCY AND CONSERVATION FOR BUILDINGS IN SOUTH EAST ASIA

Lane Xang Hotel, Vientiane, Lao PDR

11 November 2005

TENTATIVE PROGRAMME

8.30	-	9.00	**Registration**
9.00	-	9.10	**Welcome Remarks** Mr. Houmphone Bulyaphol Director-General, Ministry of Industry and Handicrafts and SOE Leader for Lao PDR
9.10	-	9.20	Opening Statement Mr. Yoshitaka Ushio General Manager, Energy Conservation Centre, Japan (ECCJ)
9.20	-	9.30	Opening Statement Dr. Weerawat Chantanakome Executive Director, ASEAN Centre for Energy (ACE)
9.30	-	10.00	**Photo Session and Coffee Break**
Session 1: EE&C BEST PRACTICES (Moderator: ACE)			
10.00	-	10.15	**Overview of ASEAN EE&C Programmes** Mr. Christopher G. Zamora, Manager, ACE
10.15	-	10.45	**Overview of EE&C Initiatives and Activities in Lao PDR** Mr. Khamso Kouphokham, MIH
10.45	-	11.15	**Concept and Initiatives Towards Sustainable Buildings in Japan** Mr. Yoshitaka Ushio, General Manager, ECCJ
11.15	-	11:45	**Energy Efficiency & Conservation Best Practices of Lao Plaza Hotel Building, Lao PDR**
11:45	-	12.15	**Energy Efficiency & Conservation Best Practices of Plaza BII Building, Indonesia** Mr. Reynaldo Baura
12.15	-	12.30	**Q & A**
12.30	-	14.00	**LUNCH**
14.00	-	14.30	**Energy Efficiency & Conservation Best Practices in Malaysia** Mr. Faizul Ramdan, Pusat Tenaga Malaysia

14.30	-	15.00	**EE&C Best Practices of Selected Buildings in the Philippines** Mr. Jose Hilario, ENMAP, Philippines
15.00	-	15.30	**EE&C Best Practices of Alexander Hospital Building, Singapore** Steward Tai, Building Facility Manager
15.30	-	15.45	**Q & A**
15.45	-	16.00	**COFFEE BREAK**
SESSION 2 : THE WAY FORWARD (MODERATOR – ACE)			
16.00	-	16.15	**Development of a Technical Directory (Proposal for Further Step)** **Mr. Hisashi Amano,** Expert, ECCJ
16.15	-	16.30	**Development of a Database/ Benchmarking/ Guideline for Buildings: Advanced Energy Management Tool for Buildings in Japan** Mr. Akira Kobayashi, Expert, ECCJ
16.30	-	16.45	**Q & A Session**
16.45	-	17.00	**Closing Remarks**

V. Viet Nam

1. Activity Overview

In Viet Nam, we conducted an energy audit of Heritage Halong Hotel (Halong Bay) and follow-up audits of Hotel Nikko Hanoi and Lake Side Hotel. In Viet Nam, too, we held a seminar/workshop at Hanoi Horison Hotel as in other audit venues.

Participants from International Engineering Department

Yoshitaka Ushio (General Manger)

Akira Kobayashi (Technical Expert)

Hisashi Amano (Technical Expert)

Schedule

Date	Activity	Participant
November 12	Moved from Vientiane(20:20) → Hanoi (21:25)	Ushio/Amano/ Kobayashi
November 14 (Mon.) – 15 (Tue.)	Energy audit of Heritage Halong Hotel Rounding up of and reporting on results	Ushio/Amano/ Kobayashi
November 16 (Wed.)	Follow-up energy audit of Hotel Nikko Hanoi	Ushio/Amano/ Kobayashi
November 17 (Thu.)	Follow-up energy audit of Lake Side Hotel Rounding up of and reporting on results	Ushio/Amano/ Kobayashi
November 18 (Fri.)	Seminar/Workshop	Ushio/Amano/ Kobayashi
November 19 (Sat.)	Left for home: Hanoi (0:10) → Narita (6:40)	Ushio/Amano/ Kobayashi

Hanoi is the capital city and the center of politics and culture of Socialist Republic of Viet Nam. The city has a population of about 3 million (83 million people in the entire country). In the suburbs of the city, many foreign-invested plants and factories are being built, which tells that the country’s economic development is advancing with great speed. In this rapidly growing Viet Nam, hotels are in great demand and thus many new hotels are being constructed. In the meantime, due to the rises in energy costs, the electric power rate will be increased in the next year. Public awareness of energy efficiency and conservation is enhanced. Our activities in Hanoi this time were developed under such circumstances.

We conducted an energy audit of Heritage Halong Hotel, a hotel owned by Ministry of Industry (MOI), located in Halong Bay about 3 hours and a half drive from Hanoi, which is one of the most famous scenic spots in Viet Nam and designated as a World Heritage site, on November 14

(Mon.) and 15 (Tue.). From the government of Viet Nam, Mr. Le Tuan Phong of MOI and 3 other people participated in the audit. On the part of the hotel, Mr. Dinh Tho Tiep, General Manager and Maintenance Manger responded. Based on the questionnaire delivered to them in advance, we conducted an energy audit through gaining energy information.

In this hotel, what lie in the way of promoting energy efficiency and conservation are the lack of employees' awareness and insufficient funds for investments in energy conservation. Regarding the measure to cope with the former, we were explained that energy conservation targets were set for respective sections and bonuses would be granted for the attained goals. In addition, as a new measure, an electric power meter is installed on each floor to help them understand the wasteful use of electricity in guest rooms. As regards the latter hurdle, although proposals are prepared to seek high-level decision, they say, it is difficult to gain approval because the hotel is a state-run company. However, we were impressed by the willingness and motivation of GM, the top management of the hotel. Detailed information and the results of the energy audit of the hotel are mentioned below. The current unit energy consumption is as low as 901MJ/m^2/yr and it is very reasonable level when it is taken in account that this hotel is located in a sightseeing area and therefore the time that guests spend in hotel is much shorter than those in hotels in urban areas. We closed our activities in the hotel, by making a presentation on the results of the audit.

Through exchanging the questions and answers on energy efficiency and conservation with the manager and staff members of the hotel in a sightseeing resort that is registered as a world heritage site and expected to be further developed in the future, we actually felt that people's awareness of energy conservation was improving also in this venue due to the hikes in energy prices.

In early morning of the next day, we moved to Hanoi to carry out a follow-up audit in two locations. First of all, we took time in auditing Hotel Nikko Hanoi for which many improvements had been suggested in the previous audit. In this audit, Mr. Phong of MOI, 4 people from Institute of Energy and 4 people from the hotel participated. Utilizing the questionnaire delivered to them in advance, we heard their explanation on how the hotel addressed the improvements that had been pointed out 3 years ago. Then, in order to check their efforts on the proposed improvements and to find new points for improvement, we toured the facilities. They were ready and positive for our audit and provided us with all information and material that we requested A detailed report on the audit is given in the subsequent chapter. We had an impression that the awareness of energy efficiency and conservation was improving in this hotel due to the price increase of electric power rate. Next day, we reported on the results of the energy audit of the previous day in Hotel Nikko Honoi.

We visited Lake Side Hotel, another hotel on which we conducted an energy audit 3 years ago, and conducted a hearing with them on the post-audit condition. Although we could not have sufficient questions and answers, because the person who was in charge of the building maintenance 3 years ago had already retired, we toured the facilities and made suggestions for improvement, such as adjustment of the cooling water temperature of chillers, the use of high-efficiency lighting lumps, etc. .

In addition, we held a workshop in Hanoi Horison Hotel with the purpose of promoting and disseminating energy efficiency and conservation in buildings in Viet Nam. 47 people (39 participants on the part of Viet Nam) participated in the workshop. This workshop served as a place for exchanging useful opinions and information on the promotion of energy efficiency and conservation in buildings in Viet Nam.

2. Energy Audit of Heritage Halong Hotel

2.1 Outline of Heritage Halong Hotel

1) Name of the building: Heritage Halong Hotel

2) Use: Hotel

3) Size: One floor below the ground and eight floors above the ground, Total floor area: 10,487 m2

Number of guest rooms in the hotel: 101, Two restaurants, One club,

One large meeting room, One small meeting room, Pool, Spa, Tennis court

4) Built: 1995 (ten years old)

5) Outline of electrical systems: Service voltage: 35 KV, Transformers: 560 kVA × 2 units, 400-V 4-line type

Generator: 500 kVA × 1 unit (for emergency)

Elevators: 11 kW × 2 units

The power of guest rooms was turned on by turning the key tag.

No BEMS (Building Energy Management System) was installed.

6) Outline of air-conditioning systems: Split type × 141 units

7) Sanitary facilities

a. Water supply facility: Elevated water tank

b. Hot water supply: Individual electric water heaters in guest rooms: 1.5 kW × 30 L to 2.5 kW × 50 L

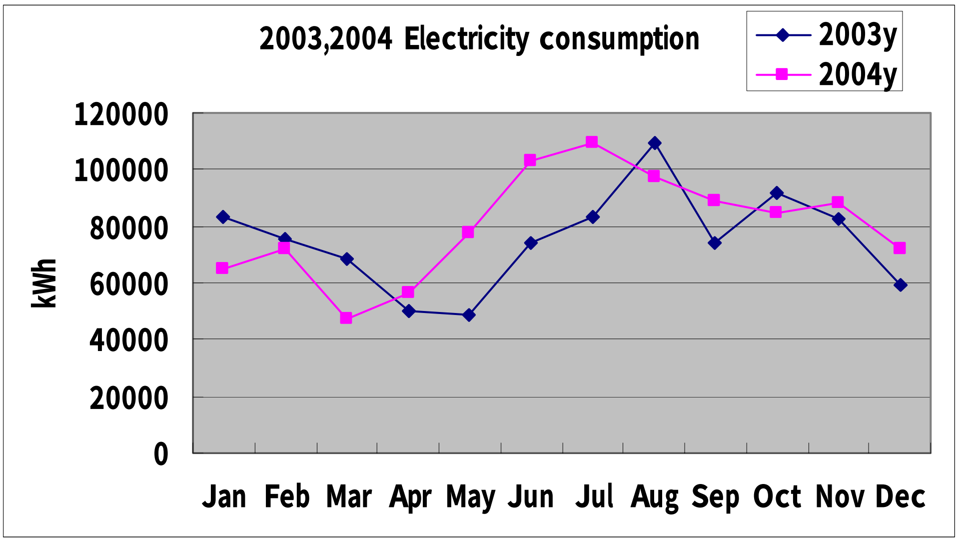
c. Laundry facility: Two dryers were run by LPG. Other dryers were electrically run.

d. Kitchen: The heat source was LPG.

2.2 Analysis and Evaluation of Current Status

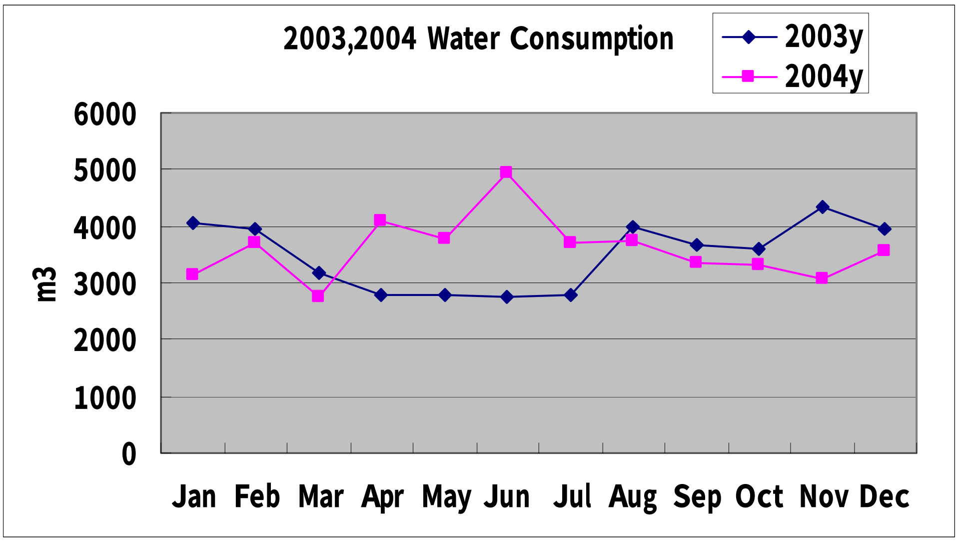
(1) Monthly electric energy

The following graph shows the monthly electric energy consumption in 2003 and 2004. After April 2003, the electric energy consumption decreased probably because the number of guests dropped due to SARS. The level of electric energy consumption in 2004 is probably the usual pattern. Electric energy consumption was high from June to August where the temperature was high.



(2) Monthly water consumption

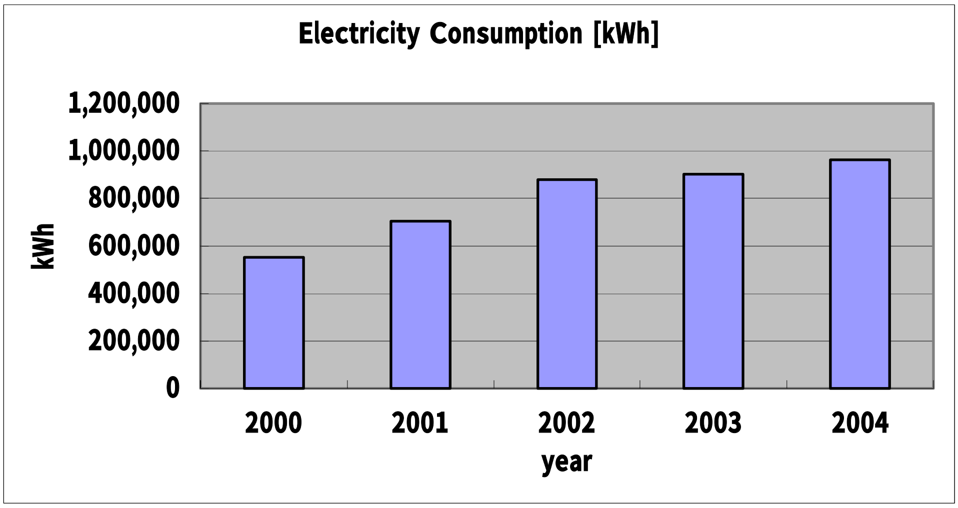
The following graph shows the water consumption in 2003 and 2004. As mentioned above, the water consumption decreased after April 2003 probably due to SARS. Since the air conditioning system consisted of the split type air conditioners, the water consumption was not affected by air conditioning. Basically, the variation in monthly water consumption is due to the variation in the number of guests.



(3) Changes of electric energy consumption in five years

The following graph and table show the changes of electric energy consumption in five years from 2000 to 2004. The electric energy consumption steadily increased every year. The average percentage of annual increase in four years is 18.5% and the electric energy consumption in 2004 is 174% of that of 2000.

Since the average operation rate of the hotel in 2004 was 62%, the electric energy consumption will probably continue to increase.



	kWh	%
2000y	552,440	100%
2001y	703,420	127%
2002y	879,833	159%
2003y	901,050	163%
2004y	961,710	174%

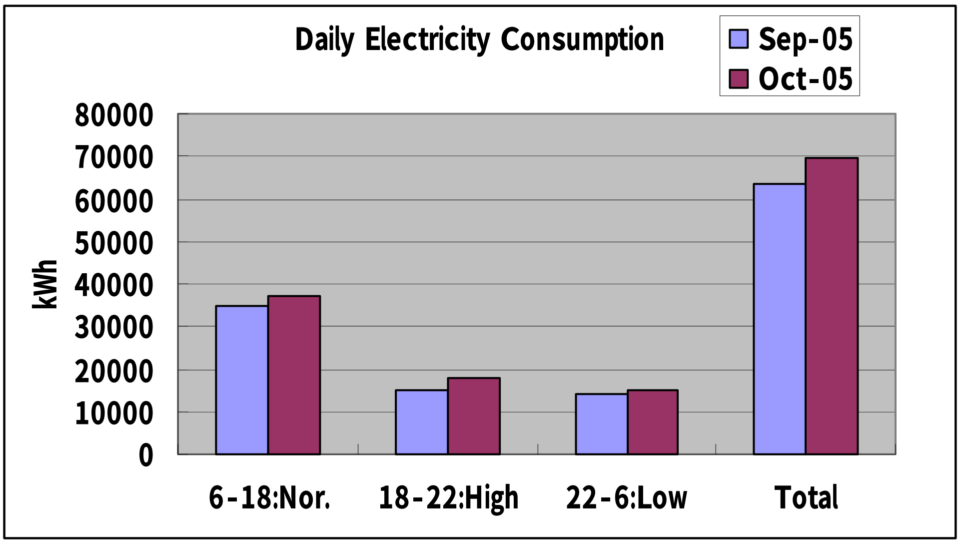
(4) Electric energy consumption in different time zones

The electric power charge system in Viet Nam was based on time zones. The correspondence between the time zones and the charges is shown below:

	Time zone	Charge (VND/kWh)
Normal Time	6：00—18：00	1,600
High Time	18：00—22：00	2,400
Low Time	22：00-6：00	800

The following graph and table show the electric energy consumption based on time zones in September and October in 2005 and their rates.

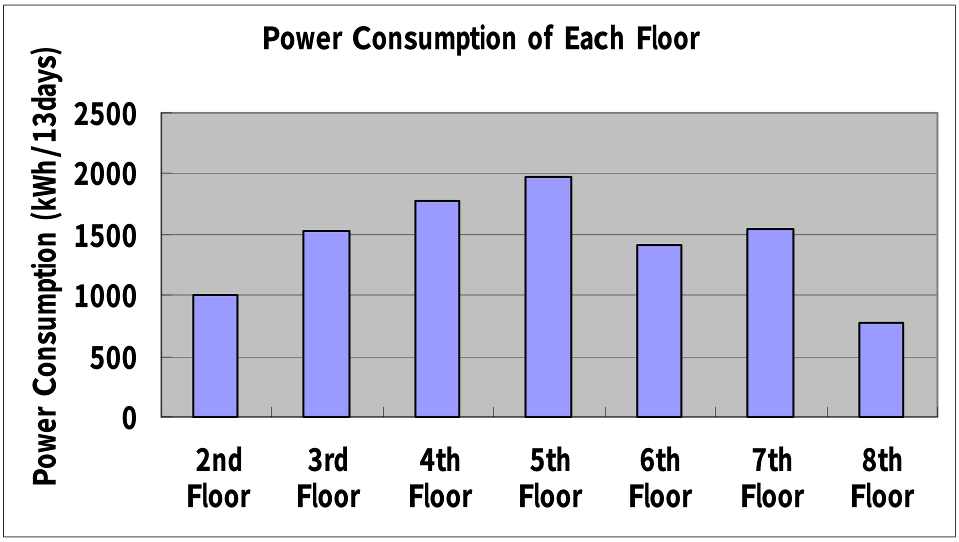
In the normal time between 6:00 to 18:00, the hotel used 53 to 55% of the total electric energy. The hotel used 23 to 25% between 18:00 to 22:00 with the highest cost. To decrease the cost of electric energy, reducing the electric energy between 18:00 and 22:00 is effective.



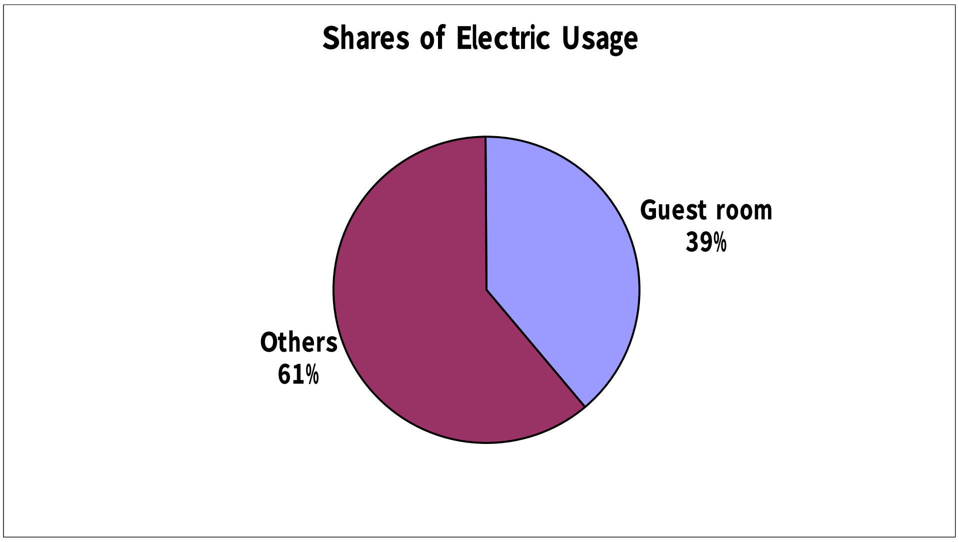
	6-18:Nor.	18-22:High	22-6:Low	Total
Sep-05	55%	23%	22%	100%
Oct-05	53%	25%	21%	100%

(5) Electric energy consumption by user

The hotel installed watt-hour meters on each floor of guest rooms to measure and manage energy. The following graph shows the electric energy of each floor in 13 days in November 2005. We can determine whether electric energy was used effectively when we can determine the operation status of each floor. However, we could not obtain the operation status data.



By determining the total electric energy consumption and the one on each floor of guest rooms, we can calculate the percentage of electric energy used in guest rooms and the percentage of electric energy used elsewhere. The result is shown in the pie chart. 39% of electric power was used in guest rooms and 61% was used elsewhere.



(6) Evaluating energy consumption

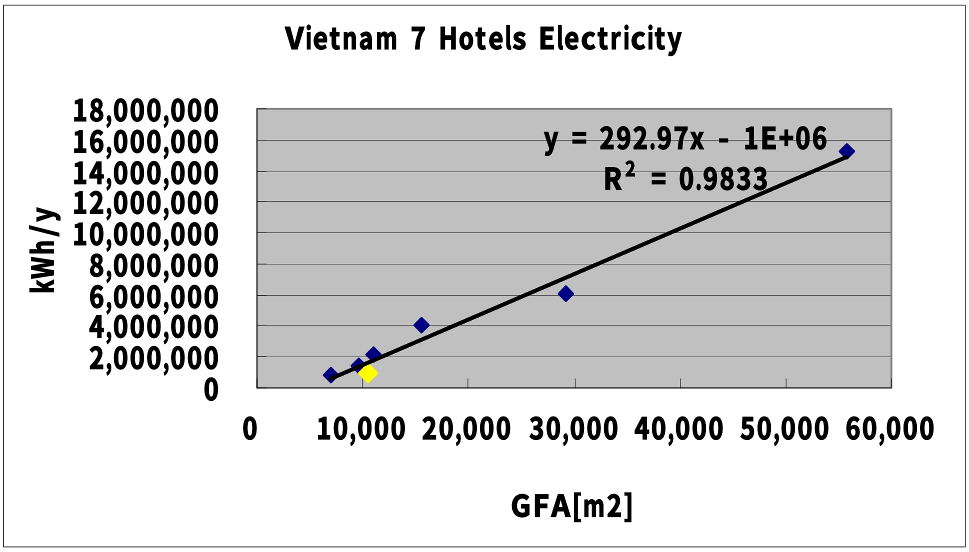
1) Evaluating electric power consumption rate (comparison with other hotels in Viet Nam)

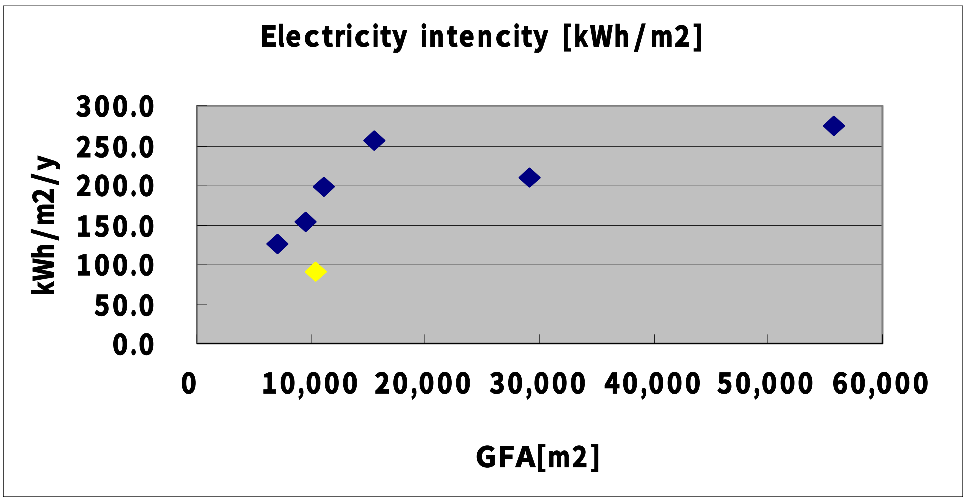
We use the electric energy in 2004 to calculate the energy consumption per unit area and compare it with the values of other hotels. The electric energy per unit area in this hotel was 91.7 kWh/m2. When the value is converted using the conversion coefficient of 9.83 MJ/kWh, the electric energy is 901 MJ/m2.

Electricity：2004	961,710	kWh/m2
GFA	10487.5	m2
EEI(2004:kWh)	91.7	kWh/m2
kWh→ＭＪ	9.83	MJ/kWh
EE(2004:MJ)	901	MJ/m2

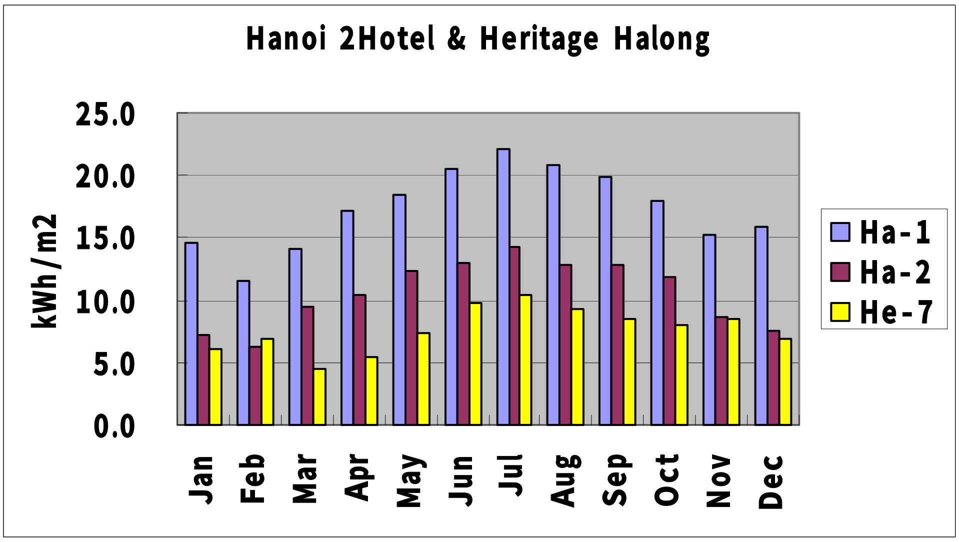
We have the data of seven hotels in Viet Nam. We create a graph plotting the total floor area as the horizontal axis and the annual electric energy consumption as the vertical axis. Heritage Halong Hotel comes just below the average line. When we create a graph plotting the total floor area as the horizontal axis and the electric energy per m2 as the vertical axis, Heritage Halong Hotel shows the least value. This indicates that Heritage Halong Hotel is an energy saving hotel with less energy consumption.

However, the other hotels we used for comparison are not always the resort hotels like Heritage Halong Hotel and the number of hotels is limited. We may need to collect more data and make comparison.



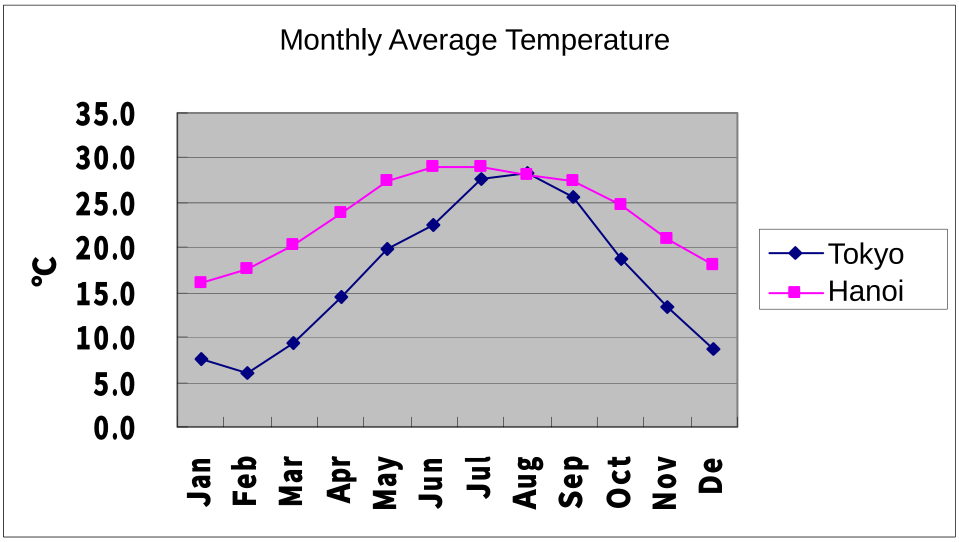


Since we have the monthly data of two hotels in Hanoi, we compare the monthly electric energy consumption per m2 of Heritage Halong Hotel and that of the two hotels in Hanoi. He-7 indicates Heritage Halong Hotel. The trend of monthly changes seems the same for all three hotels probably because all of them are in the area of the same climate.

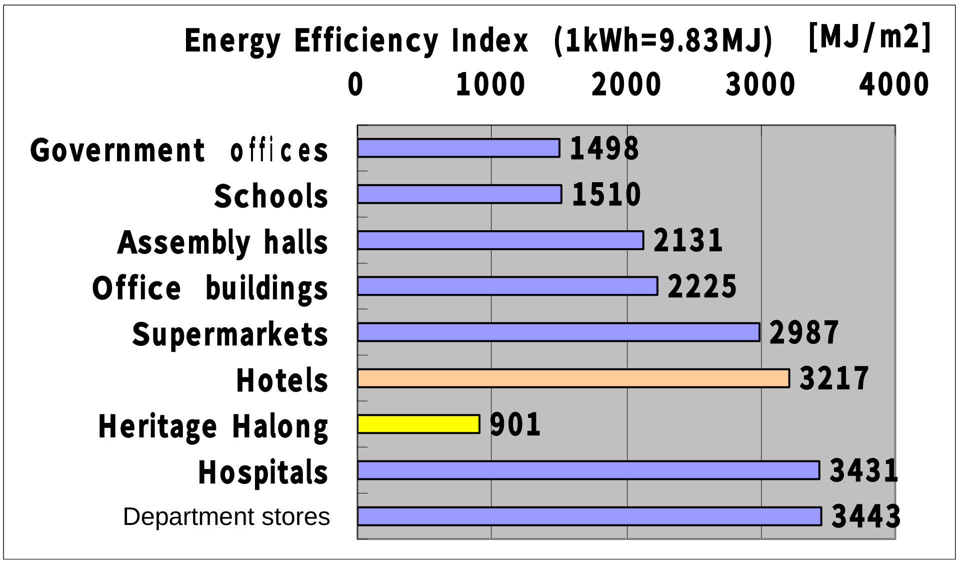


2) Evaluating electric power consumption rate (comparison with Japanese hotels)

Since we have little data on the hotels in Viet Nam, we compare the data of Heritage Halong Hotel with that of Japanese hotels. Before we make comparison, we present a graph showing the monthly average temperature in Tokyo and Hanoi.



The following graph shows the electric power consumption rates by use of the buildings in Japan added with the electric power consumption rate of Heritage Halong Hotel. The average of Japanese hotels is 3,217 MJ/m2 while the value of Heritage Halong Hotel is 901 MJ/m2, which is less than one third of the Japanese average. The Japanese average is calculated based on the values of the hotels in the cities in Japan. Although the energy consumption by use differs greatly between such Japanese hotels and a resort hotel like Heritage Halong Hotel, you can see that Heritage Halong Hotel is run with a very low electric power consumption rate.



(6) Assuming the electric energy consumption by user

1) Daily electric energy consumption

The following graph shows the hourly electric energy consumption in each time zone and the daily average electric energy consumption calculated from the electric energy data based on time zones in September and October 2005.

The hourly electric energy consumption is 100 kWh/h in the normal cost zone (6 a.m. to 6 p.m.), 128 to 143 kWh/h in the high cost zone (6 p.m. to 10 p.m.), and 60 kWh/h in the low cost zone (10 p.m. to 6 a.m.). Electric energy is used mostly in the high cost zone. Since this time zone is the peak operation time of the hotel, it may be inevitable. However, reducing the electric energy in this time zone is effective in reducing cost.

The table also shows that the daily electric energy is about 2,200 kWh ranging between 2,196 and 2,248 kWh.

Hour	12	4	8	24
	6am-6pm	6pm-10pm	10pm-6am	Total
2005 Sep	34,810	14,890	13,970	63,670
29days	1,200	513	482	2,196
kWh/h	100	128	60	91
2005 Oct	37,060	17,750	14,870	69,680
31days	1,195	573	480	2,248
kWh/h	100	143	60	94

2) Electric energy consumption in guest rooms

The following table shows the assumed electric energy consumption per guest room based on the facilities in a standard guest room and the occupancy rate of guest rooms. When we assume that each room is used eight hours a day and the occupancy rate of 101 guest rooms is 0.63, the daily electric energy used in guest rooms is 839.5 kWh, which is 38% of the total electric energy consumption of the hotel which is 2200 kWh. This value almost matches the measured value (39%) indicated before.

Total Guest Room 1Day

1 Guest Room	1649	W
	101	Rooms
	166.6	kWh
Occupancy rate	0.63	
Sub Total	104.9	kW
	8	h
Total	839.5	kWh

1 Guest Room

1,649	W
8	h
13.2	kWh

3) Electric energy consumption by user

We have the electric energy consumption data in guest rooms mentioned before and assume the amount of electric energy consumed for other purposes in the following tables. As this table shows, 37% of electric energy is used for guest rooms. The next highest user is restaurants and the kitchen, and the third highest user is the laundry. According to our interview, the laundry was continuously run for long hours and most of the facilities in the laundry including the steam generator were run by electricity. We suggest the reduction of operation hours since it can be done. The details about the suggestion are described later.

Among the facilities in guest rooms, air conditioners use the largest electric energy, 21% of the electric energy consumption in the hotel.

The values regarding guest rooms in the following table almost match the measured values. The value of the "Club, Office and Massage room" section was measured. It was 252 kWh in September and 305 kWh in October. The average is 279 kWh. Therefore, the estimated value, 270 kWh, is an appropriate value.

However, the measured values were not available in other systems and we cannot determine whether the estimated electric energy values were adequate for those systems. We hope that the hotel will make more measurements in the future.

1Guest Room : 8Hours Average

	W	Num	W	Load Ratio	W
Incandescent lamp	40	5	200	0.8	160
Fluorescent lamp	26	3	78	0.8	62.4
	36	1	36	0.8	28.8
	10	1	10	0.8	8
Lamp Total					259.2
AC	1920	1	1920	0.5	960
Hot Water	2000	1	2000	0.2	400
TV	53	1	53	0.3	15.9
Refrigerator	70	1	70	0.2	14
Total			4367		1649

	kWh/d	%
Lamp	132	6%
AC	489	21%
Hot Water	204	9%
TV	8	0%
Refrigerator	7	0%
Guest RoomTotal	839	37%

	Installed capacity	Load Ratio		OP Hour	kWh/d	
	kW	%	kW	h	kWh/d	%
Guest Room	167	0.63	105	8	839	37%
Lobby	15	0.5	8	24	180	8%
Restaurant, Kitchen	50	0.5	25	15	375	16%
Club, Office, Mas	90	0.5	45	6	270	12%
Meeting Room	30	0.2	6	6	36	2%
Laundry	50	0.3	15	20	300	13%
Machine room, ELV	20	0.3	6	24	144	6%
Staff Rooms & Others	20	0.3	6	24	144	6%
1 Day Total	442		215		2,288	100%

2.3 Points for Improvement and Expected Effects

The status of energy consumption is mentioned before. This section describes the points for improvement and the amount of expected effects based on the field tour and the energy data investigation.

(1) Improving the lights in guest rooms

Incandescent lamps were used in guest rooms as shown in the photographs. By replacing those incandescent lamps with high-efficiency lamps, electric power can be reduced.

The following table shows the amount of expected effects of the improvement. By replacing 40-W incandescent lamps with 7-W fluorescent lamps, 24,528kWh electric energy consumption can be reduced annually.

Incandescent lamp	40	W	5	Num	200	W	0.8	160	W
High Efficiency Lamp	7	W	5	Num	35	W	0.8	28	W
Difference								132	W
Energy Saving/room	132	W							
	101	Room							
	13.3	kW							
Occupancy rate	0.63								
	8.4	kW							
	8	h							
Energy Saving/day	67.2	kWh/d							
	365	d							
Energy Saving/year	24,526	kWh/y							

(2) Replacing incandescent lamps in other areas

Incandescent lamps were also used in corridors, external walls, and restaurants. By replacing those incandescent lamps with high-efficiency lamps, electric power can be reduced.

The following table shows the amount of expected effects of the improvement. This improvement can reduce 10,407 kWh annually.

							Save					
Corridor	40	W	8	Num	7	W	33	W	12	h	3.168	kWh/d
Wall	40		48		7		33		12		19.008	kWh/d
Restaurant	40		16		7		33		12		6.336	kWh/d
Total											28.512	kWh/d
1 Year							365			d	10,407	kWh/y

(3) Linking air conditioners with key tags

The power of the guest rooms in this hotel was linked with key tags and the power was turned on when a key tag was inserted. However, the power of air conditioners was not included in the system and it was always turned on. Unless a guest stops the air conditioner, the air conditioner keeps running even after the guest leaves the room. This may often happen when guests leave their rooms to go outside or dine out. The electric energy consumed by air conditioners in guest rooms is assumed to occupy 21% of the total electric energy consumption as mentioned in the previous table, which is a large value.

By linking air conditioners with key tags, energy is not wasted when guests leave their rooms. When we assume air conditioners stop for two hours, the amount of electric energy that can be saved hotel-wide is 44,592 kWh as shown in the table.

AC	1920	W
Load Ratio	0.5	
1 Guest Room	960	W
	101	Rooms
	96.96	kWh
Occupancy rate	0.63	
Sub Total	61.085	kW
Saving Time	2	h
Total	122.17	kWh/d
	365	d
1 Year	44,592	kWh/y

(4) Improving the maintenance of refrigerators

As shown in the photograph, frost was accumulated in the refrigerators in guest rooms, greatly reducing the cooling efficiency. Since refrigerators were not linked with the key tag system, they always ran in all the rooms. Although the electric energy consumed by each refrigerator is small, we can expect some effect if all the refrigerators in the hotel are improved. When we assume the rate of the effect of the improvement to be 0.2 and calculate, 826 kWh can be reduced annually by improving the maintenance of the refrigerators.

Refrigerator	70	W
Load Ratio	0.2	
	14	W
	8	h/d
	112	Wh
	101	Rooms
	11.3	kWh
Efficiency Recover	0.2	
	2.26	kWh/d
	365	d
1Year	826	kWh/y

(5) Summary of points for improvement

The following table shows the four points for improvement and the amount of expected effects. The four points allow reduction of 80,350 kWh electric energy, which is 8.4% of the total electric energy in the hotel. The reduction in cost is 117,846,824 VND.

		kWh/y		VND
1	Improvement of Guest Room Lamps	24,526	2.6%	35,970,803
2	Improvement of Incandescent Lamps	10,407	1.1%	15,263,424
3	AC synchronized with key Tag system	44,592	4.6%	65,401,459
4	Improvement of Refrigerator Maintenance	826	0.1%	1,211,138
	Total Saving	80,350	8.4%	117,846,824
	2004 Electricity Consumption	961,710		1,410,508,000
	1,467	VND/kWh		

2.4 Additional Proposals

(1) Introducing a water heating system

In this hotel, an electric storage type water heater was used in each guest room to supply hot water. The specifications of the water heaters are as follows and there were several different grades.

1500 W × 30 L: 70 units, 1500 W × 50 L: 20 units, 2500 W × 30 L: 30 units, 2500 W × 50 L: 30 units

The general manager told us that they were considering replacing these individual electric water heaters with a central water heating system operated by gas or oil. Here, we compare the running cost in case of electricity and LPG.

The following table shows that the cost per 1-kcal electricity is 1.8 VND assuming the average electric power cost per hour is 1,467 VND/kWh and the efficiency of an electric water heater is 0.95. When we assume the unit price of LPG per kilogram is 13,000 VND and the boiler efficiency is 0.65, the cost per 1-kcal LPG is 1.67 VND. When we compare the unit prices, LPG is cheaper by about 7%. However, this value is not so attractive. The unit price may decrease more when the fuel is oil instead of LPG. However, replacing the current individual water heaters with a central water heating system requires installing hot water supply pipes all over the hotel, and it is a very large construction job. If the purpose is to reduce energy cost, a central water heating system is not recommended due to the number of years required to recover the investment.

However, guests will be more satisfied with a central water heating system that sets no limit in the amount of hot water supply compared to the individual water heaters with limited amount of hot water and this helps the hotel to be higher graded. A central water heating system is meaningful if the purpose is to satisfy guests. However, installing new pipes will be difficult considering they take space. We reviewed part of the document regarding the introduction of a central water heating system. The document contained only the running cost when using oil as the fuel and the hotel did not seem to have considered the details about the required construction work and the cost for it. We hope the hotel will carefully examine the details about the construction work and the cost.

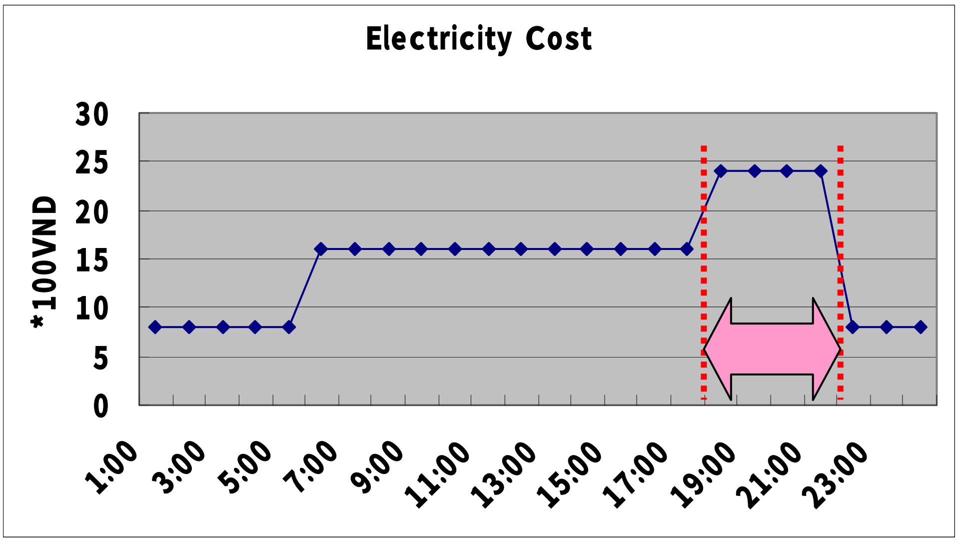
			kcal			VND/kcal	Eff	VND/kcal/Eff
Electricity	1	kWh	860	1,467	VND/kWh	1.71	0.95	1.80
Electricity	1	kWh	860	2,400	VND/kWh	2.79	0.95	2.94
Electricity	1	kWh	860	800	VND/kWh	0.93	0.95	0.98
LPG	1	kg	11990	13,000	VND/kg	1.08	0.70	1.55
LPG	1	kg	11990	13,000	VND/kg	1.08	0.65	1.67

(2) Changing the operation of the laundry

The laundry operated 16 hours or sometimes 24 hours a day continuously.

Except for the dryers that used LPG as the fuel, most facilities including washing machines, dehydrators and irons were working by electricity, and the total electric power consumption exceeded 50 kW. The laundry probably needs to respond to the requests of guests. However, we recommend the operation avoiding the peak hours of the electric power cost as much as possible. As shown in the graph below, the peak hours are 6 p.m. to 10 p.m. We recommend that these peak hours should be used as the break as much as possible.

We are not certain about the operation status since we could not obtain the hourly electric power data. Like the meters that were installed on each floor to manage energy, we recommend that such meters should be installed in the laundry as well to manage the electric power consumption of each time zone. We asked the laundry manager to record the electric energy of each time zone. We recommend that the laundry staffs voluntarily manage the electric energy consumption and create a system where the management results are reflected



1 Day Management

Electricity	E	kWh/d
Water	W	m3/d
Electricity Cost	Ec	VND/d
Water Cost	Wc	VND/d
Occupied Room	Or	room
Guest Number	Gn	person

E.. Consumption Index	E/Or	kWh/d/room
W. Consumption Index	W/Or	m3/d/room
W. Consumption Index	W/Gn	m3/d/person
E.. Cost Index	Ec/Or	VND/room
W. Cost Index	Wc/Or	VND/room

(3) More measurements

In this hotel, the total electric energy consumption was measured and detailed measurements were also conducted by installing watt-meters on each floor of guest rooms. However, the electric energy of major parts of the hotel, such as the laundry and the restaurants mentioned above, was not measured. To reduce electric energy, the management need to know how much electric energy is used first. We recommend more detailed measurements for further energy conservation.

To effectively use the measured data, it is important to analyze the data in terms of energy conservation. We recommend that the hotel should actively participate in energy conservation trainings held in Viet Nam and learn the methods.

As for water consumption, it was not measured daily although water meters were installed. We recommend that the hotel should incorporate the recording of measurements in daily tasks to obtain the daily water consumption like electric energy.

(4) Managing energy

Advanced hotels determine and analyze the relationship between the daily occupancy rate of guest rooms and the energy consumption as energy management. Heritage Halong Hotel should learn from those examples and perform a higher level of the energy management.

An example of analyzing energy consumption, water consumption, and occupancy rate of guest rooms is as follows.

1 Day Management

Electricity	E	kWh/d
Water	W	m3/d
Electricity Cost	Ec	VND/d
Water Cost	Wc	VND/d
Occupied Room	Or	room
Guest Number	Gn	person

E.. Consumption Index	E/Or	kWh/d/room
W. Consumption Index	W/Or	m3/d/room
W. Consumption Index	W/Gn	m3/d/person
E.. Cost Index	Ec/Or	VND/room
W. Cost Index	Wc/Or	VND/room

3. Follow-up Energy Audit of Hotel Nikko Hanoi

3.1 Outline of Hotel Nikko Hanoi

(1) Name of the building: Hotel Nikko Hanoi

(2) Use: Hotel (260 rooms)

(3) Size: One floor below the ground and 17 floors above the ground
: Total floor area: 29,164 m^2

(4) Age: Six years old

(5) Outline of electrical systems: Service voltage: 10 kV, Transformer capacity: 1500 kVA × 2 units,
Generators: 810 kVA × 2 units (water cooled)
Elevators: 18 kW × 3 units, service elevator: 18 kW × 1 unit

(6) Outline of air-conditioning systems: Turbo chillers: 300 RT (199 kW) × 3 units, Air conditioners + fan-coil unit systems

(7) Sanitary facilities: Steam boilers (diesel oil): 8 kg/cm2 × 2400 kg/h × 2 units,
Receiving water tanks: 225 m3 × 2 units (city water, well),
Lift pumps: 30 kW × 2 units, Elevated water tank: 100 m3

3.2 Outlined Results of the Audit in 2002

(1) Date of energy audit: First audit: January 7 and 9, 2003
Second audit: February 18, 2003

(2) Audited by: Akira Ueda (technical expert) and Akira Kobayashi (technical expert) from the Energy Conservation Center, Japan

(3) Outlined results of the diagnosis
The energy consumption per unit area in Hotel Nikko Hanoi was 3,248 MJ/m^2, which is almost the same as the average of Japanese hotels, 3278 MJ/ m^2. The hotel

was designed by a Japanese architect office and many of the guests were Japanese. That may be the reason for the similarity.

The electric energy had increased by about 10% every year in three years, assuming the electric energy of 2000 was 100. The electric energy of 2001 was 112 and the electric energy consumption of 2002 was 122. The main factor in the increased total energy consumption is probably the increase of the annual average operation rate from 31.9% to 48.3% to 68.5%.

When we calculate the rates of energy consumption by use, the energy rate of hot water supply and steam is about 12% for Japanese hotels while the rate is nearly doubled for Hotel Nikko Hanoi, which is 26%. This indicates that the management of boilers which produces hot water and steam is the key point.

We proposed the following six items as the points for improved energy conservation.

(1) Improving the chilled water temperature

The outlet temperature of chilled water of chillers was low even in seasons with light load. We suggested that they should increase the temperature of chilled water in light load seasons to achieve highly efficient operation of chillers. The expected reduction in electric energy was 50,561 kWh and the percentage of reduction was 0.8% of the total electric energy of the building.

(2) Changing chilled water pumps to the variable flow rate type

There were three secondary pumps for chilled and hot water. The number of pumps to be used was controlled based on the return flow rate of chilled and hot water. By adding inverter control, the pump power could be reduced further.

The expected reduction in electric energy was 278,444 kWh and the percentage of reduction was 4.6% of the total electric energy of the building.

(3) Improving the boiler fuel air ratio

There were two oil-fired steam boilers. Since they did not measure the fuel air ratio to control the operation, we thought the fuel air ratio was excessive. We suggested that they should measure the fuel air ratio and run the boilers in optimum condition. We assumed the fuel air ratio was 1.5 at the time. If the hotel improved it to 1.2, the expected reduction in oil consumption was 18,992 liters and the percentage of reduction was 3.0% of the total oil amount used for boilers.

(4) Switching to high-efficiency lamps and lighting fixtures

Although most lamps were changed to high-efficiency lighting fixtures, old fixtures were used in guest rooms and corridors of the guest room floors. We suggested that they should replace them. The expected reduction in electric energy was 46,154 kWh and the percentage of reduction was 0.8% of the total electric energy of the building.

(5) Improving the heat insulation of steam pipes and valves

Some of steam pipes, valves, and flanges were not heat-insulated. There was energy loss due to heat radiation and we suggested the applicable parts should be heat-insulated. The expected reduction in oil consumption was 17,062 liters and the percentage of the reduction was 2.7% of the oil consumption of boilers.

(6) Recovering heat from the cooling water of generators

Diesel generators were contributing to the reduction in electric power cost since they were run during the time period of high electric power cost. However, the waste heat was not effectively used. Therefore, we suggested that they should use the waste heat of generators to preheat hot water supply. The expected reduction in oil consumption was 20,265 liters and the percentage of reduction was 3.2%.

3.3 Follow-up of the Previous Proposals

Some of the proposals in 2002 mentioned above were considered and executed. The following describes the result of the follow-up of the previous proposals.

(1) Improving the chilled water temperature

We suggested the improvement of the temperature of chilled water during the first audit in January 2003. During the second audit in February, the ex-chief engineer reported that the improvement reduced electric energy.

However, the new chief engineer did not know about the improvement very well. The temperature of chilled water was not raised any more. The temperature setting of chilled water on the operation panel of chillers was 7°C and it was the same throughout the year. The operation management records showed the temperature of chilled water changed between 7 and 10°C. We were not sure whether the recorded temperatures were correct. However, we suggested the same improvement again.

(2) Changing chilled water pumps to the variable flow rate type

They accepted our improvement proposal and installed a Variable Speed Drive (VSD) in March 2003 to perform variable control.

(3) Improving the boiler fuel air ratio

Our suggestion was not executed since there was no device to measure the fuel air ratio and they did not ask external measurement companies to measure the fuel air ratio. They were not aware that the key point in managing the operation of boilers was the fuel air ratio. We suggested the same proposal again.

(4) Switching to high-efficiency lamps and lighting fixtures

Previously, we suggested the incandescent lamps in guest rooms and corridors on the guest room floors should be changed to high-efficiency compact lamps. The lamps in the common areas such as corridors were replaced. However, the conventional incandescent lamps were still used in guest rooms because of aesthetic values.

(5) Improving the heat insulation of steam pipes and valves
We suggested this proposal during the first audit in 2003 and they quickly applied the proposal before the second audit.

(6) Recovering heat from the cooling water of generators
In 2003, diesel generators were run during the time periods (18:00 to 22:00) with the high electric power cost to reduce electric power cost. That is why we suggested that they should recover the heat from the generators. However, their method changed due to backup and maintenance problems of the generators after the chief engineer changed. Generators were run only in emergencies at the time of our follow-up. Our proposal became ineffective.

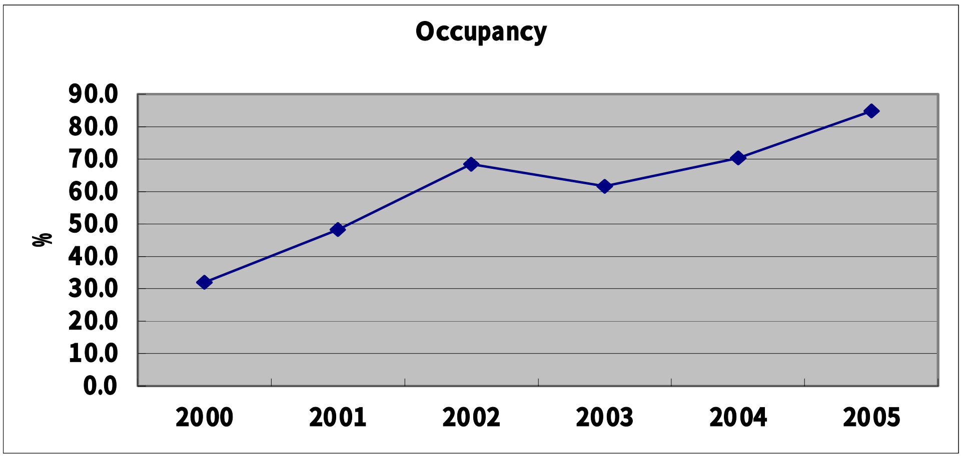
(7) Summary of the follow-up of the previous proposals
The following table lists the results of the above follow-up:

	Improvement proposals made in 2002	Execution status	
1	Improvement of the chilled water temperature	No	Not performed. The same proposal was made again.
2	Change of cooled and hot water pumps to the variable flow rate type	Yes	A VSD was introduced.
3	Improvement of the boiler fuel air ratio	No	Not performed. The same proposal was made again.
4	Switching to high-efficiency lamps	Partly yes	Executed in common areas and not executed in guest rooms.
5	Heat insulation of steam valves	Yes	Executed.
6	Heat recovery from cooling water of generators	Not applicable	The operation method of generators was changed.

3.4 Results of Follow-up Energy Audit

(1) Changes of operation rate
It is well known that the energy consumption in hotels is greatly affected by the operation rate of the hotels. The following graph shows the annual average operation rate from 2000 to 2005 of Hotel Nikko Hanoi.
The operation rate drops in 2003 because of SARS. The operation rate is recovered from the influence in 2004 and returned to the level of 2002 before SARS. The operation rate of 2005 is not yet fully determined. However, it is higher than that of

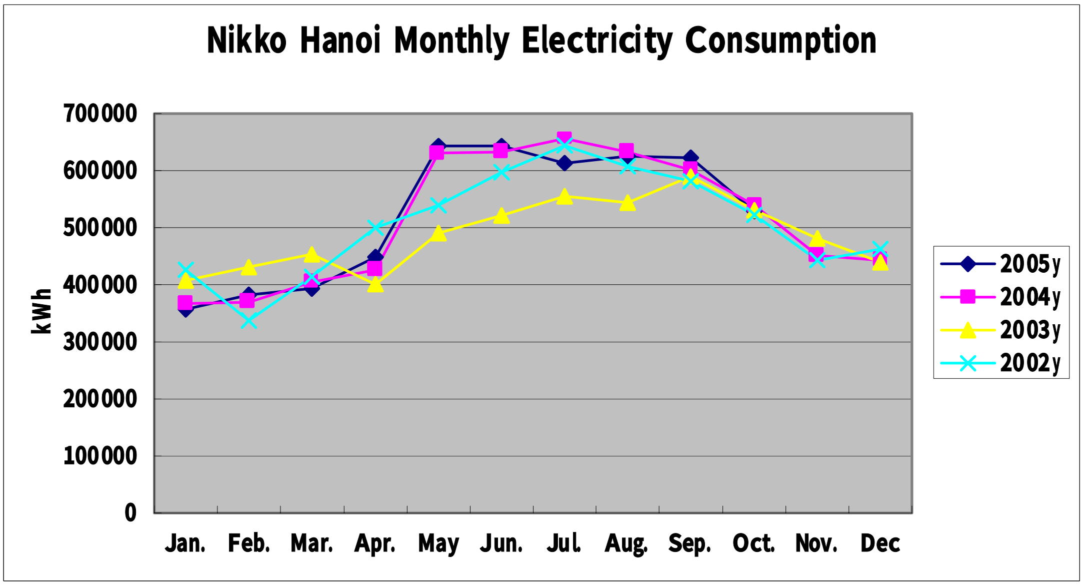
2004. Since the ASEAN summit is scheduled in Hanoi in 2006, the operation rate is expected to rise more in 2006.



(2) Changes of electric energy consumption

The following graph shows the monthly electric energy consumption from 2002 to the middle of 2005.

As mentioned in the previous section, the electric energy drops from April 2003 because of SARS. The monthly energy consumption tells that much energy is consumed between May and September. This is probably much energy is required for air conditioning in the hot season.

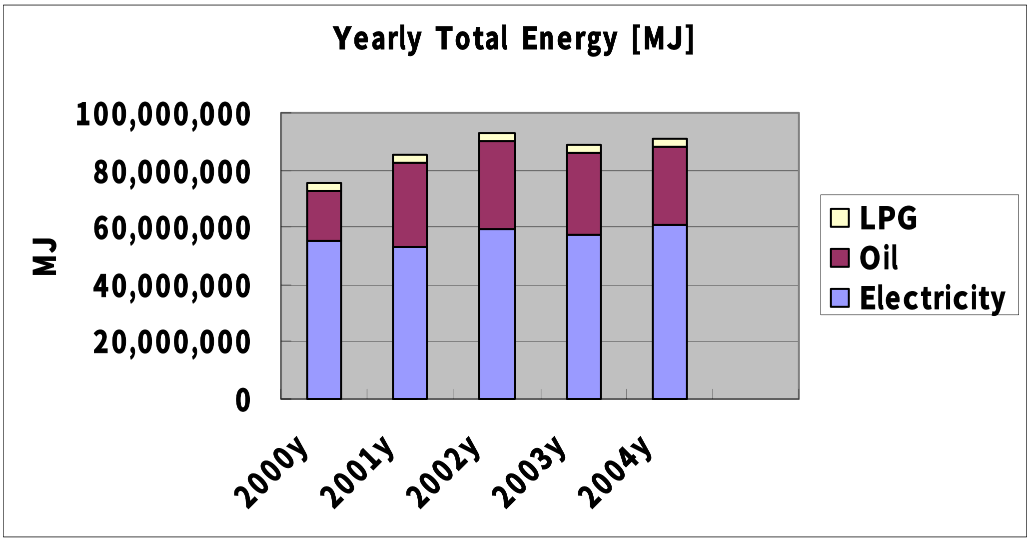


(3) Changes of energy consumption in five years

The hotel used steam for hot water supply, heating, humidifying, and laundry. To generate steam, the hotel had an oil-fired steam boiler. The hotel also used LPG-for the kitchen. The total energy and electric power is converted to MJ values using the following conversion units and the status of total energy and electric power since 2000 is shown in the following graph.

Electric energy: 1 kWh = 9.83 MJ
Oil: 1 liter = 38.93 MJ
LPG: 1 liter = 27.61 MJ

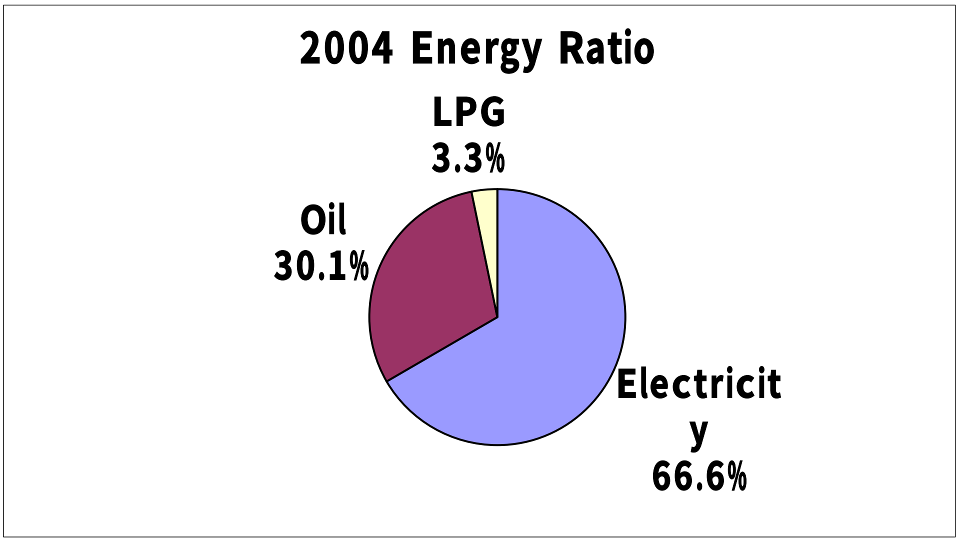
The influence of SARS in 2003 is clearly seen in the total energy values.



(4) Energy consumption rates by energy resource

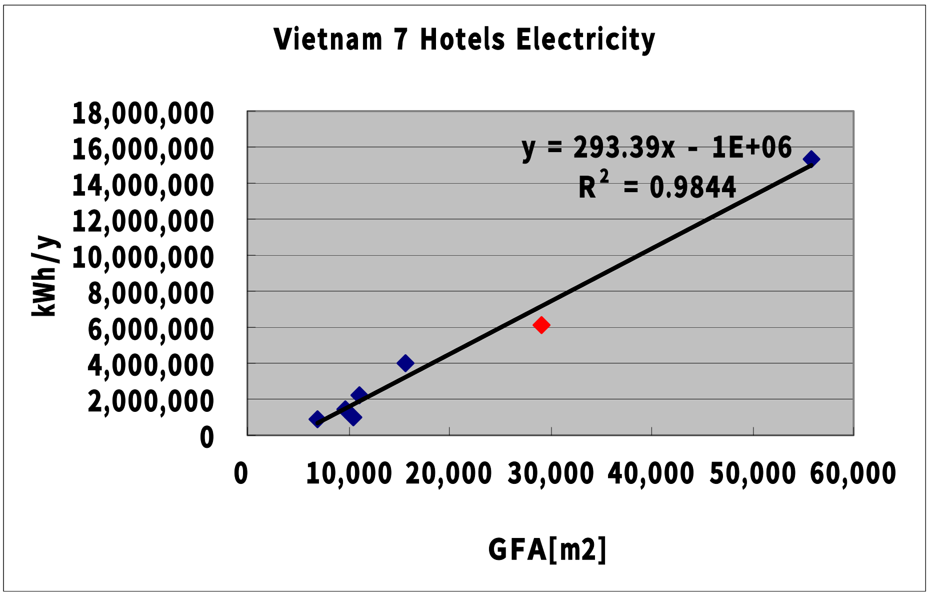
The following pie chart shows the energy consumption rates by energy resource in 2004.

Electric power is 67%, oil is 30%, and LPG is 3%. These values are not very different from the 2002 values where electric energy is 66%, oil is 31%, and LPG is 3%.

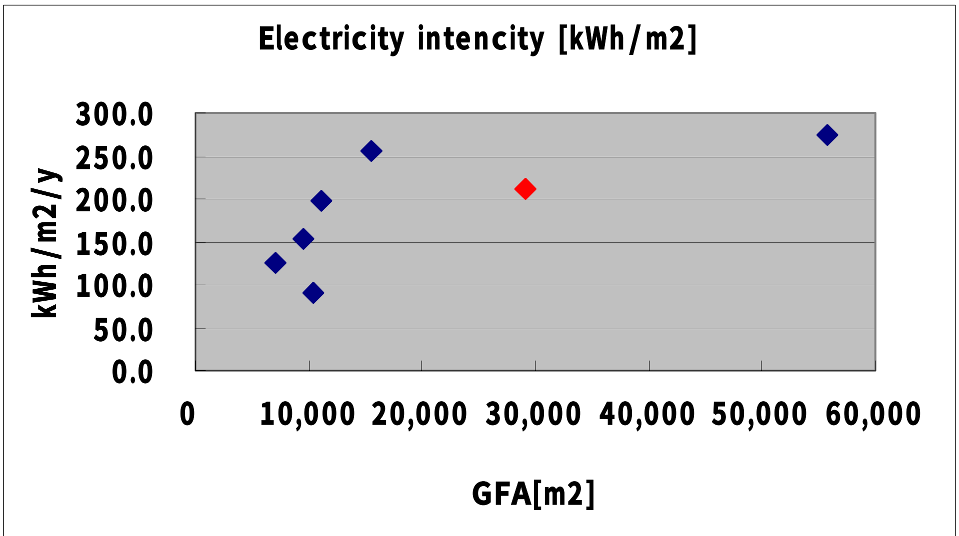


(5) Evaluations of electric energy

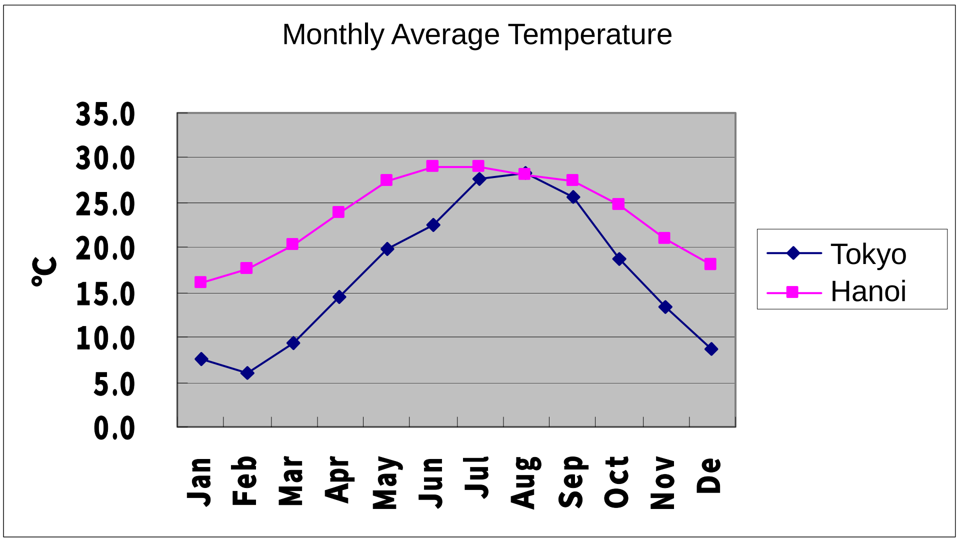
The electric energy consumption of Hotel Nikko Hanoi in 2004 is compared with the electric energy consumption of other hotels in Viet Nam. The data was acquired in different years depending on the hotel. The following graph shows the relationship between the total floor areas and the annual electric energy of seven hotels including Hotel Nikko Hanoi. Although the sources of data are limited, Hotel Nikko Hanoi is located below the average line indicating the hotel is more energy saving than the average hotels in Viet Nam.



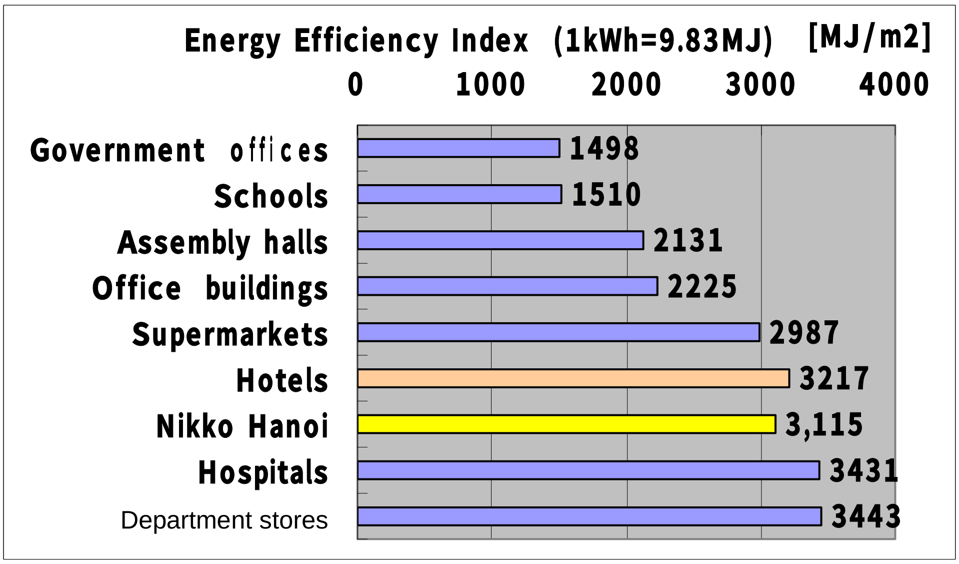
The following graph shows the annual electric energy per unit area (the annual electric energy is the vertical axis). The value of Hotel Nikko Hanoi is 211 kWh/m2.



Since the number of hotels that can be compared in Viet Nam is small, we compare the value of Hotel Nikko Hanoi with the average value of Japanese hotels. The following graph shows the average temperature of each month in Hanoi and Tokyo.



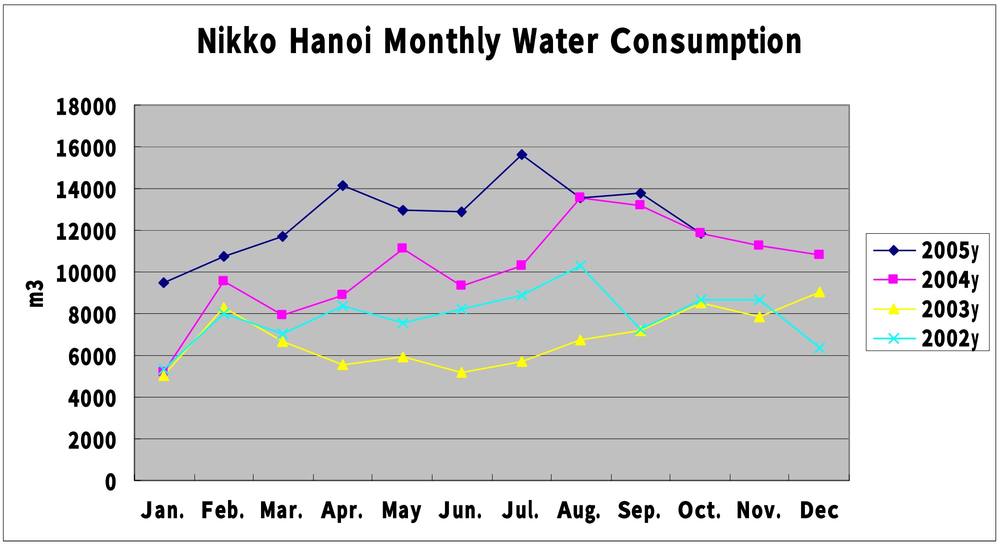
The average value of Japanese hotels is 3,217 MJ/m2 while the value of Hotel Nikko Hanoi is 3,115 MJ/m2, which is a little smaller than the Japanese average.



(6) Changes of water consumption

The following graph shows the monthly water consumption from 2002 to the middle of 2005.

Due to the influence of SARS, the water consumption clearly drops in 2003. The water consumption increase in 2004 and 2005 indicates that guests came back to the hotel. The water consumption is large between April and September probably because more cooling water was required for more air conditioning.

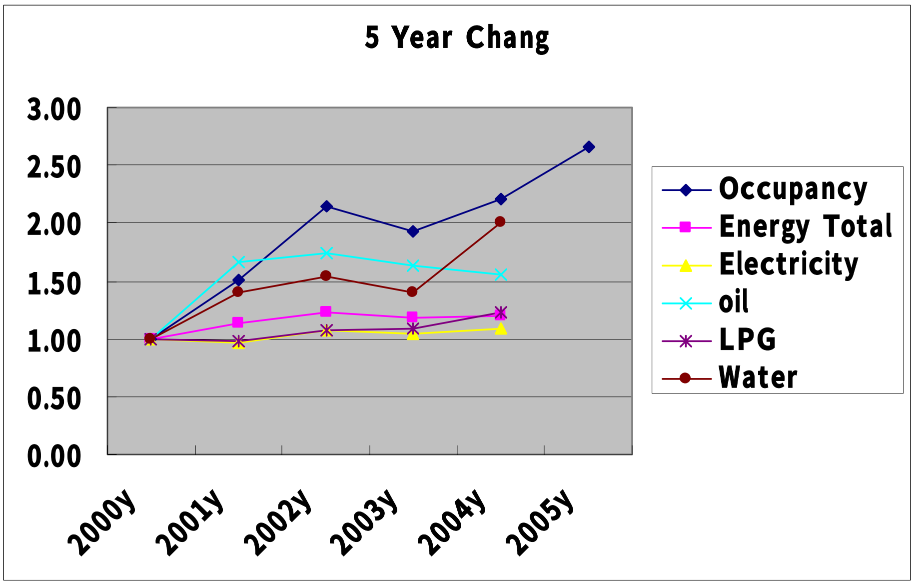


(7) Relationship among operation rate, energy consumption, and water consumption

We were able to obtain the data on the operation rate, energy consumption, and water consumption of the hotel. The following graph shows the rate of changes assuming 2000 as the basis.

Water consumption has the strongest correlation with operation rate. Energy consumption is less correlated with operation rate probably because of the large basic energy consumption in the hotel that is not related with the number of guests.

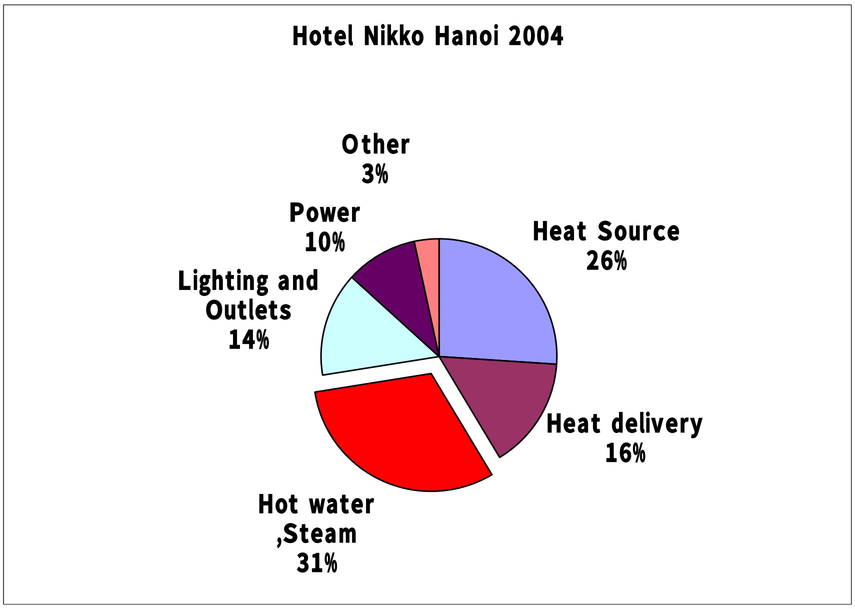
Oil consumption is decreasing probably because generators are now used only for emergencies. The generators used to be run during the peak hours of electric power.

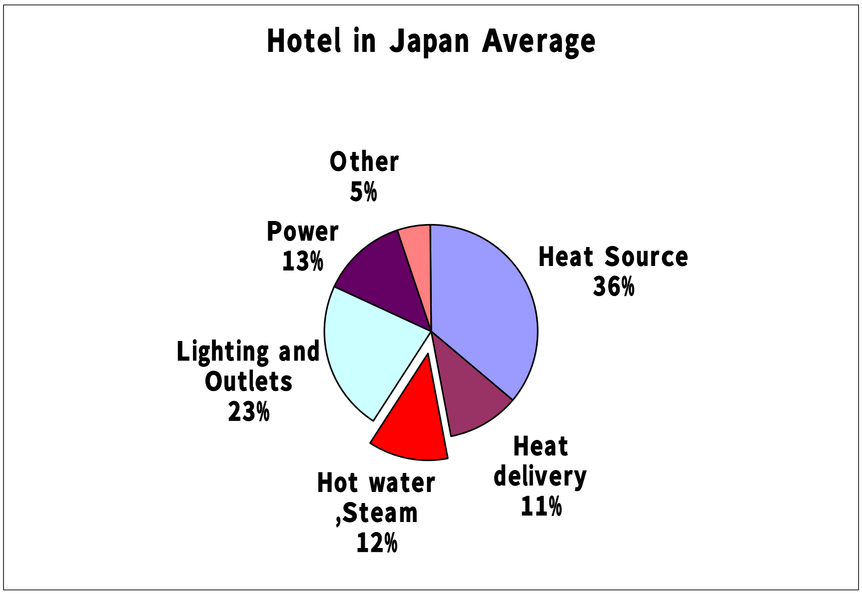


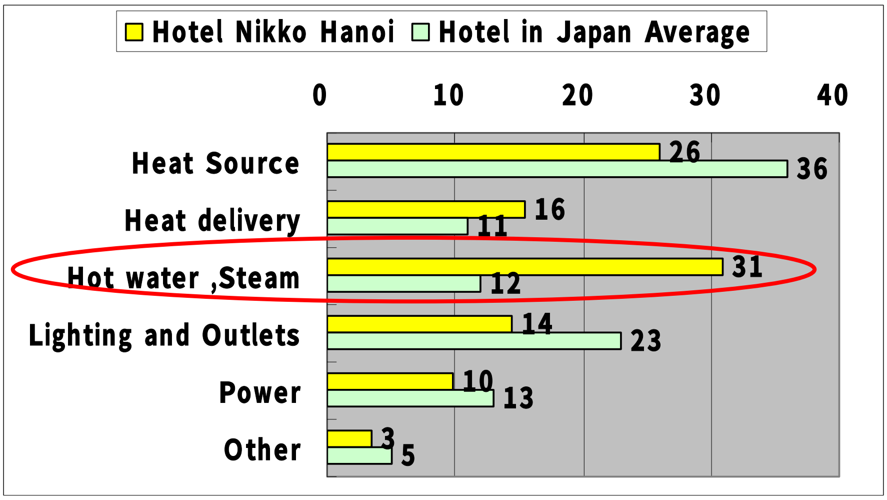
(8) Energy consumption rates by user

We calculate the energy consumption for each user and describe the rates in a pie chart. When the rates of Hotel Nikko Hanoi are compared with the average values of Japanese hotels, the section of hot water supply and steam is very large.

The graph indicates that the point for improvement in the hotel is hot water supply and steam, which means how to run boilers.







(9) Voluntary improvements

The chief engineer, Mr. BIEN BANAO had been working in the hotel since 2003 and he said he had been conducting the following energy conservation improvements. Energy data was managed appropriately and his energy management was at a high level.

① A circulation system was created for overblown water of pools to reduce water consumption.

② An opening was made in the external walls of the cooling towers to improve efficiency. The exhaust duct was improved since it was affecting the cooling towers badly.

③ The schedules for starting and stopping air conditioners and exhaust fans were reviewed in detail and improved.

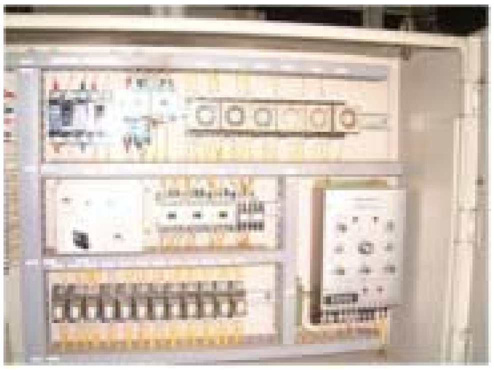
3.5 Additional Proposals for Improvement

The following describes the proposals for improvement that were suggested previously and not executed in the follow-up energy audit and some additional proposals.

(1) Improving the chilled water temperature

【Current status】

The chillers were run with the outlet temperature of chilled water being set to 7°C throughout the year.



【Proposal for improvement】

Raise the outlet temperature of chilled water during the seasons with less cooling load to run the chillers efficiently.

【Calculated effects】

Seasons with less cooling load: Six months including January to March and October to December

Outlet temperature of chilled water: Current: 7°C Improved: 10°C

Percentage of saving when the outlet temperature of chilled water is improved: 7%

Average load factor: 80%

Chiller power: 209 kW

Average electric energy cost: 0.09 $/kWh

Calculations

Reduction in electric energy

$209 \times 0.8 \times 24 \times 30 \times 6 = 722{,}304$ kWh

$722{,}304 \times 0.07 = 50{,}561$ kWh

Reduction in cost

$50{,}561 \times 0.09 = 4{,}702$ \$/y

Percentage of energy reduction

Note that 1 kWh is equal to 9.83 MJ.

50,561 kWh = 497,017 MJ

Total energy consumption in 2004 ＝ 90,837,476 MJ

$497{,}017 \div 90{,}837{,}476 = 0.0055 \rightarrow 0.55\%$

The following table summarizes the above calculations:

Seasons of low cooling load	6	months
Chilled water outlet temperature	7 → 10	℃
Saving rate	7	%
Power of chiller	209	kW
Average load factor	80	%
Reduced power consumption	50,561	kWh
Reduced power consumption	497,017	MJ
Reduced Rate per Total Energy	0.55	%
Unit Cost	0.09	$/kWh
Reduced cost	4,702	$/y
2004 Energy Consumption	90,837,476	MJ

(2) Managing and improving the boiler fuel air ratio

【Current status】

Two oil-fired boilers were run. However, the boilers were run without measuring and managing the fuel air ratio.

【Proposal for improvement】

Measure the fuel air ratio and run the boilers at an adequate ratio.

【Calculated effects】

Current fuel air ratio: 1.5 (assumed value)

Target fuel air ratio: 1.2

Difference between the current and target fuel air ratios: 0.3

Exhaust gas temperature: 200°C (assumed value)

Percentage of reduction in oil due to the improvement: 3.0%

Oil consumption in 2004: 702,160 L

Calculations

Reduction in oil consumption

702,160 × 0.03 = 21,065 L

Reduction in cost

Unit price of oil: 0.25 $/L

21,065 × 0.25 = 5,266 $/y

Percentage of energy reduction

1 L ＝ 38.937 MJ/L

21,065 × 38.937 = 820,200 MJ

Total energy consumption in 2004: 90,837,476 MJ

Percentage of reduction: 820,200 ÷ 90,837,476 = 0.009 → 0.9%

The following table summarizes the above calculations:

Current air ratio (Assumed)	1.5	
Target air ratio	1.2	
Reduction rate after improvement	3.0	%
Yearly oil consumption for boiler [2004]	702,160	l
Reduced oil consumption	21,065	l
Reduced oil consumption	820,200	MJ
Reduced Rate per Total Energy	0.90	%
Unit Cost	0.25	$/l
Reduced cost	5,266	$/y
2004 Energy Consumption	90,837,476	MJ

(3) Automatically cleaning the cooling water tubes in chillers

【Current status】

The cooling water tubes in chillers were not cleaned.

【Proposal for improvement】

Automatically clean the cooling water tubes.

【Calculated effects】

Annual electric energy of chillers: 1,809,937 kWh (assumed value)

Percentage of the effect of the improvement: 3.0%

Reduction in electric energy

1,809,937 × 0.03 = 54,296 kWh

Reduction in cost

54,296 × 0.09 = 4,702 $/y

Percentage of energy reduction

54,296 × 9.83 = 533,750 MJ

533,750 ÷ 90,837,476 = 0.0059 → 0.59%

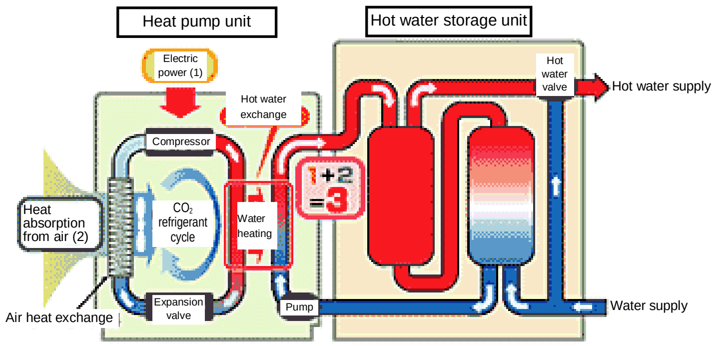
The following table summarizes the above calculations:

Chiller Electricity Consumption	1,809,937	kWh
Saving rate	3	%
Reduced power consumption	54,298	kWh
Reduced power consumption	533,750	MJ
Reduced Rate per Total Energy	0.59	%
Unit Cost	0.09	$/kWh
Reduced cost	5,050	$/y
2004 Energy Consumption	90,837,476	MJ

(4) Heating water using the heat recovered from the laundry room (introduction of a heat pump water heater)

The laundry room was always hot since lots of steam was used. We introduce a heat pump water heater to use the hot temperature in the laundry room as the heat source so the laundry room can be cooled and heat can be recovered at the same time.

This water heater uses CO2 refrigerant to enable hot water supply. To recover heat in the laundry room, you need to place an outdoor unit, which is usually placed outside, in the laundry room (to cool the laundry room). This water heater is becoming popular in Japan. However, it is not known in Viet Nam. The following photograph shows the components of a heat pump water heater.

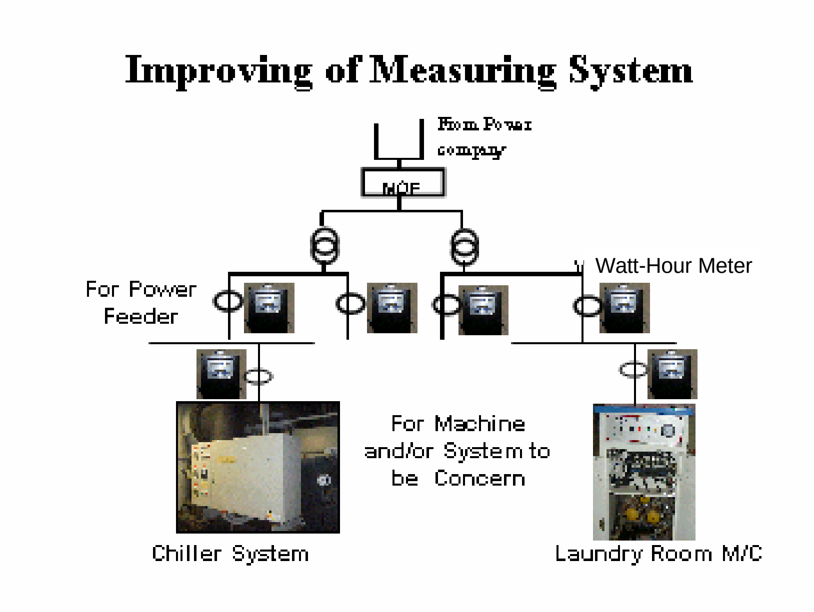


(5) Suggesting detailed measuring

The electric energy was measured by using the watt-hour meter for supplied electric power. No meter was installed in the later systems and the electric energy consumption per user or per device was not measured.

The largest user of electric energy in this hotel was chillers. Therefore, the electric energy consumed by the chillers should be measured at least.

The following figure shows an image of detailed measuring.



(6) Summary of proposals for improvement

The following table lists the proposals for improvement mentioned so far. The three items will reduce 2% of total energy consumption.

No	Theme	Electricity [kWh]	Oil [L]	Rate [%]	Remarks
1	Improvement of Chilled Water Temperature	50,561		0.55	
2	Improvement of Air Ratio of Boiler		21,065	0.90	
3	Automatic Condenser Cleaning	54,298		0.59	
4	Laundry Heat Makes Hot Water				New Technology
5	Improving of Measuring System				
	Total			2.04	

3.6 The Barriers for the Promotion of Energy Conservation, and Measures Against Those Problems

(1) Propagation of technologies

The improvement of the boiler fuel air ratio was included in the previous proposals for improvement and never performed. Boilers consumed 30% of the energy used in the hotel. The energy consumption of the boilers is excessive compared to the energy consumption by use in Japanese hotels.

Building managers did not know that the key to energy management of boilers was the management of fuel air ratio and the exhaust gas needed to be analyzed to manage the fuel air ratio.

Propagation of basic knowledge about energy conservation and easy access to measuring companies are mandatory for wider spread of energy conservation activities. We hope that necessary technologies will be well spread in Viet Nam in the future.

(2) Importance of aesthetic values

The lamps in common areas such as corridors were replaced by high-efficiency lamps. However, the incandescent lamps in guest rooms were still used for aesthetic values. Since the lamps themselves were not designed to be artistic, we want to recommend high-efficiency lamps if the function is the same. However, it was difficult to persuade the hotel staff to accept high-efficiency lamps at the moment.

We hope that the designers and the manager will be more aware of the need for energy conservation.

(3) Transfer of technologies

Since the chief engineer changed, the previous proposals for improvement were not passed on correctly to the successor. This kind of thing happens very often. However, the know-hows for energy conservation should not be kept to specific individuals but need to be communicated correctly to the people involved.

To achieve this goal, the technical databases and technical directory for ASEAN countries should be completed as soon as possible.

4. Follow-up Energy Audit of Lake Side Hotel

4.1 Outline of Lake Side Hotel

(1) Name of the building: Lake Side Hotel

(2) Use: Hotel (76 guest rooms)

(3) Size: Five floors above the ground and no floors below the ground
: Total floor area: 6,981.1 m^2

(4) Age: 10 years old

(5) Outline of electrical systems: Service voltage: 20 kV
Transformer capacity: 1,000 kVA
Generator (for emergency): 800 kVA
Elevators: 10.2 kW × 2 units

(6) Outline of air-conditioning systems:
Chillers: 74 kW × 3 units
(fan-coil units)

(7) Sanitary facilities (water heating systems): Solar panels (96 panels) + electric boiler: 162 kW,
Hot water storage tanks: About 5,400 L × 4 units

4.2 Outlined Results of the Audit in 2002

(1) Date of energy audit: First audit: January 8 and 9, 2003
Second audit: February 17 and 19, 2003

(2) Diagnosed by: Akira Ueda (technical expert) and Akira Kobayashi (technical expert) from the Energy Conservation Center, Japan

(3) Outlined results of the diagnosis

1) Energy consumption by use

- The peak electric energy consumption month (about 80 MWh/month) was either June or July. The least electric energy consumption month (about 40 MWh/month) was either February or November.
- The annual electric energy consumption dropped from 890 MWh (2000) to 830 MWh (2002).
Since the operation rate of the hotel increased from 75% to 90% in the above period, the reduction was due to the energy conservation activities.
- The percentage of consumed electric power in calorie was 85% and the percentage of consumed LPG (for the kitchen) in calorie was 15%.
- The maximum user of energy was heat conveyance from heat sources, which was 53%. The next highest user was outlets for lamps, which was 26%.

Since solar panels were used to heat water, the energy for water heating was less than 4%, which is very low.

- The average unit price of electric power was 0.18 $/kWh which was twice as high as that of H hotel in the same city.
  The reason for this high unit price needs to be investigated and a better contract should be considered.
- The water consumption rate (rate of water consumption per floor area) was 5.12 m^3/m^2 and it was about 1.5 times of that of H hotel. The employees should be more aware of water conservation.

2) Proposals for improvement

- Improving the temperature of hot water supply: The temperature of hot water supply should be decreased from current 80°C to 60°C to decrease the heat radiation loss in pipes.
- Employing another heat source for heating water: The heat source for secondary heating should be changed from electricity to LPG.
- Managing electric energy: Creating a system for measuring the consumed electric energy is recommended.

4.3 Follow-up of the Previous Proposals

We visited the hotel and performed a follow-up energy audit between 8:30 and 11:30 on November 17. From the hotel, Mr. Pham Thanh Hai (Front Office Manager of Lake Side Hotel) and one more person received us.

The building manager who received us for the previous energy audit was not with the hotel anymore and the details about the previous energy audit and our last proposals were not passed on sufficiently.

(1) Performance status of the previous proposals

1) Decreasing the temperature of hot water supply

The hotel reduced the temperature from 80°C to 60°C as we suggested. However, guests requested hotter water so the hotel supplied 70°C hot water which is 10°C colder than the original temperature.

2) Employing another heat source for heating water (switching from electricity to LPG)

Not performed. This is probably because an investment for a new facility is required.

We suggested this idea to reduce the cost since the unit price of electric power was high at 0.18 $/kWh. However, the unit price was about 1,100 VSD/kWh at the time of the follow-up audit which was similar to that of other hotels. Therefore, the effect of switching to LPG is smaller. However, electric power is generally costly and it should not be used for secondary heating of hot water.

3) Managing electric energy

We were not able to confirm this.

4.4 New Proposals

1) Adjusting the temperature of cooled water of chillers

The hotel staff told us that the temperature of cooled water supplied by chillers was 6°C in summer and warmer in winter. Since the temperature decreases in winter in Hanoi, the chillers can be run with less load in winter. By increasing the outlet temperature of cooled water, the efficiency of chillers increases, resulting in energy conservation. The graph shows the relationship between the outlet temperature of cooled water and the electric energy consumed by compressors.

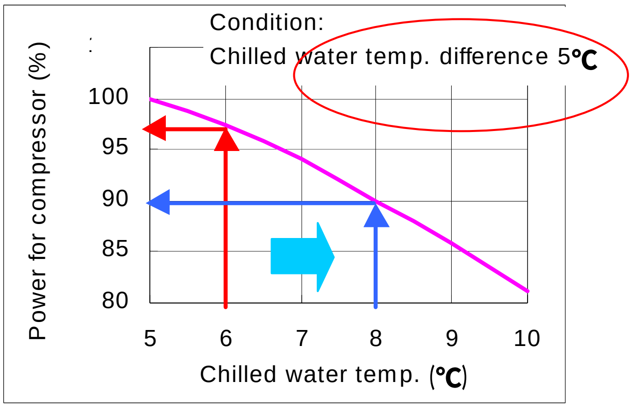


Figure 1 Relationship Between the Temperature of Cooled Water of a Turbo Chiller and the Required Input of a Compressor (%)

For example, if the temperature of output cooled water is increased from 6°C to 8°C, about 8% of energy can be saved.

2) High-efficiency lamps

A great deal of energy can be saved by replacing general incandescent lamps with compact fluorescent lamps with edison screw bases. The features of a compact fluorescent lamp with edison screw base are as follows:

- The electric power consumption is one fourth or one fifth of an incandescent lamp with the same luminance.

  Example: The electric power consumed by a compact fluorescent lamp with edison screw base is 8 W compared to a 40-W incandescent lamp, and 13 W compared to a 60-W incandescent lamp.

- The life of a compact fluorescent lamp with edison screw base is six times longer than that of an incandescent lamp. The life of an ordinary incandescent lamp is 1,000 hours while the life of a fluorescent lamp is 6,000 hours. If a lamp is lit six hours every day, you need to replace an incandescent lamp every six months while you only need to replace a fluorescent lamp every three years.
- You do not need to change lighting fixtures to use fluorescent lamps with edison screw bases.
- You can choose fluorescent lamps with edison screw bases from the daylight color type, white daylight color type, and incandescent light color type.
- The heating value is small since the electric energy consumption is small.

  You need to be aware of the following points when you decide to use fluorescent lamps with edison screw bases:
- A fluorescent lamp weighs heavier than an incandescent lamp.
- A fluorescent lamp is more expensive, about 11 times more.

3) Measuring electric energy

As mentioned in the previous audit, the first step to energy conservation is measuring. The monthly data of consumed electric energy is the most basic. To perform energy conservation activities, the daily electric energy consumption and the daily load curve must also be obtained. Although measuring using dedicated watt-hour meters and installing demand meters are the best way, the meters in a substation are also adequate to make measurements with sufficient accuracy. The procedures are shown below.

- Measuring daily electric energy consumption

  At the power reception point, there is a watt-hour meter installed by a power company. You read the indication of the watt-hour meter at the specified time every day and subtract the value of the day before from the value of the day to easily obtain the daily electric energy consumption.

  An example record form is shown below.

Table 1 Received Electric Power Management Table

Receiving power daily report Apr. 2005

day	Voltage V	Current A	P. Factor %	Acc.power kWh	Power kWh
1(Fri)				①	=②−①
2(Sat)				②	=③−②
3(Sun)				③	=④−③
4(Mon)				④	=⑤−④

- Obtaining daily load curve

  There is appropriate timing for energy conservation activities. To determine that timing, check the time of target electric energy consumption on the daily load curve. The following graph shows an example daily load curve of the hotel.

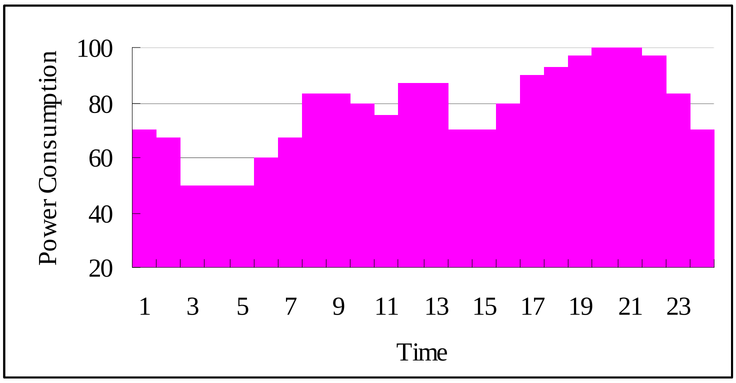


Figure 2 Example Daily Load Curve

From this daily load curve, you can consider cutting back the peak electric power, optimizing the electric power consumption in the nighttime and the daytime, and reducing the preparation and cleanup of banquets as the issues to be addressed for energy conservation.

Basically, you can create a daily load curve by recording the indications of a watt-hour meter every hour. However, the indications may be rough and include errors.

Using a watt-hour meter is the best way to make measurements. You can also read the current values every hour and calculate the electric energy.

To determine the electric energy P, use P = 1.73 × service voltage × current × power factor. If a power factor meter is available, use the readings. If you do not have a power factor meter, consider the power factor to be about 0.9. This assumption may be a little coarse but sufficient for our purpose.

You can also ask outside electricians to make measurements. In that case, select the month with the highest electric energy consumption and ask the electrician to measure more than one week continuously.

4) Installing water saving disks

The previous energy audit revealed that the tap water consumption was larger compared to that of other hotels.

You need to investigate the cause. If water leakage is the cause, it is very uneconomical.

The most simple solution to saving water is the use of water saving disks. A water saving disk is a tool recommended by the Japanese Waterworks Bureau for saving water. You install a water saving disk inside a faucet to replace a built-in disk to save about six liters of water per minute at maximum.

As you can see in the following figure, the bottom part of a water saving disk is larger than that of an ordinary disk.

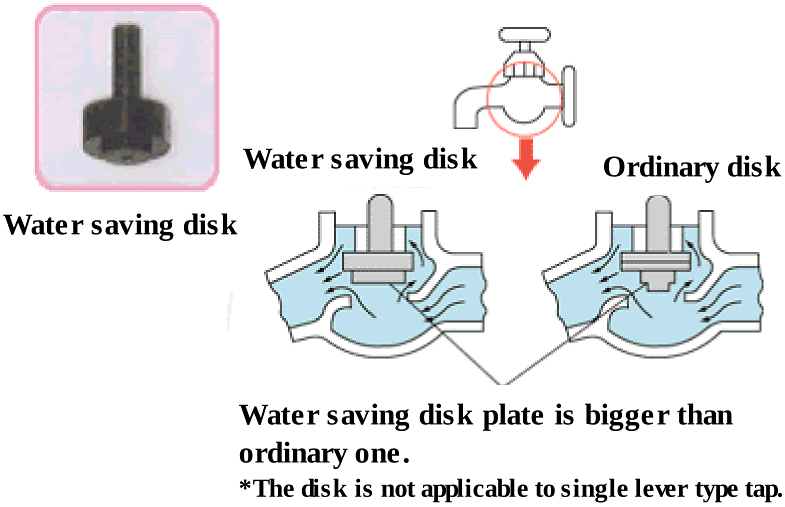


Figure 3 Structure of a Water Saving Disk

The following graph shows the effect of a water saving disk in relation to the opening of a tap.

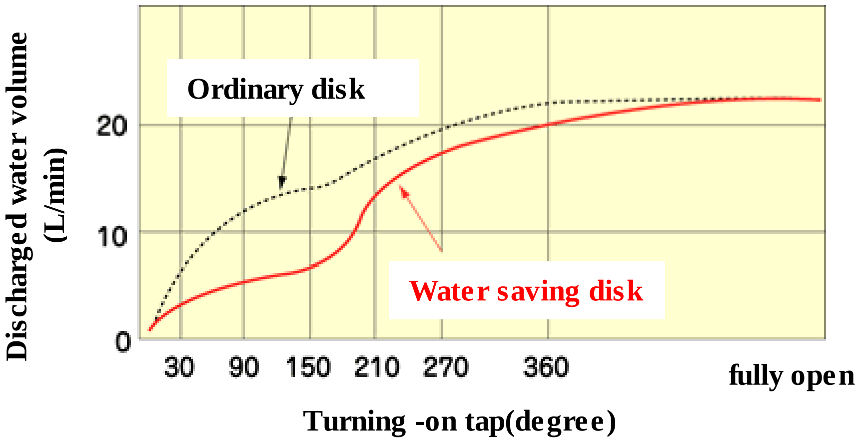


Figure 4 Characteristics of a Water Saving Disk

When a water saving disk is fully open, it allows the same amount of water to go through as an ordinary disk. If the water saving disk is open less than 180 degrees, the water saving effect takes place.

However, as explained in Figure 3, you cannot use a water saving disk in a single lever type tap.

5. About the Result of the Workshop

5.1 Outline

The workshop was held at Harison Hotel in Hanoi. The agenda is as described below. Mr. Zamora of ACE acted as the moderator and there were a total of 39 participants on the part of Viet Nam, including Mr. Vu Van Thai (Deputy Director-General of Ministry of Industry (MOI) and ASEAN SOE Leader for Viet Nam), Mr. Le Tuan Phong (Official of Science and Technology Department of MIO), Dr. Pham Hoan Luong (Hanoi University of Technology) and Mr. Huynh Kim Tuoc (The Energy Conservation Center in Ho Chi Minh City). The workshop had also 3 presenters from ASEAN (Mr. Jhon Budi Haryanto (Indonesia), Mr. Amado DE Juses (United Architects in Philippines) and Dr. Vorasun Branakarn (Chulalongkorn University, Thailand)), 2 from Ace (Mr. Christopher G. Zamora and Mr. Ivan Ismed) and 3 from Japan in addition.

5.2 Details about the Seminar/Workshop

The seminar/workshop began with welcome remarks by Mr. Vu Van Thai, Deputy Director-General of Ministry of Industry (MOI) and ASEAN SOE Leader for Viet Nam. In the remarks, he mentioned that legislative preparations were in progress under the energy conservation decree and energy efficiency and conservation initiatives were proactively exercised through the provision of training and education, the implementation of energy audits, etc. and that the country was ready to learn Japan's energy conservation technologies through the PROMEEC project and also thankful for the cooperation of the government of Japan (METI).

This was followed by opening statements by a representative from ECCJ (Ushio) and Mr. Chris Zamora of ACE that included explanation on the PROMEEC project and the purpose of this seminar/workshop. The seminar/workshop proceeded in accordance with the following program. The titles of the respective presentations (presenters in the parentheses) are given below. Please see the attached material for details.

(1) Energy efficiency and conservation activities and promotion in Viet Nam (Mr. Le Tuan Phong)

(2) Concept and initiatives for Sustainable Buildings in Japan (Mr. Ushio)

(3) Energy efficiency and conservation training programs provided in Viet Nam (Dr. Pham Hoan Luong: Hanoi University of Technology)

(4) Activities for promotion of energy efficiency and conservation in Viet Nam (Mr. Huynh Kim Tuoe, Energy Conservation Center in Ho Chi Ming City)

(5) Energy efficiency and conservation best practice buildings in Thailand (Dr. Soontorn Booyatikarn, Chulalogkorn University)

(6) Energy efficiency and conservation best practice buildings in Indonesia (Mr. Jhon Budi Haryanto)

(7) Energy efficiency and conservation best practice buildings in Philippines (Mr.

Amado de Jesus, United Architects of Philippines (UAP))

(8) Proposal for preparation of Energy Conservation Technical Directory (TD) (Amano, technical expert)

(9) Development of unit energy consumption management tools in Japan (Kobayashi, technical expert)

In the presentation by Japanese delegates, titled “Concept and initiatives for Energy Efficiency and Conservation /Environmental Issues in the area of buildings in Japan”, as in the Workshop held in Laos , CASBEE(the comprehensive assessment system for building environmental efficiency), a system of rating buildings in terms of environmental performance, advanced management tools of unit energy consumption for buildings that are being developed in the Energy Conservation Center and the system of recognizing energy conservation good practice buildings were introduced and the importance of development of database and technical directory (TD) was emphasized. In the current seminar, a sample of Technical Directory for Energy Efficiency and Conservation (TD) that is in the process of preparation at ACE was shown and the progress status in preparation was explained.

The greatest obstacle lying in the way of promoting energy efficiency and conservation in Viet Nam consists of the building owners’ lack of awareness of energy conservation and the resulting lack of funds and the shortage of technical experts in energy conservation. In this respect, the current seminar/workshop that had a detailed presentation on human resource development plans for prompting energy conservation in Viet Nam left a special impression on us. Therefore it was very regrettable that a half of the participants from Viet Nam left after lunch although all of them stayed until noon. However, all participants from the hotels subject to audit this time stayed through the last listening attentively to presentations. We felt this difference in attitude came from the difference of the awareness of the importance of energy conservation.

The 3 presentations made by delegates of other ASEAN countries were based on very specific actual instances and therefore easy-to-understand for local participants as those made in the workshop in Laos. In addition, these presentations must have impressed local participants with the high level of ASEAN energy conservation activities in the area of buildings.

We are confident that participants from Viet Nam are quite content with our activities in Viet Nam including this seminar/workshop where we could introduce advanced energy efficiency and conservation technologies and promotion activities of Japan and ASEAN member countries.

SEMINAR ON PROMOTION OF ENERGY EFFICIENCY AND CONSERVATION FOR BUILDINGS IN SOUTH EAST ASIA

Press Center, Hanoi, Vietnam

18 November 2005

TENTATIVE PROGRAMME

8.30	-	9.00	**Registration**
9.00	-	9.10	**Welcome Remarks** Mr. Vu Van Thai, ASEAN SOE Leader for Vietnam Ministry of Industry
9.10	-	9.20	**Opening Statement** Mr. Yoshitaka Ushio General Manager, Energy Conservation Centre, Japan (ECCJ)
9.20	-	9.30	**Opening Statement** Mr. Christopher G. Zamora, Manager, ACE Executive Director, ASEAN Centre for Energy (ACE)
9.30	-	10.00	**Photo Session and Coffee Break**
Session 1: Policy and EE&C Best Practices (Moderator: ACE)			
10.00	-	10.15	**Overview of ASEAN EE&C Programmes** Mr. Christopher G. Zamora, Manager, ACE
10.15	-	10.30	**Overview of EE&C Initiatives and Activities in Vietnam** Mr. Phong Le Tuan, Expert, Ministry of Industry
10.30	-	11.00	**Concept and Initiatives Towards Sustainable Buildings in Japan** Mr. Yoshitaka Ushio, General Manager, ECCJ
11.00	-	11.30	**Training on energy efficiency and conservation in Vietnam** Dr. PHAM Hoang Luong, Hanoi University of Technology
11:30		12:00	**Energy Efficiency & Conservation Best Practices in Vietnam** Mr. Huynh Kim Tuoc, Energy Conservation Center of Hochiminh City
12:00	-	12:30	**Energy Efficiency & Conservation Best Practices in Thai Buildings** **Dr. Vorasun Buranakarn, Chulalongkorn University, Thailand**
12.30		14.00	**LUNCH**
14.00	-	14.30	**Energy Efficiency & Conservation Best Practices in Indonesian Buildings,** Mr. John Budi Haryanto
14.30	-	15.00	**Energy Efficiency & Conservation Best Practices in Philippine Buildings** Mr. Amado de Jesus

15.00	-	15.15	**Question and Answer**
15.15	-	15.30	**COFFEE BREAK**
SESSION 2 : THE WAY FORWARD (MODERATOR – ACE)			
15.30	-	15.50	**Development of a Technical Directory (Proposal for Further Step)** **Mr. Hisashi Amano,** Expert, ECCJ
15.50	-	16.20	**Development of a Database/ Benchmarking/ Guideline for Buildings: Advanced Energy Management Tool for Buildings in Japan** Mr. Akira Kobayashi, Expert, ECCJ & Ms. Maureen Balamiento, ACE Database Staff,
16.20	-	16.45	**Q & A Session**
16.45	-	17.00	**Closing Remarks**