2003 Survey Report

Infrastructure Improvement Project for Rationalization of International Energy Use (Survey Project on Best Practices of Energy Conservation for Building in South-East Asian Countries)

March, 2004

New Energy and Industrial Technology
Development Organization (NEDO)
Entrusted to The Energy Conservation Center, Japan

Infrastructure Improvement Project for Rationalization of International Energy Use (Survey Project on Best Practices of Energy Conservation for Buildings in South-East Asian Countries) The Energy Conservation Center, Japan March, 2004
Study purpose: This survey is intended to render technical assistance for the smooth promotion and operation of the best practice building award system and the creation of a database, benchmarks and guidelines for promoting energy conservation for commercial buildings in ASEAN countries. The best practice building award system was set up by ACE (ASEAN Center for Energy) in 2000 in order to reduce ever-increasing energy consumption by commercial buildings. The objectives of the survey are to provide technical assistance in improving evaluation of criteria for the award system and implementation of building energy audits, and transfer those technologies and experience for energy conservation.

Preface

Recently, efforts to prevent global warming have been recognized as a challenge to be shared by all humankind, while sustainable development of economy has been sought for. Mankind is facing with the challenge of harmonizing the two different conditions entirely conflicting each other.

In order to get over these severe conditions, what are required are technical innovations such as technologies to use energy efficiently and develop energy causing as little burden on the environment as possible, hence little impact on the environment, etc.

So as to contribute to the balanced development of economy protecting environment in developing countries, it is necessary to render support that is adoptable and appropriate to the respective countries concerned based on the understanding of the actual condition of energy use and environmental measures as well as the results of in-depth surveys on the progress in development of infrastructure, life styles, etc in these countries.

In such circumstances, we conducted energy audits for the current year with a focus on the establishment of a system and foundation to develop the database/benchmark/guideline for further advancing energy conservation in buildings in ASEAN countries in the future, based on the actual results and experiences of the projects implemented in the ASEAN countries in the past three years to support the award system for best practices in energy conservation in business-use buildings and transfer technologies and know-how for energy audits. For the fiscal year of 2003, 3 countries were subject to our survey. One "Best Practice" building was selected in each country to conduct energy audits including actual measurement. In the field, we carried out energy audits in a way of OJT (On the Job Training) including demonstration in order to further ensure technical transfer. In the workshops, we developed specific discussions on approaches and the methodology of development of database/benchmark/guideline, while we encouraged participants into actually experiencing data analysis and processing using the simulation method.

The countries subject to the current survey vary form Lao PDR aiming at developing its economy in the future to Malaysia continuing further development from now onward. We believe that it was very meaningful that we implemented this project in these countries and could confirm both a future direction of activities and a large potential of effective energy conservation though the conditions differ from country to country. In the past 4 years, we completed energy audits and workshops on an OJT basis in all 10 ASEAN countries and created a common ground for promoting energy conservation in buildings in the respective countries. Based on this achievement, we could continue to work on the development of database/benchmark/guideline for individual countries and the whole ASEAN in which we had been involved since last year. As a result, we could establish a firm foundation for further developing energy conservation promotion activities.

We hope that this project will contribute to energy conservation and environmental protection in the respective ASEAN countries helping them eventually achieve environment-friendly and sustainable development in each economy and that this project will serve as a bridge of technical exchange and friendship between Japan and the countries concerned.

March 2004

The Energy Conservation Center, Japan

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SUMMARY

The economy in ASEAN countries has been rapidly growing, as a result, it will be more required to efficiently use energy and to consider about the prevention of the global warming because of the quick increase in energy consumption.

This is the 4th year of the projects for Promotion of Energy Efficiency and Conservation (hereinafter referred to as “PROMEEC”). Therefore, the activities of ASEAN Center for Energy (hereinafter referred to as “ACE”) have been established, which results in enhancing and disseminating the awareness on PROMEEC toward reducing energy consumption in the ASEAN countries. In this fiscal year of 2003, as the 1st year of the 2nd stage, the PROMEEC activities are directed toward implementing and disseminating the fruit achieved to date by further self effort, based on the actual achievements through the project activities for the past three years. The first activities of the 2nd stage was started with conducting energy audits and holding workshops in the countries where these activities have not yet realized, which resulted in providing all ASEAN countries with opportunities for the persons in the countries to experience the project activities together with Japanese experts. These project activities have established the basis that all the ASEAN countries can equally implement the project activities through the similar understanding and experience of the technologies and practice for energy conservation.

In this fiscal year, the energy audits were conducted at one building in each country, or Malaysia, Brunei Darussalam (hereinafter referred to as “Brunei”) and Lao People’s Democratic Republic (hereinafter referred to as “Lao PDR”). The results of the energy audits should be the basis of the activities aiming at implementation and dissemination of recommended improvement for energy conservation at buildings in each country and should be related to evaluation for the system to award best practice buildings for energy conservation. Moreover, in the workshops held in the three countries, the discussions were made for developing database / benchmark / guideline for each country based on both the results of energy audits and the data of other buildings collected in the respective countries. The discussion results shall be the basis for developing database / benchmark / guideline for ASEAN by the ASEAN task force organized last year.

The actual site activities were commenced with the Inception Workshop (common workshop with “Major Industry” project) held in October 2003 and completed by the Post Workshop (common workshop with “Major Industry” project) held at the end of January 2004.

In Inception Workshop, the implementation plan was explained and finally confirmed after the presentation of technologies realized in Japan aimed at better understanding the points of

energy audits. In the Board of Judges (hereinafter referred to as “BOJ”) consecutively held for the purpose of discussing the evaluation of the award system, discussion on revision of the evaluation criteria was made. As a result, the project activities could be smoothly started. On the other hand, in the Post Workshop, the actual results of the activities including achievements in the three countries were reported to share the information among all ASEAN countries. After then, discussions on development of database / benchmark / guideline were made including the explanation of the activity results by ASEAN task force. Finally, the participants discussed the proposed plan and direction to implement and disseminate the recommended improvement and to develop the database / benchmark / guideline for ASEAN.

The following are the specific activities for 2003 – 2004.

(1) Holding Inception Workshop and Board of Judges : October 22nd – October 25th, 2003

“Inception Workshop of The SOME-METI Project on PROMEEC - Buildings and PROMEEC - Industries” (common with “Major Industry” Project) was held on October 23rd and 24th at Singapore. The following were implemented.

- ♦ Presentation of the recent topics on policy, law, energy management and typical technology for promoting energy conservation for the building and industrial sectors in Japan
- ♦ Explanation on status of realization and dissemination of recommendations including future activity by each country
- ♦ Explanation and discussion of the project plans of the fiscal year of 2003 for “Building and Major Industries”
- ♦ Confirmation and discussion on the schedule and the required arrangement for the site surveys for the projects of “Building and Major Industries”
- ♦ Discussion on the development of database / benchmark for promoting energy conservation at buildings

“9th Meeting of the Board of Judges, ASEAN Energy Efficiency and Conservation Best Practice Competition for Energy Efficient Buildings, ASEAN Energy Award 2004” was held on October 25th at Singapore and the following were implemented.

- ♦ Explanation and discussion on aspects of evaluation criteria for ASEAN Energy Award by the Japanese side
- ♦ Review of results of evaluation for the award for the fiscal year of 2002
- ♦ Review of the definition and evaluation criteria for “Tropical Building” and “Special Submission”
- ♦ Clarification of questions and request on the evaluation results by each country

(2) 1st Site Survey : November 2nd – November 15th, 2003

In Malaysia, Brunei Darussalam and Lao PDR, the energy audits were conducted at three buildings and the 1st workshop was held. The energy audit was implemented on a basis of OJT. In the 1st workshop, the procedure of energy audit was explained and discussed including the presentation on typical technologies for energy conservation of building realized in Japan.

- ♦ Presentation on typical technologies for energy conservation of building realized in Japan
- ♦ Energy audit at one office building in Kuala Lumpur, Malaysia
- ♦ Energy audit at one hotel in Brunei
- ♦ Energy Audit at one hotel in Vientiane, Lao PDR

(3) 2nd Site Survey : January 18th – January 27th, 2004

In Malaysia, Brunei Darussalam and Lao PDR, the results of energy audit and recommended measures for improvement were explained and discussed using the preliminary report. Furthermore, the approach to develop database / benchmark / guideline was discussed including OJT for data processing.

- ♦ Explanation and discussion of the results of energy audit at one office building in Kuala Lumpur, Malaysia (including additional survey)
- ♦ Explanation and discussion of the results of energy audit at one hotel in Brunei (including additional survey)
- ♦ Explanation and discussion of the results of energy audit at one hotel in Vientiane, Lao PDR (including additional survey)
- ♦ Discussion on development on database / benchmark / guideline in the three countries

(4) Holding Post Workshop : January 28th – January 31st, 2004

"Post Workshop on Promotion of Energy Efficiency and Conservation (PROMEEC) (Major Industry and Building), SOME – METI Work Program 2003 – 2004" (common with "Major Industry" Project) was held on January 29th and 30th at Singapore. The following were implemented.

- ♦ Presentation on energy management and energy manager system in Japan
- ♦ "Building" Project : Reporting / Discussion of results of energy audits for buildings in Malaysia, Brunei Darussalam and Lao PDR, including comments by the countries
- ♦ "Major Industry" Project : Reporting / Discussion of results of energy audits of factories for the caustic soda industry in Thailand and the food processing industry in Singapore, including comments by each country
- ♦ Reporting / Discussion on the results of case study of database / benchmark / guideline development in Malaysia, Brunei Darussalam and Lao PDR
- ♦ Reporting / Discussion of actual results and action plan for the activities to develop

database / benchmark / guideline for ASEAN by the taskforce

- ♦ Discussion on the proposal of the future direction and plan of the projects and points to be reflected to ASEAN Plan of Action for Energy Cooperation (APAEC) 2004-2009

The concerned members in Malaysia, Brunei and Lao PDR provided Japanese experts with very good cooperation. Furthermore, thanks to the enthusiastic joint activities by all the participants, the smooth project activities could be realized. As a result, the achievements are great since the recommended improvements were actually implemented in a short time or will be shortly implemented.

First of all, we would like to express our sincere appreciation for the big efforts and good preparation / arrangement made by the concerned persons from the three countries, including their smooth decision of the buildings for energy audit. In this fiscal year, the buildings categorized to "Best Practice Building" were selected for energy audit as follows.

- Sapura @ MinesBuilding as an office building at Putrajaya in the suburbs of Kuala Lumpur, Malaysia
- Orchid Garden Hotel in Brunei
- Lao Plaza Hotel at Vientiane in Lao PDR

Lao PDR has been making effort to establish the national infrastructure aiming at further developing the economy, while Malaysia and Brunei have been achieving the developed economies as well as the developed countries in the world, under their abundant energy resources. In spite of the above featured contrast among the three countries, the enthusiasm and attitude of all the participants from these countries towards the energy conservation are similarly strong and good.

As well as the activities last year, the field activities were focused on OJT (On the Job Training) manner. Namely, a demonstration type of activity was applied to specific activities with Japanese experts for the energy audit starting with the actual filling data in the questionnaire through field survey including measurement. In the workshops in the second site survey, the participants collected data in addition to the actual results by energy audits, input the data into personal computers and calculated audit parameters by themselves including simulative practice. Especially in Malaysia, the participants prepared available data from 55 buildings. Large effort by Japanese experts realized the OJT practice, since this kind of practice required much load and time for preparation by them. The participants in each country understood the effort and enthusiasm of Japanese experts, which brought fruitful results for the three countries and Japan.

The energy audits in these three countries resulted in experiencing similar activities in all the

10 ASEAN countries with Japanese experts. As a result, the basis to develop activities for promoting energy conservation has been established, on which each country and all ASEAN countries would be possible to proceed their activities. This is a very important milestone to be achieved.

It is wished that the following would be realized to contribute to promoting energy conservation and environmental protection in ASEAN countries.

(1) Implementation of the recommended improvements at an earlier timing

(2) Effective utilization of technologies and experience transferred by Japanese experts

(3) Dissemination of achievement in ASEAN countries based on cumulated experience through the above activities

Finally, we would like to thank the persons from ACE and ASEAN including the persons belonged to the buildings for their kind and perfect cooperation extended to the Japanese members.

I. Purposes and Background of the Survey

The purpose of this project is to promote energy conservation in buildings in Southeast Asian countries. The larger goal of this project is to contribute to energy conservation and environmental protection in those countries by assisting ASEAN activities in selecting and awarding model energy-efficient buildings in ASEAN countries, which helps to promote the energy conservation in each of the ASEAN countries.

This project was set up in 2000 with the aim of reducing energy consumption in commercial buildings that continue to emerge in the ASEAN region with the cooperation of ASEAN Center for Energy that served as the core organization. This project supports the award system of the best practice building in for business use buildings in ASEAN countries in its technical and operational aspects.

ASEAN Center for Energy (hereinafter referred to as "ACE") that serves as a representative of ASEAN countries for this project understands the purposes of this project as follows:

1. Enhancing even more the cooperative relationship between ASEAN countries and Japan in the field of energy
2. Promoting energy efficiency and energy conservation in buildings in ASEAN countries
3. Promoting transfer of Japanese technologies in this particular field including introduction of successful energy-saving cases realized in Japan to ASEAN countries
4. Improving qualities and technical capabilities for energy conservation of ASEAN countries through energy audits on a basis of OJT
5. Developing and establishing guidelines, database and benchmarks to be utilized for the energy audit in ASEAN countries

Based on the discussion with ASEAN members including ACE, this cooperative project is considered to consist of the three stages as follows. The activities in this fiscal year situate as the first year activities of the second stage. Now the project has been conducted in all the ten ASEAN countries including the activities of the last three years of the first stage. As a result, all the ASEAN members established the common base on which further energy conservation activities can be developed. This fiscal year is viewed as the place to start implementing/disseminating actual improvement measures and to determine the direction for promoting energy conservation in buildings. This year, the survey was conducted in three countries, Malaysia, Brunei and Lao PDR.

1st stage 2000-2002	Transfer of technologies and experience from Japan to ASEAN countries (completed last year)
2nd stage 2003-2006	Cooperative work between Japan and ASEAN countries for implementing improvement measures and promoting energy conservation in each country, including the dissemination in other countries
3rd stage 2007-	Advancement in energy conservation through ASEAN countries'

self efforts

Surveys on the actual condition of energy management through energy audits were implemented specifically by the following process.

① Checking of the overall conditions of a building
② Checking of the overall conditions of facilities and systems for a building
③ Checking in details of the condition of energy management according to the replies to the questionnaire on energy management which had been requested to prepare beforehand, and confirming the actual operation record if necessary
④ Actually checking the buildings and facilities to determine the energy use status, operation of facilities, maintenance status, and measurements
⑤ Presenting the recommended improvements in facilities and energy management for the reduction of energy consumption based on the results obtained from the steps mentioned above

The database, benchmarks and guidelines that provide rough standards of energy consumption in buildings should differ from country to country due to their differences in climate, lifestyle, established infrastructure, etc. As it is impossible to establish unified database/benchmark/guideline for all ASEAN countries from the beginning, we suggested that respective countries should establish their own standards independently in the first place, then work together to complete database/benchmark/guideline that can be used commonly by ASEAN countries. Based on the procedure mentioned above, since last year, we have developed activities to establish local database/benchmark/guideline in workshops held in Vietnam and Myanmar. The same procedure was conducted in Malaysia, Brunei, and Lao PDR this year.

At the end of the last year, a task force was formed to develop the database, benchmark and guideline for ASEAN. The results of the activities by each country mentioned above and by the task force were reported and discussed in the Post Workshop where the representatives of ASEAN countries and the task force members gathered to determine the future direction for the work to be done in further developing the database, benchmarks and guidelines for ASEAN.

These discussions are related to the evaluation of the award system for the best practices of energy conservation for buildings in ASEAN. We also participated in the meeting of the Board of Judges (BOJ), which is the evaluation committee for the award system, to advise for reviewing the evaluation criteria.

II. Malaysia

1. Summary of Site Survey

Survey conductors and audit periods
1st site survey : November 3 through 5, 2003
2nd site survey : January 19 and 20, 2004
Participants from the International Engineering Department of The Energy Conservation Center, Japan. (ECCJ)

- Kazuhiko Yoshida (General Manager) November 3 through 5, 2003
- Takashi Kato (Technical Expert) November 3 through 5, 2003; January 19 and 20, 2004
- Akira Kobayashi (Technical Export) November 3 through 5, 2003; January 19 and 20, 2004

(1st site survey)

Date	Events, destination, etc.	Description
Nov. 3 (Mon.)	Workshop Sapura @ Mines Building (conference room of Pusat Tenaga Malaysia (PTM))	• Welcome remarks • Opening statement • Presentation on the current energy conservation program and policy in Malaysia • Presentation on the profile of Sapura @ Mines Building and the energy conservation program • Presentation on the ACE's participation on the PROMEEC project and the plan for the year • Presentation on the energy conservation status in buildings in Japan • Presentation on the procedure of auditing buildings Participants Mr. Francis Xavier Jacob (Deputy Director, EE & Innovation Dept., Energy Commission) Ms. Nurhafiza Binti Mohd Hasan (Assistant Director, EE& Innovation Dept., Energy Commission) Dr. Anuar Abdul Rahman (Chief Executive Officer / Director, Pusat Tenaga Malaysia (PTM)) Mr. Ahmad Zairin Ismail (Deputy Director, Energy Industry Development Division, PTM)

Date	Events, destination, etc.	Description
		Mr. Asfaazam Kasbani (Program Manager, Energy Industry & Sustainable Development Div., PTM) Ms. Azah Ahmad (Research Officer, Energy Industry Development Division, PTM) Mr. Nik Mohd Aznizan Nik Ibrahim (Energy Industry Development Division, PTM) Mr. Christopher Zamora (Project Coordinator, ASEAN Center for Energy) and 20 other persons
Nov. 4 (Tue.)	Checking and audits of Sapura @ Mines Building (where Pusat Tenaga Malaysia (PTM) is located)	• Provided the participants with OJT for energy audits through checking and auditing Sapura @ Mines Building (office building). Use: Office Size: 11 floors above the ground Gross floor area: 51,282 m^2 • Survey on the overall condition of the building by documents/interviewing • Survey on the overall condition of the equipment by documents/interviewing • Survey on energy consumption by documents/interviewing • On-site investigation There were many participants mainly from PTM. Participants: Mr. Ahmad Zairin Ismail (PTM) Mr. Asfaazam Kasbani (PTM) Ms. Azah Ahmad (PTM) Mr. Nik Mohd Aznizan Nik Ibrahim (PTM) Mr. Christopher Zamora (ACE) and 15 other persons

Date	Events, destination, etc.	Description
Nov. 5 (Wed.)	Wrap-up meeting (conference room of Pusat Tenaga Malaysia (PTM))	• Summarized the results of surveys and energy audits of Sapura@Mines Building and reported to participants. Participants: Ms. Nurhafiza Binti Mohd Hasan (EE& Innovation Dept., Energy Commission) Dr. Anuar Abdul (PTM)) Mr. Ahmad Zairin Ismail (PTM) Mr. Asfaazam Kasbani (PTM) Ms. Azah Ahmad (PTM) Mr. Nik Mohd Aznizan Nik Ibrahim (PTM) Mr. Phubalakan Karunnakaran (MIEEIP, PTM) Mr. Christopher Zamora (ACE) and 12 other persons

(2nd Site Survey)

Date	Events, destination, etc.	Description
Jan. 19 (Mon.)	Pre-report meeting Interim reports on the audit results for Sapura @ Mines Building (conference room of Pusat Tenaga Malaysia (PTM))	• Made interim reports based on the results of the 1st survey and energy audit of Sapura@Mines Building. • Major contents • Analysis of the current condition (electric power consumption, total energy consumption, energy composition, trends in monthly energy consumption, comparisons with other buildings, water consumption data) • Recommendations and expected effects (improvement of the room temperature setting, adjustment of fresh in-take air volume from the outside, total closure of VAV units in unused rooms, review on the operation of chillers during low load, high-efficiency operation of receiving power transformers) • Measurement of CO_2 concentration In relation to the adjustment of fresh intake air volume from the outside, the CO_2 concentration meters brought from Japan were used at the applicable locations to measure the actual CO_2 concentration with the participants. Participants: Mr. Francis Xavier Jacob (Energy Commission) Mr. Muhammad Fendi Mustafa (PTM) Mr. Ahmad Zairin Ismail (PTM) Mr. Asfaazam Kasbani (PTM) Ms. Azah Ahmad (PTM) Mr. Nik Mohd Aznizan Nik Ibrahim (PTM) Mr. Christopher Zamora (ACE) and 11 other persons

Date	Events, destination, etc.	Description
Jan. 20 (Tue.)	Workshop on energy conservation promotion in buildings (conference room of Pusat Tenaga Malaysia (PTM))	• Conducted the presentation on the preliminary report of the results of the energy audit of Sapura@Mines Building. • Conducted the presentation on the benchmarks and database established in Japan. • Conducted the presentation on the benchmarks and database for Malaysia. • Discussion: How to use the benchmarks, energy conservation points in hospitals Participants: Mr. Francis Xavier Jacob (Energy Commission) Mr. Muhammad Fendi Mustafa (PTM) Ms. Azah Ahmad (PTM) Mr. Nik Mohd Aznizan Nik Ibrahim (PTM) Mr. Christopher Zamora (ACE) and 13 other persons

2. Political and Economic Conditions in Malaysia

2.1 National Indicators, Political System and Economic Indicators

(1) National indicators

1)	Area:	Approximately 330,000 km^2 (approx. 0.9 times the area of Japan)
2)	Population:	24,530,000 (2002 from the Statistics Bureau)
3)	Capital city:	Kuala Lumpur
4)	Ethnic distribution:	Malay (65.1%), Chinese (approx. 26.0%), Indian (approx. 7.7%), others (1.2%)
5)	Languages:	Malay (official language), Chinese, Tamil, English
6)	Religions:	Islam (federal religion), Buddhism, Confucianism, Hinduism, Christianity, native beliefs

(2) Political system

1)	Form of government:	Constitutional monarchy (parliamentary democracy)
2)	Head of state:	12th King Syed Sirajuddin (Sultan of the State of Perlis, elected from the conference of Sultans and inaugurated in December 2001 for 5-year terms)
3)	Parliament:	Bicameral 70 seats for the Senate. Term of office: 3 years. 44 appointed by the King, 26 appointed by the state assemblies. 193 seats for the House of Representatives. Term of office: 5 years. Directly elected (single-seat constituency).
4)	Government:	Prime Minister: Abdullah Badawi (inaugurated in October 2003) Minister of Foreign Affairs: Syed Hamid (inaugurated in January 1999)

5) Internal political conditions:

The Deputy Prime Minister Abdullah Badawi took office following Prime Minister Mahathir's resignation in October 2003 and became the fifth Prime Minister. Mahathir led Malaysia for 22 years. The current Prime Minister Abdullah has clearly pledged to continue Mahathir's policies and there seems to be no large changes in policies. The National Front (Barisan Nasional) is the ruling coalition party with the Malay-based United Malays

National Organization (UMNO) at the core. The National Front has most of the parliamentary seats in the House of Representatives (150 out of 193) and the current administration is stable.

(3) Economic indicators

1) Main industries: Manufacturing (electric devices), agriculture and forestry (rubber, palm oil, lumber), and mining (tin, crude oil, LNG)

	1998	1999	2000	2001	2002
2) GDP (billion dollars)	480	507	552	554	577
3) Per capita GDP (dollars)	3,093	3,238	3,509	3,386	3,610
4) GDP growth rate (%)	▲7.4	5.8	8.5	0.4	4.1
5) Consumer price increase rate (%)	5.3	2.8	1.6	1.4	1.8
6) Unemployment rate (%)	3.2	3.4	3.1	3.6	3.5

7) Total trade balance (2002): (1) Exports: 93,263 million dollars
(2) Imports: 79,868 million dollars

8) Export/import items: (1) Exports: Electrical appliances, crude oil, LNG, palm oil, chemical products
(2) Imports: Manufacturing machines, transport equipment, food

9) Trading partners (2002):
(1) Exports: US (20.2%), Singapore (17.1%), Japan (11.2%)
(2) Imports: Japan (17.8%), US (16.4%), Singapore (12.0%)

10) Currency: Ringgit. Fixed exchange rates after September 2, 1998: 1 dollar = 3.8 ringgit

11) Exchange rate: 1 ringgit = 30 yen approximately

(4) Relationship with Japan

1) Political

The relationship between Malaysia and Japan is generally well due to the “Look East Policy*” suggested by the former Prime Minister Mahathir, frequent visits of the leading persons of the two governments, close economical relationship through direct investments, trading and technical transfer, and active exchange of culture and students. Prime Minister Abdullah has pledged to continue the Look East Policy.

Based on the survey and research regarding the current status and problems of the development and development plans in Malaysia, and political dialogues with Malaysia, Japan views the protection of the environment, eradication of poverty, regional development, and development of human resource and small- and medium-scale enterprises as the important targets of aid.

*Look East Policy

The former Prime Minister Mahathir viewed human resource development as an important issue. The Look East Policy was introduced to change the work ethics of Malaysians to develop their talent by learning the experience of development and work ethics in Japan and Korea. To achieve this goal, Malaysia is sending students and trainees to both countries. Japan has received approximately 2,800 students and 3,300 trainees so far.

2) Economic

(1) Trading with Japan

- Trade items

  Exports: Machinery, mineral fuel such as LNG, lumber, and others

  Imports: Electronic devices such as semiconductor devices, general machinery, steel, and others

- Trade balance (overview of foreign trade, unit: billion yen)

  Exports: 1,496.6 (2000), 1,337.2 (2001), 1,377.6 (2002)

  Imports: 1,562.7 (2000), 1,561.3 (2001), 1,401.4 (2002)

(2) Direct investments from Japan (statistics of the Ministry of Finance, unit: billion yen)

97.1 (fiscal year of 1997), 65.8 (fiscal year of 1998), 58.6 (fiscal year of 1999), 25.6 (fiscal year of 2000), 32.0 (fiscal year of 2001)

(5) Political situation

Malaysia is a multi-race nation (race composition: 62.8% Malays, 26.3% Chinese, 7.5% Indian, 3.5% others). Immediately after the general election in 1969, racial riots (incident of May 13) broke out between Malays and Chinese. The most important task of the past and present administrations is to reconcile different races and improve the economic status of Malays who are relatively poor compared to non-Malays (Bumiputra policy).

1) Current political situation

The House of Representatives was dissolved on November 11, 1999 before its time of June 7, 2000. The tenth general election was held on November 29 of the same year. As a result, the ruling coalition party BN (National Front) led by Prime Minister Mahathir was returned to power with more than two-thirds (148) of the parliamentary seats out of 193 of the House of Representatives. The Pan-Malaysian Islamic Party (PAS: Muslim-based opposition party) largely increased its seats in the House of Representatives. PAS retained control of the state of Kelantan and won the additional state of

Terengganu in the elections of state assemblies.
In May 2000, the election of directors (3 years of terms) of UMNO (Prime Minister Mahathir used to be the leader since 1981) was held. Mahathir was reelected as the leader (7th term) and Deputy Prime Minister and Minister of Home Affairs Abdullah were reelected as the deputy leader. As a result, the Mahathir - Abdullah system was established in the party.

In June 2001, Finance Minister Daim resigned and Prime Minister Mahathir decided to serve concurrently as Finance Minister. After the September 11 incident in the US, while the Government severely criticized the terrorism, it also said “no” to the military actions of the US and other countries considering the feelings of moderate Muslims. In Malaysia, 48 extremists claming to establish an Islamic nation were arrested. The Democratic Action Party (DAP) left the opposition coalition because of the antagonism regarding the establishment of the Islamic nation.

During the closing speech at the 56th UMNO general assembly on June 22, 2002, the UMNO President Mahathir announced resignation from the presidency post and other all posts of the UMNO and the coalition party (BN). On June 25, Deputy Prime Minister Abdullah (Vice President of UMNO) was announced to be his successor.

2) Foreign affairs

The basic foreign policies include: strengthening the cooperation with the ASEAN countries, cooperation with Muslim countries, equidistant diplomacy with big powers, South-South cooperation and promotion of economic relations with foreign countries. Prime Minister Mahathir was critical of big powers such as the US and EU, and he insisted on protecting the positions and rights of small, developing countries. The main foreign policies are as follows:

a. Maintaining and strengthening the friendly cooperating relationship with neighboring countries, especially ASEAN countries

   Through mutual visits at all levels of the members of ASEAN meetings and main cabinet members, close cooperating relationship are to be maintained and strengthened (Malaysia was the 1997 ASEAN chairman and 1998 APEC chairman).

b. Cooperation with Muslim countries

   As a Muslim nation, Malaysia showed strong interest in the Bosnia-Herzegovina situation. Malaysia broke diplomatic relations with Serb’s new “Federal Republic of Yugoslavia” in August 1992 and started to support Bosnia by accepting Muslim refugees and conducting fund raising campaigns. In June 2001, an OIC meeting of ministers of foreign affairs was held in Malaysia. Although Malaysia is not a member of OPEC, it sends an observer to support the policies of OPEC.

c. South-South cooperation

In light of the international economic status of developing countries and to decrease the overdependence on developed countries and promote self-help through strengthening the cooperation among developing countries, the Government supports the Malaysia technical cooperation program and private enterprises establish joint ventures to promote the South-South cooperation.

d. Activities for the United Nations

Malaysia plays an active part in the United Nations. For example, Malaysia was a non-permanent member of the United Nations Security Council (1999 to 2000) and participated in PKO missions. Malaysia is also active in environmental issues and it hosted the second United Nations Conference on Environment and Development (UNCED) in April 1992 and played a role of a spokesman for developing countries in UNCED held in Rio de Janeiro.

(6) Economic situations

The economy of Malaysia used to be monoculture, producing mainly rubber and tin. The Government initiated the import substitution industrialization policy mainly for consumer goods in 1960s. In 1970, the Government initiated to encourage the export-oriented industries and its main task was establishing export processing areas. In 1985, the economy contracted due to the price drops of primary products which were the main export products. In 1986, the Government lifted the restriction of foreign capital and initiated active introduction of foreign capital to fully implement the export-oriented industrialization policy. Through the rapid industrialization, Malaysia achieved 8 to 9% growth rate between 1988 and 1996.

1) Current economic situations

After the summer of 1997, Malaysia was faced with economic difficulties due to a financial crisis. However, Malaysia did not ask the IMF for support and implemented its own economic policies. The Government reduced fiscal 1998 budget and announced austerity measures (reduction of the federal government budget, postponement of some large-scale projects). With the onset of 1998, the National Economic Action Council (NEAC), led

by Prime Minister Mahathir, discussed economic strategies. The Government announced comprehensive measures (tightening fiscal and monetary policies, strengthening the structure of financial institutions) to regain the confidence of investors. To stop the worsening of the economy, the Government shifted to stimulus packages (additional fiscal spending mainly for the social sector, lowering interest rates), wrote off bad loans, and restructured financial institutions. In September 1998, the Government introduced foreign exchange control (centralized control of foreign exchange by the central bank, revision of the foreign exchange control system) and shifted to a fixed exchange rate system (1 US dollar = 3.8 ringgit). The foreign exchange control was lifted on February 15, 1999.
To alleviate the recession due to the slowdown of the US economy which became evident at the end of 2000, the Government announced the New Economic Policy (NEP) which included the expansion of financial stimuli and consumption.

2) Developmental plans

In February 1991, Prime Minister Mahathir announced an economical and social development plan, Vision 2020, to make Malaysia into a developed industrial country. In June 1991, the Government of Malaysia announced the National Development Policy (NDP) which covered 1991 to 2000 as a long-term development policy after the New Economic Policy (1971 to 1990) based on Vision 2020. The NDP, like the NEP, aimed to build national unity and had the same two goals as the NEP, which were eradication of poverty and reorganization of the society. As for the ownership of 30% share capital for Bumiputra (Malays and indigenous people), which was a target set in the NEP, no deadline was set to allow for flexibility in order not to hinder the growth. The actual policies were conducted in the Sixth and Seventh Malaysia Plans (five-year plans).

In April 2001, the Third Outline Perspective Plan (OPP3, 10-year plan from 2001) and the Eighth Malaysia Plan (8MP, five-year plan from 2001) were announced. These plans set the basic economic and social operation policy of the Government of Malaysia for the next five to ten years, and the economy with “sustainable growth” and “resilience and competitiveness” is set as the target. The main goal is to shift from the labor-insensitive economy to the knowledge-insensitive economy (K-Economy), make full use of telecommunications technologies, develop human resource, prepare information infrastructure, and improve the productivity and efficiency of industries. Emphasis was always put on the telecom infrastructure in the previous plans. The promotion of the Multimedia Super Corridor (MSC) is emphasized in OPP3 and 8MP as well to make Malaysia an important hub for telecommunications technologies and multimedia. OPP3 and 8MP also mention the establishment of telecommunications technologies and necessary infrastructure in rural areas to address the digital divide issues. The target economic growth rate for five years is 7.5% as mentioned in OPP3.

Under Vision 2020 aiming to join the group of developed industrial countries by 2020, the following large-scale projects are under way or completed:

- New Kuala Lumpur International Airport (KLIA)
  Opened in June 1998. The area is 10,000 hectare and 14-fold of Narita International Airport.

- New administration city "Putrajaya"
  Scheduled to be established 25 km south of Kuala Lumpur. The Prime Minister's Office was scheduled to move in June 1999. Other offices are scheduled to move sequentially. The city became a federal jurisdiction on February 1, 2002.

- Multimedia Super Corridor (MSC)
  A plan to establish the latest telecommunications infrastructure at an area of 50 km (south-north) × 15 km (east-west) which connects Kuala Lumpur, Putrajaya, and the new airport to attract high-tech information technology enterprises.

- PETRONAS Twin Tower
  A skyscraper of 452 m high (currently highest in the world). Built by Japanese and Korean companies.

2.2 Energy Situations in Malaysia

(1) Energy policy of Malaysia

During the oil shock in 1973, Malaysia also had to find alternate oil suppliers and alternate energy sources like other countries.

The energy policy of Malaysia is based on the Petroleum Development Act 1974 (PDA). PETRONAS is given exclusive rights for owning and developing oil fields and natural gas fields and producing oil and natural gas. PETRONAS was brought under control of the Prime Minister and it is also responsible for planning, investing, and regulating the activities of energy suppliers.

Immediately after the implementation of the Petroleum Development Act 1974 (PDA), the National Petroleum Policy of 1975 was introduced to regulate the oil and gas industries to fulfill the development requests of the nation.

The Government announced the following three principles of the energy policy in 1979 to give directions for the future development of the energy sector.

1) Supply objective
   Alternate energy supply sources must be developed and used to secure adequate and economical energy supply.
2) Utilization objective
   Efficient use of energy must be promoted to regulate fruitless non-productive energy consumption.
3) Environment objective
   The burden and ill-effect on the environment must be minimized during the energy supply chain.

In 1980, the National Depletion Policy (NDP) was incorporated into the National Petroleum Policy (NPP) to regulate the production of major oil fields to preserve the oil and natural gas field development. As a result, the amount of oil production was restricted to 650,000 barrels per day. When liquefied natural gas is included, the actual amount of oil production is larger than this Figure. According to the Seventh Malaysian Plan Report (1995), the NDP set the upper limit for gas production including natural gas in the Malay Peninsula to two billion standard cubic feet per day.

In 1981, the Government applied the Four Fuel Strategy to the NDP to reduce the country's overdependence on oil (especially thermal power generation) and find the best balance among four types of energy sources: oil, natural gas, hydropower and coal. The Government added the fifth element, renewable energy, in the 21st century and replaced the strategy with "Five Fuel Strategy".

The draft of the Energy Efficiency Regulation states to specify the offices that use excessive energy, appoint energy management officers, and label equipment. This Regulation is assumed to be implemented before the end of the Eighth

Malaysia Plan period (2000 to 2005). The Government is well aware of the need to promote energy conservation in order to reduce the number of industrial devices that use energy inefficiently and fruitlessly in industries.

(2) Recent energy statistics (primary energy supply and final energy consumption)

In 2001, the growth of the primary energy supply in the commercial sector was relatively small, 5.4% compared to 28.5% in 2000. This is due to the increase in the production of natural gas, which increased from 52,432 ktoe in 2000 to 53,659 ktoe in 2001, a 2.3% increase. The crude oil production decreased from 33,835 ktoe in 2000 to 32,851 ktoe in 2001, a 2.9% decrease, due to less export demand (especially from the markets of the neighboring countries).

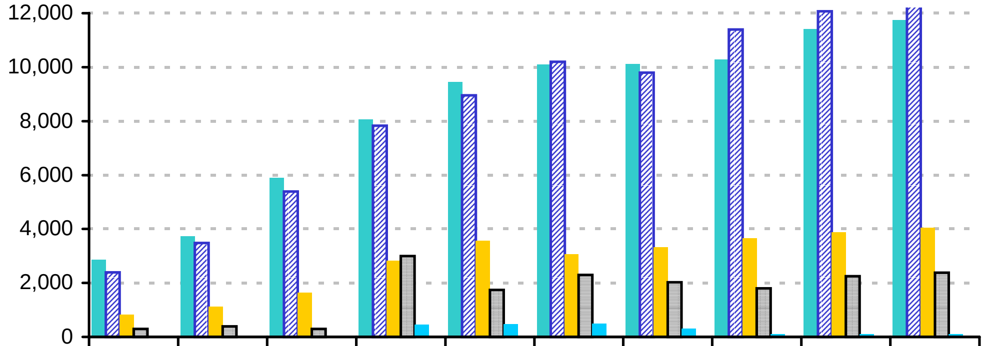
In the same period, the production of coal increased 42.5%. The amount of imported coal increased 37.1%, which caused increase in the overall coal supply of 19.5%. The percentage of crude oil and refined oil in the total energy sources increased from 49.2% in 2000 to 51.1% in 2001. The percentage of natural gas supply decreased from 42.4% to 39.7% in the same period. The percentage of hydropower and the percentage of coal and coke remained the same, both 3%.

The total of the maximum electricity demand for TNB, SESB and SESCO increased from 11,055 MW to 11,834 MW in 2002, a 7% increase. The number of customers requiring electricity increased from 5,868,095 to 6,156,600, which is a 4.8% increase and the sold energy increased 4.8% from 62,514 GHh. The composition of energy sources for the electricity generated by the above three companies and IPP was: 75% gas, 11% coal, 7.1% hydropower, and the remaining is oil and other fuels.

(3) Final energy use by sectors

According to the National Energy Balance 2001, the transport sector remained the main consumer of final energy as usual, 42% in 2001. The industrial sector consumed approximately 37%, the residential and commercial sector consumed 13%, and the agriculture sector consumed 0.3%. The final energy demand by the commercial sector was 31,515 ktoe while it was 29,699 ktoe in 2000. The reason for this increase is the growth of the service industry, the regional industry and the construction industry. Figure 2.2-1 and Figure 2.2-2 show the importance of the commercial sector in all the energy consumption in Malaysia.

FINAL ENERGY USE BY SECTORS (ktoe)



	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001
Industrial	2,870	3,726	5,885	8,060	9,443	10,106	10,121	10,277	11,406	11,755
Transport	2,398	3,477	5,387	7,827	8,951	10,201	9,793	11,393	12,071	13,236
Resid. & Comm.	826	1,123	1,646	2,837	3,557	3,073	3,314	3,653	3,868	4,050
Non-energy	291	386	299	2,994	1,744	2,298	2,023	1,799	2,250	2,379
Agriculture	0	0	0	446	472	490	307	106	104	98
Total	6,385	8,712	13,217	22,164	24,167	26,168	25,558	27,228	29,699	31,514

Figure 2.2-1 Trend of Final Energy Use by Sectors (2001)
(Source: National Energy Balance 2001)

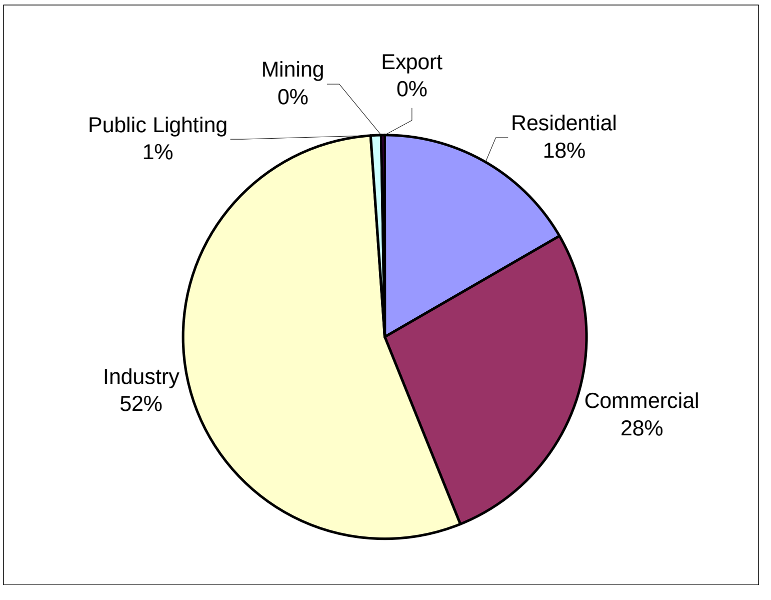


Figure 2.2-2 Electricity Consumption by Sectors (2002)
(Source: Suruhanjaya Tenaga, 2003)

2.3 Situations of Buildings in Malaysia

From the view point of global environment, improving the energy efficiency in buildings is effective in reducing the emissions of greenhouse gases. In Malaysia, the commercial sector emitted 27% of greenhouse gases in 2000 and the volume of emissions of the gases from buildings is expected to increase 7.6% in the 2001 - 2005 period.

The building of Ministry of Energy, Communications and Multimedia (MECM) in Putrajaya was designed as a low energy office (LEO) from the initial stage of the project. The entire building will be occupied by 2004 and its economical energy-efficient equipment will be publicly open as a showcase that can be easily implemented in both public and private buildings.

Pusat Tenaga Malaysia (PTM) designed its office building based on the LEO concept. The target energy consumption of this building is half of the MECM building, 50 kWh/m2. PTM is currently responsible for coordinating the 5-Year Energy Audit in Government Buildings project which is funded by the Malaysian Electricity Supply Industry Trust Account (MESITA). The main goal of this project is to heighten the awareness for energy conservation among the Government organizations and propagate the information. In 2001, the Malaysian Association of Energy Service Companies (MAESCO) established the “Energy Audit Guideline for Commercial Buildings” and the “Technical Reference” to standardize energy audits.

In addition, MS 1525:2001 “Code of Practice on Energy Efficiency and Use of Renewable Energy for Non Residential Buildings” was established to give directions for the best practices of energy efficiency in buildings. This code gives the minimum standard for designing new and existing buildings and the measures to fulfill the criteria and this standard. It also provides the measures to design, construct, operate, and maintain buildings without sacrificing the comfortableness and productivity of the functions of buildings and people living in the buildings while conserving energy.

(Sources)

National Energy Balance, 2001

Statistics of Electricity Supply Industry in Malaysia 2003

Eighth Malaysia Plan (2001 - 2005)

3. Procedure of Energy Audit for Buildings

3.1 General Process

The energy audit for buildings is generally proceeded in the 6-step sequence described below.

In STEP 1 and STEP 2, general information and data on the building and equipment concerned are collected and the obtained energy consumption data are analyzed.

The participants collaborated with Japanese experts from STEPs 1 to 3 for this year's audit. In the wrap-up meeting held on completion of the 1st site survey, ECCJ specialists gave an outline of the improvement points in STEP 4. In the interim report meeting in the 2nd site survey, the study results on the measures for the improvement and expected effects were explained, and for further confirmation, additional surveys were conducted. This report reflects the results of the 2nd site survey.

STEP-1 Gather and confirm general information and data of the building
STEP-2 Gather and confirm general information and data of the equipment
STEP-3 Gather and confirm data of energy consumption
STEP-4 Identify improvement points through data analysis and evaluation
STEP-5 Study recommended methods for improvement including expected effects
STEP-6 Determine and explain the recommendations to be implemented

3.2 Description of Each Step

Major survey items of each step are as follows:

(1) STEP-1 Gather and confirm general information and data of the building
1) Year of construction completed
2) Size: Gross floor area (area for major use, indoor parking area), number of stories, building structure
3) Usage
4) Owner
5) No. of employees, No. of clients (on business days and holidays), and other items

(2) STEP-2 Gather and confirm general information and data of the equipment
1) Air-conditioning system, electrical system, sanitary facilities
2) Specifications for equipment and facilities
3) Operation management status: Operating hours, setting of room temperature, and other items

(3) STEP-3 Gather and confirm data of energy consumption
1) Monthly energy consumption
2) Changes in yearly energy consumption

3) Energy consumption by day of the week
4) Energy consumption by hour of the day
5) Energy consumption by usage
6) Data on water consumption, and other items

(4) STEP-4 Identify improvement points through data analysis and evaluation

1) Comparison of the total energy consumption of the building concerned with those of similar buildings
2) Comparison of its energy consumption by usage with those of similar buildings
3) Analysis of its monthly energy consumption trends
4) Analysis of changes in energy consumption for a period of several years
5) Analysis of its energy consumption by day of the week and hour of the day
6) Confirmation of room environment: Temperature, humidity, CO_2 concentration, luminance
7) Confirmation of operation log: Operation status during peak load hours, operation status during light load hours, No. of equipment units in operation, operation time and operation temperature conditions
8) On-site inspection: Operation status of equipment, temperature indicators, ammeters, voltmeters and power factor indicators, valve condition, damper condition, heat insulation, layout of equipment, maintenance of equipment and piping
9) Determination of how the facilities and equipment are actually used: Density of people in a room, condition of OA equipment, identification of locations of energy loss, and other items

(5) STEP-5 Study recommended methods for improvement including expected effects

1) Studying improvement plans: Application of other successful improvement cases and most-advanced technologies
2) Estimation of effects of improvement: Amount of reduced energy consumption and costs
3) Estimation of costs for improvement

(6) STEP-6 Determine and explain the recommendations to be implemented

1) Determination of the recommendations to be applied
2) Preparation of a report
3) Explaining the report

3.3 On-site Auditing Procedure

The energy audits for the building concerned were conducted in accordance with the following procedure.

(1) Interviewing
  1) General description of the building
  2) General description of the equipment
  3) How the building is used and the operation status of equipment
  4) Data and information on overall energy use
(2) Confirmation on drawings and reference materials
  1) Building design drawing
  2) Equipment drawings including drawings of air-conditioning systems, electrical systems and sanitary facilities
  3) Operation log
  4) Energy consumption data
  5) Room environment data
(3) On-site confirmation
  1) Typical room
  2) Machine room
  3) Electrical room
  4) Outdoor facilities and equipment (placed on rooftop and on the ground)
(4) Simple measurements (if possible)
  1) Temperature, humidity and luminance
  2) Electric current
  3) CO_2 concentration, etc.

4. Energy Audits of Sapura@Mines Building

4.1 Outline of Sapura@Mines Building

(1) Name: Sapura@Mines Building

(2) Use: Office

(3) Size: 11 floors above the ground
Gross floor area: 51,282 m^2

(4) Age of the building: 5 years

(5) Central building management and control system:
Building Automating System (BAS)

(6) Outline of electrical systems:
Receiving voltage 11 kV, Transformer capacity 1,500 kVA × 2 sets, 2000 kVA × 1 set, Power generator 800 kVA × 1 set, Elevator 20 kW × 6 sets, Service elevator 16 kW × 2 sets, Special-purpose elevator 22.4 kW × 1 set

(7) Outline of air-conditioning systems:
Turbo chiller 500RT (327 kW) × 3 sets, Turbo chiller 150RT (104 kW) × 1 set, Air-conditioning equipment: VAV, partially fan-coil unit (FCU), split-type and packaged

(8) Sanitary facilities:
Water receiving tank (city water), Lifting pump 18.5 kW × 3 sets, Lifted water tank

4.2 Analysis of Current Status of Energy Use

(1) Monthly energy consumption

1) Electric energy and maximum demand (2002)

Figure 4.2-1 shows the monthly electric energy and maximum demand in 2002. As the graph shows, electric power consumption peaks in July and drops most in February. The maximum demand also peaks in July.

The maximum demand notably drops in September compared to August and November. The recorded data is accurate and the reason is unknown.

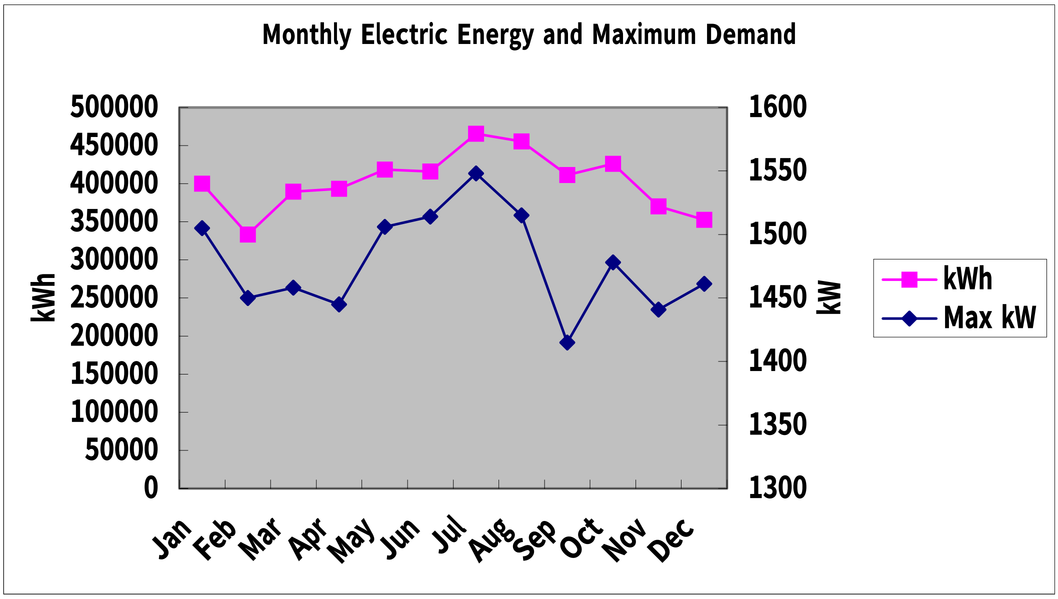


Figure 4.2-1 Monthly Electric Energy and Maximum Demand

(2) Estimated energy consumption by use

Sapura@Mines Building's (abbreviated as "Sapura Building" hereafter) energy consumption by use, which was calculated based on the drawings of the building and the observed operating status of the equipment on the day of the on-site survey, is shown below. These approximate calculations are made based on experience and not accurate; they should be used for reference only. Figure 4.2-2 and Table 4.2-1 show the results of the calculations.

The pie chart shows that Sapura Building uses approximately 39% of the energy as the heat source for air-conditioning, approximately 14% for heat transfer, and approximately 16% for lighting and outlets. Items 2) to 5) show how the energy consumption by use is calculated.

1) Composition of energy consumption by use

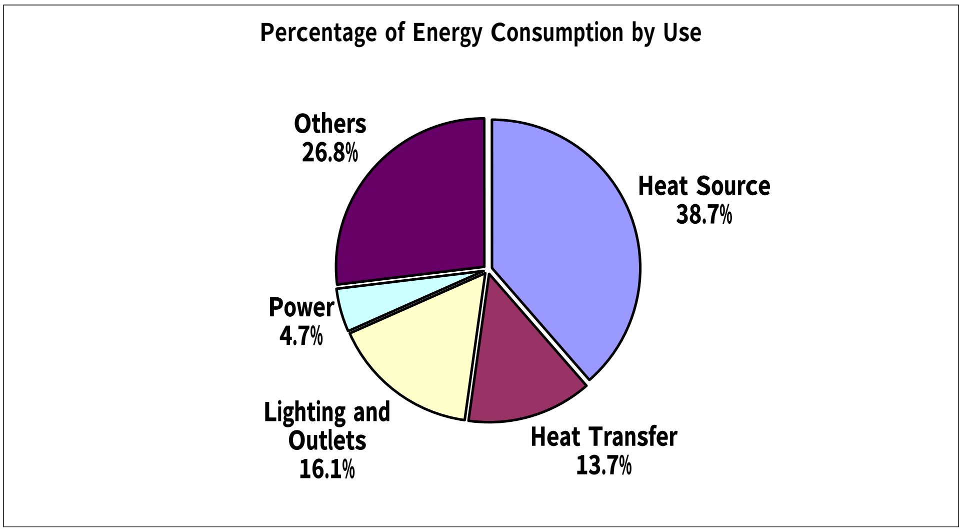


Figure 4.2-2 Percentage of Energy Consumption by Use

Table 4.2-1 Amount of Energy Consumption by Use

Purpose	kWh/d	%
Heat source	6,872	38.7%
Heat transfer	2,426	13.7%
Lighting and outlets	2,859	16.1%
Driving power	837	4.7%
Others	4,767	26.8%
Total	17,761	100.0%
Daily average	17,761	kWh/d

2) Calculation of the energy consumption for heat sources

	Quantity	kW	Hour	Load factor	kWh/D	%
Chiller	2	327	10	0.8	5,232	29.5%
Cooling tower	2	22	10	0.8	352	
Cooling water pump	2	37	10	0.8	592	
Split-type air conditioner	29	3	10	0.8	696	
Total					6,872	38.7%
Annual electric power consumption	4,830,876			kWh/y		
Daily electric power consumption (average)	17,761			kWh/d	272 days	

3) Calculation of the energy consumption for heat transfer

	Quantity	kW	Hour	Load factor	kWh/D	
Cold water pump	2	55	10	0.8	880	
Air-conditioner (18 units)	1	180.2	10	0.8	1441.6	Except for the 5th floor
Fan-coil unit	20	0.65	10	0.8	104	
Total					2425.6	

4) Calculation of the energy consumption for lighting and outlets

		m^2	W/m^2	kW	Hour	Operating rate	kWh
Ground		5100	10	51	10	0.4	204
1st floor		5100	10	51	10	0.6	306
2nd floor	Parking lot	5100	2	10.2	10	0.8	82
3rd floor	Parking lot	5100	2	10.2	10	0.8	82
4th floor	Parking lot	5100	2	10.2	10	0.8	82
5th floor	Empty	5100	2	10.2	10	0.8	82
6th floor	Office	5100	15	76.5	10	0.8	612
7th floor	Office	5100	15	76.5	10	0.8	612
8th floor	Office	5100	15	76.5	10	0.4	306
9th floor	Office, theater	5100	15	76.5	10	0.6	459
10th floor	Office	282	15	4.23	10	0.8	34
Total		51282					2,859

5) Calculation of the energy consumption for driving power

	Quantity	kW	Hour	Load factor	kWh/D
Ventilation fan (27 units)	1	90.7	10	0.8	726
Makeup pump	1	2.2	2	0.8	4
Suction pump	1	7.5	2	0.8	12
Elevator	8	15.0	2	0.8	192
Total					933

(3) Comparison with other buildings in Malaysia

Figure 4.2-3 shows the relationship between the gross floor area of each of 59 buildings in Malaysia (Sapura Building is red) and electric power consumption. Since Sapura Building is below the regression line, Sapura Building consumes less energy than the average. The simple average per floor area of 59 buildings is 144.4 kWh/m^2 and that of Sapura Building is 94.2 kWh/m^2. Sapura Building consumes approximately 65% of the average. The area of operating rooms in 47 buildings is determined. Figure 4.2-4 shows the area. The simple average per operating floor area of 47 buildings is 181.5 kWh/m^2 and that of Sapura Building is 153.4 kWh/m^2, which is approximately 85% of the average.

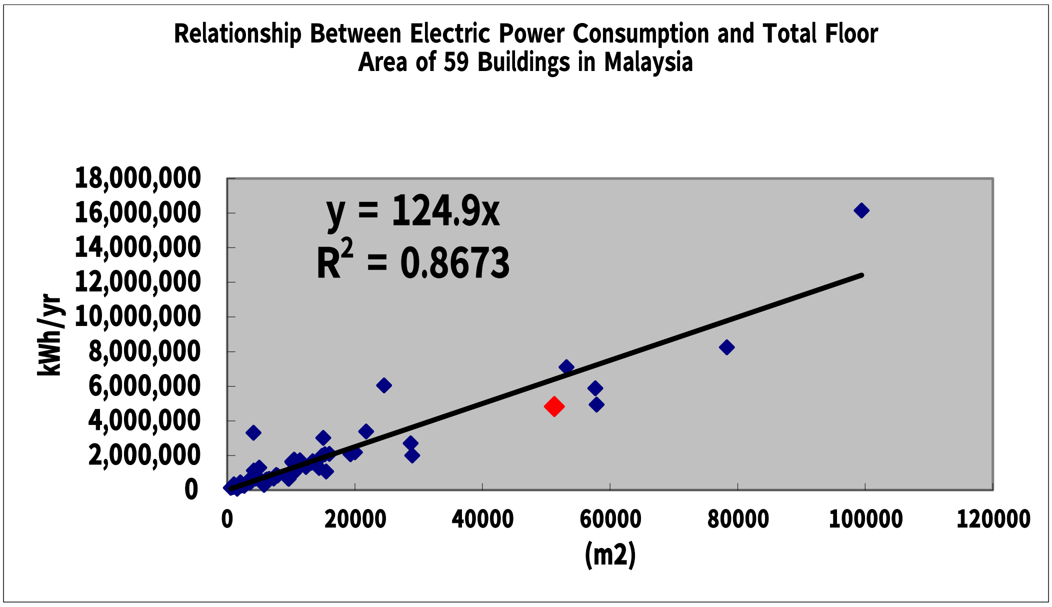


Figure 4.2-3 Relationship Between Electric Power Consumption and Total Floor Area of 59 Buildings in Malaysia

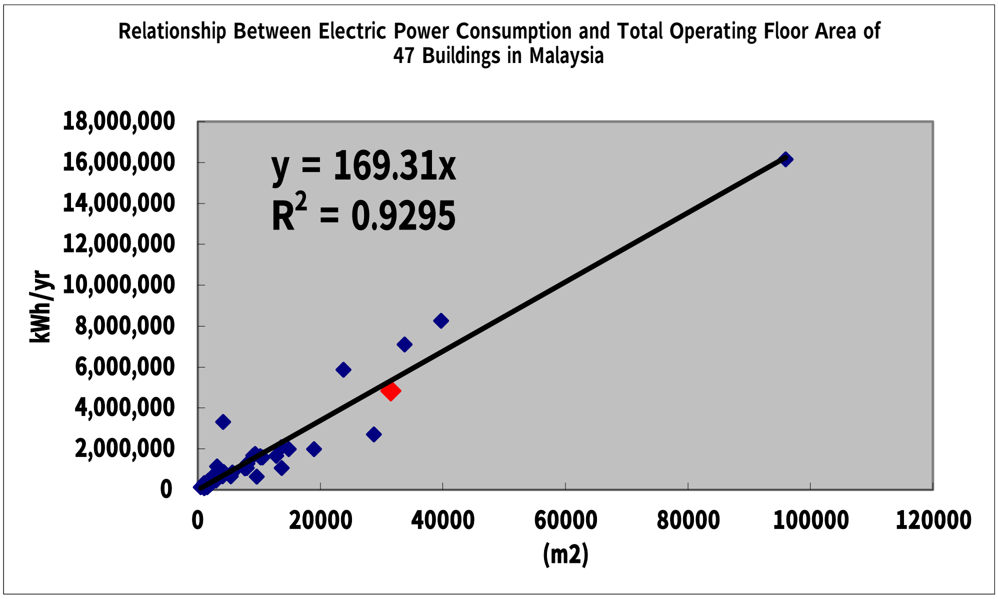


Figure 4.2-4 Relationship Between Electric Power Consumption and Total Operating Floor Area of 47 Buildings in Malaysia

(4) Comparison with the buildings in Japan

1) Comparison of temperatures between Kuala Lumpur and Tokyo

To evaluate the energy usage in the buildings in Malaysia, the buildings are compared with those in Japan. Before comparing the energy consumption per unit area, the monthly average temperature is compared between Tokyo and Kuala Lumpur since it determines the amount of energy required for air-conditioning.

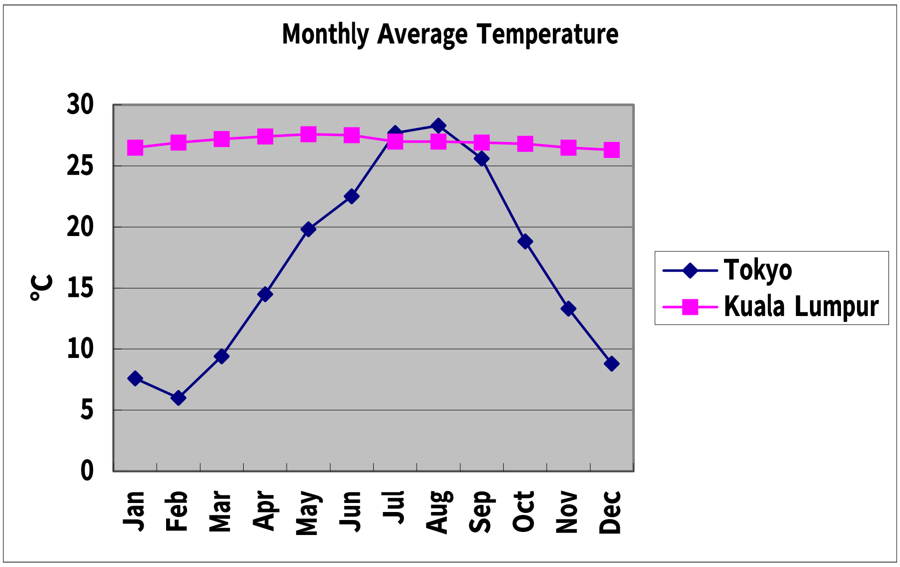


Figure 4.2-5 Monthly Average Temperature

2) Comparison of energy consumption intensity with that of buildings in Japan

According to the data of the Energy Conservation Center, Japan, the average energy consumption intensity in office buildings in Japan is 2177 MJ/m^2. The energy consumption intensity per operating floor area (total area is 31,494 m^2) in Sapura Building is 1503 MJ/m^2, which is approximately 69% of the Japanese average.

In Japan, energy data is calculated using the unit "MJ/m^2" which is determined using the following conversion value. Therefore, the data of Sapura Building is also converted in the same manner. (Note: This conversion coefficient of electric power is used in Japan taking the power generation efficiency and other points in power plants into consideration. It is determined by dividing 1 kWh = 3.6 MJ by the average power generation efficiency (approximately 37%) of Japanese electric power companies.)

	Primary energy conversion coefficient	
Electric power	9.8	MJ/kWh

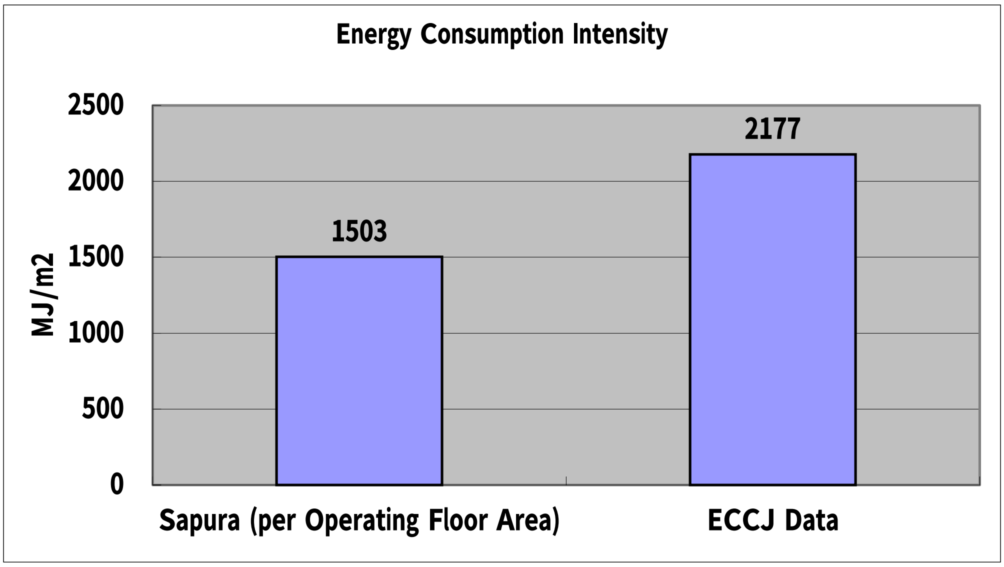


Figure 4.2-6 Energy Consumption Intensity

2) Composition of energy consumption by use in office buildings in Japan
The following pie chart shows the composition of energy consumption by use in office buildings in Japan. In comparison of the composition of Japan with that of Sapura Building, it is noted that the percentage of the heat source for air-conditioning is large and the percentage of lighting and outlets is small in Sapura Building.

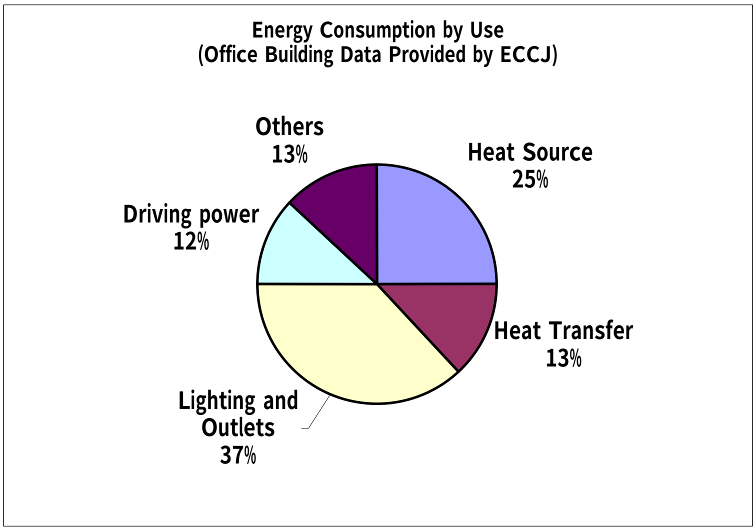


Figure 4.2-7 Energy Consumption by Use

(5) Water consumption data

1) Monthly water consumption
Figure 4.2-8 shows the monthly water consumption in 2002.
The water consumption of March is small compared to other months. The reason could not be confirmed.

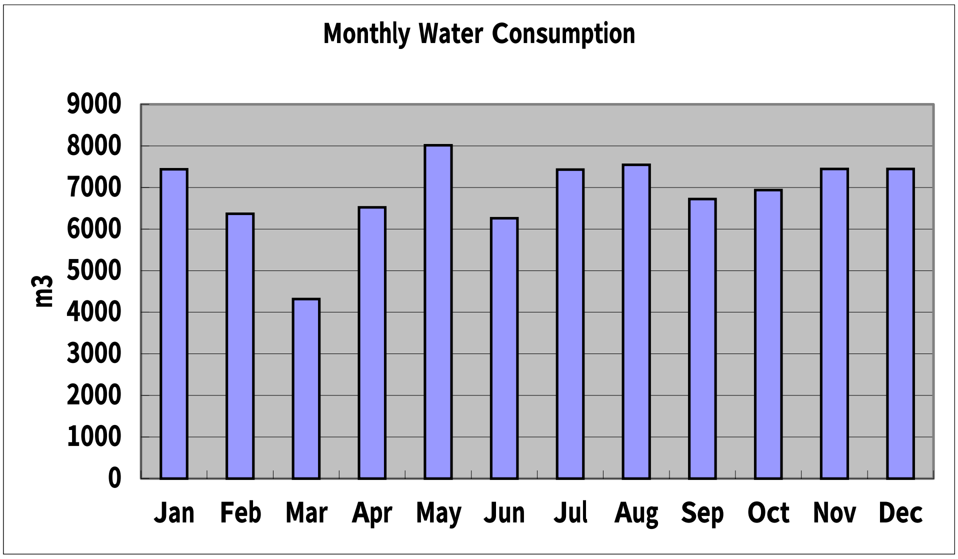


Figure 4.2-8　Monthly Water Consumption

2) Comparison with other buildings

When evaluating the water consumption, it is necessary to check the consumption of the total floor area and compare it with other data. However, there is no other comparable data in Malaysia. Therefore, the data of Sapura Building was compared with the data of Japan given by The Energy Conservation Center, Japan. In office buildings in Japan, the water consumption is 0.98 m^3/m^2 while it is 2.62 m^3/m^2 in Sapura Building (total operating floor area is 31,494 m^2). The water consumption of Sapura Building is approximately 2.7 times more of that of Japan.

We were doubtful about this result in the first survey. During the second survey, a technician of Sapura Building reported that water leakage from a pipe was found and then water consumption was reduced to half after the damage was repaired.

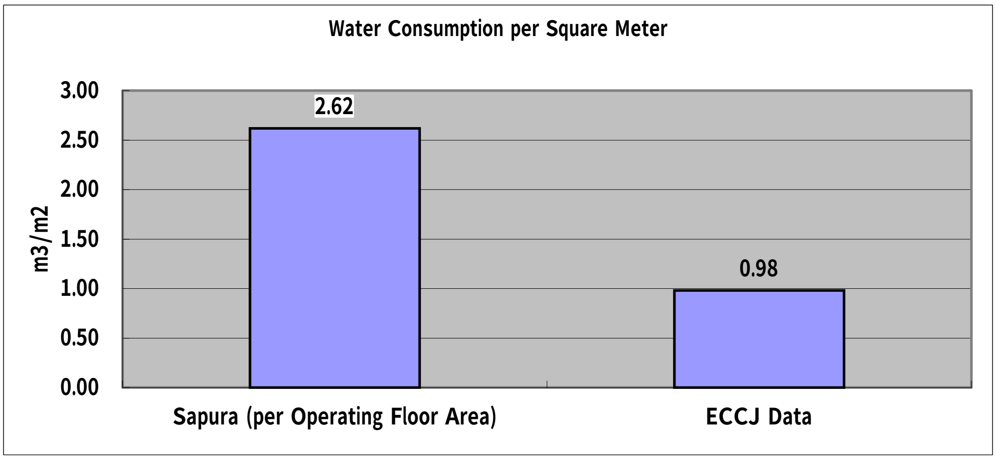


Figure 4.2-9　Water Consumption per Square Meter

4.3 Proposed for Improvements and Expected Effects

(1) Improvement of the room temperature setting

Current condition

The temperature of the room air-conditioning was set to 22°C to 23°C which needed to be improved for energy conservation.

Proposed improvement

Raising the temperature by approximately 2°C to 24 or 25°C

Calculation of expected effects

The effects were calculated assuming that the temperature was raised by 2°C with the following conditions:

Conditions

	Temperature	Humidity	Enthalpy
	°C	%	KJ/kg
Current room temperature	22.5	50	45
Improved room temperature	24.5	50	50
Average outside air temperature	27	50	57

Rate of outside air load out of the entire load	Assumed to be 0.3
Current load	12 KJ/kg
Improved load	7 KJ/kg
Outside air load reduction rate	0.42

Rate of heating load out of the entire load	Assumed to be 0.15
Current load temperature difference	4.5°C
Improved load temperature difference	2.5°C
Heating load reduction rate	0.44

Total reduction rate	0.3 × 0.42+0.15 × 0.44＝0.192

Annual electric power consumption	4,830,876 kWh
Percentage of turbo chillers	29.5%
Reduced electric power	4,830,876 × 0.192 × 0.295＝273,621 kWh
Percentage in the annual electric power consumption	5.7%

(2) Adjustment of outside air intake volume

Current condition

Outside air is taken inside to change air in rooms. However, whether the volume of the current outside air intake was appropriate was not assessed.

Proposed improvement

Measuring the concentration of carbon dioxide (CO_2) in the room to reduce the volume of the outside air intake to an appropriate amount

Measurement

During the second survey, we showed the participants how to use the device brought from Japan that measures concentration of carbon dioxide and measured the CO_2 concentration. The actual CO_2 concentration was 600 ppm in all three sections in the room and 400 ppm outside. The following pictures show the scenes of measuring the CO_2 concentration.

Calculation of expected effects

The effects were calculated considering 800 ppm as the targeted concentration of carbon dioxide in rooms and reducing the outside air intake volume accordingly.

Electric power currently required to process the heat of outside air		
Annual electric power	4,830,876 kWh	
Percentage of turbo chillers	29.5%	
Rate of outside air load	30%	
Electric power required to condition outside air	426,931 kWh	
Current CO_2 concentration in rooms (measured value)	600 ppm	
Current CO_2 concentration of outside air (measured value)	400 ppm	
Targeted CO_2 concentration in rooms	800 ppm	
Current amount of ventilated air	V1	m^3/h
Improved amount of ventilated air	V2	m^3/h
		400V1 + X = 600V1
		400V2 + X = 800V2
		V2 / V1 = (600 – 400) / (800 – 400) = 0.5
Outside air intake reduction rate	0.5	
Reduced electric energy	213,466 kWh	
Reduction percentage in the total electric energy	4.4%	

(3) Total closing of VAV units in unused rooms

Current condition

Although the offices at the west side of the south wing of the eighth floor were not used, air-conditioning was provided.

Proposed improvement

Closing all the VAV units in unused areas to stop ventilation air and reducing the power for chillers and air supply

Calculation of estimated effects

The effects were calculated assuming that all the VAV units in unused rooms were closed with the following conditions:

Area (approximate) of the 8th floor south wing’s west side		734 m^2
Total air-conditioned area		31494 m^2
Percentage of the 8th floor south wing’s west side		2.3%
Chiller		
Percentage of air-conditioning load except for lighting and human bodies		Assumed to be 70%
Annual electric power		4,830,876 kWh
Percentage of turbo chillers		29.5%
Reduced power for chillers		23,217 kWh
AHU	FAN	11 kW
The required air supply for air-conditioned areas is set to 20%.		2.2 kW
Reduced power		8.8 kW
Number of daily operating hours		10h
Number of operating days		272d
Load factor		0.8
Reduced AHU fan power		19,149 kWh
Total reduced power		42,366 kWh
Percentage in the annual electric power		0.9%

(4) Review of the operating method of chillers during low load period

Current condition

Three 500RT turbo chillers and one 150RT turbo chiller were installed, and two 500RT turbo chillers were used even during the low air-conditioning load period.

Proposed improvement

Using one 500RT turbo chiller and one 150RT turbo chiller during the low load period

Calculation of expected effects

The effects were calculated assuming that the turbo chillers were operating with the following conditions:

Current: Two 500RTs Operation

	Quantity	kW	Hour	Load factor	kWh/D
Chiller	2	327	10	0.6	3,924
Cooling tower	2	22	10	0.8	352
Cooling water pump	2	37	10	0.8	592
Cold water pump	2	55	10	0.8	880
Total		882			5,748

Proposed Improvement: One 500RT and one 150RT Operation

	Quantity	kW	Hour	Load factor	kWh/D
Chiller	1	327	10	092	3,008
	1	104	10	0.92	957
Cooling tower	1	22	10	0.8	176
	1	3.75	10	0.8	30
Cooling water pump	1	37	10	0.8	296
	1	18.5	10	0.8	148
Cold water pump	1	55	10	0.8	440
	1	18.5	10	0.8	148
Total		585.75			5,203

Difference		296.25			1,062

Number of operating days	272 day
Rate of low load appearance	Assumed to be 0.4
Reduced electric energy	59,274 kWh
Percentage in the annual electric energy	1.2%
Annual electric energy	4,830,876 kWh

(5) High-efficiency operation of power receiving transformers

Current load conditions:

Load of power receiving transformer TX1 (1500 kVA): 348 kVA (23.2%)
Load of power receiving transformer TX2 (1500 kVA): 355 kVA (23.7%)
Load of power receiving transformer TX3 (2000 kVA): 876 kVA (43.8%)
The above values were observed during the day of audit of the first survey.
Figure 4.3-1 shows the estimated average load curve of a day calculated from the actual annual electric energy consumption of 2002 (4,830,876 kWh) with power factor 0.9.

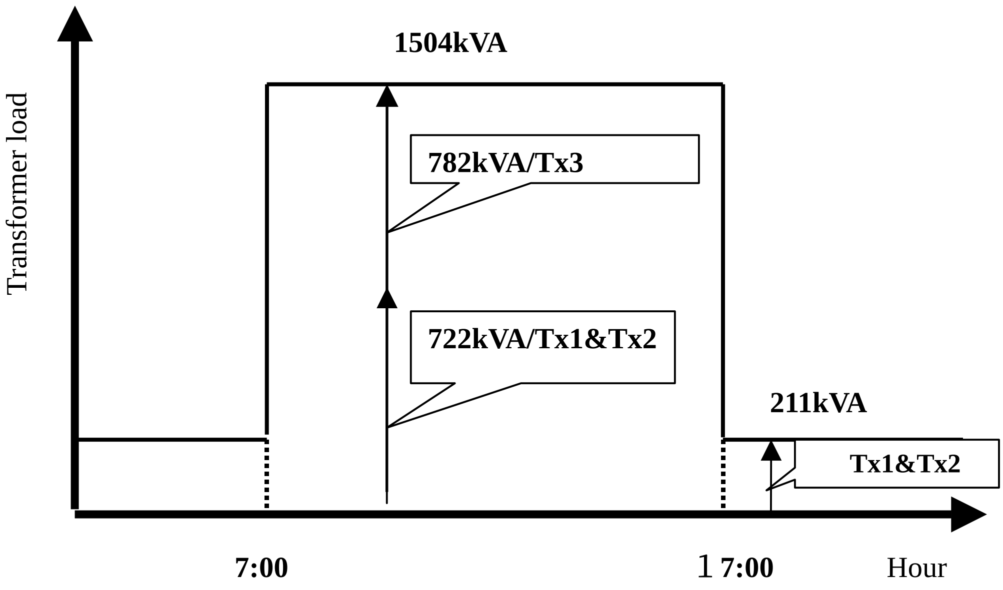


Figure 4.3-1　Average Electric Power Load of a Day (Assumed)

Proposed improvement

As Figure 4.3-2 shows, a standard transformer achieves the highest efficiency when the load is approximately 60%. Therefore, by reducing the number of receiving power transformers from three to one, the transformer load factor increases and high efficiency can be achieved.

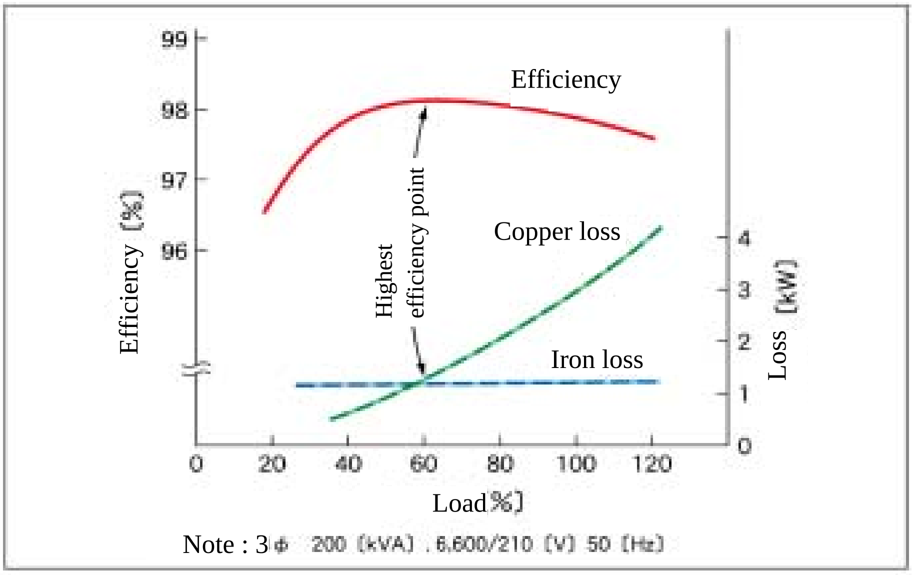


Figure 4.3-2　Transformer Load, Efficiency and Loss

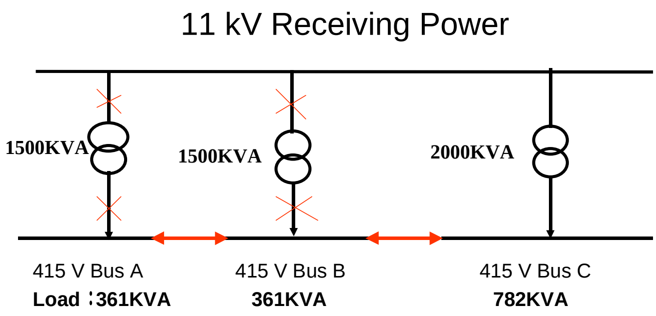


Figure 4.3-3 Proposed Improvement for the Power Receiving System

Calculation of expected effects

1) Conditions

- Characteristics of transformers

Loss \ kVA	1500	2000
No-load loss (Wi)	2,380 W	3,040 W
Load loss (Wc) (when load is 100%)	15,910 W	18,170 W

- Operating conditions: 272 days per year, 10 hours per operating day
- Transformer load

  TX1 and TX2: When operating: 361 kVA/transformer

  When not operating: 106 kVA/transformer

  TX3: When operating: 782 kVA
- Loss calculation formula: Wt (total loss) = Wi + Wc × $(Pe)^2$

  Pe: Transformer load factor

2) Calculation

- Loss when using transformers TX1, TX2 and TX3

  Wt1 = 2380W × 8760h × 2 + 15910W $(361/1500)^2$ × 10h × 272 days × 2 + 15910W $(106/1500)^2$ × 14h × 272 days × 2 + 15910W $(106/1500)^2$ × (365 – 272) days × 24h × 2
  + 3040W × 8760h + 18170W $(782/2000)^2$ × 10h × 272 days
  = 81,856 kWh/year

- Loss when using only transformer TX3

  Wt2 = 3040W × 8760h + 18170W $(1504/2000)^2$ × 272 days × 10h + 18170W $(211/2000)^2$ × {272 days × 14h + (365 – 272) days × 24h}
  = 55,800 kWh/year

- Advantages

Wt1 – Wt2 = 81,856 kWh – 55,800 kWh

= 26,056 kWh/year (equivalent to 0.5% of the annual electric energy consumption)

Reduced cost: 7,400 RM (average electricity unit charge: 0.284 RM/kWh)

(6) Summary of effects of improvement

Table 4.3-1 lists the proposed improvements (five), electric power to be reduced and costs to be reduced.

When all the five improvements are implemented, 13.9% of reduction in electric power consumption is expected. Nos. 1 to 4 do not require any modification to the building and they alone can achieve 13.4% of reduction.

Table 4.3-1 Proposed Improvement and Expected Effects

No	Point to be improved	Reduced electric energy [kWh]	Reduced cost [RM]	%
1	Room temperature setting	273,621	77,708	5.7
2	Volume of outside air intake	213,466	60,624	4.4
3	Total closing of VAV units in unused rooms	42,366	12,032	0.9
4	Review of the operating method of chillers during the low load period	115,546	32,815	2.4
5	High-efficiency operation of transformers	26,056	7,400	0.5
	Total	671,055	190,580	13.9
	Annual electric energy consumption	4,830,876		
	Average electricity unit charge	0.284	RM/kWh	

5. Database, Benchmarks and Guidelines for Malaysia

(1) Current status of Malaysia

In regard to the energy conservation of buildings in Malaysia, Pusat Tenaga Malaysia (PTM: Malaysia Energy Centre) made reports on the first and second surveys. The materials are included in "VI. Attachment 2". The outline of the database, benchmarks and guidelines is as follows.

The energy data regarding 55 buildings in Malaysia was already obtained and the basic materials for the database were already prepared. The history of gathering data up to the current point was as follows.

2001: MAESCO created the "Energy Audit Guideline" and the "Materials for Energy Audit Skills".

2002: Twelve government buildings were audited.

2003: Energy conservation measurement was demonstrated in a retrofitted building and ASEAN benchmarks were created for the existing office buildings (total of 55 buildings).

Table 5-1 lists the data for the twelve government buildings mentioned above. The average Building Energy Index (BEI) is 180.41 kWh/m2/year.

Table 5-1

No.	Buildings	BEI ($kWh/m^2/yr$)
1	Menara PKNS, S'gor	246.84
2	BSN HQ, KL	246.4
	Wisma	257
	Block A&B	385
3	M'sian Institute of Nuclear Technology (multiple)	211.29
	MINT Bangi	208.88
	MINT Dengkil	213.69
4	Kompleks Pej. Kerajaan Jln Duta, KL	168.36
	Block 8	184.85
	Block 8A	165.35
	Block 9	144.11
	Block 10	167.61
	Block 11	180.59
**5	National Science Centre	155.38
6	Wisma Persekutuan, KT	152.44
7	Kementerian Pertanian	149.45
8	Wisma Persekutuan, KB	133.72
9	Bang. Rumah Persekutuan, KL	132.73
10	JPS HQ, KL	121.64
**11	Kolej Universiti Teknologi Tun Hussein Onn (multiple)	85.4
12	Wisma Persekutuan, Kuantan	77.94
	Average	180.41

The frequency distribution of the BEIs of the 55 buildings is shown below. The average is 166 kWh/m^2/year.
As you can see, the BEI that can be used as a benchmark is already established although the number of government buildings and commercial buildings collected as samples is small.

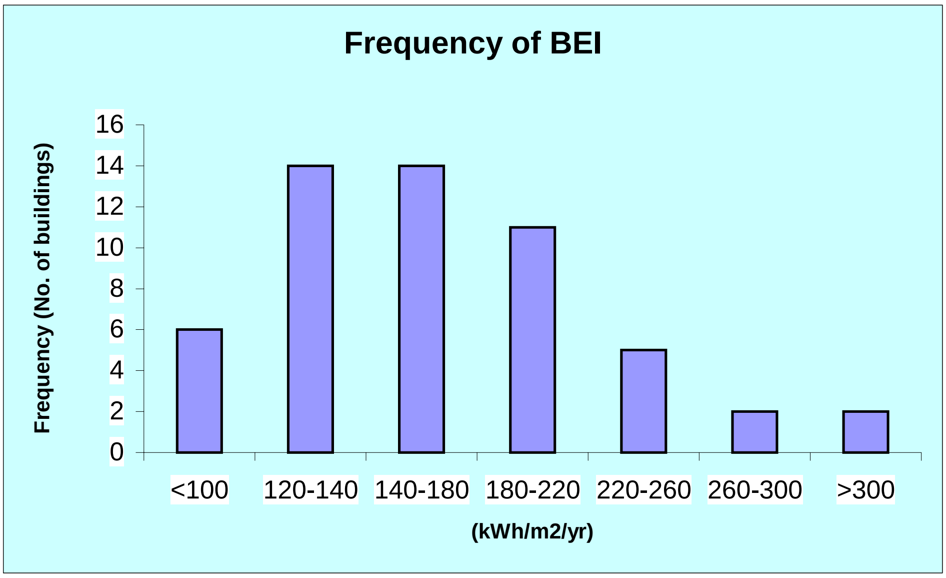


Figure 5-1 Frequency Distribution of BEI (55 Buildings)

The guideline for energy conservation in buildings was created in 2001: "Code of Practice on EE and Use of RE for Non-residential Buildings" - MS 1525: 2001 by Department of Standards.

The following plans are scheduled or being conducted for further energy conservation in buildings:
The energy-saving building of the Ministry of Energy, Communications and Multimedia (MECM) is scheduled to be completed in February 2004. This building was designed from the start using the energy conservation measures that are cost-effective. When it is completed, it will be open to public and used as a model for other buildings.
The PTM building is aiming for higher standards as an energy-efficient building with 50 kWh/m2/year as the target BEI, which is half of that of the MECM building. The PTM building is currently being designed.
The Energy Commission (EC) is currently conducting a three-year project to prepare the standards and guidelines for energy conservation.

(2) Comment

In Malaysia, the basic measures for energy conservation for buildings are already taken and the second stage is being conducted. The following points are required to create the database, benchmarks and guidelines:

1) Conducting more detailed surveys

The existing survey data covers only the areas of buildings and annual energy data. To fully understand the energy characteristics of each building, monthly energy consumption and the applicable equipment should be investigated at the same time. To achieve this goal, survey sheets need to be reviewed. It is recommend that measurements should be taken even in small buildings, and energy consumption by use and 24-hour measurements should be conducted. By analyzing the data in detail, the points to be improved for energy conservation can be determined regarding energy conservation in buildings.

2) Conducting surveys in other types of buildings

Since the current data covers only the government buildings and private office buildings, it is recommend to collect data for hospitals, hotels and commercial buildings that consume more energy.

3) Increasing the number of buildings to be checked and continuing surveys

It is recommended to increase the number of buildings to be surveyed from 55 for improving the accuracy of data and to establish a system to continue the survey.

(3) Photos

A photo of a workshop in progress and a group shot in Malaysia are shown below.

1) Workshop photo

2) Group photo

III. Brunei

1. Summary of Site Survey

Participants and audit periods

1st site survey : November 6 through 10, 2003

2nd site survey : January 22 through 24, 2004

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

- Takashi Kato (Technical Expert) November 6 through 10, 2003
January 22 through 24, 2004
- Akira Kobayashi (Technical Export) November 6 through 10, 2003
January 22 through 24, 2004

(1st site survey)

Date	Events, destination, etc.	Description
Nov. 6 (Thu.)	Workshop (Orchid Garden Hotel, Bandar Seri Begawan, Brunei Darussalam)	• Welcome Remarks • Opening Statement • Presentation on the profile of Orchid Garden Hotel and its energy management status • Presentation by ACE on its engagement in the PROMEEC project and its action plans for the current year • Presentation on the conditions of energy conservation in buildings in Japan • Presentation on the procedure of energy audits of buildings Participants Mr. Amir Sharifudin Bin Haji Mohd Ali (Department of Electrical Services) 25 persons in total: Breakdown (No. of persons): Department of Electrical Services: 8 Ministry of Development: 2 Ministry of Health: 3 Institut Teknologi Brunei: 4 Ministry of Defense: 2 Ministry of Industry & Primary Resources: 1 Brunei Shell Petroleum: 2 Orchid Garden Hotel: 3 Mr. Christopher Zamora (Project Coordinator, ASEAN Center for Energy)

Date	Events, destination, etc.	Description
Nov. 8 (Sat.)	Survey/audit of Orchid Garden Hotel (Bandar Seri Begawan Brunei Darussalam)	• Provided OJT in energy auditing to participants through the survey/audit of Orchid Garden Hotel Use: Hotel (155 guest rooms) Size: 1 basement floor and 10 floors above the ground Gross floor area: 20,121.18 m^2 • Survey on the overall condition of the building by documents/interviewing • Survey on the overall condition of the equipment by documents/interviewing • Survey on energy consumption by documents/interviewing • On-site investigation There were many participants including those from Department of Electrical Services. Participants: Mr. Amir Sharifudin Bin Haji Mohd Ali and 20 other persons
Nov. 10 (Mon.)	Wrap-up meeting (Conference room of Department of Electrical Services (DES))	• Summarized the results of the survey/energy audit of Orchid Garden Hotel and reported to the participants. Participants: Mr. Amir Sharifudin Bin Haji Mohd Ali and 20 other persons

(2nd Site Survey)

Date	Events, destination, etc.	Description
Jan. 22 (Thu.)	Pre-report meeting Interim report on the audit results for Orchid Garden Hotel	• Made an interim report based on the results of the 1st survey/energy audit of Orchid Garden Hotel. • Major contents • Analysis of the current condition (electric power consumption, total energy consumption, energy composition, trends in monthly energy consumption, comparison with other buildings and water consumption data) • Recommendations for improvement and expected effects (Repair of BAS system, review of operation time of air conditioning, improvement in room pre-set temperature, heat retention of hot-water supply line, high-efficiency operation of transformers of received electricity, renewal to high efficiency lighting fixtures and shorter-time operation of swimming pool circulation pump) • Measurement of CO_2 concentration: We carried out measurement of CO_2 concentration, which is necessary for control of fresh air intake, at relevant places in cooperation with the participants using the CO_2 concentration meter brought from Japan. Participants: (1) Hotel: Dr. HJ. Ahmad (Assistant General Manager) and 2 staff members of maintenance DES: Mr. Amir Sharifudin and Mr. Christopher Zamora (ACE)

Date	Events, destination, etc.	Description
Jan. 24 (Sat.)	Workshop on promotion of energy conservation in buildings (Orchid Garden Hotel)	• Pre-report presentation on the results of the audit of Orchid Garden Hotel • Presentation on benchmarks and databases established in Japan • Made a hearing investigation on benchmarks and databases for buildings in Brunei. As a result, one example of university data (ITD) was presented. • Discussions: Meaning and usage of benchmarks, analysis of the data on university (ITD), etc. Participants: 19 persons including Mr. Amir Sharifudin Breakdown (No. of persons) Department of Electrical Services: 3 Ministry of Development: 1 Ministry of Health: 3 Institut Teknologi Brunei: 4 Ministry of Defense: 1 Ministry of Industry & Primary Resources: 1 Public Works Department: 3 Radio Television Brunei: 1 Orchid Garden Hotel: 2 Mr. Christopher Zamora (ACE)

2. Political and Economic Conditions in Brunei

2.1 National Indicators, Political System and Key Economic Indicators

(1) National indicators

Country name:	Brunei Darussalam
Area:	5,765 km^2 (almost the same size with Mie Prefecture of Japan)
Population:	345,000 (2001)
Capital city:	Bandar Seri Begawan
Ethnic distribution:	Malayan group (including other native people) 68.0%, Chinese (15.0%) and others (17.0%)
Languages:	Malay (official language), English, Chinese, etc.
Religions:	Islam (official religion), Christianity, Buddhism, Taoism, etc.

(2) Political system

Form of government:	Limited monarchy
Head of state:	His Majesty Sultan, Haji Hassanal Bolkiar Mu'izzaddin Waddaulah (the 29th Sultan)
Assembly:	Legislative assembly (Consists of 21 members all of whom are appointed by the Sultan including the Chairman. However, the assembly has been discontinued since resumption of the independence in 1984)
Government:	(1) Prime Minister: Served concurrently by Sultan (2) Minister of Foreign Affairs: His Royal Highness Prince Mohamed Bolkiar (real young brother of the Sultan)

Internal administration:

Besides being the Sultan and the head of the religion of Brunei Darussalam, His Majesty Sultan Haji Hassanal Bolkiah is concurrently the Prime Minister, Defense Minister and Finance Minister and has been in complete control of the conduct of state affairs since the resumption of full political independence of the country. As one of the world's large crude oil and natural gas producers, Brunei is enjoying its high economic standard. The nation has a well-developed social welfare system and its internal politics are very stable.

(3) Economic indicators

1) Main industries: Crude oil, natural gas
2) Nominal GDP (US $) $4.16 billion (Estimated for 2002)
3) Nominal per capita GDP (US$) 12,221 (Estimated for 2002)
4) GDP growth rate 0.8% (2001)
5) Inflation rate (consumer goods) 0.6% (2001)
6) Unemployment rate 4.9% (1995: including foreign residents)
7) Total trade value (in units of million Brunei dollars)
   (1) Exports: 6,734 (2000) 6,522 (2001)
   (2) Imports: 1,908 (2000) 2,046 (2001)
8) Trade items
   (1) Exports: Crude oil, natural gas (approx. 89% of the total export value)
   (2) Imports: Machines, transportation equipment, articles of manufacture, food products.
9) Trade partners (2001)
   (1) Exports: Japan (46%), Korea (12%), Thailand (12%)
   (2) Imports: Singapore (24%), Malaysia (21%), America (9%), Japan (2%)
10) Currency: Brunei Dollar
11) Exchange rate: about 68 yen/B dollar (as of August 2003)
    (Note: Brunei Dollar and Singapore Dollar are exchanged at an equivalent value)
12) Trends in key economic indicators

Item	1997	1998	1999	2000	2001
Population (thousand)	314	323	331	338	345
Increase rate in population (%)	3.0	2.8	2.4	2.3	2.1
Actual GDP (million US$)	2,436	2,354	2,398	2,384	2,346
Nominal GDP (million US$)	4,540	4,210	4,533	4,595	4,181
Per capita GDP (US$)	14,442	13,029	13,707	13,579	13,412
Actual GDP growth rate (%)	3.6	−4.0	2.6	2.8	−0.4
Increase rate in consumer prices (%)	1.7	−0.4	−0.1	1.2	1.1

<Trade>

Exports (million Brunei$)	3,971	3,194	4,325	6,734	6,522
Imports (million Brunei$)	3,154	2,338	2,251	1,908	2,046
Trade balance (million Brunei$)	817	856	2,074	4,826	4,476
¥Exchange rate (yearly average against US$)	1.68	1.67	1.69	1.72	1.79

Production of oil/natural gas (Data source: BP, Statistical Review of World Energy 2003)

	1998	1999	2000	2001	2002
Crude oil (10,000 barrels/day)	15.7	18.2	19.3	20.3	21.0
Natural gas (billion m^3/year)	10.8	11.2	11.3	11.4	11.5

(Note) 1 Brunei dollar equals to about 63 yen (as of October 2003)
Brunei dollar and Singapore dollar are exchanged at an equal value.

(4) Relationship with Japan

	1997	1998	1999	2000	2001
Exports to Brunei	149	62	52	56	56
Imports from Brunei	2,108	934	1,072	1,659	1,704
Balance	1,959	872	1,020	1,603	1,648

Brunei and Japan established diplomatic relations in April 1984, shortly after Brunei's political independence. Japan opened its embassy in Brunei in June 1984 and Brunei opened its embassy in Japan in March 1986. VIPs of both countries often visit mutually and a good bilateral relationship has been developed.

Japan has been Brunei's largest trade partner over years (Exports to Japan account for about half of the country's total export value while imports from Japan are 5th after Singapore, Malaysia, America and England). About 27% and 90% respectively of the crude oil and LNG exported from Brunei come to Japan. In the meantime, 0.6% and 11% respectively of the crude oil and LNG imported to Japan comes from Brunei (5th next to Indonesia, Malaysia, Australia and Qatar).

Brunei has supplied LNG to Tokyo Electric Power Co., Inc., Tokyo Gas Co., Ltd. and Osaka Gas Co., Ltd. since 1993 on the long-term contract for a period of 20 years. The imported LNG is used as clean raw materials and fuels in Japan's two largest urban areas, Tokyo and Osaka. The ratios of the above 3 companies' LNG purchase from Brunei to their total contract quantity of LNG are respectively about 28%, 24% and 17%.

(5) Political condition

1) Domestic politics

Brunei is a constitutional sultanate proclaiming "Melayu Islam Beraja" (Malay Islamic Monarchy) as its national philosophy and the monarch is hereditary. His Majesty Sultan Hassanal Bolkiaha who ascended the Throne on 5th October 1967 has not only been the leader of the national religion as the 29th of his line but also the center of political power after the nation’s independence in 1984. He is now concurrently Prime Minister, Defense Minister and Finance Minister and his next younger brother serves as Foreign Minister. The legislative assembly whose members are appointed by the monarch has not been convened since the independence of the country. The Sultan who is also Prime Minister establishes and promulgates laws, the national budget, treaties, etc. by royal command. He holds legislative authority also.

The current regime is supported by royal family members, military personnel, police, bureaucrats and religious circles and the nation’s political situation is highly stable.
As the nation’s only legal political party that advocates the policy of the current government, Brunei Solidarity National Party (PPKB) was formed in February 1986 but remains inactive because the legislative assembly has long been dissolved.

The government of Brunei is making efforts to improve living standards of its people through providing preferential treatments to government employees that account for 70% of the nation’s employed population and enhancing welfare programs.

The Sultan’s youngest brother, Prince Jefri, who was allegedly associated with the demise of royal family-run corporations including Amedeo, resigned from the position of Finance Minister in 1998. In 1999, when Minister of Justice and Minister of Health resigned, the post of Justice Minister was eliminated. Prince Jefri faced the charges filed against him in February 2000. Although judgment was delivered, the government of Brunei established Global Evergreen Corporation in November 2001 and bought bad debts to settle the dispute out of court.

2) Diplomacy

Immediately after the nation’s complete independence, Brunei became a member of British Commonwealth of Nations, ASEAN and Organization of Islamic Conference and has tried to maintain close relationships with these nations, U.S.A., Korea and Japan. In 1992, Brunei joined Conference of the Non-Aligned Countries. Currently it has 30 consular facilities abroad to serve embassies and representatives to international organizations, while 23 countries have established their embassies in Brunei (as of January 2003).

Since the country became the 6th member of ASEAN in January 1984, it has placed priority to maintaining and strengthening the unity of ASEAN as the pillar of its foreign policy in view of guarantee of security for the small country, historical bonds with neighboring countries, etc.

In 1998, Sultan Sir Hassanal Bolkiah made official visits to Vietnam, Laos and Cambodia that became new members of ASEAN. He has actively made visits with VIPs of respective member countries in attempt to enhance relationships with them. In 1989 and 1995, Brunei, as the chair of ASEAN, held various conferences including ASEAN Ministerial Meeting. It also held ASEAN summit in November 2001 and ASEAN +3, and ASEAN Regional Forum (ARF) in July 2002.

Brunei has special relationship with England, the former colonial power. Production of petroleum and natural gas, Brunei's principal industries, is a joint venture with Shell Oil Co., Ltd. (Royal Dutch/Shell Group having England and Holland as shareholders).

Brunei is trying to keep close and firm relationship with Islamic countries from a religiously close feeling toward them. However, their wariness of Islamic Fundamentalism is strong and they are cautious about its trend. In July 2000, Sultan Sir Bolkiar publicly announced the concept of developing Brunei as the international financial center with the intention of strengthening linkage with financial institutions of overseas Islamic countries.

Although the country did not have diplomatic relations with socialist counties for a certain period of time after its independence, as all other ASEAN countries had diplomatic relations with China, Brunei also established diplomatic ties with China, Union of Soviet Socialist Republics and Vietnam respectively in September 1991, October 1991 and February 1992.

(6) Economic Condition

The country has realized a stable economy and high income standards owing to the production of ample amounts of oil and natural gas. In addition, it holds significant amounts of foreign assets. However, the country plans to make a shift to a diversified economy moving away from the current overdependence on energy resources and has implemented a series of "5-year National Development Plan" for that purpose.

Oil production was started in Seria in 1929 and presently Brunei Shell Petroleum Co. Sdn, Bhd. (The government of Brunei and Shell has a 50% stake each) holds the right of production and sale. The major oil fields include 2 land oil wells and 7 offshore oil fields and the offshore oil fields produce 90% of the total oil and gas production. The production of crude oil in 2002 was 210,000 barrels per day. The production of LNG is 11.5 billion m3 yearly and Brunei LNG Co., Ltd. (The government of Brunei, Shell Oil Co., Ltd. and Mitsubishi Corporation made investments of 50%, 25% and 25% respectively.) holds the right of production and sale. Crude oil, petroleum products and LNG combined account for about 90% of Brunei's total export value).

As the country's 8th 5-year National Development Plan (2001-2005), the government announced its scheme to shift from the government-lead development to the development at the initiative of private sectors with emphasis on the promotion of economic diversification. In this plan, the government of Brunei showed its determination to move away from its conventional role of executing fund management and development. It aims not only to strengthen and expand natural resource-based industries but also to continue intensive development of non-oil-based industries, particularly, value-added industries so as to increase exports and create employment opportunities for its people.

In response to the proposals of economic reconstruction formulated in 1998 by the Economic Council chaired by Prince Mohamed Bolkiah, Minister of Foreign Affairs, the government established the Board of Economic Development of Brunei (BEDB) in 2002 with the view to developing new industries in Brunei by inviting foreign capitals. The BEDB introduced a two-pillared economic strategic plan to make advances in economic diversification. One pillar is a project assuming foreign investments of US$4.5 billion and creation of permanent employment of 6,000 people. It consists of: (1) development of downstream industries of oil centering on the production of ammonia and methanol from natural gas and the refining of ammonium and (2) development of Muara as a giant hub port. Another pillar is a project exploring potential other industries. On-site surveys on oil downstream industries have already been started.

Recently, Brunei has marked the worst unemployment rate (about 5%) since its independence. Although the government continued to employ people seeking a job, it now refrains from hiring under the severe financial condition. Opportunities for government employment that is most wanted by job seekers are becoming scarce accordingly. Increasing frustration among the unemployed is creating an element of social instability and thus presenting an important agenda for the Sultan and the government to immediately address.

2.2 Energy Situation in Brunei

(1) Energy situation

Oil and natural gas are Brunei's key energy supply sources and also strategic industries that earn more than half of its annual profit. The development and utilization of these energy supply sources is the foundation of the national energy plan.

Under the oil conservation policy introduced in 1980 and enforced in 1981, oil production rate was set at 150,000 barrels per day. However, as the result of the government's deregulation of the policy after November 1990, oil production was increased to the level commensurate with the capacity of the equipment and its capacity operation rate. In 2000, Brunei Natural Gas Policy (Production and Utilization) was introduced. This policy contains retaining of the production level of natural gas in order to satisfy the current responsibilities properly and promote more dynamic development activities including development of new areas by existing or newly entering companies. The utilization of natural gas for the country, particularly power generation, receives preferential treatment. Brunei's average production volumes of crude oil/ condensate and natural gas in 2001 were 195,000 barrels and 32 million m3 per day respectively. Most of natural gas produced was exported to Japan and Korea in a form of liquid natural gas (LNG). 85% of LNG was exported and 9% was utilized for electric power generation, while 97% of oil produced was exported and a small quantity went to oil refinery (daily production capacity: 20,000 barrels) to make oil products for home use.

With respect to Brunei's demand and supply of energy, it has been confirmed that the country, as an oil-exporting country, has sufficient deposits of oil and liquid natural gas (LNG) for contractual sale and national use. Overall demand forecasts of natural gas are made based on the following assumptions.

1) Ensuring the current contract quantity until 2013 and the 3rd expanded amount for the ensuing 20 years from 2013
2) Considering an additional yearly production of 4.2 million ton in the BLNG 6th Train Expansion Opportunity (The current yearly production is 7.2 million ton. B$2.4 billion has been invested over the period of the past 13 years.)
3) Estimating yearly increases from 3% up to 7% in domestic demand for electric power generation depending on economic conditions
4) Estimating downstream industrial demand at 2.25 TCF (on a natural gas basis). The study of the Master Plan regarding downstream oil and gas industries completed in May 2001 includes the following industries.

- Gas industry such as ammonia, methanol and urea
- Industry of derivatives such as aromatics, organic compounds and olefins
- Energy intensive industries such as aluminum refining etc.

5) Sell consumption by oil industry

Natural gas currently produced has been used in three sectors: Sale of LNG, power generation and own use by oil industry. Breakdown of gas demand of 2001 and 2002 is shown in Table 2.2-1 below.

Table 2.2-1 Demand for Natural Gas by Sector

Gas Demand Sector (tcf)	2000	2001
LNG	0.344	0.351
Power Generation	0.036	0.037
Own use by oil industry	0.032	0.026
TOTAL	0.412	0.414

Brunei Shell Petroleum Co. Sdn. Bhd. is the main producer and supplier of oil and natural gas. In February, 1999, Block B Joint Venture became Brunei's second natural gas producer and has been engaged in mining in Maharajalela-Jamalulalam Field. The Brunei's proven oil and natural resources, some of which have been developed and some remains undeveloped, are particularly in the depth of the sea. Brunei Deepwater Block J and K will contribute to the nation's gas supply over a long period.

The nation's power supply networks cover 99% of the nation's population and the rest of the people living in remote areas are supplied with electricity by independent power stations and substations. The major fuel of power stations is natural gas. Currently there are 7 gas power stations in the country and satisfy 99% of its electric needs. The rest of the needs is satisfied by diesel power generation.

Yearly growth rates of electric power generation are forecast at 7% (2002-2005), 5% (2006-2010) and 3% (2011-2020).

<u>Forecast of demand for natural gas</u>

Forecast of demand for natural gas is shown in Figure 2.2-1.

An increase of a cumulative total of 12.1tcf is expected for the period from 2002 to 2020.

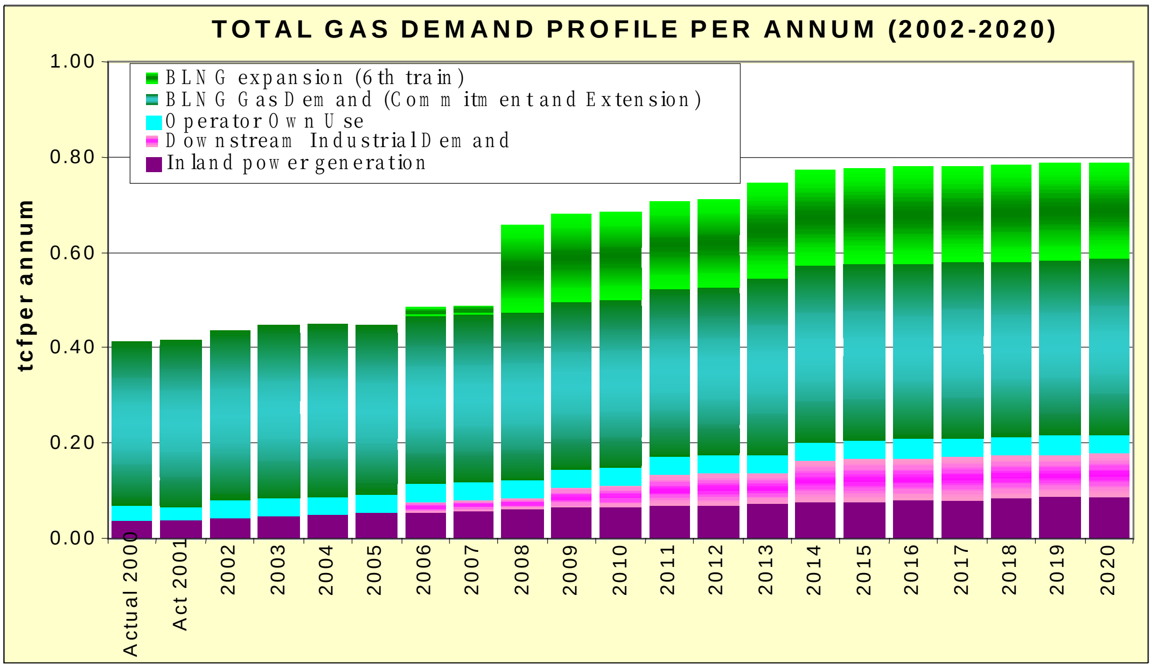


Figure 2.2-1 Forecast of Demand for Natural Gas

(Source) Brunei Darussalam 8th National Development Plan
Petroleum Unit, Prime Minister Office, Department of Electrical Services, Ministry of Development.

(2) Energy Conservation Policy, Laws and Standards

1) Energy Policy

Prime Minister's Office (PMO) develops energy policy at state level. Petroleum Unit under the control of PMO operates and supervises National Energy Committee, while Department of Electrical Services of Ministry of Development takes charge of planning and coordination for the Committee. Brunei's energy policy aims to;

- Optimize the national economy and reduce its dependence on oil and natural gas
- Diversify economy
- Promote energy conservation programs

In order to achieve the above goals, the following policy actions are taken;

- Supply energies from other energy sources such as mini hydraulic power and solar energy
- Promote the private sector's participation in the energy development by the BOO system (Build-Own-Operate)
- Consider building of only highly efficient power stations such as combined cycle power plants
- Review the price system of electricity to prevent energy waste and raise awareness of the high value of energy.

- Promote energy efficiency in designing of buildings and selecting materials

2) Laws and standards concerning energy

The existing laws and regulations for buildings mainly provide for matters concerning safety and hygiene and at present there are no laws and standards stipulated for energy performance in buildings. In other words, there are regulations that lay down the sizes and numbers of windows of certain rooms for health reasons. Although the standards of designing and construction are established following those of England and U.S.A., they are not completely observed. The guideline currently available is only the directives issued by Department of Electrical Services that instruct in what standards of designs, equipment and installation are acceptable. Plans for building to be submitted to relevant organizations for approval must conform to Building Guidelines and Requirements (PBD 12:1994) issued by Ministry of Development. PBD 12:1994 (Brunei Darussalam Standard 12:1994) contains the same energy conservation standards as those applied in other ASEAN member countries including the following, for example.

a. Requirements regarding ventilation
   (Same as Building Energy Conservation of Singapore and ASHRAE Fundamentals Handbook)
b. Window/wall) ratio of surface
c. Room temperature setting

Generally, the methods of designing and the specifications of materials contained in PBD 12: 1994 are based on internationally accepted standards such as British Standards, Institution of Electrical Engineers (IEE) Wiring Regulations and ASHRAE.

In the meantime, there aren't sufficient numbers of public and private energy auditing companies and organizations involved in energy conservation. Accordingly, monitoring of energy performance by sector has not been provided. In the late 1980's, ASEAN countries except Singapore developed their respective energy standards of building (compulsory standards or supplementary standards to apply to the existing buildings) in the ASEAN-US Energy Conservation in Buildings Project. Brunei did not participate in this project.

As there have been almost no energy audit activities and audit specialists, it is very difficult to establish the foundation for formulating regulations and standards of buildings. In addition it isn't easy to persuade people into investments without data on energy use status and potential of energy conservation.

Units and organizations in charge of promotion of energy conservation in buildings

(Government)

Prime Minister's Office (PMO) is the organization responsible for implementation of the government's energy conservation policy. In addition there are the following energy units.

- Petroleum Unit (Under the supervision of PMO)
  Assigned to the promotion of development/use of oil and natural gas and the management of National Energy Committee
- Department of Electrical Services (Under the supervision of Ministry of Department)

Assigned to the generation, transformation and transmission of electricity and the pricing of electricity (hereinafter DES)

These organizations aim to diversify energy source and reduce the nation's dependency on oil and natural gas that are estimated to be depleted in 20 years if the current production continues. They plan to promote efforts to achieve these goals in line with the efforts to shift to a diversified economy centering on tourism. The diversification of energy source includes the efficient use of energy in buildings through designing and selection of materials.

(Energy Audit Companies)

There are no public or private organizations that provide energy audits. There are no consultants that have competence needed to give advice for energy use. Under the current situation where there are no energy specialists giving advice regarding energy use including energy audits, budget planners get no advice regarding the merits of energy conservation from nowhere.

(Energy Service Companies)

In Brunei, energy management business has not yet been established and is at an early stage of development. There are no specialists and specialized companies that give advice concerning energy management, energy audit, etc. on a full time basis. Like other countries, although there may be companies that provide energy conservation services in regard to air-conditioning equipment, boilers, and other devices used in buildings, they currently give guidance in operation and maintenance. Such services are given in connection with the equipment delivery contract.

(Energy Conservation Center)

At present there is no energy conservation center or any organization corresponding to it.

(Equipment Manufacturing Companies)

Brunei imports almost all equipment and materials used in the building industry and thus is able to buy new technologies through overseas companies and domestic importing businesses. These companies can exert strong influence on the equipment used in buildings. New technologies have been introduced to the country at a rapid pace and new equipment and materials are under the influence of the market of equipment rather than the economy of energy. Fortunately, the equipment developed with new technologies is highly energy-efficient. However, the problem is the maintenance of such equipment. Brunei is disadvantageous in that personnel costs and maintenance and construction expenses are high.

(Schools and Research Institutes)
There are no institutes that are engaged in the development and research of energy use in buildings.

(Building Construction Companies)
Generally speaking, construction companies in Brunei have competence needed to design buildings that conform to the international standards of design and construction. Although they have awareness of the importance of energy conservation, as the energy efficient designing requires more specific knowledge, they have not actually done designing for energy efficiency such as calculations of heat transfer on walls and glass parts of the buildings. In addition, as there are no design criteria for energy conservation in buildings to conform to, designers have not developed their concept of the standards of the appropriate energy consumption in various types of buildings, in other words, specific energy consumption (SEC).

(Energy Supplying Companies)
Electric power companies are playing an important role in energy conservation. Electricity, as well as LPG occupies the largest portion of energy consumption in buildings. Accordingly the saving of electricity is a key factor of energy conservation. On the other hand, the availability of electricity at low prices is creating a major obstacle for energy conservation. The rates of electric power are low compared with those of other ASEAN countries. The pay-out period is extended and electric consumers hardly develop an idea of “Pay now-Save later”.

Along with the introduction of Asia-Pacific Free Trade Agreement (AFTA), the tariff on import equipment such as air-conditioning apparatus, etc. will be lowered. However, there is a view that it may create a hindrance to energy efficiency. It is a concern that energy use may not be reduced with low costs of electricity and more installation of energy-consuming equipment.

2.3 Situations of Buildings in Brunei

(1) Old buildings

In the past when buildings were less equipped, weather had a big influence on buildings. In other words, there were two concepts for buildings.

- To prevent water from coming into the building
- To maintain bearable air temperature and air flow in the building

Typical buildings in Brunei are stilted and roofed with water-proof materials to make rain water go down smoothly. Beams of the roof are bare and the roof has opening to maintain appropriate ventilation and cool temperature. A veranda attached to the entrance helps lower the temperature inside the building.

Buildings in Brunei are characterized with deep influence from culture and religion. Wood building materials have carvings of various patterns that make decoration elements of the buildings. Under the rule of Almarhum Sultan Ali Saifudin, an architect of modern Brunei, the consciousness of the foreign countries came to be reflected in buildings. At that time, buildings in Brunei became a fusion of buildings of Brunei and foreign countries without losing its traditional characteristics. Since immediately after the independence, Brunei has incorporated the cultural philosophy of Malay, Islamic and Monarchy (MIB) into buildings. This philosophy has a direct influence on Brunei's current buildings that express the traditional and modern Islamic culture.

(2) Current buildings

Architects, engineers and designers have, in general, the awareness of the importance of the rational use of energy in buildings. However, energy conservation is not taken into account in designing of buildings. Although they have technical abilities of designing buildings that meet international building standards, architects, in particular, often put priority on aesthetic factors.

Some of the architectural elements of buildings in Brunei meet factors essential to energy conservation in buildings, though they are not of big importance. There are buildings, for example, that are built after a "Passive Design" to achieve low energy consumption. These buildings use natural ventilation, shades of trees, daylights, etc. on a small scale. In the meantime, the use of solar energy is studied not from the viewpoint of energy consumption but for the sake of comfortableness.

The walls of typical buildings are made of bricks 900mm thick. Ground glass is used in some buildings though the use of it is not common. There are also buildings that use energy-saving type of lighting and BEMS (Building Energy Management System). Cogeneration system has not been introduced in Brunei.

(3) Management of buildings

The major use of energy in buildings is air-conditioning system and it uses up 60% of the total energy consumption. Air-conditioning system is generally centralized and equipped with chillers for AHU (Air Handling Unit). Chillers are of a centrifugal type and their operation time is usually controlled. Energy used for lighting fixtures and hot water supply system accounts for the rest of the total energy consumption. Solar energy is used for hot water supply in few facilities.

As the designing and management of buildings are subject to the funds available, projects in the private sector generally aim at the minimum construction costs and tend to discard luxury equipment. Because the budgets for building projects in the public sector are decided 2 to 3 years before the actual designing takes place, the budgets available at the time of implementation of the projects are old and it is probable that desirable equipment and policy are not adopted. In addition, low rates of electricity become even lower when the consumption increases and thus, investments in energy conservation are not attractive. In short, the financial effects of energy saving efforts do not offset or lighten the burden of investments and the periods to recoup investments easily go beyond the reasonable range.

Maintenance of equipment and electric facilities in building appears to be the problem of Brunei. In private sectors, buildings where the owners have not provided sufficient maintenance are seen everywhere. Such buildings are managed with minimum maintenance, which is “break-down maintenance” rather than “preventive maintenance”.

Buildings owned by the government are provided with maintenance by DES and its outsourcees. The problems are the shortage of personnel who are qualified and have skills for maintenance and obtaining of parts for old equipment. Thus, the early introduction of new technologies is demanded.

(4) Potential of energy conservation

Brunei is in the middle of rapid development and so is the building industry. The growth of electric consumption over the period from the 1980’s to the 1990’s is attributed to this rapid pace of development. Although the current condition of energy use in buildings shows that there is much room for improvement, no energy-saving measures including the introduction of advanced technologies have been implemented so far. In addition, too much focus on the introduction of new technologies has often left repair and maintenance behind. The owners of buildings and maintenance businesses should work on preventive maintenance. Energy conservation designing is, in a way, a measure to prevent future potential maintenance. If standards of designing are established, energy conservation in buildings can be achieved in both management and maintenance. Appropriate repair and maintenance will enable energy consuming equipment to maintain its efficient and effective performance. Moreover, the operation and maintenance guide for energy conservation will supplement the guidelines for designing and help lower maintenance costs.

Energy consumption in buildings will decrease with proper applications of new energy conservation technologies. However, in order to avoid possible problems such as maintenance, reasonable technical assessments will be necessary. For such assessments, the following criteria may be used.

- Simplified system that meets the life style and conditions of the country concerned.
- Maximum use of domestic resources (effective also for reduction in total costs and longer operating time of equipment)
- Easy management and maintenance of system
  (Need for special kinds of spare articles and highly experienced personnel leads to long-time suspension of operation of the equipment)
- Flexibility of system (Easiness of replacement of equipment, local procurement of parts, and remodeling)
- Effective energy project

In order to strengthen local qualification systems and technological skills, the training in repair and maintenance of buildings must be provided. Comparably cheap electricity prices are creating a significant obstacle to the promotion of energy conservation.

It is necessary to enhance general public's awareness and understanding of energy conservation. As long as electricity costs remain low and no incentives or subsidies are offered, energy conservation will not progress except through so-called passive designs as follows.

- Make persons concerned participate in the planning stage of a new building
- Employ natural ventilation as much as possible where air-conditioning equipment is not necessary
- Use as much sunlight as possible in buildings that are used during the daytime
- Limit the area for installation of air-conditioning system

The government of Brunei declared in 1989 that it would endeavor to achieve a 10% cut in energy consumption in the government buildings. Although whether the goal was achieved or not remains unclear, it appears that not much progress has been made. Now is the time to give an order laud again to make serious efforts for energy conservation. All persons concerned and involved should understand the importance of energy conservation in preparing for constructing energy efficient buildings, so that all plans and policies can function. This does not mean abandoning pursuing comfortableness but means achievement of the same level of comfortableness with the effective use of less energy.

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3. Procedure of Energy Audit for Buildings

3.1 General Process

The energy audit for buildings is generally proceeded in the 6-step sequence described below.
In STEP 1 and STEP 2, general information and data on the building and equipment concerned are collected and the obtained energy consumption data are analyzed.
The participants collaborated with Japanese experts from STEPs 1 to 3 for this year's audit. In the wrap-up meeting held on completion of the 1st site survey, ECCJ experts gave an outline of the improvement points in STEP 4. In the interim report meeting in the 2nd study results of the study on the measures from the improvement and expected effects were explained, and for further confirmation, additional surveys were conducted. This report reflects the results of the 2nd site survey.

STEP-1 Gather and confirm general information and data of the building
STEP-2 Gather and confirm general information and data of the equipment
STEP-3 Gather and confirm data of energy consumption
STEP-4 Identify improvement points through data analysis and evaluation
STEP-5 Study recommended methods for improvement including expected effects
STEP-6 Determine and explain the recommendations to be implemented

3.2 Description of Each Step

Major survey items of each step are as follows:

(1) STEP-1 Gather and confirm general information and data of the building
1) Year of construction completed
2) Size: Gross floor area (area for major use, indoor parking area), number of stories, building structure
3) Usage
4) Owner
5) No. of employees, No. of clients (on business days and holidays), and other items

(2) STEP-2 Gather and confirm general information and data of the equipment
1) Air-conditioning system, electrical system, sanitary facilities
2) Specifications for equipment and facilities
3) Operation management status: Operating hours, setting of room temperature, and other items

(3) STEP-3 Gather and confirm data of energy consumption
1) Monthly energy consumption
2) Changes in yearly energy consumption

3) Energy consumption by day of the week
4) Energy consumption by hour of the day
5) Energy consumption by usage
6) Data on water consumption, and other items

(4) STEP-4 Identify improvement points through data analysis and evaluation

1) Comparison of the total energy consumption of the building concerned with those of similar buildings
2) Comparison of its energy consumption by usage with those of similar buildings
3) Analysis of its monthly energy consumption trends
4) Analysis of changes in energy consumption for a period of several years
5) Analysis of its energy consumption by day of the week and hour of the day
6) Confirmation of room environment: Temperature, humidity, CO_2 concentration, luminance
7) Confirmation of operation log: Operation status during peak load hours, operation status during light load hours, No. of equipment units in operation, operation time and operation temperature conditions
8) On-site inspection: Operation status of equipment, temperature indicators, ammeters, voltmeters and power factor indicators, valve condition, damper condition, heat insulation, layout of equipment, maintenance of equipment and piping
9) Determination of how the facilities and equipment are actually used: Density of people in a room, condition of OA equipment, identification of locations of energy loss, and other items

(5) STEP-5 Study recommended methods for improvement including expected effects

1) Studying improvement plans: Application of other successful improvement cases and most-advanced technologies
2) Estimation of effects of improvement: Amount of reduced energy consumption and costs
3) Estimation of costs for improvement

(6) STEP-6 Determine and explain the recommendations to be implemented

1) Determination of the recommendations to be applied
2) Preparation of a report
3) Explaining the report

3.3 On-site Auditing Procedure

The energy audits for the building concerned were conducted in accordance with the following procedure.

(1) Interviewing
   1) General description of the building
   2) General description of the equipment
   3) How the building is used and the operation status of equipment
   4) Data and information on overall energy use

(2) Confirmation on drawings and reference materials
   1) Building design drawing
   2) Equipment drawings including drawings of air-conditioning systems, electrical systems and sanitary facilities
   3) Operation log
   4) Energy consumption data
   5) Room environment data

(3) On-site confirmation
   1) Typical room
   2) Machine room
   3) Electrical room
   4) Outdoor facilities and equipment (placed on rooftop and on the ground)

(4) Simple measurements (if possible)
   1) Temperature, humidity and luminance
   2) Electric current
   3) CO_2 concentration, etc.

4. Energy Audit of Orchid Garden Hotel

4.1 Outline of Orchid Garden Hotel

(1) Name: Orchid Garden Hotel

(2) Use: Hotel

(3) Size: 1 basement and 10 floors above the ground
Gross floor area: 20,121.18 m^2

(4) Age of the building: 4 years

(5) Central building management and control system:
Building Automation System (BAS)

(6) Outline of electrical systems:
Receiving voltage 11 kV, Transformer capacity 1,000 kVA × 2 sets
Power generator 800kVA × 1 set
Elevator 14 kW × 2, Service elevator 14 kW × 1

(7) Outline of air-conditioning systems:
Chiller 300RT (205.32 kW) × 3 sets, Air conditioning equipment (7 sets), Fan coil unit (FCU) (207)

(8) Sanitary facilities:
Hot-water supplying boiler (electricity) 340l/h, 46 kW × 12 sets
Water receiving tank, Lifting pump 4 kW × 2 sets, Booster pump 3 kW × 3 sets, Elevated water tank

4.2 Analysis of Current Status of Energy Use

(1) Monthly energy consumption (2002)

Monthly energy consumption is shown in Figure 4.2-1. As no accurate data for November and December 2002 was available, the graph was completed based on the data of 2001. This graph shows that electric consumption in January and February are low compared to other months.

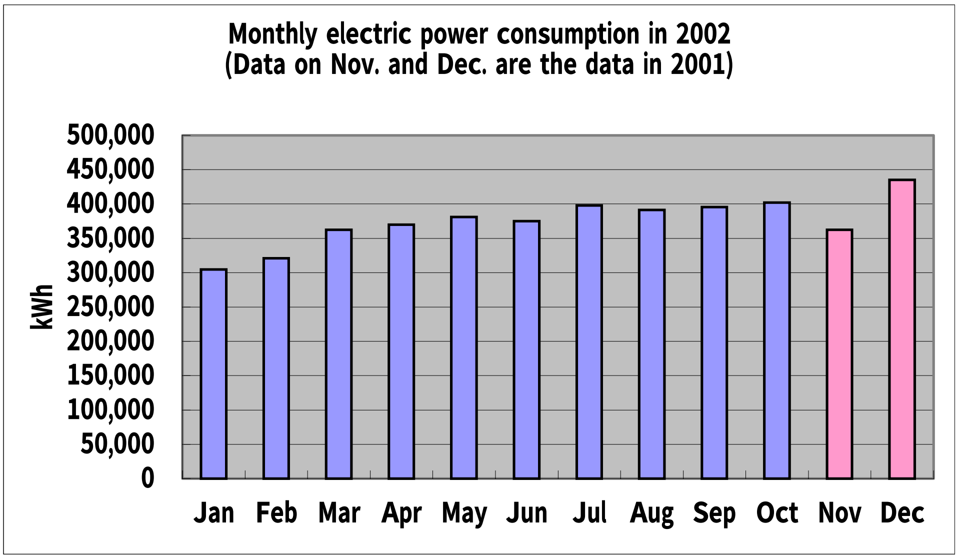


Figure 4.2-1 Monthly Electric Power Consumption in 2002
(Data on Nov. and Dec. are the data in 2001)

(2) Electric Power Consumption by Use

Electricity used in Orchid Garden Hotel is measured by intended use. The line graphs in Figure 4.2-2 show electricity used for air conditioning and other uses respectively. Electric use for air conditioning accounts for 70% of the total annual eclectic consumption and electricity for other uses makes up the remaining 30%.

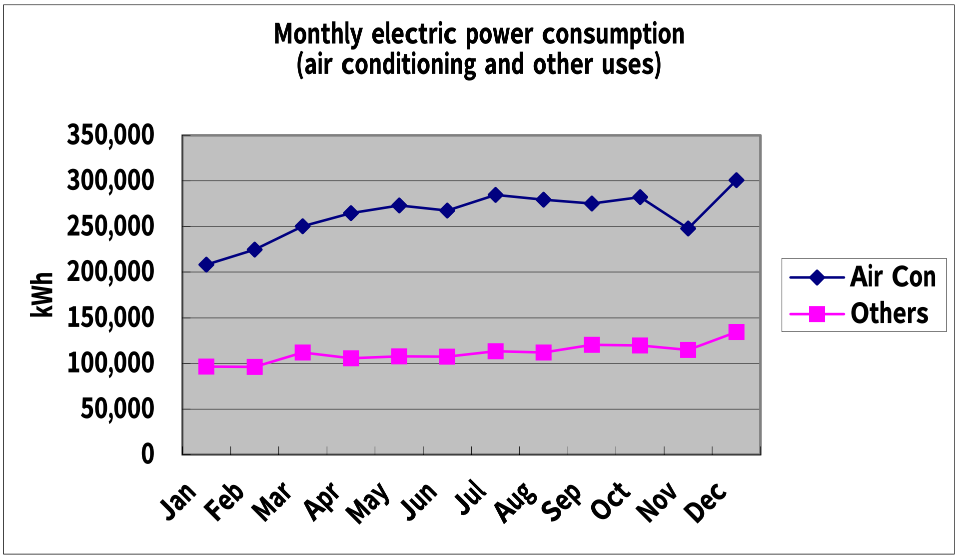


Figure 4.2-2 Monthly Electric Power Consumption
(Air Conditioning and Other Uses)

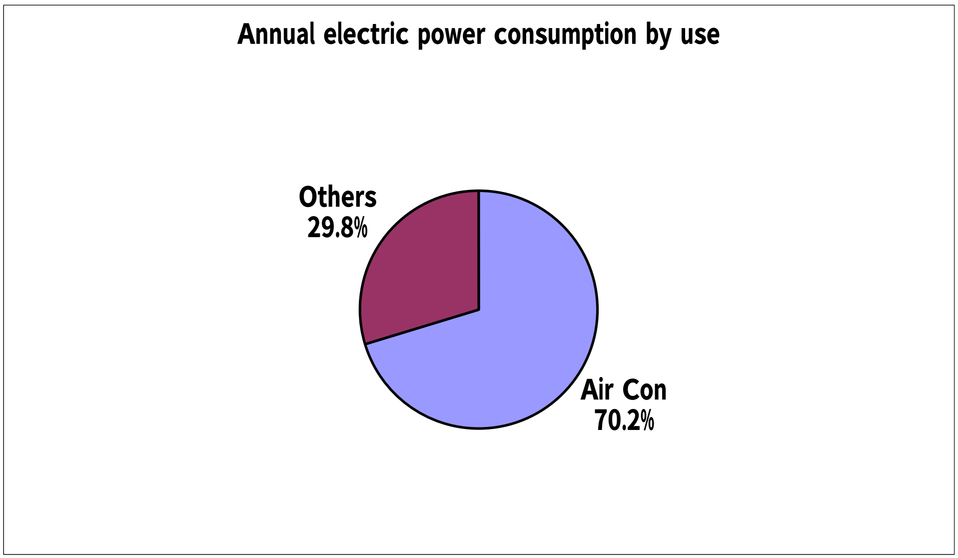


Figure 4.2-3 Annual Electric Power Consumption by Use

(3) Energy consumption by use

1) Detailed breakdown of energy consumption

Orchid Garden Hotel's energy consumption by use on the day of the on-site survey was calculated based on the design drawing of the facilities and the observed operation status of the equipment. It should be noted that this calculation is based on the values experienced in the past and the calculated values represent rough estimates and not accurate values. The results are shown in Figure 4.2-4 and Table 4-2-1.

This pie chart shows that one of the conspicuous characteristics of energy consumption in Orchid Garden Hotel is heat transfer, which accounts for about 32% of the total energy consumption. Breakdown of heat transfer in Item 3) shows that "reheating of air-conditioning equipment" is the major use of heat transfer. Reheating system of air-conditioning is, thus, a key factor of the energy consumption structure.

Figure 4.2-5 shows a simplified diagram of reheating system for air conditioning.

Calculations of energy consumption by use are shown in Item 2) to 6).

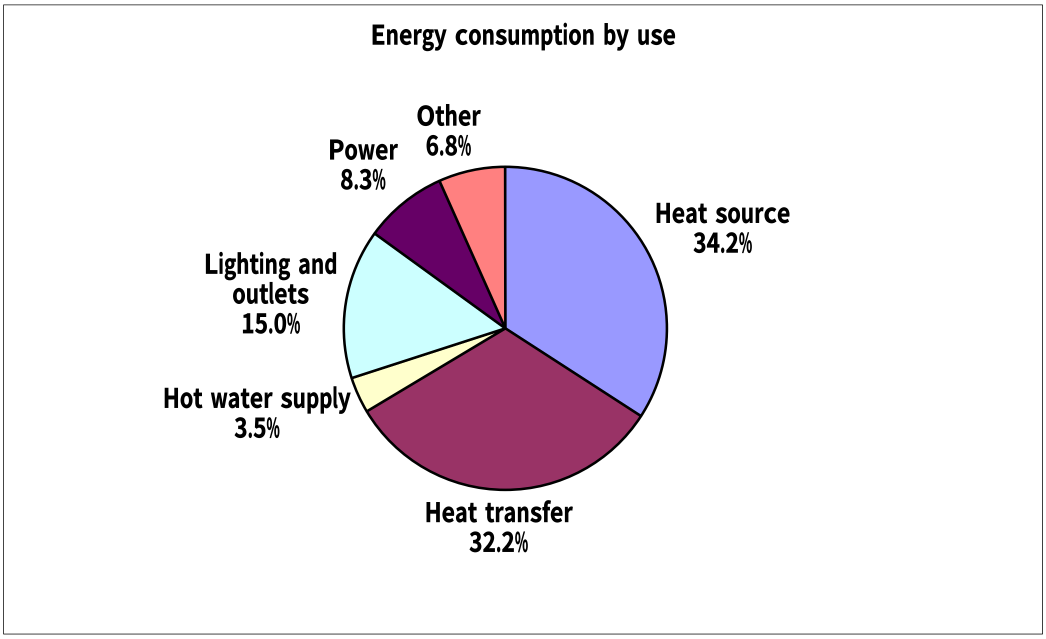


Figure 4.2-4　Energy Consumption by Use

Table 4.2-1　Energy Consumption by Use

	kWh/d	%
Heat source	4,214	34.2%
Heat transfer	3,965	32.2%
Hot water supply	436	3.5%
Lighting and outlets	1,848	15.0%
Power	1,027	8.3%
Other	833	6.8%
Total	12,324	100.0%

	Air Conditioner	Others	Total
Annual total	3,158,219	1,339,926	4,498,145
Daily average	8,653	3,671	12,324

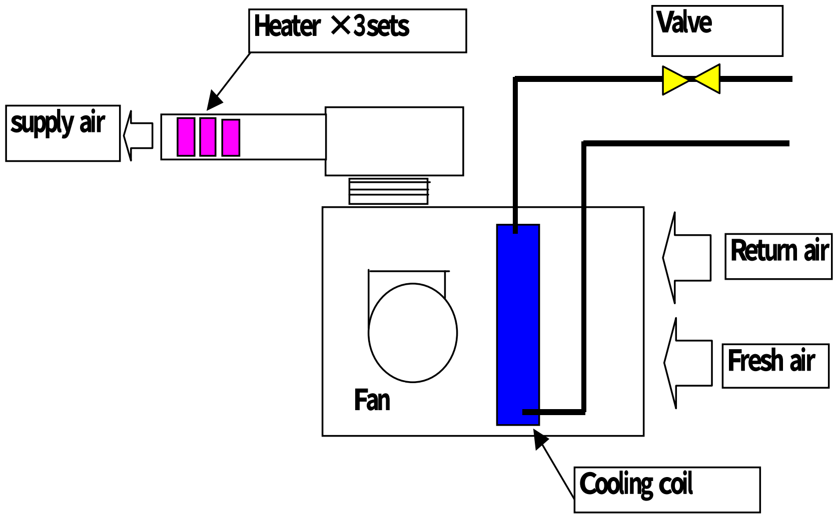


Figure 4.2-5 Reheating System

2) Calculations of energy consumption for heat source

	KW	h	Load factor	kWh/D
Chiller	196	24	0.7	3,293
Cooling tower	11	24	0.8	211
Cooling water pump	37	24	0.8	710
Total				4,214

3) Calculations of energy consumption for heat transfer

	kW	h	Load factor	kWh/D
Air conditioning machine fan	50.2	24	0.8	964
Air conditioning machine reheat	220	24	0.4	2,112
FCU fan	9.315	24	0.8	179
Cooing water pump	37	24	0.8	710.4
Total				3,965

Air conditioning machine	Fan kW	Heater 1 kW	Heater 2 kW	Heater 3 kW	Total kW	8-Nov kW
Function Room 1	11	5	10	20	35	
Function Room 2	5.5	5	10	20	35	
Fresh Air	11	10	15	30	55	55
Office	2.2	1	2	4	7	3
Lobby	5.5	3	5	10	18	
Restaurant	4	5	10	20	35	35
Coffee House	11	5	10	20	35	
Total	50.2	34	62	124	220	93

Colored parts show heaters in operation on the day of survey.

4) Calculations of energy consumption for hot water supply

Guest room	155	
Average occupancy rate	0.3	
Occupied rooms	46.5 →	50
Hot water use/room	0.3 m^3	
Hot water supply	15 m^3	
Temperature C	(Outlet) 45	(Inlet) 20
Δt C	25	
Heat quantity	375000 kcal	
Conversion factor	860 kcal/kWh	
	436 kWh	

5) Calculations of energy consumption for lighting and outlets

	m^2	W/m^2	kW	h/24h	Load factor	kWh/D
Basement	3600	3	10.8	24	1	259
Ground Floor	3600	15	54.0	24	0.7	907
1F	1920	15	28.8	12	1	346
2F	1920					0
Sauna, etc.	768	20	15.4	12	1	184
Corridor			0.5	24	1	12
3F to 7F	1296					0
8F	1296	10	13.0	4	0.1	5
	No	kW/No				
Guest room	155	0.2	31.0	8	0.3	74
Corridor	5	0.5	2.5	24	1	60
Total			155.9			1,848

6) Calculations of energy consumption for driving power

	kW	h	Load factor	kWh/D
ELV 3 sets	42	24	0.1	101
Booster pump	3	24	0.6	43
Lifting pump	4	24	0.1	10
Pool pump	1.1	24	0.8	21
Ventilation of parking facilities	37.5	12	0.8	360
Ventilation fan No. 5 to No. 16	4.8	12	0.8	46
Ventilation fan No. 21 to No. 30	7.9	12	0.8	76
Ventilation fan No. 31 to No. 34	19.3	24	0.8	371
Total				1027

(4) Comparison of other buildings

1) Comparison of air temperature between Brunei and Tokyo

As no comparable data that can be used for assessment of energy use in this building was available in Brunei, the data obtained has been compared with those of buildings in Tokyo. Before comparing energy consumption per unit area between the two places, it is desirable to compare the ambient conditions between Brunei and Tokyo because those affect energy use for air conditioning. However, as weather data in Brunei was not available, monthly average temperatures in Singapore and Kuala Lumpur are shown in Figure 4.2-6.

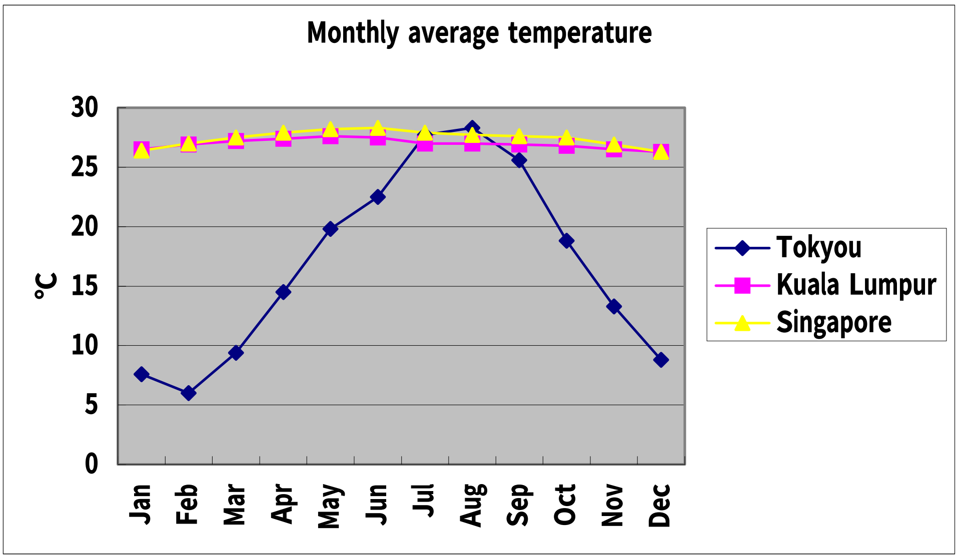


Figure 4.2-6 Monthly Average Temperature

2) Comparison of energy consumption intensity of Orchid Garden Hotel with those of buildings in Japan

The average energy consumption intensity for hotels in Japan is 3,280MJ/m^2 according to the Energy Conservation Center of Japan while that of Orchid Garden Hotel is 2,191 MJ/m^2, which is about 67% of the average value of Japan.

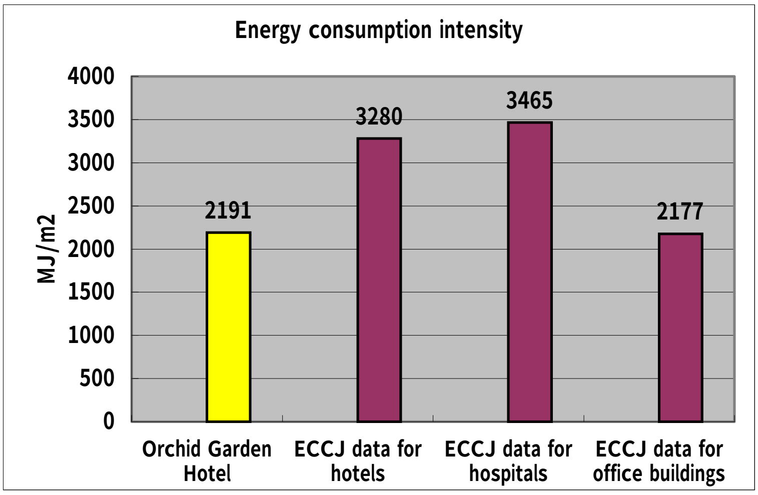


Figure 4.2-7 Energy Consumption Intensity

3) Energy consumption by use for hotels in Japan

In Orchid Garden Hotel's energy consumption by use, "heat transfer" accounts for a significantly large portion as mentioned before, compared with those of hotels in Japan.

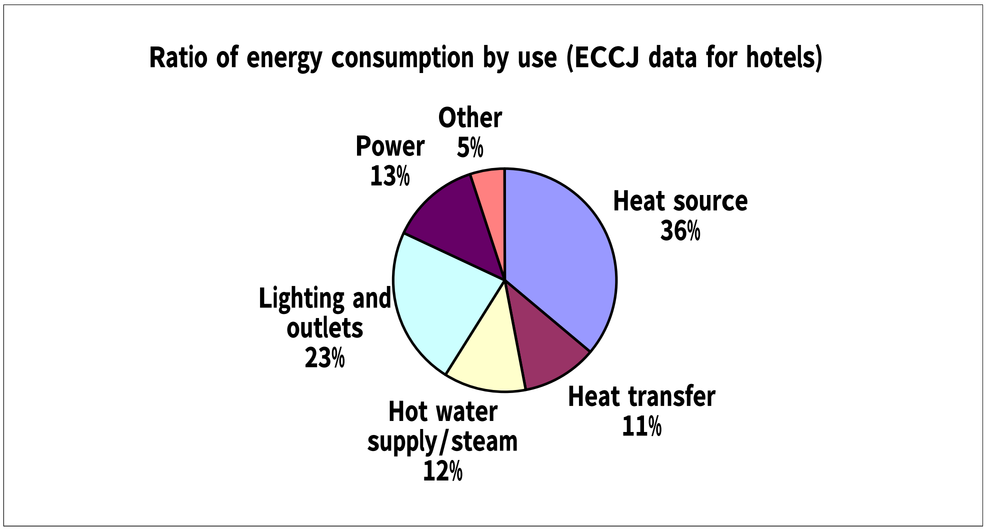


Figure 4.2-8 Ratio of Energy Consumption by Use (ECCJ data for hotels)

(5) Data of water consumption

1) Meaning of assessment of water consumption

It is possible to assess a building's water use status by comparing its water consumption for total floor area calculated from annual water consumption with those of other buildings. However, as water consumption largely varies between the bathtub type and the shower type in terms of bathing style, it is necessary to check habits of guests staying at the hotel concerned. In addition, as water consumption is related to the number of users, it is also possible to estimate the operating rate of the building concerned.

In Orchid Garden Hotel, although we could not obtain data of the actual water consumption, it was recommend that the management of water use should be implemented as part of energy management practices.

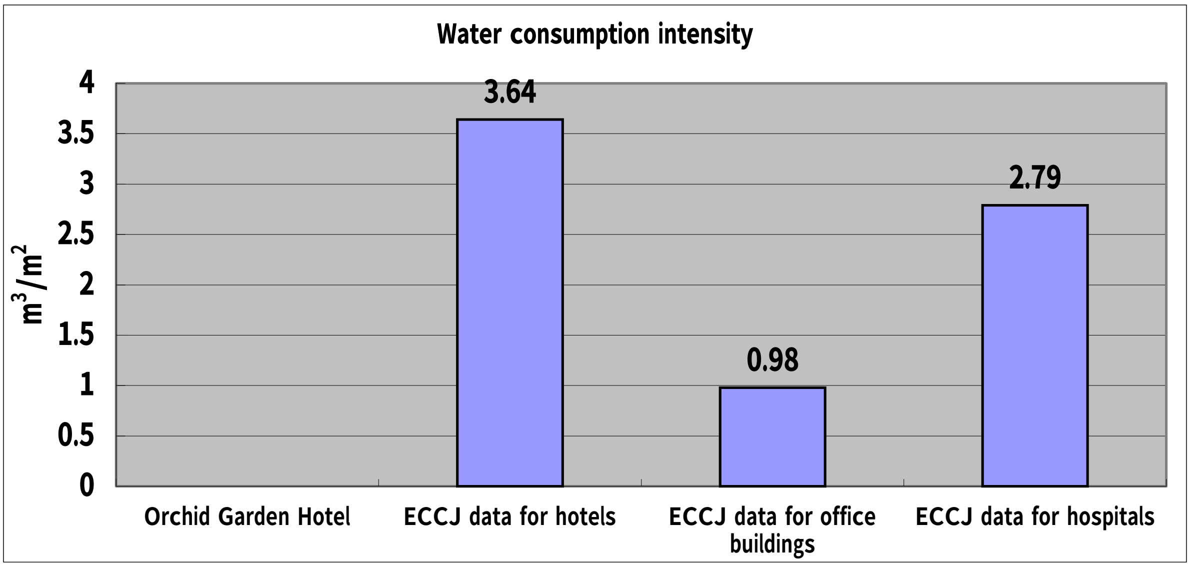


Figure 4.2-9 Water Consumption Intensity

4.3 Proposed Improvements and Expected Effects

(1) Repair of BAS

Despite the installation of the advanced BAS, the system was not in normal operation. Thus, 2 valves of the air conditioning unit to control cooling water did not automatically work. Their opening had been manually adjusted and fixed for operation. This means that a constant quantity of cool water flows, and a super cooled state is created, which excessively activate the reheating electric heaters placed in the downstream of cooling coil. As this causes a double energy loss for cooling water and reheating air, the system needs to be improved immediately.

(2) Review of operating hours of air conditioning equipment

The 2 conference rooms and restaurants on the 1st floor are constantly air-conditioned for 24 hours including the times when they are not used. It appears that because of the high humidity climate, air-conditioning is turned on to prevent mold. However, improvements in the operation management of air conditioning in rooms not in use should be considered. Those improvements will include intermittent operation of air conditioning systems and completely stopping of the outside intake air.

(3) Review of operating hours of FCU in guestrooms

FCUs in guest rooms are also, like air conditioners, in operation for 24 hours. Although it appears that they cannot be completely turned off because of the need to prevent mold, some improvements should be made such as the operations by the timer control.

(4) Review of preset room temperatures

Currently room temperature is set at 22°C to 23°C. By raising this preset temperature, electric power used for cooling machines can be reduced.
Effects in the case of a raise in room temperature by 2°C have been estimated.

Conditions of calculation

	Temperature	Humidity	Enthalpy
	°C	%	KJ/kg
Current state of room	22.5	50	45
After improvement	24.5	50	50
Outside air average	29	50	65

Ratio of load of outside air to total load	0.3(assumed)
Current load	20KJ/kg
Load after improvement	15KJ/kg
Outside air load reduction rate	0.25

Ratio of heat transmission load to total load	0.15(assumed)
Temperature difference under current load	6.5°C
Temperature difference under improved load	4.5°C
Heat transmission load reduction rate	0.31
Total reduction rate	0.3 × 0.25 + 0.15 × 0.31 ＝ 0.121

Annual electric power consumption	4,498,145 kWh
Ratio of turbo-chiller	26.7%
Reduced electric consumption	4,498,145 × 0.121 × 0.267 ＝ 145,322 kWh
Ratio to annual electric power consumption	3.2%

(5) Heat insulation of hot water supply line

Hot water piping in the boiler room is not insulated, which causes heat loss from the pipeline.

Effects from the heat insulation have been calculated.

Formula

- (Heat radiation reduced by heat insulation) × (length of piping line) × (time)
- Formula for calculating amount of heat radiated from insulated piping

$$Q = 2\pi (t_1 - t_2)/\{2/(d_2 \cdot \alpha) + 1/\lambda \times \ln (d_2/d_1)\}$$

Q: Heat radiated from surface of 1-m pipe/per hour [w/m]

t_1: Fluid temperature inside the pipe 45°C

t_2: Boiler room temperature: 30°C (assumed)

d_1: Outer diameter of piping: 0.053 (assumed)

d_2: Outer diameter of insulated piping: 0.093

α: Heat transfer coefficient [$W/(m^2 \cdot K)$]: 12

λ: Heat transfer coefficient of insulating materials [$W/(m \cdot K)$]: 0.052

Heat transfer coefficient of copper pipe [$W/(m \cdot K)$]: 385

Amount of heat radiation without heat insulation: Q_0 = 30.0 W/m

Heat radiation with 20 mm-thick heat insulation: Q_{20} = 7.5 W/m

Reduced heat loss by heat insulation: ΔQ = 30.0 – 7.5 = 22.5 W/m

Estimation of effects

1) Conditions of calculation

The following are added to the above condition.

Pipe diameter: 50 mm

Length of pipe line 50 m (estimated)

Operation time: 24h × 365d = 8760h

2) Calculation of reduced electricity

22.5 × 50 × 8760/1000 = 9,855 kW

3) Effects

Annual electric power consumption for hot water supply (estimated)

436 kWh/d × 365d = 159,140 kWh

Ratio of reduced electricity to annual energy consumption for hot water supply

9.855/159,140 = 0.062 6.2%

Ratio of reduced electricity to annual total energy consumption

9,855/4,498,145 = 0.0022 0.2%

(6) High-efficiency operation of power receiving transformers

Current load conditions:

Load of power receiving transformer TX1 (1000 kVA-air conditioning) 390 kVA (39.0%)

Load of power receiving transformer TX2 (1000 kVA-electricity)

213 kVA (21.3%)

The above values show loads measured by the energy audit on one day during the primary survey.

Yearly average loads calculated from the actual annual electric power consumption in 2001 (TX1 – 3,027,861 kWh, TX2 – 1,392,682 kWh) are 384 kVA (calculated based on a power factor of 0.9) for TX1 and 177 kVA for TX2.

Proposed improvement:

One of the features of standard transformers is, as shown in Figure 4.3-1, that their best efficiency is gained at about 60% load. Accordingly, as shown below, if the current two-transformer operation is changed to the one-transformer operation, the load factor of the transformer will become higher than now and the operation efficiency also will increase.

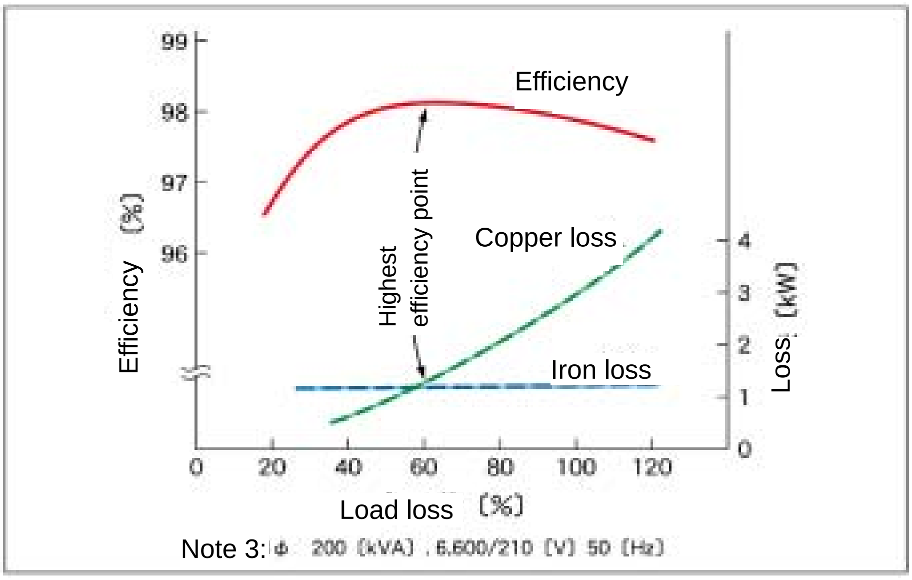
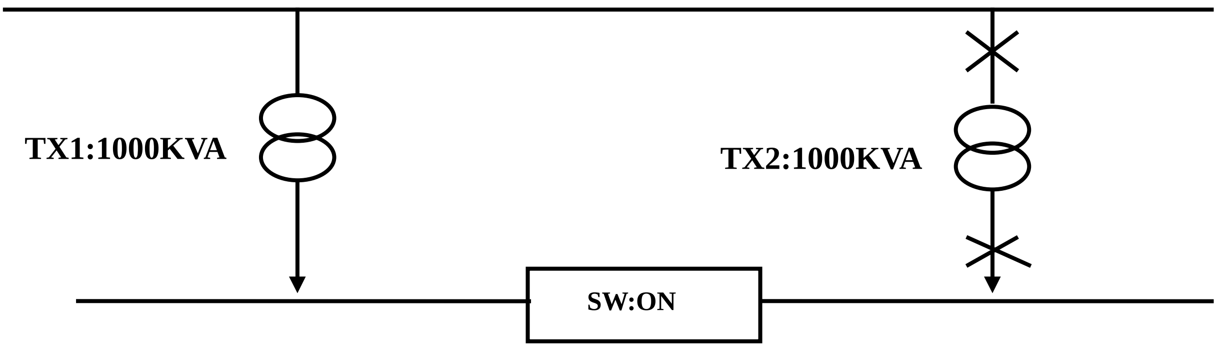


Figure 4.3-1　Efficiency and Losses in Relation to Load of Transformer

Power Receiving at 11 KV



415 V bus line for air conditioning 384 kVA　　　415 V bus line for electricity 177 kVA

Total load:　561 kVA

Figure 4.3-2　Proposed Power-receiving System

Estimation of effects

1) Conditions for estimation

- Characteristic of transformer (one example):

Loss \ kVA	1000
No-load loss (Wi)	1,880 W
Load loss (Wc) (at the time of 100% load)	11,890 W

- Operation condition: 365 days without shutdown
- Calculating formula of loss: Wt (total loss) = Wi + Wc × $(Pe)^2$
  Pe: Load factor of transformer
- Load of transformer: TX1 – 384 kVA, TX2 – 177 kVA
  Constant for 24 hours

2) Calculation

- Loss when both transformers TX1 & TX2 are used
  Wt1 = 1880 W × 8760h + 11890 W $(384/1000)^2$ × 8760h + 1880 W × 8760h + 11890 W $(177/1000)^2$ × 8760h = 51,559 kWh/year
- Loss when only transformer TX1 is used
  Wt2 = 1880 W × 8760 h + 11890 W $(561/1000)^2$ × 8760h
  = 49,249 kWh/year
- Merit
  Wt1 – Wt2 = 51,559 kWh – 49,249 kWh = 2,310 kWh/year (Equivalent to 0.05% of the annual electric power consumption)
- Reduced cost: 300B$ (Average unit price of electricity: 0.13B$/kWh)

(7) Replacement by high-efficiency lamps and lighting fixtures

Current condition

Conventional types of incandescent lamps (25 W × 2) are used in corridors of the guest room floors

Proposed improvement

Replacement by fluorescent lamps

Estimation of effects

1) Conditions of estimation

Current lighting with incandescent lamps

	1 lighting fixture: 25 W × 2, 16 rows /F, 5 guest room floors
Lighting time	8760 hours
Reduction plan	25 W × 2 → 13 W fluorescent lamp

2) Calculation

- Reduced electricity

  (25 W × 2 − 13 W) × 16 rows × 5 floors × 8760h = 25,930 kWh/year

  (Equivalent to 0.6% of the annual electric power consumption)

- Reduced cost: 3.371B$ (Average unit price of electricity rate: 0.13 B$/kWh)

  Merits of changing from candescent lamps to fluorescent lamps include extended lifetime of lamps (1000h → 8000h) in addition to the cost reduction

(8) Shortening of operation time of the circulating pump for the swimming pool

Current condition

The pump is in operation for 24 hours regardless of the number of pool users.

Proposed improvement

Operation limited to the busiest time zone (8 hours/day)

Estimation of effects

1) Conditions of estimation

Capacity of circulating pump	1.1 kW
Operating time	8h/day, 365 days/year

2) Calculation

Reduced electricity

1.1 kW (24 − 8)h × 365 days = 6.424 Wh (Equivalent to 0.14% of the annual electric power consumption)

Reduced cost: 835B$ (Average unit price of electricity: 0.13B$/kWh)

(9) Summary of improvement effects

The 8 improvement plans proposed above and their effects are summarized in Table 4.3-1.

Results of the improvements in No. 2 and No. 3 depend on the operation time, while effects of those in No. 4 to No. 8 are estimated to total to 4.2%.

Table 4.3-1 Proposed Improvement Plans and Expected Effects

No	Improvements	Reduced electricity [kWh]	Reduced cost [B$]	%
1	BAS (Central Supervisory Control System)			
2	Review of operation time of air conditioning	Depends on operation time		
3	Review of FCU in guest rooms	Depends on operation time		
4	Review of preset room temperature	145322	18892	3.2%
5	Thermal insulation of hot water supply piping	9855	1281	0.2%
6	High efficiency operation of transformers	2310	300	0.1%
7	Change to high-efficiency lamps and lighting fixtures	25930	3371	0.6%
8	Review of operation time of pool circulating pump	6424	835	0.1%
	Total	189841	24679	4.2%
	Annual electric consumption	4498145		
	Unit electricity rate B$/kWh	0.13		

4.4 Improvements Realized

On completion of the primary survey, we made a suggestion for improvement plans listed above in the wrap-up meeting. Some of these improvement plans had already been implemented at the time of the second-stage survey.

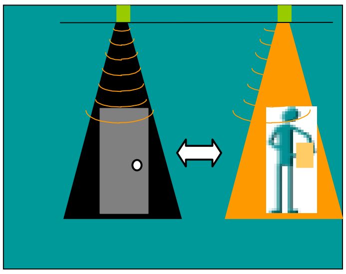
We would like to express our deep gratitude to persons concerned of Orchid Garden Hotel for taking action promptly for improvements. The estimated effects of the improvements made are shown in Table 4.3-2. Improvements in operation achieved an 8.1% cut in energy consumption.

Table 4.3-2 Realized Improvements and Effects
(Confirmed at the Time of the Second Survey)

	kW	Load factor	No. of units	hours	Days /year	kWh/y	
Fan in parking area	0.33	0.8	2	16	365	3084	
Air conditioning equipment in restaurant, Vanda	4	0.8	1	8	365	9344	
Fan in toilets, Vanda	0.15	0.8	1	8	365	350	
Ventilation fan, Goldiana	0.32	0.8	1	8	365	748	
Pool pump	1.1	0.8	1	6	365	1927	
Air conditioning equipment, Level 8, Grand Hall	11	0.8	1	24	265	55968	
Air conditioning equipment, Level 8, Cesar 1	11	0.8	1	24	265	55968	
Air conditioning equipment, Level 8, Cesar 2	5.5	0.8	1	24	265	27984	
Reheating equipment for lobby line	18	0.4	1	24	365	63072	
Reheating equipment for back office line	7	0.4	1	24	365	24528	
Reheating equipment for restaurant line	35	0.4	1	24	365	122640	
Total						365613	8.1%
Annual electric power consumption						4498145	
Unit price of electricity 0.13 B$/kWh				Reduced cost		47530	

4.5 Introduction of Available New Technologies

(1) Automatic lighting system equipped with human body sensor



- 100% lighting when human body is detected by the sensor
  Lighting is reduced to 35% normally under no person.
- Places where the system is applicable: Kitchen, toilet, etc.

Source Material from Matsushita Electric Works, Ltd.

5. Databases, Benchmarks and Guidelines for Brunei

(1) Current situation of Brunei

1) Primary step

In Brunei, almost no country-level energy conservation efforts for buildings have been made to date. Nothing comparable to database, benchmark or guideline was available. In the current project, we could obtain energy data on one hotel. Although it is data on only one case example, it is meaningful that we could establish a benchmark based on which they will be able to develop the database in the future.

Detailed data of the hotel we audited are as mentioned above. Those related to energy indices are picked up as follows:

Use of the building:	Hotel
Gross floor area:	20,121 m^2
Annual electric power consumption:	4,498,145 kWh

Energy consumption per unit area (energy consumption intensity):

223.5 $kWh/m^2/y$

2,191 $MJ/m^2/y$ (Converted by 9.8 MJ/kWh)

In the workshop, in response to our request for submission of energy data, one data was reported.

Name of building:	Institute Tecnologi Brunei
Gross floor area:	27,000 m^2
Energy consumption per unit area:	9.6 $kWh/m^2/y$

The data showed a very small scale of energy consumption for the institute (university). According to the information of utilization, it was confirmed that about two third (2/3) of the classrooms were vacant and not used. Thus, it is not appropriate to use these values for an indicator and the value per the actual operating area should be utilized.

2) Reheat system

The current energy audit of the hotel revealed that the energy use for air-conditioning was very featured. Due to the very humid climate, the dehumidifying-reheating system normally applied and the reheating energy accounts for a large portion of the total energy consumption. According to the participants, this system is also applied to hospital buildings. Breakdown of energy used in the hotel is shown again here. As shown in the pie graph (Figure 5-1), the reheating energy accounts for 17% of the building's total energy consumption.

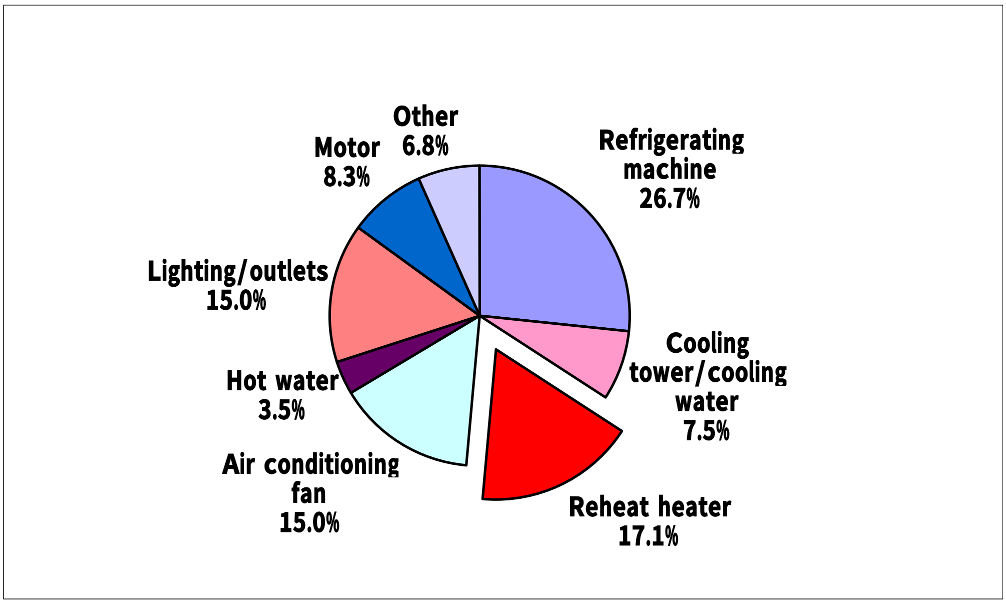


Figure 5-1　Ratio of Reheat Energy to the Total Energy Consumption

This reheating energy is a key point for promoting energy conservation in buildings in Brunei. It is important to check reheating system in the database surveys in the future.

In addition, it is effective that the guidelines include measures for energy in reheating system. At present, the “Brunei System” was proposed. That is the energy conservation system that utilizes heat of cooling water of chillers. We hope that the validity of this system will be verified and disseminated. The basic concept of the proposed reheating system for energy conservation is shown below.

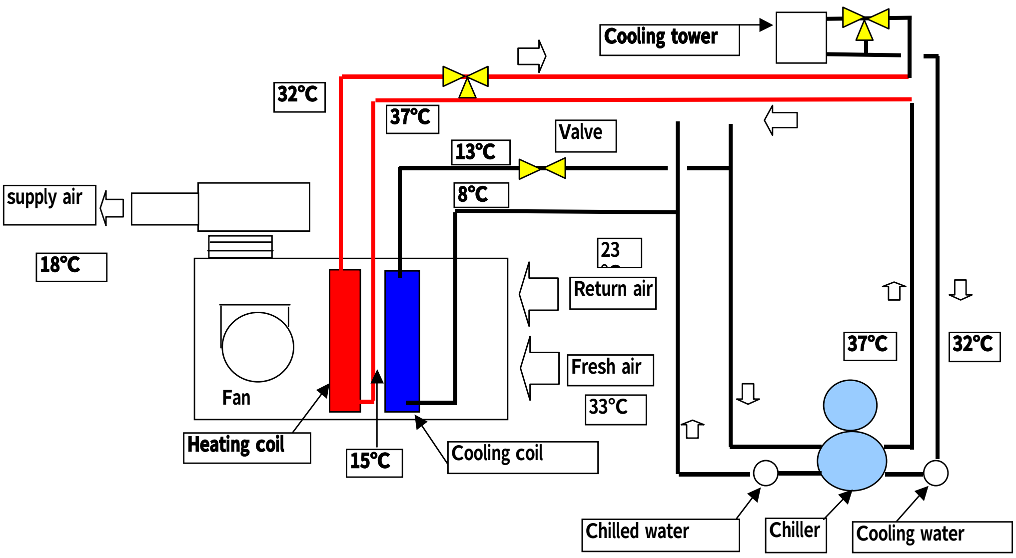


Figure 5-2　Flow Diagram of Proposed Reheating System

3) Toward future activities to develop database, etc.

We had a brainstorming session to get ideas from participants to develop databases, benchmarks and guideline in the future and the following were proposed.

FUTURE DIRECTION

ACTIVITIES

1. ENERGY SURVEY OF BUILDING
2. SET UP NATIONAL COMMITTEE ON ENERGY EFFICIENCY AND CONSERVATION TASK FORCE.
3. UPDATING THE BUILDING BY-LAWS.
4. DATA GATHERING OF POWER CONSUMPTION AND GFAS FOR GOVERNMENT BUILDINGS, COMMERCIAL AND INDUSTRIES.
5. ESTABLISHMENT OF DATA BASE.
6. GUIDELINES FOR NEW BUILDINGS
7. POLICY FRAMEWORK ON ENERGY EFFICIENCY.
8. DEVELOPMENT OF ENERGY MANAGEMENT GUIDELINES
9. CAPACITY BUILDING - TRAINING ON ENERGY EFFICIENCY
10. STUDY TOUR.
11. PROMOTION OF ENERGY EFFICIENCY & CONSERVATION
12. PROMOTING ENERGY EFFICIENCY AWARENESS AMONG THE PUBLIC
13. NATIONAL ENERGY EFFICIENCY AWARDS FOR BUILDINGS AND INDUSTRIES.
14. DEVELOPMENT OF ENERGY BENCHMARK FOR BUILDING AND INDUSTRY
15. STUDY OF ACTIVE AND PASSIVE DESIGN IN BRUNEI BUILDINGS.
16. SEMINARS, WORKSHOPS AND TRAINING
17. EDUCATION
18. RESOURCES
19. CONDUCT ENERGY AUDIT
20. DEVELOPMENT OF ENERGY EFFICIENCY CONSERVATION PLAN OF ACTION
21. CATEGORISATION OF BUILDINGS AND INDUSTRIES.
22. IDENTIFICATION OF OUR BARRIERS AND CHALLENGES AND OPPORTUNITIES
23. ENERGY MANAGER SYSTEM - BY EXAM
24. ACCREDITATION ENERGY AUDITORS
25. ENERGY STANDARDS & LABELING.
26. SUCCESSFUL CASE STORY (ROLE MODEL FOR BUILDINGS (HOTELS)

(AS OF 24TH JANUARY, 2004)

(2) Remarks

1) Starting with government buildings
It was recommended that a series of surveys should be started with government buildings where energy data is easily accessible and the actual status of energy consumption in buildings be clarified because data on only one hotel was obtained in the current survey on the energy use in buildings.

2) Focusing on reheating control
As the key point to energy consumption in buildings lies with the reheating control system for air conditioning, as mentioned previously, studying and improving this system will have a great effect on progress in energy conservation in Brunei.

3) Surveys of hospitals and hotels
The next step for developing the databases is, hopefully, to extend the survey scope from government buildings to hospitals and hotels that consume a large amount of energy.

(3) Photos

The following are photos of the workshop and participants

1) Workshop

2) Participants

IV. Lao PDR

1. Summary of Site Survey

Participants and audit periods

1st site survey : November 12 through 14, 2003

2nd site survey : January 26 and 27, 2004

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

- Kazuhiko Yoshida (General Manager) January 26 through 27, 2004
- Takashi Kato (Technical Expert): November 12 through 14, 2003
  January 26 through 27, 2004
- Akira Kobayashi (Technical Expert) November 12 through 14, 2003
  January 26 through 27, 2004

(1st Site Survey)

Date	Events, destination, etc.	Description
Nov. 12 (Wed.)	Workshop (Lao plaza Hotel, Vientiane, Lao PDR)	• Welcome Remarks • Opening Statement • Presentation on the profile of Lao Plaza Hotel and its energy management status • Presentation by ACE on its engagement in the PROMEEC project and its action plans for the current year • Presentation on the conditions of energy conservation in buildings in Japan • Presentation on the procedure of auditing buildings Participants: Mr. Sisoukan Sayarath (Chief of Electricity Management Division, Department of Electricity, Ministry of Industry and Handicraft-DOE/MIH) Mr. Khamso Kouphokham (Deputy Chief of Electricity Management Division, Department of Electricity, Ministry of Industry and Handicraft) Mr. Christopher Zamora (Project Coordinator, ASEAN Center for Energy) and 21 other persons

Date	Events, destination, etc.	Description
Nov.13 (Thu.)	Survey/audit of Lao Plaza Hotel (Vientiane, Lao PDR)	• Provided participants with OJT in energy auditing through the survey/audit of Lao Plaza Hotel Use of building: Hotel (142 guest rooms) Size: 1 basement floor and 7 floors above the ground Gross floor area: 14,972.25 m^2 • Survey on the outline of the building (by documents/ interviewing) • Survey on the outline of the equipment (by documents/ interviewing) • Survey on energy consumption (by documents/ interviewing) • On-site inspection There were many participants including those from DOE. Participants: Mr. Sisoukan Sayarath (Chief of Electricity Management Division, Department of Electricity, Ministry of Industry and Handicraft-DOE/MIH) Mr. Christopher Zamora (Project Coordinator, ASEAN Center for Energy) and 14 other persons
Nov. 14 (Mon.)	Wrap-up meeting (Lao Plaza Hotel, Vientiane, Lao PDR)	• Summarized the results of the survey/energy audit of Lao Plaza Hotel and reported to the participants. Participants: Mr. Sisoukan Sayarath (DOE/MIH) and 14 other persons

(Second Site survey)

Date	Events, destination, etc.	Description
Jan. 26 (Mon.)	Pre-report meeting Interim report on the audit results of Lao Plaza Hotel	• Made an interim report based on the results of the 1st survey/audit of Lao Plaza Hotel. • Major contents • Analysis of the current condition (electric power consumption, gas consumption, total energy consumption, energy composition, trends in monthly energy consumption, comparison with other buildings and water consumption data) • Good practice examples (Load-matched operation of turbo-chiller, appropriate operation of ventilation fans and air-conditioners, control of outside air intake at the lobby, energy conservation activities participated by hotel employees) • Recommendations for improvement and expected effects (High-efficiency operation of transformers for power receiving, renewal to high efficiency lamps) • Measurement of CO_2 concentration: Carried out measurements of CO_2 concentration, which are necessary for control of fresh air intake, at relevant places using the CO_2 concentration meter brought from Japan, in cooperation with the participants. Participants: • From the hotel: Mr. Sommai (Chief Engineer) and 2 staff members of maintenance • From DOE: Mr. Sisoukan Sayarath and 2 more persons Mr. Christopher Zamora (ACE)

Date	Events, destination, etc.	Description
Jan. 27 (Tue.)	Workshop on promotion of energy conservation in buildings (Lao Plaza Hotel, Vientiane, Lao PRR)	• Pre-report presentation on the results of energy audit of Lao Plaza Hotel • Presentation on benchmarks and databases established in Japan • Presentation on the investigations of benchmarks and databases for buildings in Lao PDR. As a result, data on Parkview Hotel was presented as an example. • Discussions: Methods of collecting data, meaning and usage of benchmarks, analysis of data on Parkview Hotel, etc. Participants: Mr. Houmphone Bulyaphol (Director General, Department of Electricity, Ministry of Industry and Handicrafts (MIH) Mr. Sisoukan Sayarath (Chief, Electricity Management Division, Department of Electricity, MIH) Mr. Khamso Kouphokham (Deputy Chief, Electricity Management Division, Department of Electricity, MIH) Mr. Viensay Chantha (Electricity Management Division, Department of Electricity, MIH) Mr. Noppadol Sommai (Chief Engineer, Lao Plaza Hotel) Mr. Christopher Zamora (Project Coordinator, ASEAN Center for Energy) And those concerned of Lao PDR government, National University and hotels(Lao Plaza Hotel, Novotel, Park View Hotel) and 18 other persons

2. Political and Economic Conditions in Lao PDR

2.1 National Indicators, Political System and Key Economic Indicators

(1) National indicators

1) Country name: Lao People's Democratic Republic
2) Area: 240,000 km^2
3) Population: 5,526,000 (2002)
4) Capital: Vientiane
5) Ethnic distribution: Lor Laum (Lowland Lao) (60%) and 49 ethnic groups in total
6) Language: Laotian
7) Religion: Buddhism
8) Brief history: In 1899, the country was incorporated in French Indochina. In 1949, the country became independent within the frame of French union. On October 22, 1953, it attained complete independence under the Franco-Laos Treaty. Although there had been a series of civil wars afterward, in February, 1973, the "Agreement on Restoration of Peace and Racial Reconciliation in Laos" was concluded. In December 1975, with the sudden change in the Indochina situation, Lao People's Democratic Republic was formed.

(2) Political system

1) Form of government: People's Democratic Republic
2) Head of state: President Khamtai Siphandon (President of Lao People' Revolutionary Party)
3) Assembly: National Assembly
   - President of the national assembly :Samane Vignaket (Politburo member)
   - Unicameral parliament (109 members)
4) Government
   - Prime Minister: Boungnhang Vorachith (Politburo member)
   - Foreign Minister: Somsawat Lengsavad (Central Committee member and Deputy Prime Minister concurrently)

(3) Economic indicators

1) Main industries: Agriculture, forestry, wood processing and hydraulic power generation
2) GDP: $2,017 million (2002)
3) Per capita GDP: $365 (2002)
4) GDP growth rate: 5.9 % (2002)
5) Inflation rate (consumer prices): 7.5% (2001)
6) Total trade value (2000)
   - Exports: $393 million
   - Imports: $591 million
7) Major trade items
   - Exports: Electric power, wood products, garments and coffee
   - Imports: Fuels, consumer goods, textile raw materials
8) Trade partner: Thailand, Vietnam, China and Japan
9) Currency: Kip
10) Exchange rate: $1 = 10,500 kip (as of October 2003)

(4) Relationship with Japan

1) Political relations: There is no particular pending issue between the two countries. Lao PDR and Japan have maintained good relationship.
2) Economic relations
   a. Trade with Japan (2002)
      - Trade value
        Export to Lao PDR: 2,252 million yen
        Import from Lao PDR: 841 million yen
      - Trade item
        Exports to Lao PDR: Vehicles, articles of iron and steel
        Imports from Lao PDR: Wood products
   b. Direct investments from Japan: Wood processing galvanized steel plate production, motorcycle assembly plants, etc.
3) Cultural cooperation: Japan has implemented cultural cooperation programs for Lao PDR since 1976 under ODA programs. Recently both countries' cultural exchange has expanded including the preservation of cultural heritages, sports exchange, people-to-people exchange, etc.
4) Japanese nationals residing in Lao PDR: 406 persons (as of October 2002)
5) Laotians in Japan: 1,729 persons (No. of foreign resident registrations as of the end of 2001)

(5) Political condition

1) Domestic politics

In December 1975, the royal government was overthrown and "Lao People's Democratic Republic" was established. Lao PDR's administration having People's Revolutionary Party (LPRP) as its only legal political party has promoted building of a socialist country through nationalization and collectivization of industries under the leadership of Kaysone Phomvihan, founding father of the nation, President of LPRP and Chairman of Council of Ministers.

The nation's full-fledged economic reform plan was officially approved as the "New Economic Mechanism---NEM) in the 4th LPRP convention in November 1986. This is the new reform policy called "Chintanakan mai "(new thinking), which was developed to be implemented in all aspects of social and economic systems, applied specifically to economic field. While the support from former Soviet Union rapidly dwindled, aids from international organizations and advanced nations in the west increased dramatically propelling the nation's economic reform that aims at a comprehensive shift from a subsistence natural economy maintained under the socialist regime to a market economy.

Due to the demise of Soviet Union in 1991, the nation replaced its closer political ties with Soviet and Vietnam by an omni-directional foreign policy based on the amicable relationship with neighboring countries including improved relationship with China while seeking the establishment of "special relationship" with Vietnam. Various reform plans implemented under the NEM policy were repeatedly assessed by the World Bank, IMF and Asian Development Bank and features of the reform were defined as listed in the table below.

After the death of Kaysone Phomvihane in November 1992, Khamtai Siphandon the new president of LPRP (also national president from 1998) and former national president Nouhak Phoumsavan, etc. succeeded the leadership. The new leadership continued to follow the reform policy centering on economic aspects that had been resolved in the 4th ('86) and ensuing LPRP conventions.

With the admission into ASEAN in July 1997, Lao PDR entered a new era of regional cooperation. In the same month, however, the currency and financial crisis in Asia broke out. The fact that Lao PDR with no short-term capital markets was also affected by this crisis proved that Lao PDR had already been incorporated in the regional economy and global economy. On the other hand, it is also true that notwithstanding the occurrence of import inflation or plunges in exchange rate, the natural social safety net functions against such impacts and shocks from the outside in rural communities based on subsistence agriculture.

The supreme National Assembly with members elected in the general election in 1989 approved a new legislative system including the adoption of a new constitution in August 1991. Based on the constitution, the 2nd general election for the National Assembly was held in December 1997. In the 3rd National Assembly of the 5th term in May 2003, the constitution was revised and proclaimed in July.

Table: Outline of the New Economic Mechanism (NEM) Reform

(1) Complete price decontrol (excluding public utilities charges)
(2) Ending state monopoly of rice distribution and liberation of agriculture
(3) Reforms of state-owned corporations
(4) 2 major reforms in taxation system:
    Reviewing and streamlining expenditure priorities (excluding wages and salaries of government employees)
    Integrating the central budget and local budgets into general budget
(5) Deregulation of trade: Simplified tariff classification, Abolishment of quantity control and special import/export privileges
(6) Unification of multiple exchange rates system, Minimization of deviations of parallel exchange rates from official rate
(7) Separation of the central bank and commercial banks
(8) Development and enforcement of legal systems
(9) Invitation of foreign direct investments

(Source) Motoyoshi Suzuki "Laos under a New Economic System" Iwanami Shoten, Publishers "Iwanami Course: History of South East Asia Vol. 9" March, 2002

(6) Economic Condition

After the planned economy that had been promoted since 1975 came to an impasse, Lao PDR has advanced an open economy policy and its shift to market economy through implementing various economic reforms in a wide range of fields such as the institution of banking system, taxation system, foreign investment laws, the privatization of state corporations, etc. under the New Economic Mechanism (NEM) in 1986.

Lao PDR achieved real GDP growth rates of 5% or up during the past decade.

However, per capita GDP remains as low as $300. Budget deficit often lead to increases in money supply, causing acceleration in inflation. Confronted with the financial and currency crisis in Asia in 1997, Lao PDR's inflation rate in 1998 reached 142% of that of the previous year due to its failure in the management of domestic macro economy. Trade deficit, in addition, created about 10 times as much plunge in foreign exchange rate that applied before the crisis. In such circumstances in which there are scarcely sufficient financial resources to advance development of infrastructure focusing on roads, bridges, water systems, airports, etc. it is not easy to improve the environment for foreign investments. In the 7th convention of LPRP (2001), the nation's long-term goals such as the departure from a LLDC, 3 times high standard of living of people, etc were developed.

In trade, import value reached $591million far exceeding $393 million of import. No improvements are recognized with the deficit structure. While Lao PDR's major export items are timber and electric power, exports of garments and coffee have recently been increasing. However, depreciation of home currency value may not create a drive for export. Due to the underdevelopment of import replacement industries in the country, diversified consumers' demand and the promoted trade deregulation policy, industries' and consumers' demand for import products is still high.

Deficiency in foreign currency and budget deficit are covered by foreign investments, remittances from Laotians residing in foreign countries and inflow of direct foreign capitals. Japan's aid to Lao PDR amounted to $168.7 million in 1998 and accounted for 86% of its bilateral assistance value.

2.2 Energy Situation in Lao PDR

(1) Basic features of the electric power department in Lao PDR

Lao PDR has a considerable scale of hydraulic energy source, the central part of which is River Mekong. In the Mekong Basin, there are, at least, two countries that are in the process of developing and providing a big energy market. Currently, 40% of a total of 875,774 households are connected to the power distribution grid. The power grid at 115kV consists of 3 regional distribution lines. No.1 line supplies power to the central part of the country and No. 2 and No3 (Largest) supply to the south region. (See Figure 2.2-1) Figure 2.2-2 shows changes in electrification in Lao PDR.

Hydro power accounts for 98% of the nation's power generation and diesel makes up the remaining portion. Electricite du Laos (EdL) manages power generation operations through a 100% state-owned company. Less than 5% of the potential capacity of hydropower has been developed so far to meet almost all of the nation's electric needs. In addition, 2 companies of the private sector have recently been established to export electricity to Thailand.

① Theun-Himboun (1998) GOL (EdL's investment 60%) 210 MW

② Huoay Ho (1999) GOL (EdL's investment 20%) 150 MW

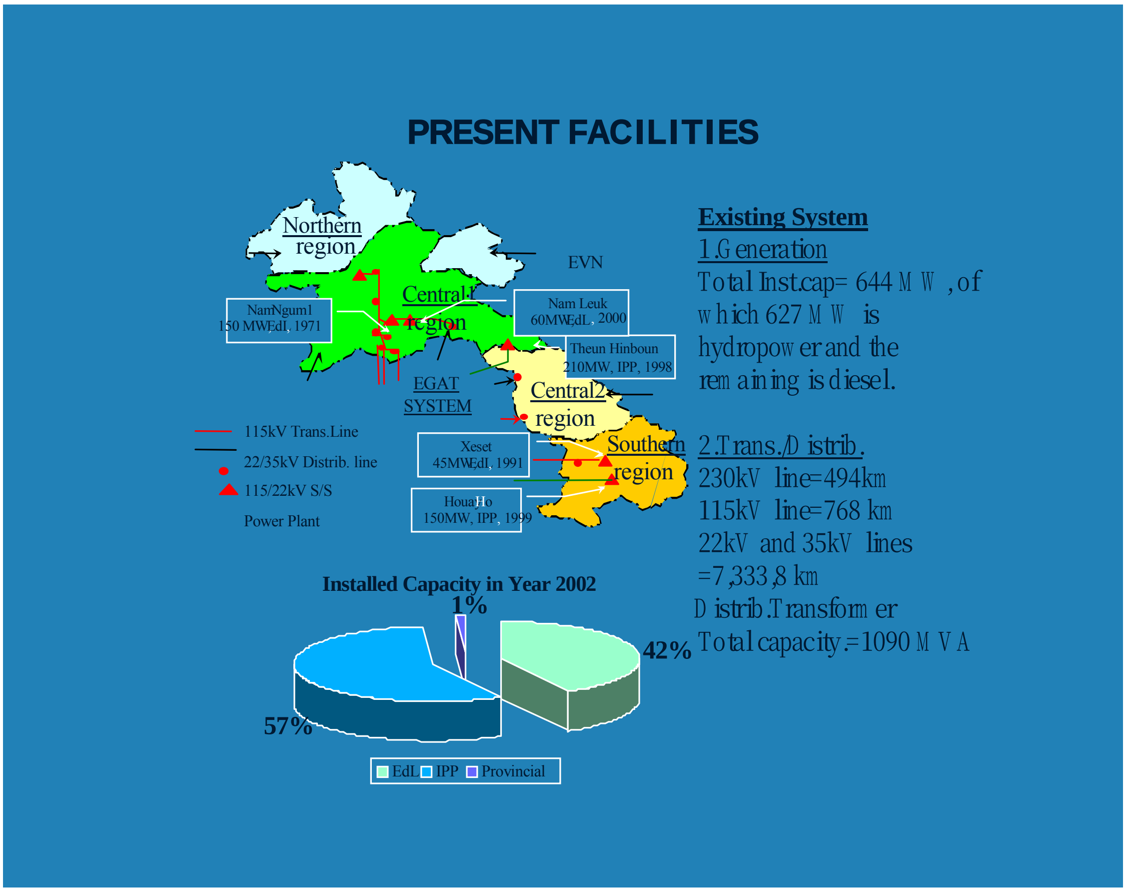


Figure 2.2-1 Electric Power Supply in Lao PDR

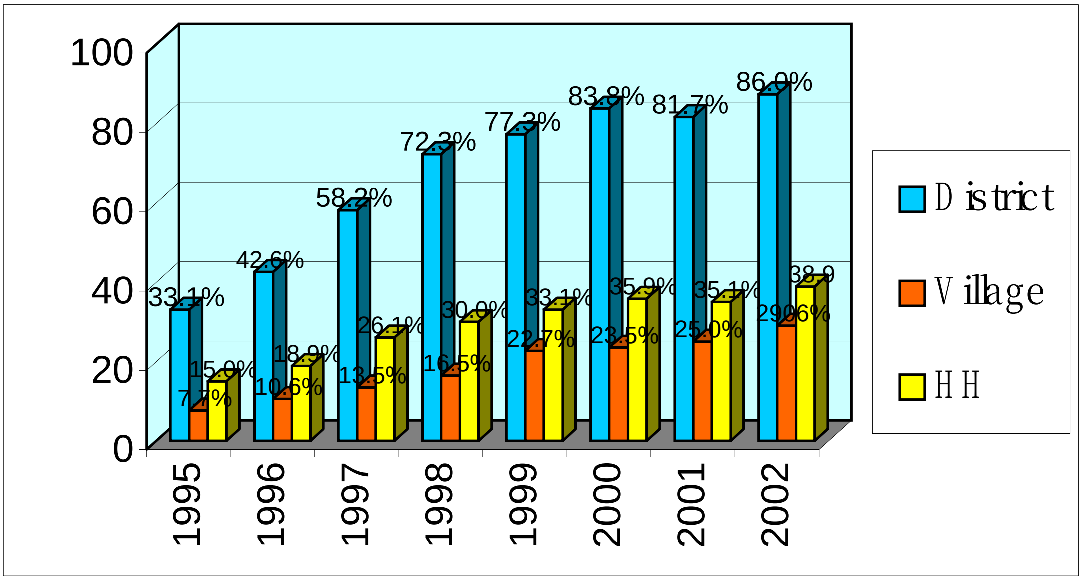


Figure 2.2-2 Rate of Electrification in Lao PDR

(2) Policy, Laws and Characteristics

Lao PDR's government places priority of its policy on the development of electric power projects as a means of achieving macro/micro economic systems and vitalization of society. Comprehensive goals of the policy of the electric power department are as follows;

- Maintain and further expand highly reliable, continual power supply in the country to promote economic and social development
- Promote power generation for export to gain profits

The achievement of the above goals is subject to the continuous progress in the following measures.

- Create and strengthen legal and regulatory frameworks so that development of electric power can effectively be guided in a proper direction and will progress
- Reform the organizations concerned to clarify where the respective responsibilities lie

<u>Legal and regulatory frameworks</u>

Over the past 10 years, enactment of reform bills has been in progress. The enactment of the laws listed below is intended to create a legal environment which encourages continuing optimum and responsible investments in the electric power department.

1) Contract Law (1990)
2) Commercial Bank and Financial Institutions Act (1994)
3) Customs Law (1994)
4) Business Law (1994)

5) Law on the promotion and management of foreign investment (revised) (1994)
6) Secured transaction law (1994)
7) Water and water resources law (1996)
8) Electricity law (1997)
9) Environmental protection law (1999)

These laws are expected to work favorably for power generation business in attracting private capital. In other words, they are considered to provide an environment that meets the rational demand of international investors.

(3) Development of electric power

In Lao PDR, electricity is supplied via either the major power distribution grid or the other networks. The major power distribution grid of EdL has the following 3 power sources.

1) Small and medium sized power generation projects with a capacity of up to about 100MW each that are developed by EdL by way of supplying to the domestic market.
2) Supply for local areas from IPP (Houay Ho, Theun-Hinboun) that is independent from the major power distribution grid
3) Imports from neighboring countries (Thailand and Vietnam, Import from China is also planned)

There are the following two supply sources for exports

1) Excessive power from EdL hydropower operation projects (Supply lines for central and southern regions)
2) Large-scale electric power generation projects by IPP

Electrification is a high priority policy of the country. The rest of the central region that has not yet been covered by the power grid and the densely populated plains along the Mekong River depend on the expansion of the power grid for electrification. However, the areas where the expansion of the grid costs high had better choose electric supply by an independent supply line of the prefecture, area or village concerned. Thus, solar energy generation and micro/pico hydropower generation are promising and supportive options in Lao PDR in view of promotion of clean energy and eradication of poverty.

(4) Forecast of demand

Future energy demand is forecast as follows. Electricity forecasts are based on the assumption that about 190,000 more households will be electrified.

Demand for energy: 1,963.3 GWh (2010)
Growth rate: 11.7% (2000-2010)
Peak electricity demand: 464.2 MW (2010)
Electricity growth: 10.5%

(5) Latest statistics on primary energy supply and final energy demand

Statistical data on primary energy supply and final energy demand is shown in Figure 2.2-3 and Table 2.2-1.

Year	Generation (GWh)	Home use (GWh)	Import (GWh)	Export (GWh)	From IPP(GWh)
1995	1085	337.5	77	675.5	
1996	1248	379.5	87.5	792.4	
1997	1218.7	433.8	101.5	710.2	
1998	2156.6	513.3	142.3	1613.5	1208.2
1999	2806.3	565.5	172.2	2228.8	1630.6
2000	3438.4	626.4	180	2792.8	2098.6
2001	3653.7	710.4	183.8	2871.4	2074.9
2002	3604.1	766.7	200.8	2798.3	2034.0

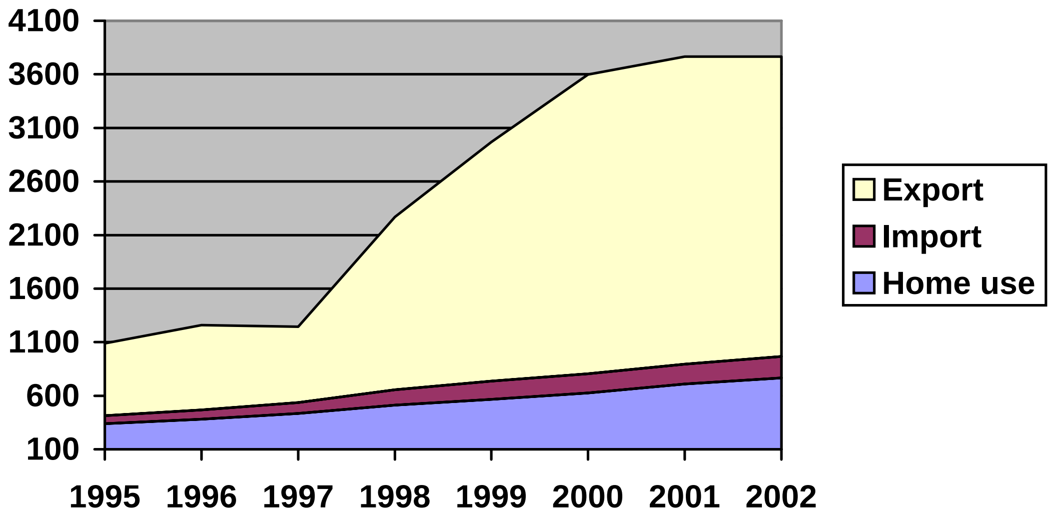


Figure 2.2-3 Energy Balance in Lao PDR

Table 2.2-1 Energy Consumption by Sector

Year	Residence	Business	Recreation	Government Offices	Agriculture (Water pump)	Embassies and International Organizations	Industries	Grand Total (kWh)
1997	218,286,703	40,094,203	9,701,282	49,623,547	16,969,721	8,098,174	91,086,827	433,860,457
1998	252,218,101	50,110,610	10,685,471	54,444,110	29,631,919	8,583,996	107,598,300	513,272,507
1999	285,053,226	58,553,120	11,068,706	54,464,514	33,905,540	7,712,277	114,789,455	565,546,838
2000	324,693,846	67,804,500	11,838,193	59,802,343	33,413,405	7,480,376	134,825,919	639,858,582
2001	371,410,713	72,441,414	12,707,319	67,210,227	40,750,934	10,928,830	134,880,705	710,330,142
2002	371,410,713	78,142,296	10,223,482	77,484,072	34,799,916	7,560,312	163,970,932	743,591,723
%	49,9%	10,5%	1,4%	10,4%	4,6%	1,0%	22%	100%

2.3 Situation of Buildings in Lao PDR

The only data and information on buildings available in Lao PDR is those contained in Table 2.2-1 above. It is an urgent business to make relevant surveys and establish a database on the results.

3. Procedure of Energy Audit for Buildings

3.1 General Process

The energy audit for buildings is generally proceeded in the 6-step sequence described below.

In STEP 1 and STEP 2, general information and data on the building and equipment concerned are collected and the obtained energy consumption data are analyzed.

The participants collaborated with Japanese experts from STEPs 1 to 3 for this year's audit. In the wrap-up meeting held on completion of the 1st site survey, ECCJ specialists gave an outline of the improvement points in STEP 4. In the interim report meeting in the 2nd site survey, the results of the study on the measures for the improvement and expected effects were explained, and for further confirmation, additional surveys were conducted. This report reflects the results of the 2nd site survey.

STEP-1 Gather and confirm general information and data of the building
STEP-2 Gather and confirm general information and data of the equipment
STEP-3 Gather and confirm data of energy consumption
STEP-4 Identify improvement points through data analysis and evaluation
STEP-5 Study recommended methods for improvement including expected effects
STEP-6 Determine and explain the recommendations to be implemented

3.2 Description of Each Step

Major survey items of each step are as follows:

(1) STEP-1 Gather and confirm general information and data of the building
1) Year of construction completed
2) Size: Gross floor area (area for major use, indoor parking area), number of stories, building structure
3) Usage
4) Owner
5) No. of employees, No. of clients (on business days and holidays), and other items

(2) STEP-2 Gather and confirm general information and data of the equipment
1) Air-conditioning system, electrical system, sanitary facilities
2) Specifications for equipment and facilities

3) Operation management status: Operating hours, setting of room temperature, and other items

(3) STEP-3 Gather and confirm data of energy consumption

1) Monthly energy consumption
2) Changes in yearly energy consumption
3) Energy consumption by day of the week
4) Energy consumption by hour of the day
5) Energy consumption by usage
6) Data on water consumption, and other items

(4) STEP-4 Identify improvement points through data analysis and evaluation

1) Comparison of the total energy consumption of the building concerned with those of similar buildings
2) Comparison of its energy consumption by usage with those of similar buildings
3) Analysis of its monthly energy consumption trends
4) Analysis of changes in energy consumption for a period of several years
5) Analysis of its energy consumption by day of the week and hour of the day
6) Confirmation of room environment: Temperature, humidity, CO_2 concentration, luminance
7) Confirmation of operation log: Operation status during peak load hours, operation status during light load hours, No. of equipment units in operation, operation time and operation temperature conditions
8) On-site inspection: Operation status of equipment, temperature indicators, ammeters, voltmeters and power factor indicators, valve condition, damper condition, heat insulation, layout of equipment, maintenance of equipment and piping
9) Determination of how the facilities and equipment are actually used: Density of people in a room, condition of OA equipment, identification of locations of energy loss, and other items

(5) STEP-5 Study recommended methods for improvement including expected effects

1) Studying improvement plans: Application of other successful improvement cases and most-advanced technologies
2) Estimation of effects of improvement: Amount of reduced energy consumption and costs
3) Estimation of costs for improvement

(6) STEP-6 Determine and explain the recommendations to be implemented

1) Determination of the recommendations to be applied
2) Preparation of a report
3) Explaining the report

3.3 On-site Auditing Procedure

The energy audits for the building concerned were conducted in accordance with the following procedure.

(1) Interviewing
   1) General description of the building
   2) General description of the equipment
   3) How the building is used and the operation status of equipment
   4) Data and information on overall energy use
(2) Confirmation on drawings and reference materials
   1) Building design drawing
   2) Equipment drawings including drawings of air-conditioning systems, electrical systems and sanitary facilities
   3) Operation log
   4) Energy consumption data
   5) Room environment data
(3) On-site confirmation
   1) Typical room
   2) Machine room
   3) Electrical room
   4) Outdoor facilities and equipment (placed on rooftop and on the ground)
(4) Simple measurements (if possible)
   1) Temperature, humidity and luminance
   2) Electric current
   3) CO_2 concentration, etc.

4. Energy Audit of Lao Plaza Hotel

4.1 Outline of Lao Plaza Hotel

(1) Name: Lao Plaza Hotel

(2) Usage: Hotel

(3) Size: 1 basement and 7 floors above the ground
Gross floor area 14,972.25 m^2

(4) Age of the building: 7 years

(5) Outline of electric systems:
Receiving voltage 22 kV, Transformer capacity 1,000 kVA × 2 sets
Power generator 275 kVA × 1 set
Elevator 10 kW × 2, Service elevator 1 1kW × 1

(6) Air-conditioning systems:
Turbo-chiller 300RT (210 kW) × 2 sets, Air conditioning equipment + Fan coil unit (FCU) system

(7) Sanitary facilities:
Hot-water supplying boiler (LPG) 625,000 Btu/h
Water receiving tank, Lifting pump 7.5 kW × 2 sets, Booster pump 7.5 kW × 2 sets, Elevated water tank

(8) Laundry equipment: Installed

4.2 Analysis of Current Status of Energy Use

(1) Monthly energy consumption

1) Electric power consumption (2001-2003)

Monthly energy consumption is shown in Figure 4.2-1. The figure shows that energy consumption does not largely vary from month to month. Peak and smallest electric power consumption in 2002 were recorded in October and January respectively. The minimum consumption was 81% of the maximum consumption.

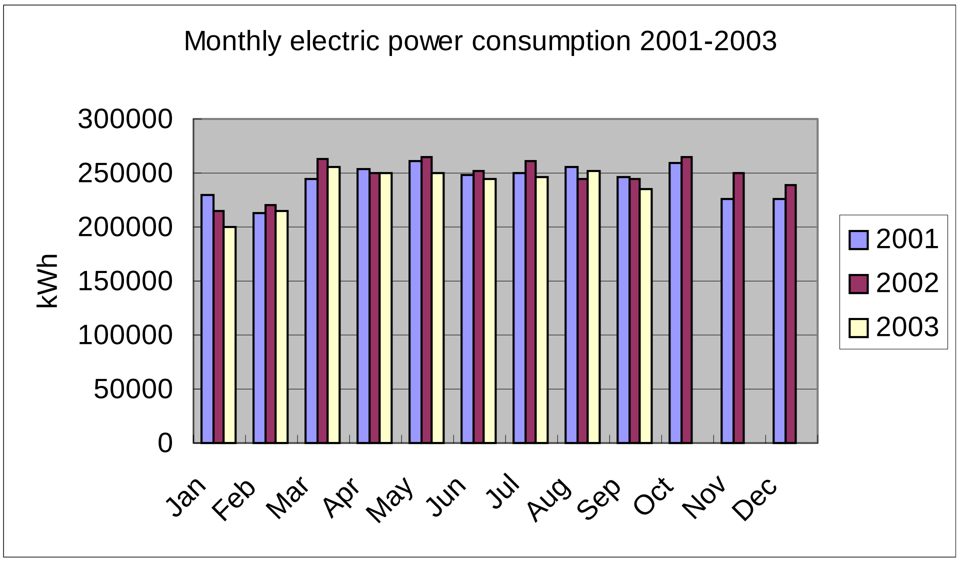


Figure 4.2-1 Monthly Electric Power Consumption 2001-2003

2) Gas (LPG) consumption (2001-2003)

Monthly gas consumption is shown in Figure 4.2-2. Gas is used for the hot supplying boiler and kitchen use. The figure shows that gas consumption increases in January, February, November and December. This is understandable because the air temperature goes down in these months. The reason for a very small amount of consumption n May 2003 could not be traced.

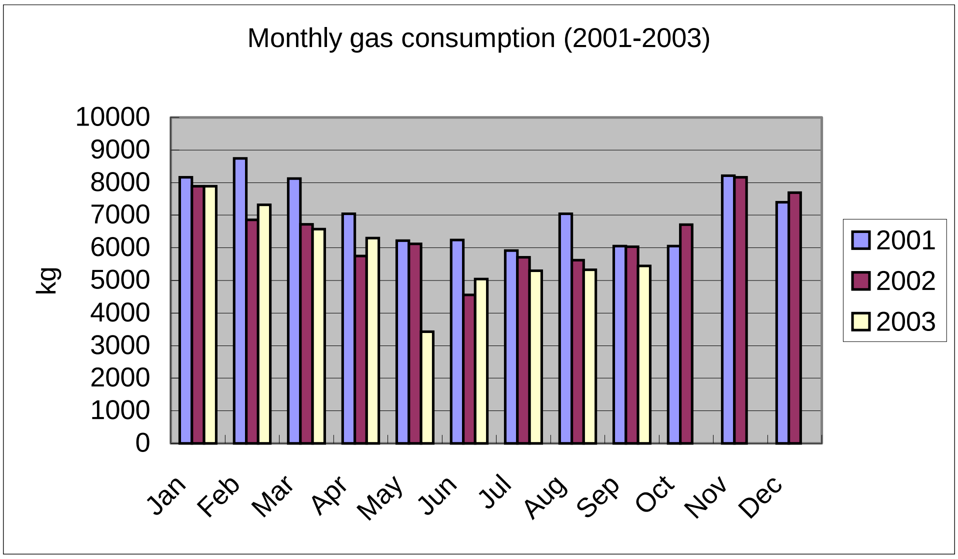


Figure 4.2-2　Monthly Gas Consumption (2001-2003)

3) Total energy consumption (2002)

Figure 4.2-3 shows monthly combined total of electric power and LPG consumption converted into calorific heat values by the conversion factors in the table below. (Note: This electricity conversion factor is that used in Japan and determined based on the factors such as power generating efficiencies of power stations, etc. It is necessary to determine a conversion factor for Lao PDR. The value used here is derived from the calculation: 1 kWh = 3.6 MJ ÷ approx. 37% (the average power generating efficiency of Japanese power companies))

	Primary energy conversion factor	
Electricity	9.8	MJ/kWh
LPG	50	MJ/kg

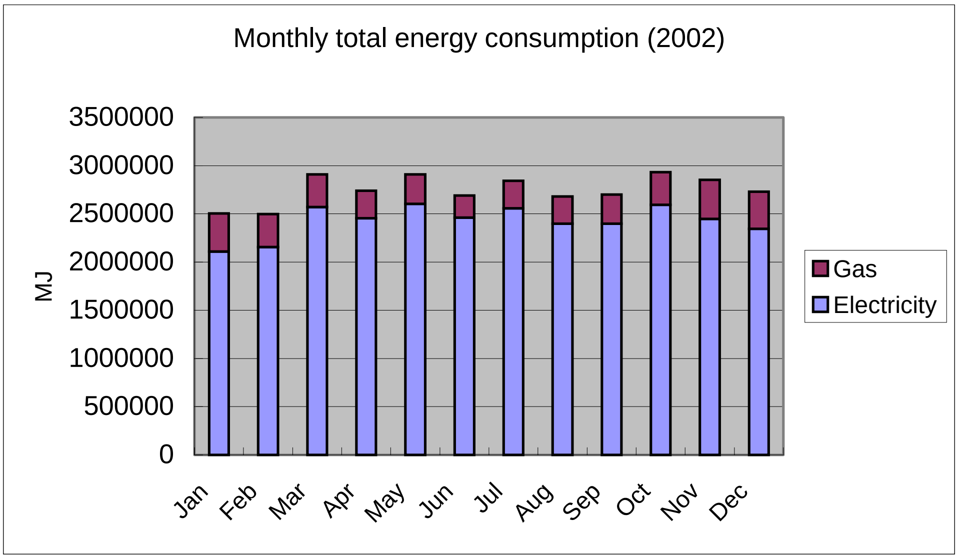


Figure 4.2-3　Monthly Total Energy Consumption (2002)

(2) Energy composition

In Lao Plaza Hotel, electricity and LPG are used as energy sources. Their composition ratios are shown in Figure 4.2-4. Electricity accounts for 88% of the total energy and LPG makes up the remaining 12%. The figure shows that it is effective to cut electric power consumption to reduce the overall energy consumption.

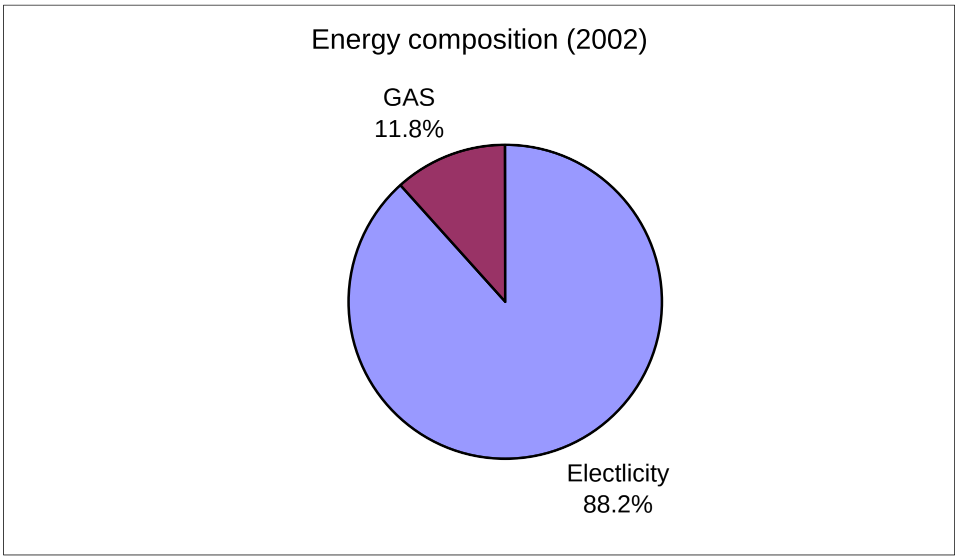


Figure 4.2-4　Energy Composition (2002)

(3) Trend in annual energy consumption

Electric consumption of the past 2 years are shown in Figure 4.2-5.
Against the electric consumption in 2001 assumed at 100, that in 2002 is 101.9, an increase of 2%.

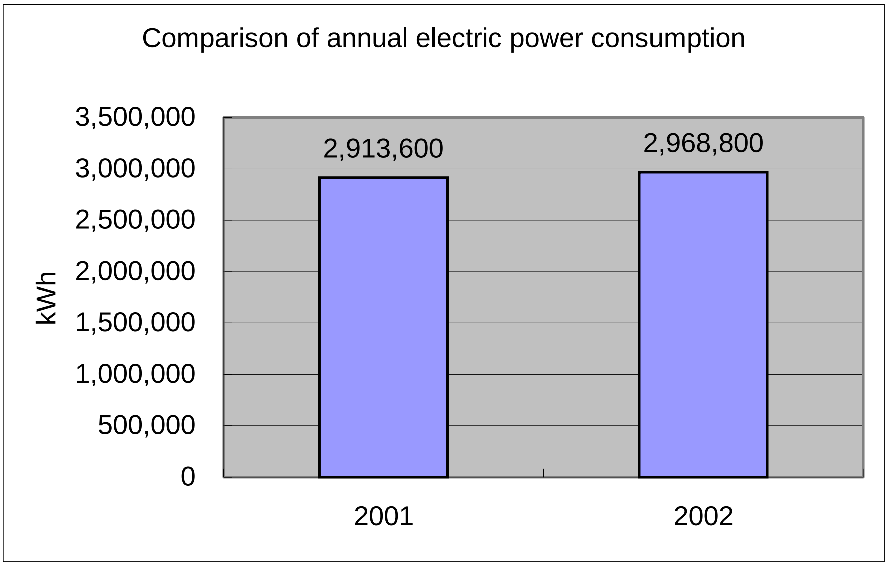


Figure 4.2-5 Comparison of Annual Electric Power Consumption

(4) Energy consumption by use

Lao Plaza Hotel’s energy consumption by use on the day of the on-site survey was calculated based on the design drawing of the facilities and the observed operation status of the equipment. It should be noted that this calculation is based on the values experienced in the past and the calculated values represent rough estimates and not accurate values. The calculation results are shown in Figure 4.2-6 and Table 4.2-1.
The pie chart shows that about 44% of the hotel’s energy consumption is shared by air conditioning. Calculation processes of energy consumption by use are shown in Items 2) to 6).

1) Composition of energy use

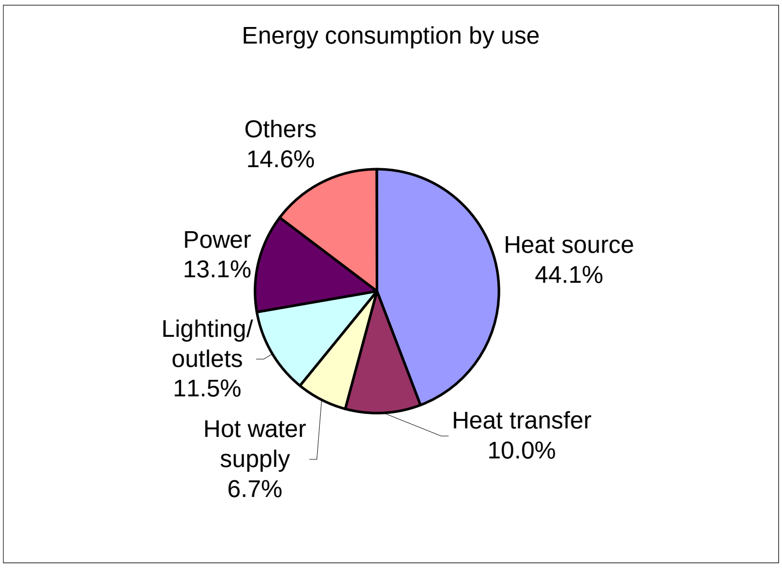


Figure 4.2-6 Energy Consumption by Use

Table 4.2-1 Energy Consumption by Use

	Electricity	Electricity	Gas	Electricity	Total	Total
	kWh/d	%	MJ	MJ	MJ	%
Heat source	4,063	50.0%		39,819	39,819	44.1%
Heat delivery	919	11.3%		9,005	9,005	10.0%
Hot water transfer	10	0.1%	5,966	99	6,065	6.7%
Lighting and outlets	1,062	13.1%		10,404	10,404	11.5%
Power	1,209	14.9%		11,851	11,851	13.1%
Other	871	10.7%	4,690	8,532	13,223	14.6%
Total	8,134	100.0%	10,656	79,710	90,367	100.0%

2) Calculations of energy consumption for heat source

Heat source	No. of set	kW	h	Load factor	kWh/D	
Refrigerating machine	1	210	24	0.7	3,528	
Cooling tower	1	7.5	24	1	180	
Cooling water pump	1	18.5	24	0.8	355	
Total					4,063	50.0%
Annual total electric power consumption	2,968,800			kWh/y		
Daily average electric power consumption	8,134			kWh/d		

3) Calculations of energy consumption for heat transfer

	kW	h	Load factor	Operating rate	kWh/D
Air conditioning machine fan	40.4	10	0.8	1	323
Air conditioning machine fan	11	24	0.8	1	211
FCU fan	8.04	7	0.8	0.65	29
Cooing water pump	18.5	24	0.8	1	355
Total					919

4) Calculations of energy consumption for hot water supply

Guest room	142			
Average occupancy rate	0.65			
Occupied rooms	92.3 →		95	
Hot water use/room	0.3 m^3			
Hot water supply	28.5 m^3			
Temperature °C	(Out) 45	(In) 20	(ΔT) 25	
Temperature difference ± °C	25			
Heat quantity kcal	712,500 kcal			
Conversion factor MJ/kcal	4.1868			
Guest room hot water supply quantity MJ	2983 MJ			
Laundry hot water supply quantity MJ	2983 MJ			
Hot water total	5,966 MJ			
	kW		h	kWh
Hot water supply pump	0.37	0.8	24	7.104
Booster pump	0.37	0.8	10	2.96
Total				10

5) Calculations of energy consumption for lighting and outlets

	m^2	W/m^2	kW	h	Operating rate	kWh
Basement	3960	5	19.8	12	0.8	190
Ground	3400	10	34	12	0.8	326
Ground	400	12	4.8	24	1	115
1F	3800	10	38	10	0.7	266
2F	500	10	5	10	1	50
2F-7F	Guest room					
	Room number	Operating rate				
Corridor	5	1	0.25	24		30
Guest room	142	0.65	0.13	7		84
Total						1,062

6) Calculations of energy consumption for power

	No. of set	No. of set in operation	kW	Load factor	h	kWh/d
Fan		1	1.2	0.8	24	23.04
Fan		1	5	0.8	10	40
Lifting pump	2	1	7.5	0.8	2.4	14.4
Booster pump	2	1	7.5	0.8	2	12
Other drain pump	10	4	0.75	0.8	0.5	1.2
Jockey pump	1	1	7.5	0.8	0	0
Pool pump	2	1	1.5	0.8	24	28.8
Elevator	2	2	10	0.8	1	16
Elevator	1	1	11	0.8	2	17.6
Drainage water treatment facilities	12		8.75	0.5	24	105
Coffee shop kitchen	16		24.3	0.3	24	174.6
Main kitchen			50	0.5	2	50
Bakery			9	1.5	24	324
Laundry			122	0.3	11	402.6
Total						1209.24

(5) Comparison with other buildings

1) Comparison of air temperature between Vientiane and Tokyo

As no comparable data that can be used for the assessment of energy use in this building was available in Vientiane, the data obtained has been compared with those of buildings in Tokyo. Before energy consumption per unit floor area are compared, as the outdoor temperature affects energy consumption for air conditioning, monthly average temperatures in Vientiane and Tokyo are compared in Figure 4.2-7.

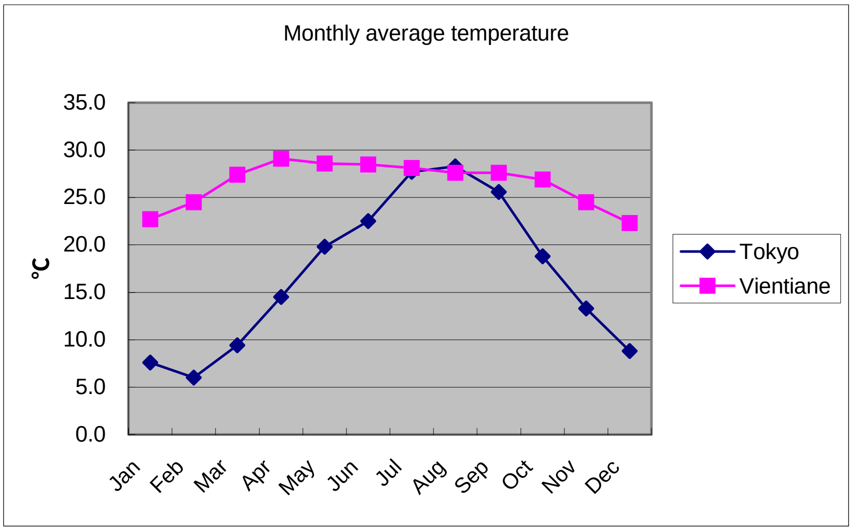


Figure 4.2-7 Monthly Average Temperature

2) Comparison of energy consumption intensity with those of buildings in Japan
The average energy consumption intensity for hotels in Japan is 3,280MJ/m^2 according to the data of The Energy Conservation Center of Japan, while that of Lao Plaza Hotel is 2,203MJ/m^2, which is about 67% of the average value of Japan.

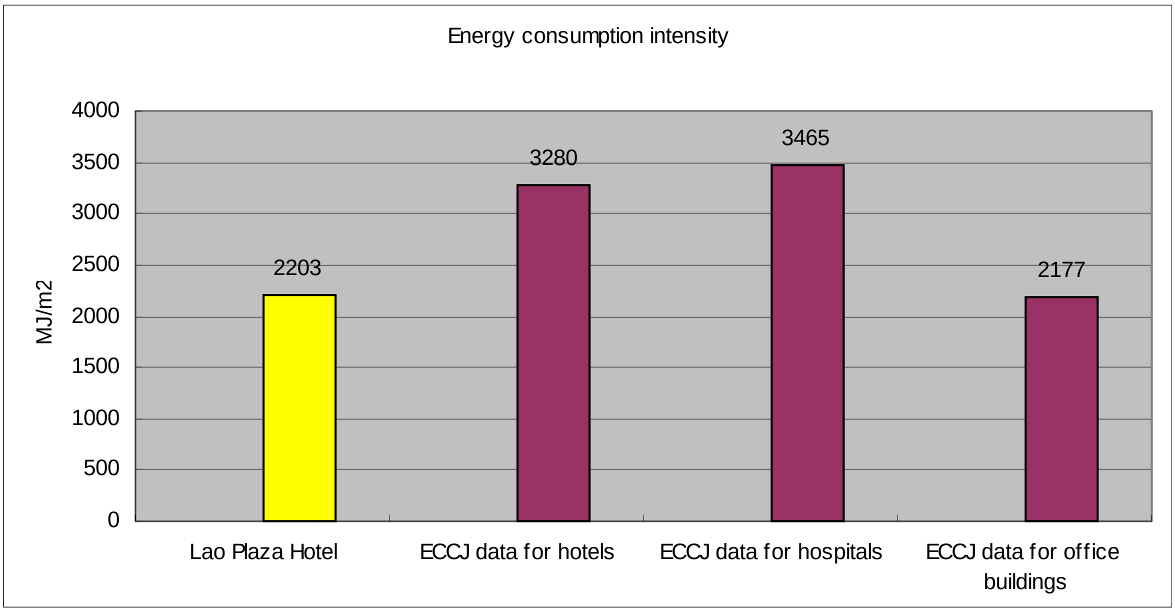


Figure 4.2-8 Energy Consumption Intensity

3) Energy consumption by use in hotels in Japan

Compared to the data on hotels in Japan, the ratio of Lao Plaza Hotel's energy consumption for heat source is larger while the ratios for hot water supply and lighting/outlets are smaller.

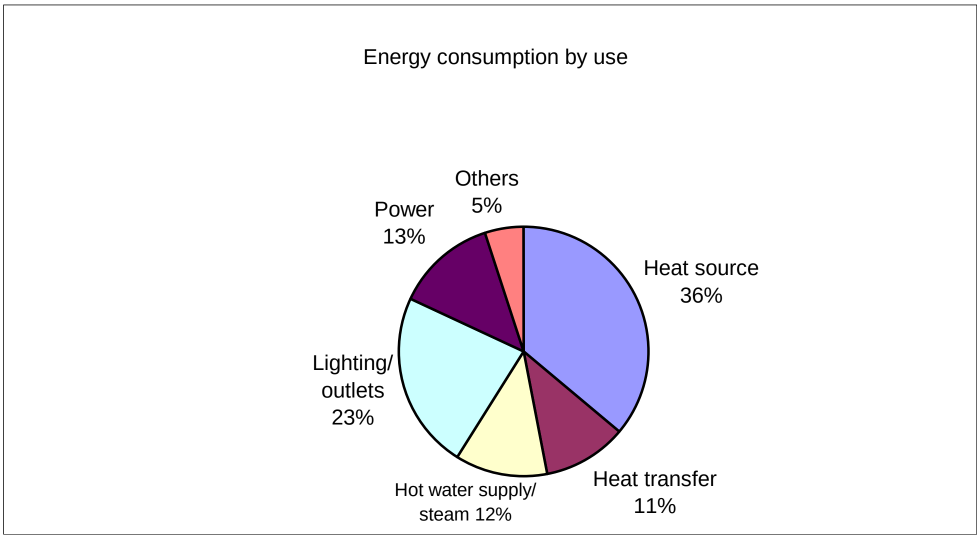


Figure 4.2-9 Energy Consumption by Use

(6) Data of water consumption

1) Monthly water consumption

Monthly water consumption for the period of 3 years from 2001 to 2003 (up to September) are shown in Figure 4-2-10. Water consumption varies little throughout a year except in September when it slightly drops.

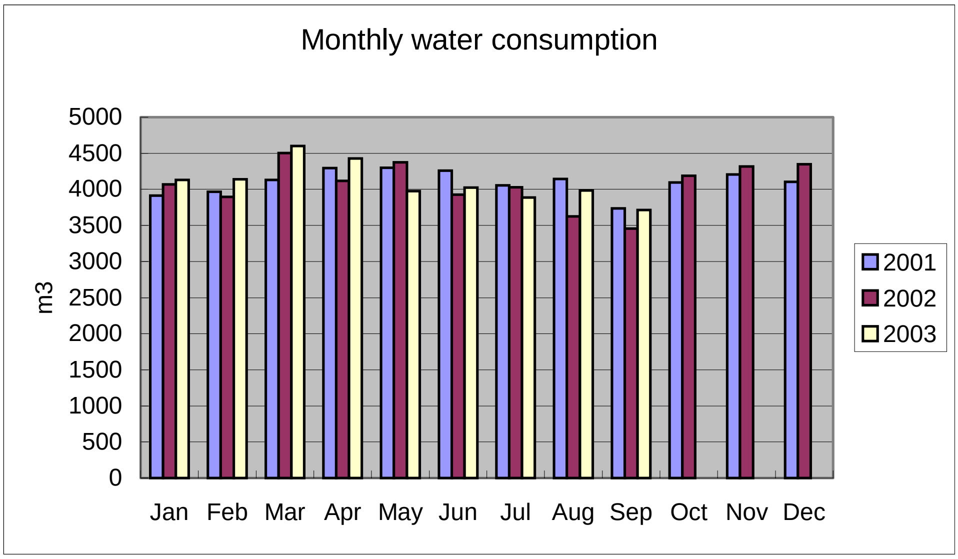


Figure 4.2-10 Monthly Water Consumption

2) Change in annual water consumption

Water consumption for two years are shown in Figure 4.2-11. Compared to the water consumption in 2001 which is assumed at 100, that in 2002 is 99, or down by 1%. As water consumption is related to occupancy rates of the hotel, it will be useful to compare the operating rates for these years.

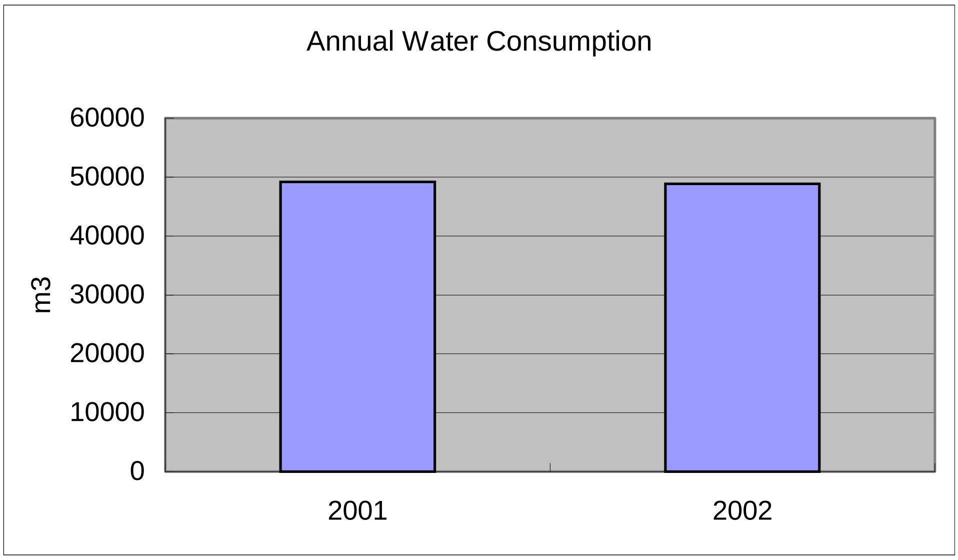


Figure 4.2-11 Annual Water Consumption

3) Comparison with other buildings

For assessment of water use, water consumption per unit floor area is compared to the reference data. As the comparable data is not available in Lao PDR, however, the data obtained has been compared with those of buildings in Japan provided by ECCJ. Compared to 3.64 m^3/m^2 for hotels in Japan, Lao Plaza Hotel's water consumption intensity is 3.26 m^3/m^2.

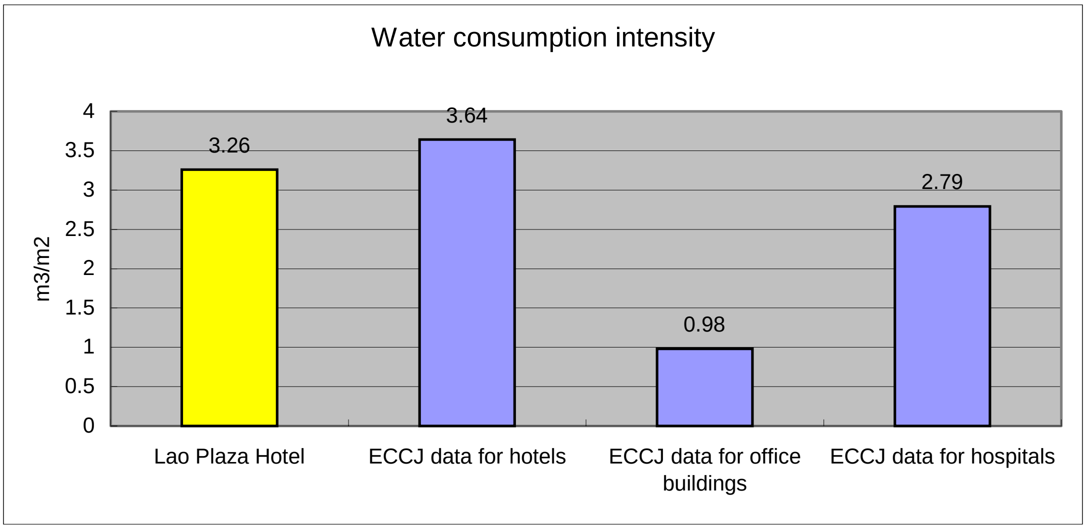


Figure 4.2-12 Water Consumption Intensity

4.3 Introduction of Good Practice Cases

(1) Management of the temperatures of cold water and cooling water in response to loading condition

We learned from the interview that the temperature of cold water of the turbo-chiller was set at a comparatively high temperature when air conditioning load was low and that the number of cooling water towers was also controlled depending on the loading conditions.

This is a proper operation manner based on good understanding of the features of turbo chiller. The effects are confirmed from the chart shown below.

Relations between temperature of cold water, temperature of cooling water and power output of electric motor of turbo chiller are shown in Figure 4.3-1.

If the temperature of cold water is raised by 2°C, output power of electric motor will be reduced by about 2%. If the temperature of cooling water is lowered by 2°C, output power can be reduced by about 2%.

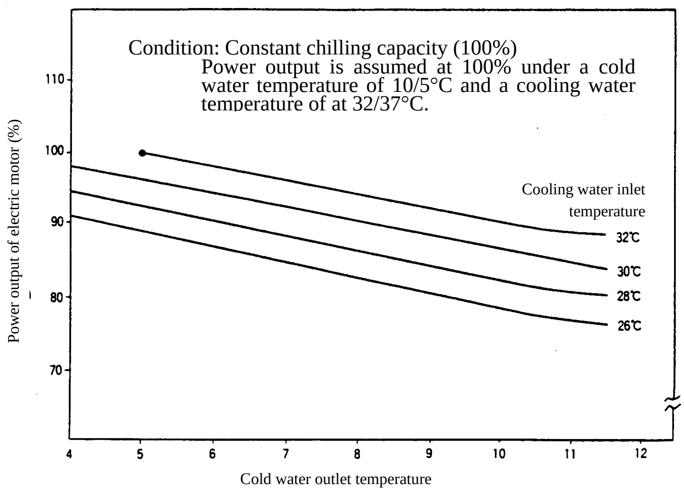


Figure 4.3-1 Relations Among Cold Water Temperature, Cooling Water Temperature and Electric Motor Power Output (Electric turbo-chiller)

(2) Proper setting of machine room temperature

The temperature of the elevator machine room was preset at 30°C. It is not overcooling and the proper temperature was properly setup.

(3) Proper operation of air conditioning equipment and ventilation fans

Two air conditioners at the lobby are in operation during the day while only one air-conditioner is in operation during the night when load is less and there are fewer people. Exhaust fans in the guest rooms are set in motion for 7 hours of the time zone in which guests stay in the rooms. While this kind of equipment is constantly in operation for 24 hours in many hotels, this is a good example for a proper way of operating based on the consideration for energy reduction.

(4) Complete consumption of LPG

When the amount of gas is scarce in the LPG cylinder, the cylinder is toppled over sideways so that LPG, a heavy gas, can be completely used up. The only notification is that safety check should be necessary as well as energy conservation efforts.

(5) Control of outside air intake at the lobby

As much outdoor air comes into the lobby each time the doors are opened and closed, the fresh air intake duct of the air conditioning system for the lobby is closed up as the photo shows.

This is one of the improvements for energy conservation based on the actual situation.
At the time of the second site survey, carbon dioxide concentration was measured at relevant places and it was confirmed that there was no problem with the indoor environmental conditions of the lobby.

Results of the measurement:	CO_2 concentration at the lobby	500 ppm
	CO_2 concentration outside the building	400 ppm

We explained how to use the CO_2 concentration meter that we brought from Japan and made participants actually take measurements. The photo below shows the scene of practice.

(6) Energy conservation activities by all-employee participation

Daily energy consumption and their costs are displayed on the bulletin board, as the photo shows, in the passageway where the employees walk everyday, so that energy reduction will appeal to employees.
This is a good example of the energy conservation activities by all-employee participation.

4.4 Proposed Improvements Plans and Expected Effects

(1) High-efficiency operation of transformers for power receiving

Current load conditions:

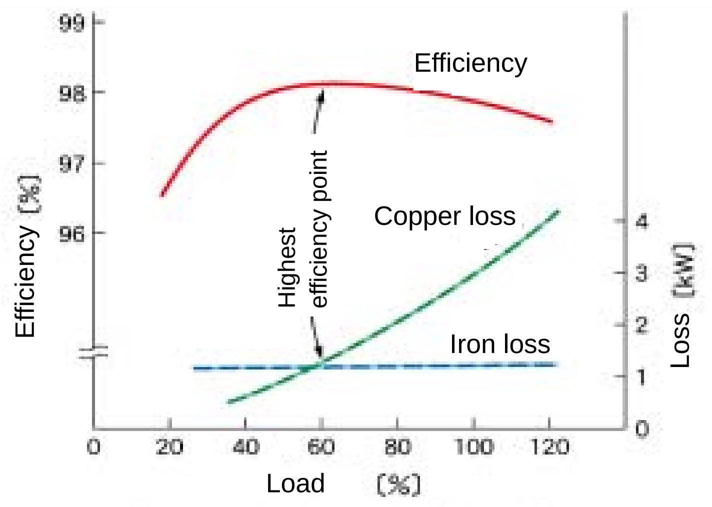
Load of power receiving transformer
TX1 (1000 kVA – 75% for air conditioning): 283 kVA (28.3%)

Load of power receiving transformer
TX2 (1000 kVA-25% for lighting, etc.): 94 kVA (9.4%)

These (377 kVA combined) are the average loads calculated based on the actual annual electric power consumption in 2002, that is 2,968,800 kWh, using power factor of 0.9.

Proposed improvement:

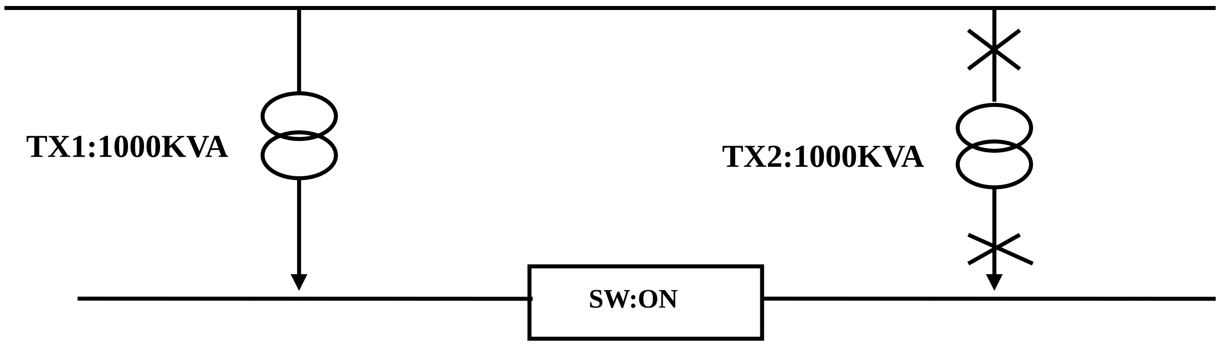
One of the features of standard transformers is, as shown in Figure 4.4-1, that their best efficiency is gained at an about 60% of load. Accordingly, as shown in Figure 4.4-2, if the current two-transformer operation is changed to the one-transformer operation, the load factor the transformer will become higher than now and the operation efficiency also will increase.



Note 3: ϕ 200 [kVA] . 6,600/210 [V] 50 [Hz]

Figure 4.4-1 Efficiency and Losses in Relation to Load of Transformer

Power Receiving at 22 KV



415 V bus line for air conditioning 283 kVA　　415 V bus line for lighting 94 kVA

Total load:　377 kVA

Figure 4.4-2　Proposed Power-receiving System

Estimation of effects

1) Conditions for estimation

- Characteristic of transformer (one example):

Loss \ kVA	1000
No-load loss (Wi)	1,880 W
Load loss (Wc) (at the time of 100% load)	11,890 W

- Operation condition: 365 days without shutdown
- Calculating formula of loss: Wt (total loss) = Wi + Wc × $(Pe)^2$
  Pe: Load factor of transformer
- Load of transformer: TX1 – 384 kVA, TX2 – 177 kVA
  Constant for 24 hours

2) Calculation

- Loss when both transformers TX1 & TX2 are used
  Wt1 = 1880 W × 8760h + 11890 W $(283/1000)^2$ × 8760h + 1880 W × 8760h + 11890 W $(94/1000)^2$ × 8760h = 42,200kWh/year
- Loss when only transformer TX1 is used
  Wt2 = 1880 W × 8760h + 11890 W $(377/1000)^2$ × 8760h = 31,273 kWh/year
- Merit
  Wt1 – Wt2 = 42,200 kWh – 31,273 kWh = 10,927 kWh/year
  (Equivalent to 0.4% of the annual electric power consumption)
- Reduced cost: 616 US$ (Average unit price of electricity: 0.0564 US$/kWh)

(2) Replacement by high-efficiency lamps and lighting fixtures

Current condition

Replacement of incandescent lamps by fluorescent lamps has been implemented since 3 years ago. Incandescent lamps in corridors have already been replaced by fluorescent lamps and those in guest rooms are in the course of replacement.

Proposed improvement

Replacement by fluorescent lamps

Estimation of effects

1) Conditions of estimation

Current lighting fittings with incandescent lamps

25 W × 2 × 3 places/room

Lighting time AM 6 to 10, PM7 to 10 7 hours in total

Reduction plan 25W × 2 → 11W fluorescent lamp × 1

2) Calculation

- Reduced electric power
  (25 W × 2 - 11 W) × 3 places × 142 rooms × 0.65 (occupancy rate) × 7h × 365d = 27,592 kWh/year
- Reduced cost: 27,592 kWh × 0.0564 US$/kWh = 1,247 US$/year
  Merits of changing from incandescent lamps to fluorescent lamps include extended lifetime of lamps (1000h → 8000h) in addition to cost reduction.

(3) Summary of improvement effects

As the operation of the equipment was well managed overall, we did not identify many points to be improved for energy conservation. The recommended improvement plans and expected effects from those improvements are summarized in Table 4.4-1.

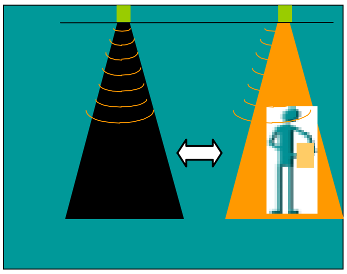
Table 4.4-1 Proposed Improvement Plans and Expected Effects

No	Improvement plans	Reduced electricity [kWh]	Reduced cost [US$]	%
1	High efficiency operation of transformers	10,927	618	0.4
2	Change to high-efficiency lamps and lighting fixtures	27,592	3,371	0.9
	Total	38,519	3,987	1.3
	Annual electric consumption	4,830,876		
	Unit electricity rate US$/kWh	0.0564	US$/kWh	

4.5 Introduction of New Available Technologies

(1) Human body sensor

Automatic lighting system equipped with human body sensor



- 100% lighting when human body is detected by the sensor
  Lighting is reduced to 35% normally under no person
- Places where the system is applicable: Kitchen, toilet, etc.

Source: Material from Matsushita Electric Works,

(2) High efficiency motor

Comparison with performance of standard motor is shown in Figure 4.5-1.

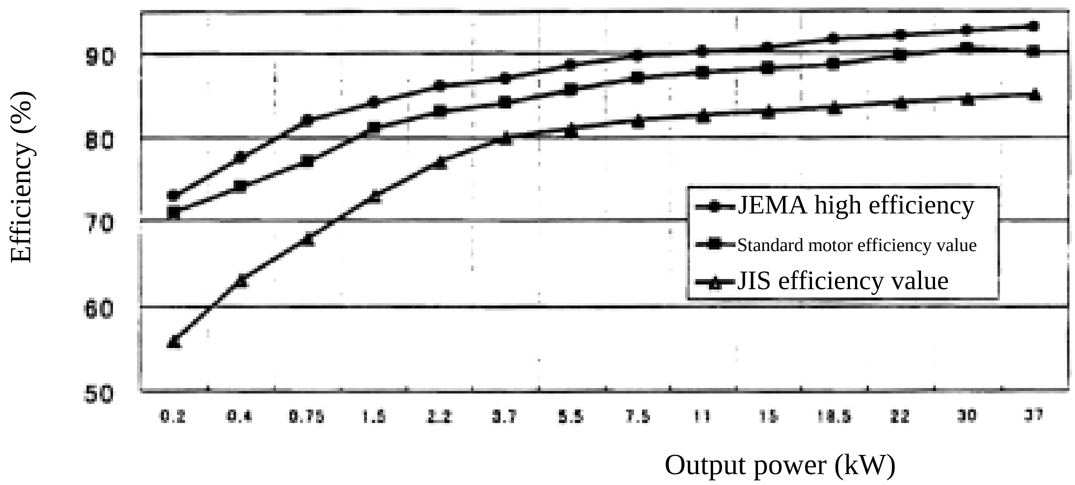


Figure 4.5-1 Relation Between Motor Output Power and Efficiency

5. Databases, Benchmarks and Guidelines for Lao PDR

(1) Current situation in Lao PDR

1) Primary step

In Lao PDR, almost no country-level energy conservation efforts for buildings have been made to date. Nothing comparable to database, benchmark or guideline was available. In the current project, we could obtain energy data on one hotel. Although it is data on only one case example, it is meaningful that we could establish a benchmark based on which they will be able to develop the database in future.

Detailed data of the hotel we audited are as mentioned above. Other information related to energy indices are as follows:

Use of the building: Hotel
Gross floor area: 14,972 m^2
Annual electric consumption: 2,968,800 kWh
Energy consumption per unit area (energy consumption intensity):
198.3 $kWh/m^2/y$
2,203 $MJ/m^2/y$ (Converted by 9.8 MJ/kWh)

In the workshop, in response to our request to the participants for submission of energy data, two cases were given.

Name of building: Parkview Executive Suites
Gross floor area: 18,534 m^2
Annual electric power consumption: 410,723 kWh
Energy consumption per unit area:
22.2 $kWh/m^2/y$
360 $MJ/m^2/y$ (Converted by 9.8 MJ/kWh)

Name of building: Government building
Gross floor area: 1,975 m^2
Annual electric power consumption: 175,489 kWh
Energy consumption per unit area: 88.9$kWh/m^2/y$

The former case is a residence-type hotel. Its air-conditioning system is of split-type individually installed and thus cannot be compared with that of general hotels. It may be appropriate to categorize the building as residence. Another case was introduced as a government building. Although detailed information was not obtained, its energy consumption appears to be typical for office buildings in Laos.

2) Toward future activities to develop database, etc.

We had a brainstorming session to get ideas from the participants to develop databases, benchmarks and guideline in the future and the following were proposed.

FUTURE DIRECTION
DATABASE, BENCHMARK, AND GUIDELINE
FOR BUILDINGS IN LAO PDR

FUTURE ACTIVITIES

1. Data collection
2. Preparation of questionnaires to collect data
3. Establish guidelines, regulation and policy
4. Establishment of national working committee
5. Capacity building such as workshop, seminar etc
6. Promotion and awareness of EEC
7. Procedures on data how collection
8. Conducting energy audit
9. International cooperation supports
10. Hardware and software
11. Development of national EE&C program
12. Establishment of Energy Service companies
13. Accreditation and certification of energy auditors
14. Training and study tours
15. Setting standard and labeling
16. Education of EE &C
17. Consultation with the stakeholders
18. Government incentives
19. Public campaign
20. Training and audit equipment-facilities
21. Energy management
22. National competition and awards for Energy Efficient buildings
23. Encourage private sector participation and investment
24. Establishment of building owner association and architect association

(2) Remarks

1) Starting with government buildings
It was recommended that a series of surveys should be started with government buildings where energy data is easily accessible and the actual status of energy consumption in buildings clarified because we obtained detailed data on energy use on only 3 buildings (the hotel audited and two buildings introduced by the participants).
2) Surveys of hotels
The next step for developing the databases is, hopefully, to extend the survey scope from government buildings to hotels of which number is relatively large

among buildings in the city of Vientiane

(3) Photos

The following are photos of the workshop and participants

1) Workshop

2) Participants

V. Approaches as ASEAN

1. Outline of the ASEAN Post Workshop

Period: Two days of January 29 and 30, 2004

Participants: 27 persons listed below

Ttszuru Nuibe — Managing Director, The Energy Conservation Center, Japan (ECCJ)
Kazuhiko Yoshida — General Manager, International Engineering Dept., ECCJ
Akira Kobayashi — Technical Expert, International Engineering Dept., ECCJ
Takashi Kato — Technical Expert, International Engineering Dept., ECCJ
Mr. Sawad Hemkamon, Deputy Director General, DEDE, Thailand (Chairman)
Dr. Guillermo R. Balce, Executive Director, ACE
Dr. Prasert Sinsuk Prasert, BERC, DEDE, Thailand
Dr. Lee Siew Eang, Associate Professor, National University of Singapore
Mr. Abdul Rashid B Ibrahim, Deputy Executive Director, Energy Market Authority, Singapore
Mr. Zulkarnain B H Umar, Engineer, Energy Market Authority, Singapore
Mr. Majid Haji Sapar, Research Fellow, National University of Singapore
Ms. Alice S. L. Goh, Building and Construction Authority, Singapore
Mr. Vincent Low Loke Kiong, Chairman, Singapore Association for Environmental Occupational Health & Safety Companies
Mr. Yeo Chee Keong, Precicon D&C Pte. Ltd., Singapore
Mr. Nik, PTM, Malaysia
Ms. Azah Ahmad, Research Officer, PTM, Malaysia
Mr. Le Tuan Phong, Official on Energy and Environment, MOI, Vietnam
Mr. Artemio P. Habitan, Science Research Specialist, DOE, Philippine
Mr. Lien Vuthy, Head of Energy Efficiency and Standard Office, MINE, Cambodia
Mr. Sisoukan Sayarath, Chief of Electricity Management Div., Ministry of Industry & Handicraft, Lao PDR
Ms. Marayam Ayuni, Ministry of Energy and Mineral Resources, Indonesia
Mr. U Aung Kyi, Director, Myanmar Industrial Construction Service, Myanmar
Mr. Christopher Zamora, Coordinator, ACE
Mr. Ian, ACE
and three more persons concerned.

This workshop is situated as the closing activity of the site activities of the current fiscal year projects for both “Buildings” and “Major Industries”. In the workshop, the results including achievements of the activities were reported and comments were given from each country subject to the current round of surveys. Then, discussions on the future plan were followed. Specifically, the workshop consisted of 5 sessions.

Session 1: PROMECC-Major Industry - Report and Evaluation of Activities

The results of the energy audits of 4 factories, i.e. 2 caustic soda production factories in Thailand and 2 food processing factories in Singapore and the discussions in the workshops were reported from ECCJ. After the Q and A by participants, reports and comments were made from delegates of Singapore and Thailand.

Session 2: PROMEEC- Buildings - Report and Evaluation of Activities

The results of the energy audits of 3 buildings, i.e. an office building in Malaysia, a hotel in Brunei and a hotel in Lao PDR were reported from ECCJ. After the Q and A by participants, comments were made from delegates of Malaysia and Laos. (No reports and comments from Brunei was made because of the absence of their delegates)

Session 3: Activity Reports and Discussions on Development of Database / Benchmark / Guideline for buildings

Comments on the results of the discussions made in the workshops in Malaysia, Brunei and Lao PDR were given from delegates of each country. Then, Japanese experts summarized the results. The results of the discussions conducted in each country will provide a valuable base for the development of the ASEAN database/benchmark/ guideline.

Then, Dr Lee of National University of Singapore made a progress report on the activities of ASEAN Task Force. In this report, he proposed a direction of developing benchmarks based on the analysis results of energy data collected in Thailand, Malaysia and Vietnam in the previous year. He closed his report by proposing a concept of the e-benchmark system utilizing the Internet including data collection system. The report was followed by active discussions on the content of the report including this proposal. The importance of the clear definition of benchmark was underlined. This was also the issue discussed during the previous project report.

Session 4: Discussions on the Future Action Plans

Based on the results of the above activity reports, the future direction and the conceptual plans for the next fiscal year were discussed. As a result, the action plans developed based on the agreement reached through discussions are to be reflected in the ASEAN 5-year plan from 2004.

Session 5: Discussions on ASEAN Plan of Action for Energy Cooperation (APAEC) 2004-2009

Dr. Prasert of Thailand explained specific action plans for energy cooperation. It was confirmed that the contents agreed upon in the discussions made in Session 4 would be reflected in the Plan related to PROMEEC with due considerations to the results of the discussions.

(POST WORKSHOP PROGRAM)

POST WORKSHOP ON PROMOTION OF ENERGY EFFICIENCY AND CONSERVATION (PROMEEC)
(MAJOR INDUSTRY AND BUILDING)
SOME-METI WORK PROGRAMME 2003-2004

Date: 29 January – 30 January, 2004

Venue: Victoria Meeting Room, ALLSON Hotel, Singapore

Day 1 : Thursday, 29 January 2004

09:00	**REGISTRATION**
	OPENING SESSION
09:10	**Welcome Remarks from the Host Country** **Mr. Wong Siew Kwong, Executive Director, Energy Market Authority (EMA) and Senior Officials on Energy (SOE) - Leader for Singapore**
09:20	**Opening Statement** **Dr. Guillermo R. Balce, Executive Director** **ASEAN Centre for Energy (ACE)**
09:30	**Opening Statement** **Mr. Tsuzuru Nuibe, Managing Director** **Energy Conservation Centre, Japan (ECCJ)**
09:40	Opening Statement **Mr. Sawad Hemkamon, Deputy-Director General, Department of Energy Development and Efficiency (DEDE) and Coordinator, EE&C-SSN**
10:00	Group Photo and Coffee Break
10:10	Adoption of the Agenda and Election of Rapporteur
10:30	**"Energy Management and Energy Manager System in Japan"** Mr. Tsuzuru Nuibe, Managing Director, ECCJ
SESSION 1	**PROMEEC - MAJOR INDUSTRY (SINGAPORE AND THAILAND)**
11:00	**Consideration and Adoption of the Results of Energy Audits / Recommendation** **Mr. Kazuhiko Yoshida, General Manager, ECCJ**
11:15	**Comments from Singapore on Energy Audit, OJT and Workshops (Energy Conservation Technologies, Database/Benchmark/Guideline for Food Industry)**
11:30	**Comments from Thailand on Energy Audit, OJT and Workshops (Energy Conservation Technologies, Database/Benchmark/Guideline for Caustic Soda Industry)**
12:00	**Q & A**
13: 30	**Lunch**
SESSION 2	**PROMEEC – BUILDING (BRUNEI DARUSSALAM, LAO PDR, & MALAYSIA)**
14:00	**Consideration and Adoption of the Results of Energy Audits / Recommendation** **Mr. Takashi Kato, Technical Expert, ECCJ**
14:15	**Comments from Brunei Darussalam on Energy Audit, OJT and Workshops**
14:30	**Comments from Lao PDR on Energy Audit, OJT and Workshops**
14:45	**Comments from Malaysia on Energy Audit, OJT and Workshops**
15:00	**Q & A**
15:30	**COFFEE BREAK**
SESSION 3	**DEVELOPMENT OF DATABASE / BENCHMARK / GUIDELINE FOR BUILDINGS**
15:50	**Comments and Perspective from Brunei Darussalam (Focal Point)**
16:10	**Comments and Perspective from Lao PDR (Focal Point)**
16:30	**Comments and Perspective from Malaysia (Focal Point)**
16:50	**Summary of Workshops on Development of Database / Benchmark / Guideline in Brunei Darussalam, Lao PDR and Malaysia** **Mr. Akira Kobayashi (Technical Expert, ECCJ)**
17:00	**Q&A**
	END of Sessions for 29 January 2004

Day 2 : Friday, 30 January 2004

09:00	**REGISTRATION**
	(Continuation of SESSION 3)
09:20	**Report on Progress of Task Force on Developing ASEAN Benchmarking System in Buildings** **Dr. Lee Siew Eang (NUS, Singapore)** (To be confirmed)
10:30	**Discussion on Direction to Develop Database / Benchmark / Guideline for ASEAN** **All Participants**
10:50	**Coffee Break**
12:00	**(Continuation) Discussion on Direction to Develop Database / Benchmark / Guideline for ASEAN** **All Participants**
13:00	**LUNCH**
SESSION 4	**FORMULATION OF WORK PLAN**
13:20	**Proposed Future Plan and Direction** **Mr. Kazuhiko Yoshida, General Manager, ECCJ**
14:30	**Discussion on "Proposed Future Plan and Direction"** **All Participants**
SESSION 5	**OTHER MATTERS**
15:30	**Consideration of the ASEAN Plan of Action for Energy Cooperation (APAEC) 2004-2009** **Focal Point of Thailand**
16:00	**COFFEE BREAK**
	CLOSING
16:10	**Mr. Tsuzuru Nuibe, Managing Director, ECCJ**
16:20	**Dr. Guillermo R. Balce, Executive Director, ACE**
16:30	**Closing Statement from Chairman** **Mr. Sawad Hemkamon, Coordinator, EE&C-SSN**
	END OF POST WORKSHOP

2. Energy Audits for Buildings

2.1 The Actual Results in the Past

Energy audits of buildings have been implemented for 4 years since 2000. The following are the actual results.

2000	Thailand	Office building
	Singapore	Complex facility
2001	Cambodia	Hotel
	Indonesia	Office building
	Philippine	Office building
2002	Vietnam	2 hotels
	Myanmar	1 Complex facility (Offices/stores)
		1 hotel
2003	Malaysia	Office building
	Brunei	Hotel
	Lao PDR	Hotel

In the energy audits in 2000 and 2001, on-site audits were implemented with the focus on technologies for improvement in energy conservation.

In 2002, in two countries, two buildings were audited respectively. Unlike the audits conducted in the previous two years, these energy audits were implemented with the focus on OJT (On the Job Training) practice for participants as well as the energy audits by Japanese technical experts.

In 2003, like in 2002, the surveys underlining energy audits in a way of OJT were realized. The local participants were present in the interviewing with the persons concerned of the buildings subject to the energy audit, so that they could understand the points to be clarified.

In the on-site investigations, participants joined the check up of the points for energy audit while they played a central role in simple measurements such as that of temperature, electric current, luminous intensity, etc.

On completion of the first site survey, the wrap-up meeting was held on the next day to report points for improvement identified in the survey and the discussions with the local percipients was made.

In the second site survey, the Japanese experts gave a lecture on the calculation methods of the effects gained from the recommended improvements and also conducted an additional survey to improve the accuracy of such calculations. In this follow-up survey, we used the CO_2 concentration meter brought from Japan to take measurements of CO_2 concentration in the places concerned, which is essential for controlling outdoor air intake. The participants actually measured CO_2 concentrations by themselves and confirmed that the device was easy to use. The actual CO_2

concentration was measured in several places inside and outside the building.
It is believed that about 20 engineers in each country could acquire energy audit skills and procedures through twice surveys for this fiscal year conducted in the three countries.

2.2 Future Prospects

In all the 3 countries where the energy audits were conducted in this fiscal year (Malaysia, Brunei and Laos), electricity charges are low. Therefore, energy conservation may not much appeal to people in the current situation. However, in the twice surveys, the local participants could experience energy audits as their OJT. Moreover, it is emphasized that many of the recommended improvements suggested to the persons in charge of repair and maintenance of the buildings concerned in the first on-site survey had already been made by the time of the 2nd survey. They appeared to be surprised to know that the effects from the improvements they made were equivalent to several % to 14% of the annual electricity consumption.
In Malaysia, the development of database and benchmark has considerably advanced. The law concerning energy conservation will be enacted in April 2004. Thus, action plans including the formulation of the guideline and the promotion of ESCO business will be necessary in the future.
On the other hand, the energy conservation in Brunei and Lao PDR are yet to be farther developed. It is necessary for these countries to conduct energy audits and questionnaire surveys for buildings, using ESCO, etc., based on the experience of the current surveys, in order to grasp the overall picture of energy consumption in buildings in their countries and go on forward to the development of database, benchmark and guideline. As this process will take time, Japan should continue to render support to these countries.

3. Database, Benchmark and Guideline for ASEAN

(1) Reports from the 3 countries

In the Post Workshop, delegates from the surveyed countries made a report on the activities and discussions developed at their respective workshops. (Delegate of Brunei was absent)

The delegate of Lao PDR explained said that although the creation of database, benchmark, and guideline of energy conservation had not been advanced and not yet even planned in their country, participants from their country could share much information on technologies and political measures concerning energy conservation. On behalf of the participants in Lao PDR, he expressed their gratitude for ECCJ.

The delegate of Malaysia made a presentation on the efforts currently being made in development of database, benchmark and guideline. In the presentation, she reported on the database on 55 buildings, benchmark obtained form the database and the guideline already formulated. On behalf of the participants in Malaysia, she expressed their gratitude to ACE and ECCJ particularly for the workshop in which they could share information that was useful and valuable to their country.

(2) Review and summary by Japanese experts

The Japanese experts made a summary report on the energy audits of buildings in 10 ASEAN countries in Post Workshop.

Energy audits conducted in these 4 years and data on energy use in buildings obtained in the workshops are shown in Table 3-1. The table shows that most of data is obtained from Malaysia. Although the figure including all the data collected does not provide significantly useful information because the data on buildings for different use. Figure 3-3 based on the reliable 9 hotels' data shows clear correlation. According to the result, although the current data has a problem with its accuracy, it is possible to develop energy indicators for all ASEAN countries through elaborately building up data.

Table 3-1 Data on Buildings collected in ASEAN Countries

		Energy Audit		Data				Total
		Office	Hotel	Com.Office	Gov.office	Hotel	Others	
2000	Thailand	1		1				1
	Singapore	1		1				1
2001	Cambodia		1			1		1
	Indonesia	1		1				1
	Philippines	1		1				1
2002	Vietnam		2	2	2	6	6	16
	Myanmar	1	1	1	6	1	3	11
2003	Malaysia	1		(47)	12			(59)
	Brunei		1			1	1	2
	Lao PDR		1		1	2		3
Total		6	6	(54)	21	11	10	(96)

* The number "Data" includes number of the data collected by "Energy Audit"

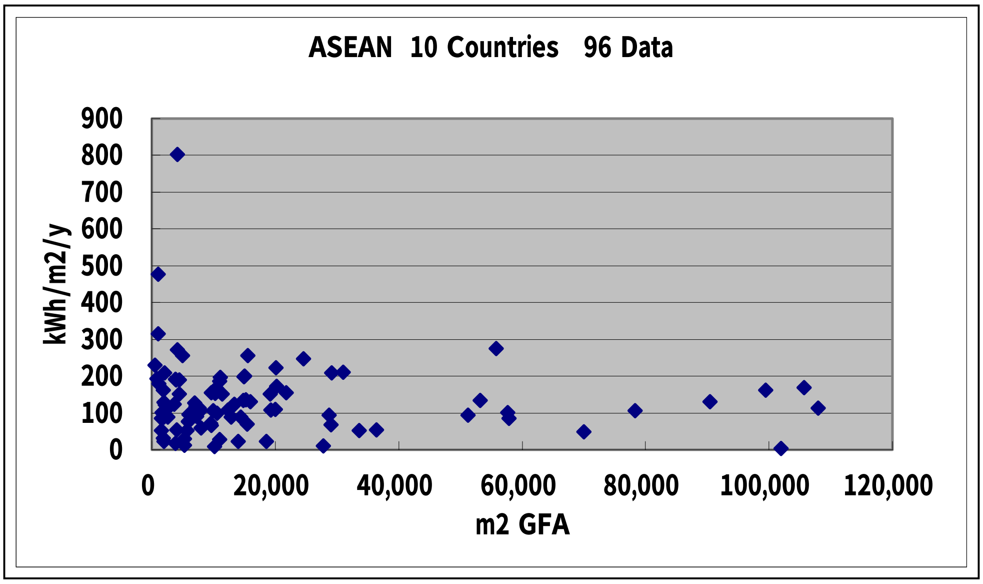


Figure 3-2 Relation Between Gross Floor Area and Energy Consumption per Unit Area (96 data from 10 ASEAN countries)

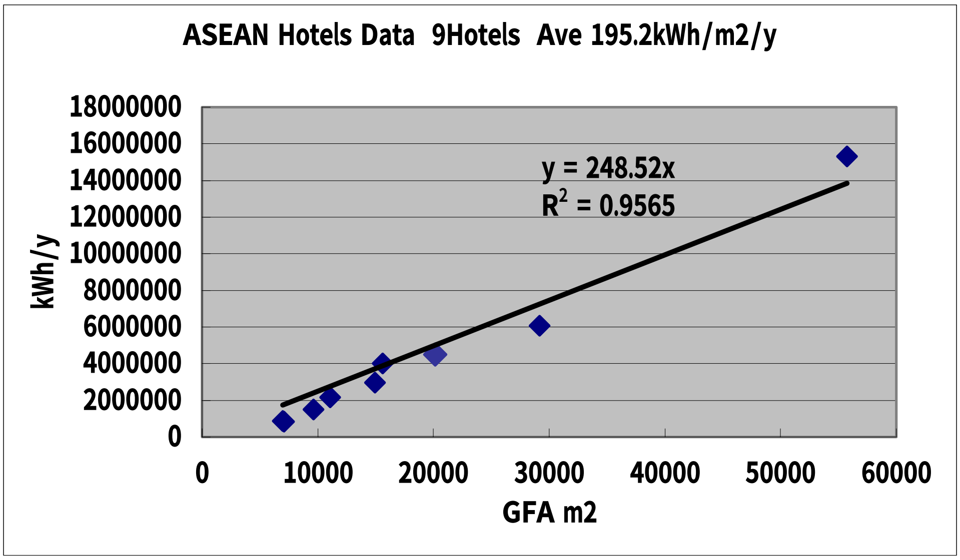


Figure 3-3 Relation Between Gross Floor Area and Annual Energy Consumption (data on 9 hotels in ASEAN countries)

We made the following suggestions for future data collection.

1) For energy unit, kWh/m^2/yr is realistic and appropriate.
(Although MJ/m^2/yr is sometimes used in Japan because gas and oil are used for heat source for cooling, kWh/m^2/yr is likely to be used more commonly in ASEAN counties considering their respective local conditions.)

2) Classification of air-conditioning system is necessary
(There are two types of air-conditioning systems, central air-conditioning system and individual air-conditioning system. Because energy consumption largely differs between the two systems, it is necessary to classify buildings by the system employed even if the buildings are of the same use.

3) Energy consumption per operating area should be evaluated
(In ASEAN countries, many of large-size buildings have a large area of parking lot in their gross areas and many office buildings have many vacant rooms. Therefore, it is appropriate to assess energy consumption for actually working area.)

Operating area =
(Gross floor area) – (area of indoor parking lot) – (area of vacant rooms)

(3) Report by Dr. Lee of National University of Singapore

On behalf of the taskforce, Dr. Lee reported that the progress of ASEAN benchmark project was 70% of the 1st phase based on the plan. He also made an interim report on the analysis of energy data of Malaysia, Thailand and Vietnam using many graphs. He proposed the following future action plans.

1) Verify the current data and expand data volume
2) Prepare for the development of the benchmarking center utilizing the Internet Web
3) Conduct detailed energy audits if possible
4) Officially launch e-Benchmarking center and workshops
5) Start the 2nd phase of the project involving all ASEAN countries

(4) Future plans

Energy audits of buildings were conducted in all 10 ASEAN countries as of the fiscal year of 2003. However, as the development of database, benchmark and guideline has just been started since the fiscal year of 2002, only 5 countries have implemented the activities, as of now. The activities should further be advanced in these countries and developed in more countries in the future, specifically from the following important aspects.

1) Collection and enhancement of data based on the conditions of the respective countries
In accordance with the differences in economic development status among the 10 member countries, the use of major buildings also differs from country to country. In some countries, namely, government buildings make up a large portion of the buildings or hotels are their major buildings. In addition, as economic activities get vitalized, the number of office buildings increase to share a large portion. Thus, it is necessary to create databases by use of building depending on the conditions of the respective countries.

2) Collaboration of the 10 countries
Although the 10 ASEAN member countries have different climates in principle, their overall climate as a region differs less, compared with that of Japan. Thus it is possible for them to develop a cooperative approach to save energy used for air conditioning that accounts for a major portion of energy consumption in buildings. It is important to promote energy conservation at a regional level by sharing and utilizing energy data on buildings.

3) Technical aids from Japan

In Japan also, analysis methods and new judgement criteria for energy conservation in buildings are being studied. It is meaningful, from an international point of view, to provide information on such technologies and know-how in Japan and to work with ASEAN countries for prevention of global warming. Japan should continue to provide necessary assistance to ASEAN countries and enhance the joint activities even more than now.

VI. Reference Materials

Reference Material - 1:	Materials for Workshops held in respective countries Audit results, development of database, etc.
Reference Material - 2:	Materials for Workshops held in respective countries Database/Benchmark/Guideline (Japan)
Reference Material - 3:	Materials for Post Workshop

Reference Material – 1

Materials for Workshops held in respective countries

Audit results, development of database, etc.

Preliminary Report
Building Energy Audit
(Malaysia)

20 January, 2004

Akira Kobayashi
Takashi Kato

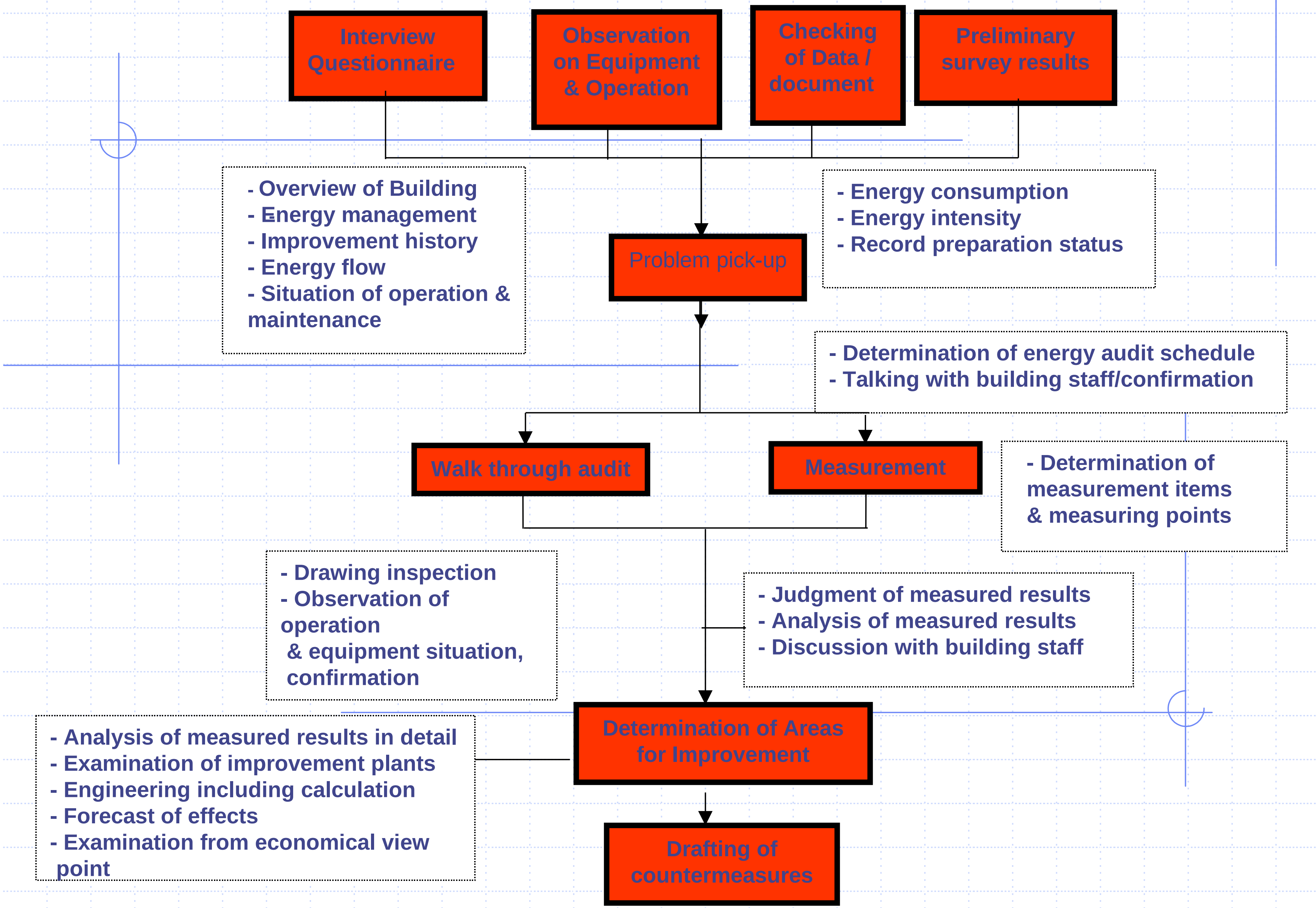
The Energy Conservation Center, Japan

Outline of Presentation

- Building energy audit flow chart
- Results of Audit in Sapura Building
  - General building information
  - Overview of electrical facilities
  - Overview of air-conditioning facilities
  - Utility consumption
  - Energy intensity
  - Improvement points and potential savings
- Summary

Building Energy Audit Flow Chart

Building Energy Audit Flow-chart



Preliminary Results of Energy Audit in Sapura Building, Malaysia

1.1 General Building Information

- Name of Building: Sapura @mines
- Category of Usage: Office building
- Number of Storeys: 11
- Total Gross Floor Area: 51,282 m^2
- Age of Building : 5 years
- Energy Management System : Building Automation System (BAS)

1.2 Overview of Electrical Facilities

- Receiving Voltage: 11 kV
- Transformer capacity:

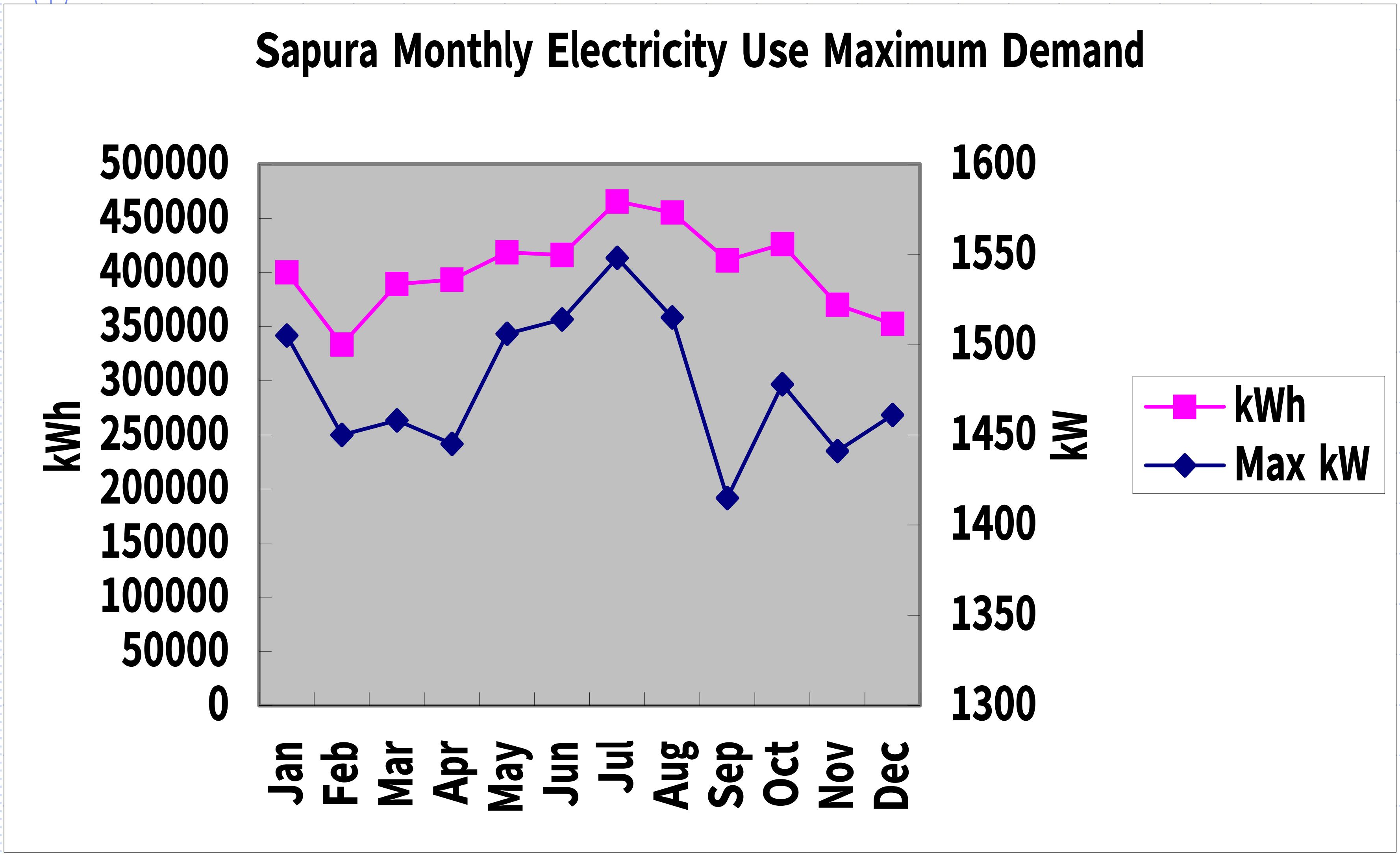
  1,500 kVA × 2 units & 2000 kVA × 1 unit
- Generator for emergency: 800 kVA x 1 unit
- Elevators : 6 units x 20 kW
- Service lifts : 2 units x 16 kW
- Special lift : 1 unit x 22.4 kW

1.3 Overview of Air-conditioning Facilities

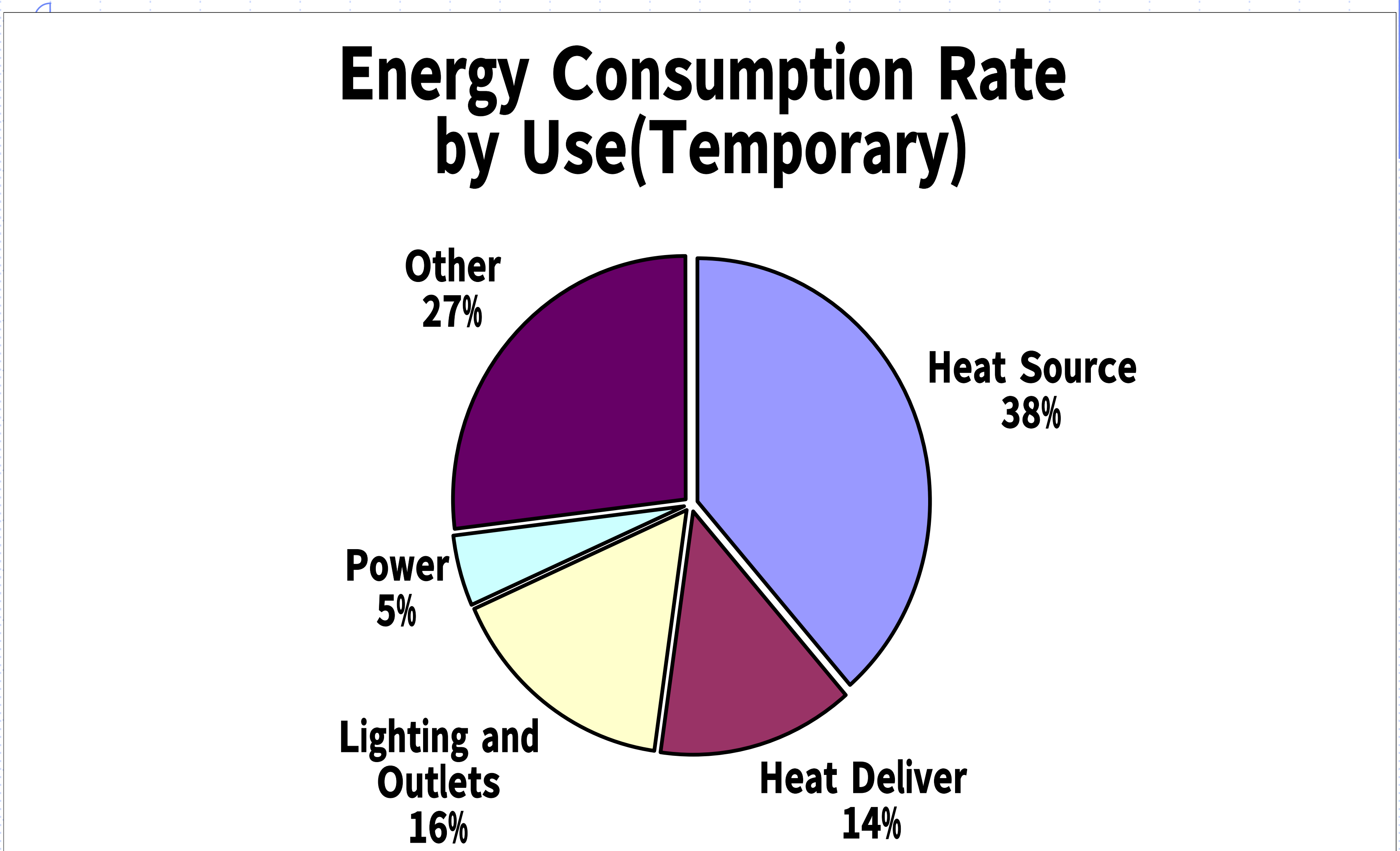
- Chiller capacity :
  - 3 units x 500 Refrigerant ton (327 kW)
  - I unit x 150 Refrigerant ton (104 kW)
- Air handling units (AHU)
- Fan coil units (FCU)
- Split type

2 Analysis of Current Situation

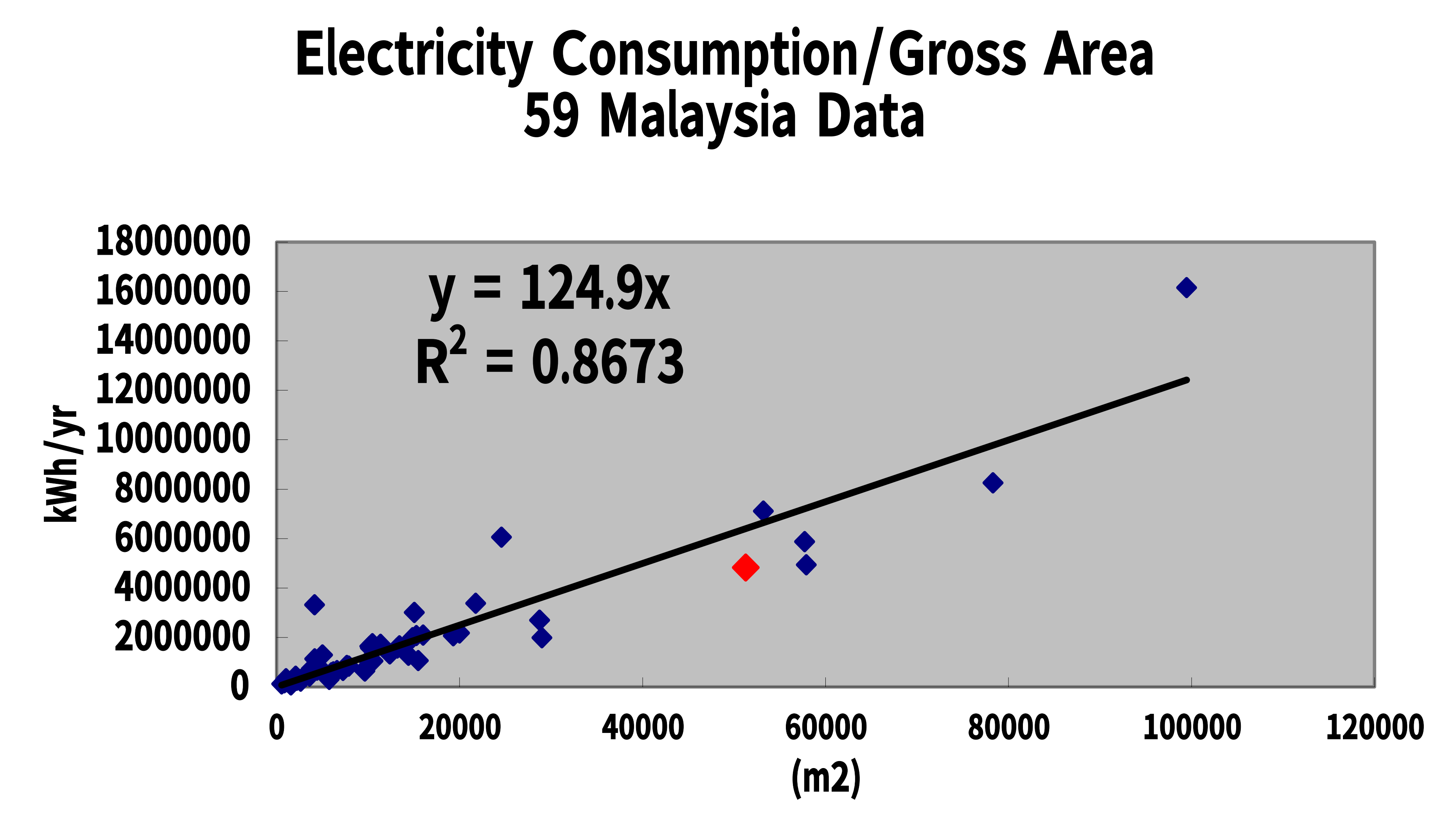
2.1 Monthly Energy Consumption (2002)

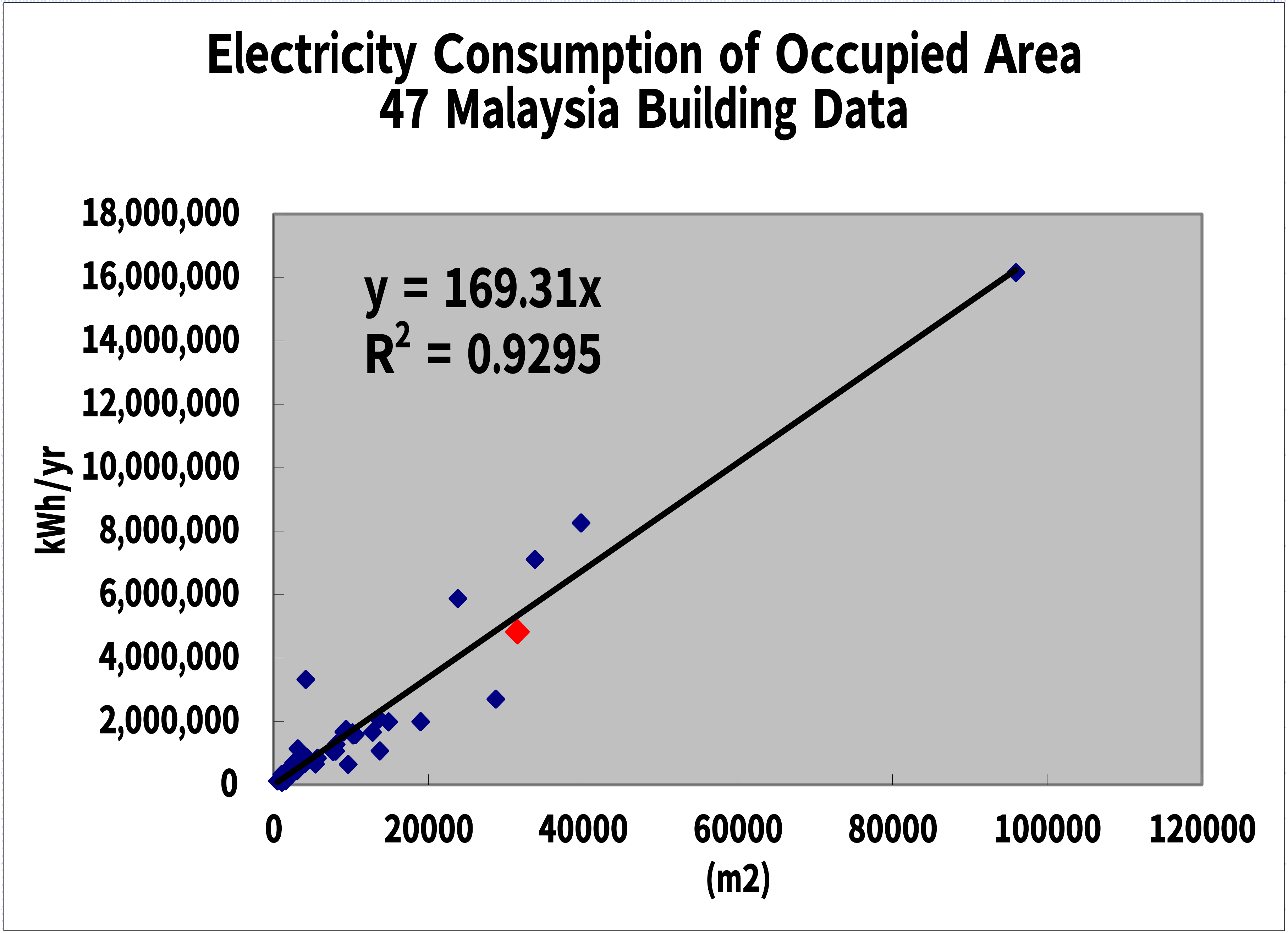


2.2 Energy Consumption by End-use (in %)

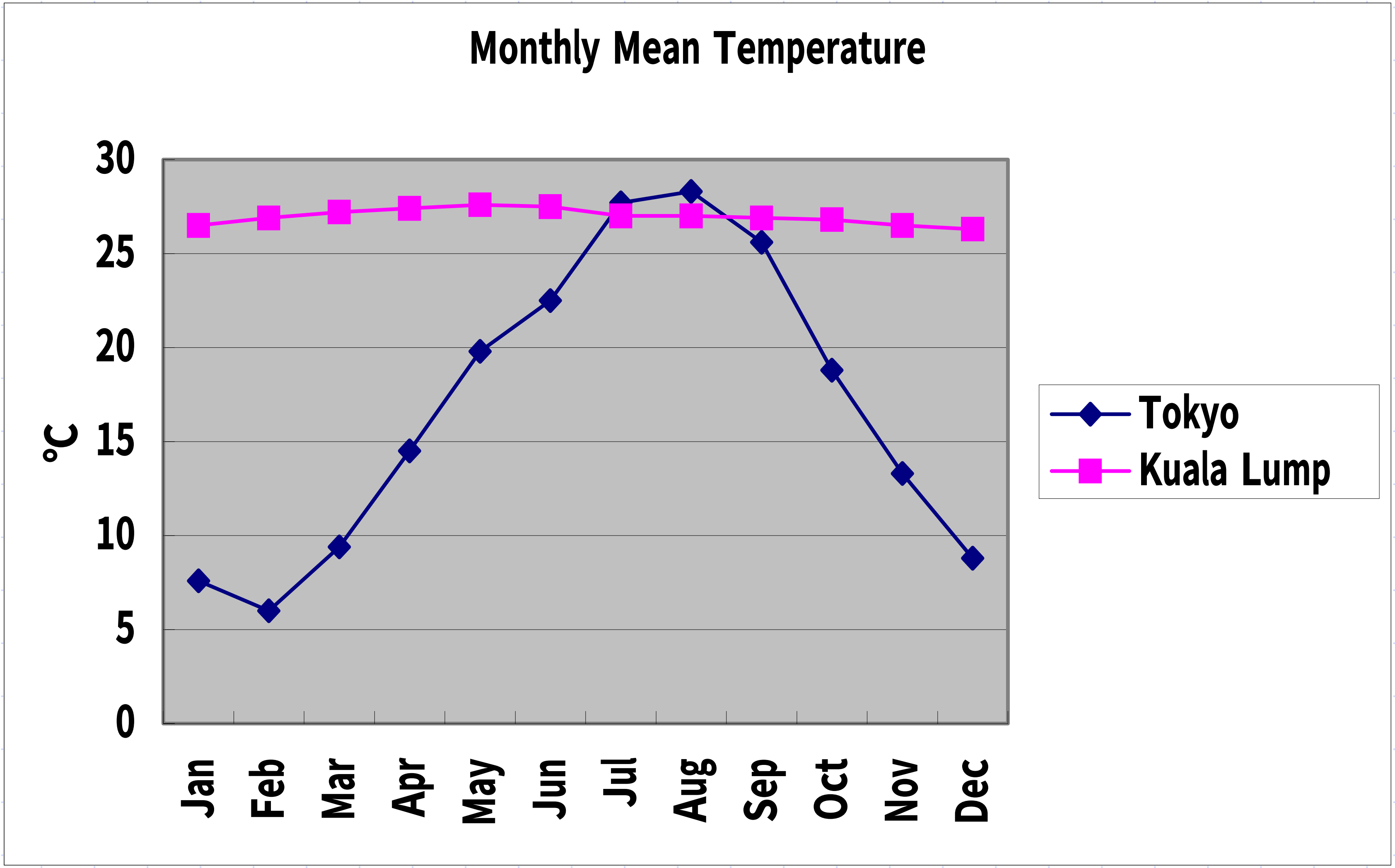


2.3 Energy Intensity: Sapura Building versus Other Malaysian Buildings (in kWh/yr/m²)

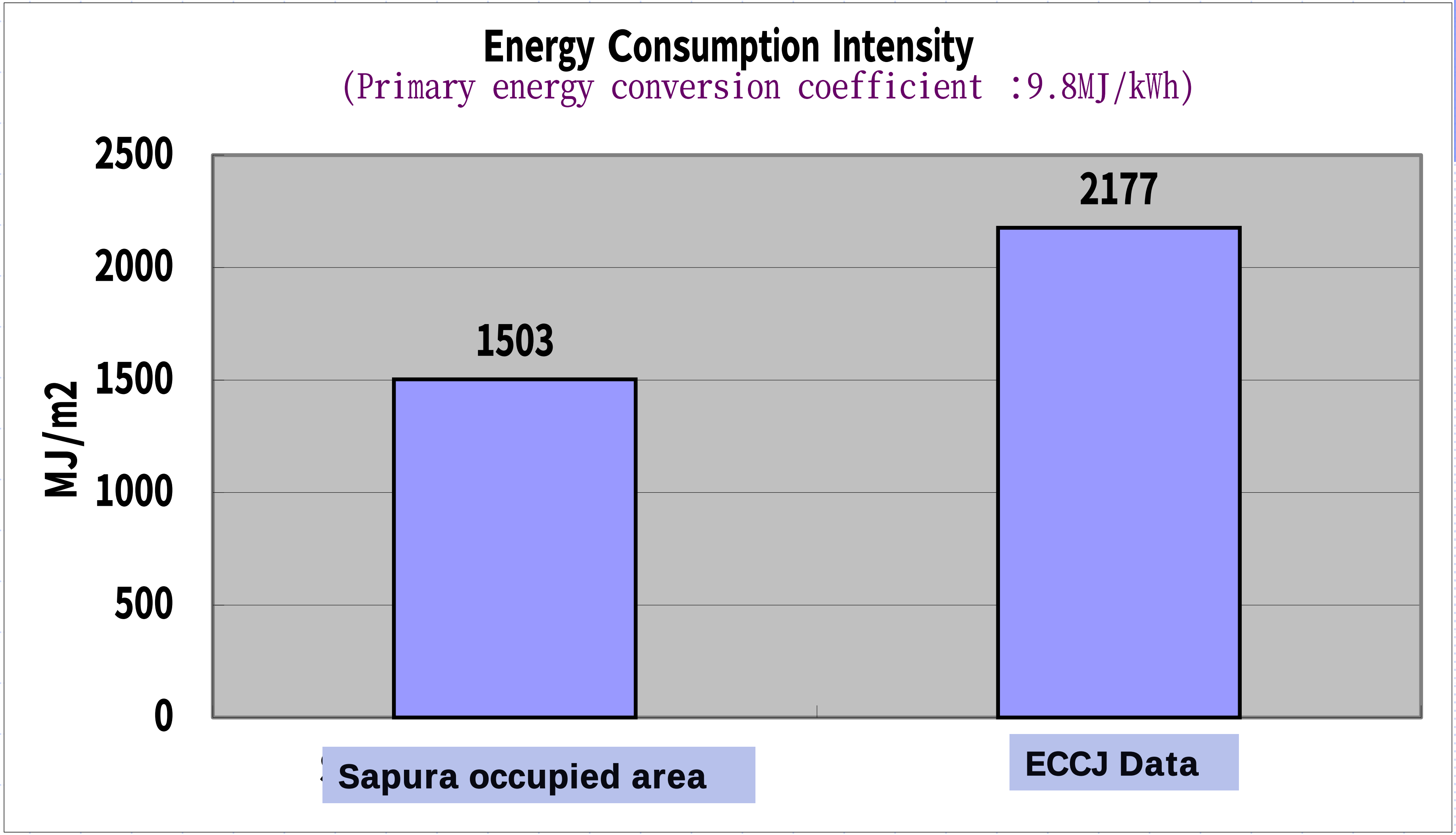



Electricity Consumption of Occupied Area
47 Malaysia Building Data
y = 169.31x
R2 = 0.9295
kWh/yr
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
0
20000
40000
60000
80000
100000
120000
(m2)

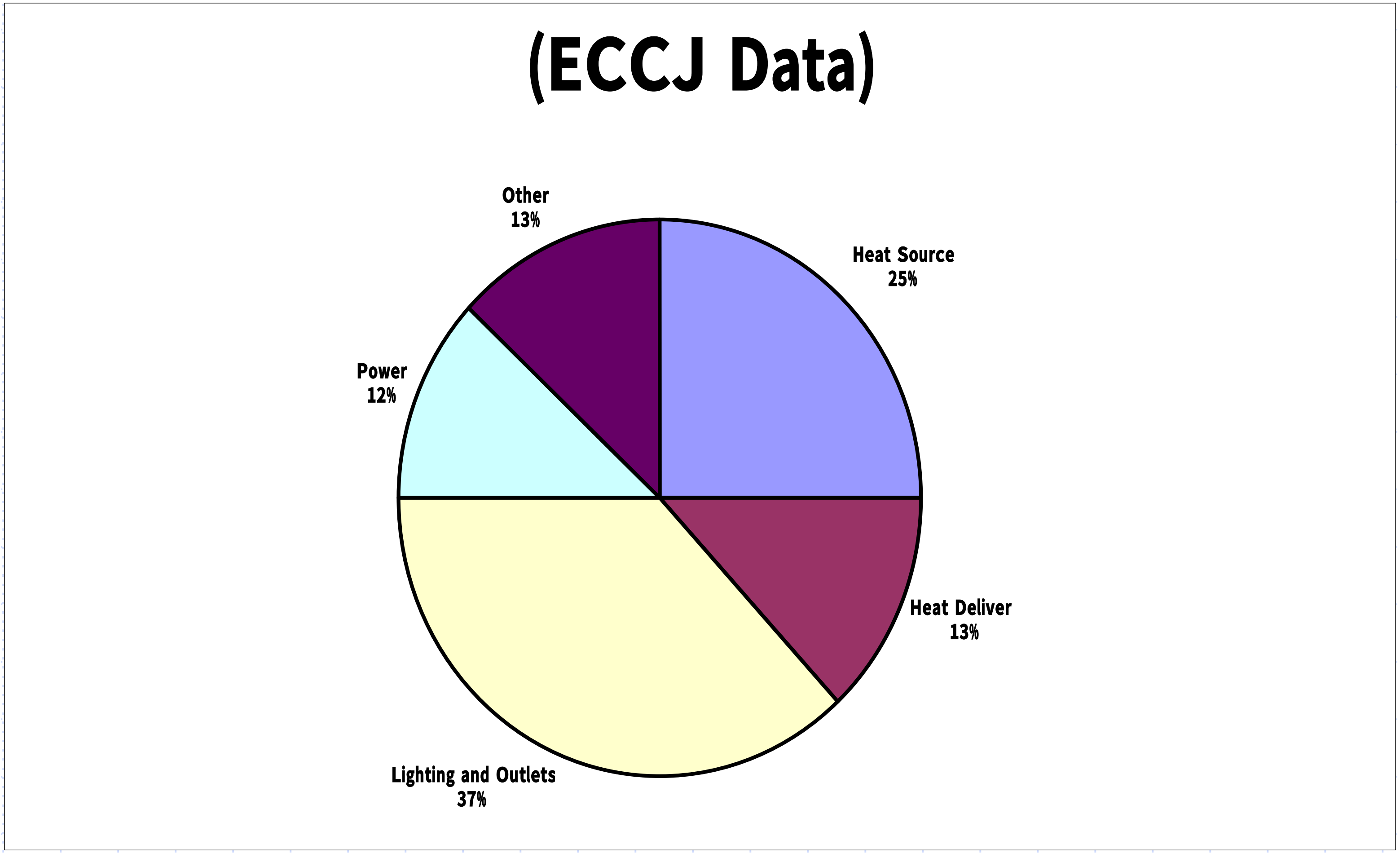
2.4 Mean Temperature : Japan vs. Kuala Lumpur



• **Building Energy Intensity: Sapura vs. ECCJ Data**

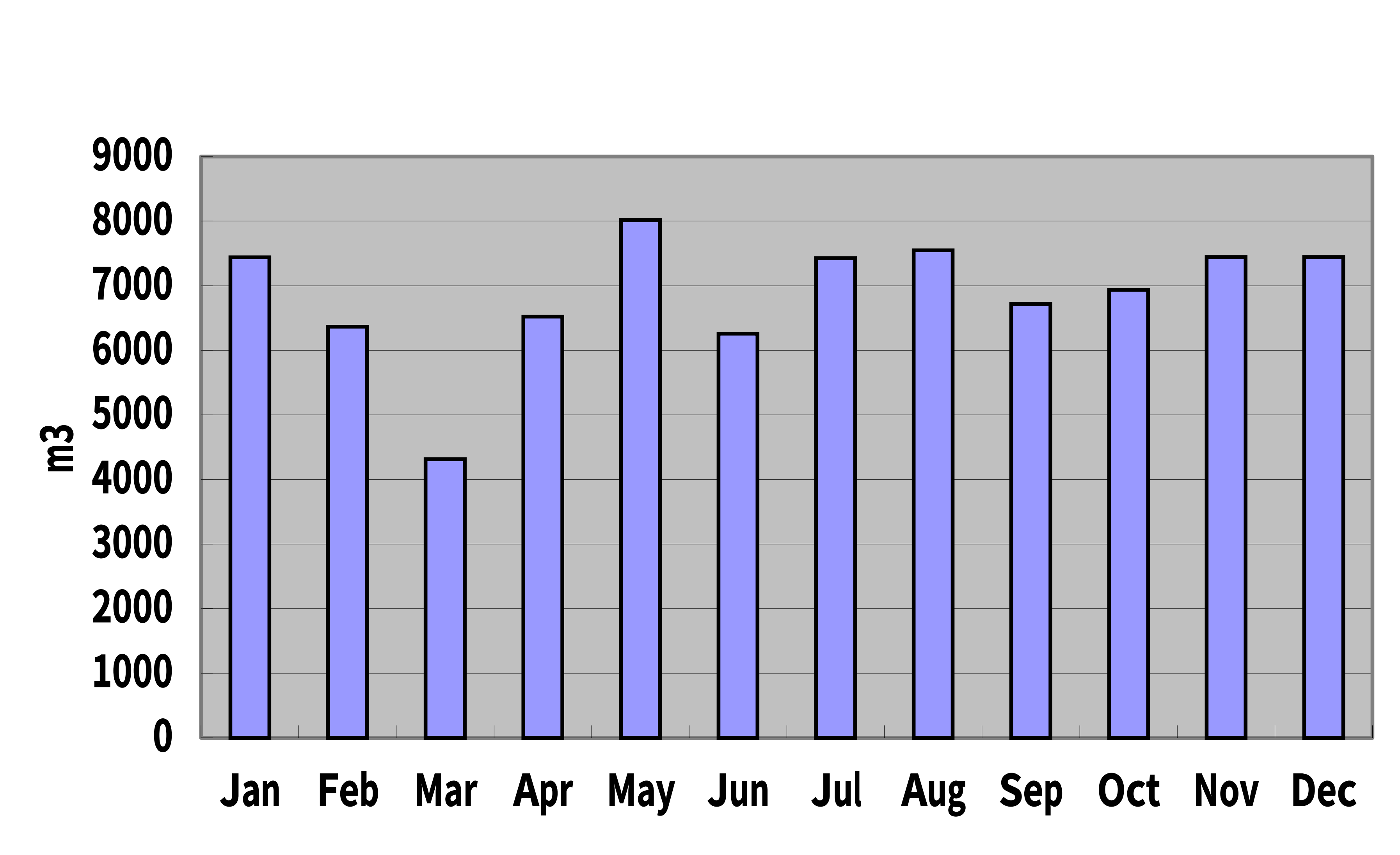


- **Energy Consumption by End-use of Japan Office Buildings (in %)**

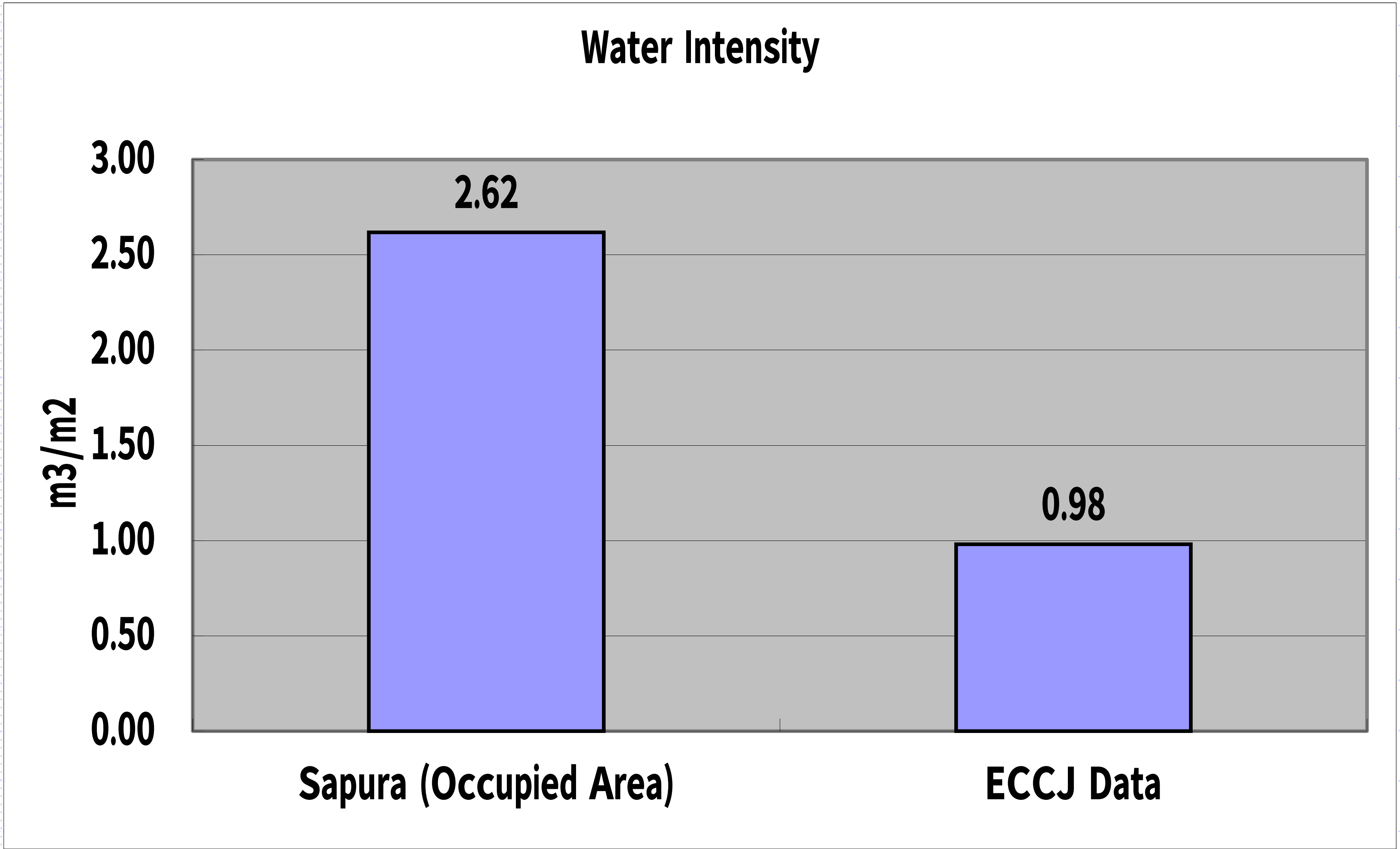


2.5 Water Consumption

(1) Monthly Water Consumption of Sapura Building in m^3



Water intensity : Sapura vs. Japan Buildings (in cubic meter per m^2)



Improvement Items and Potential Savings

Improvement Point 1.
In-door Setting of Temperature

- **Current situation** : In-door temperature setting of Sapura Building: 22℃ ～ 23℃

- **Recommended Improvement Plan**

  Decrease the electric power of the chiller by raising the in-door temperature setting by 2℃

- **Potential Savings** – 273,621 kWh/yr or 5.7% of total electricity consumption

Improvement Point 2.
Adjustment of Fresh Air Volume from Outside

- **Current situation** : In-take of fresh air volume not quantified
- **Recommended Improvement plan**

  To decrease the in-take of fresh air volume by 50% of the current volume.
- Measurement of carbon dioxide (CO_2) density outside 400 ppm, inside 600 ppm, recommendation - increase to 800 ppm
- **Potential savings** : 213,466 kWh or 4.4% of total electricity consumption

Improvement Point 3.
Full shut down of the Variable Air Volume (VAV) of unused rooms

- Current Situation : 8th Floor South West Wing are air-conditioned and ventilated
- Recommended Improvement plan

  Full closure of VAV, cut off chiller power and ventilation.
- Potential Savings:

  Chiller : 23,217 kWh/yr

  AHU : 19,149 kWh/yr

  Total : 42,366 kwh/yr or 0.9% of total electricity consumption

Improvement Point 4.
Optimization of Chiller Operation

- Current situation : 2 units of 500RT chiller are operated even when the cooling load density is low.
- 500 RT×3 units chiller and 150 RT×1 unit chiller are currently installed.
- Recommended Improvement plan

  When cooling load demand is low, only use 1 unit of 150 RT chiller.
- Potential Savings : 59,274 kwh/yr or 1.2% of total electricity consumption

Improvement Point 5.
Optimization of the Receiving Transformer

- Current situation

  - Load of the transformer TX1 (1500 kVA)

    — 348 KVA (23.2%)

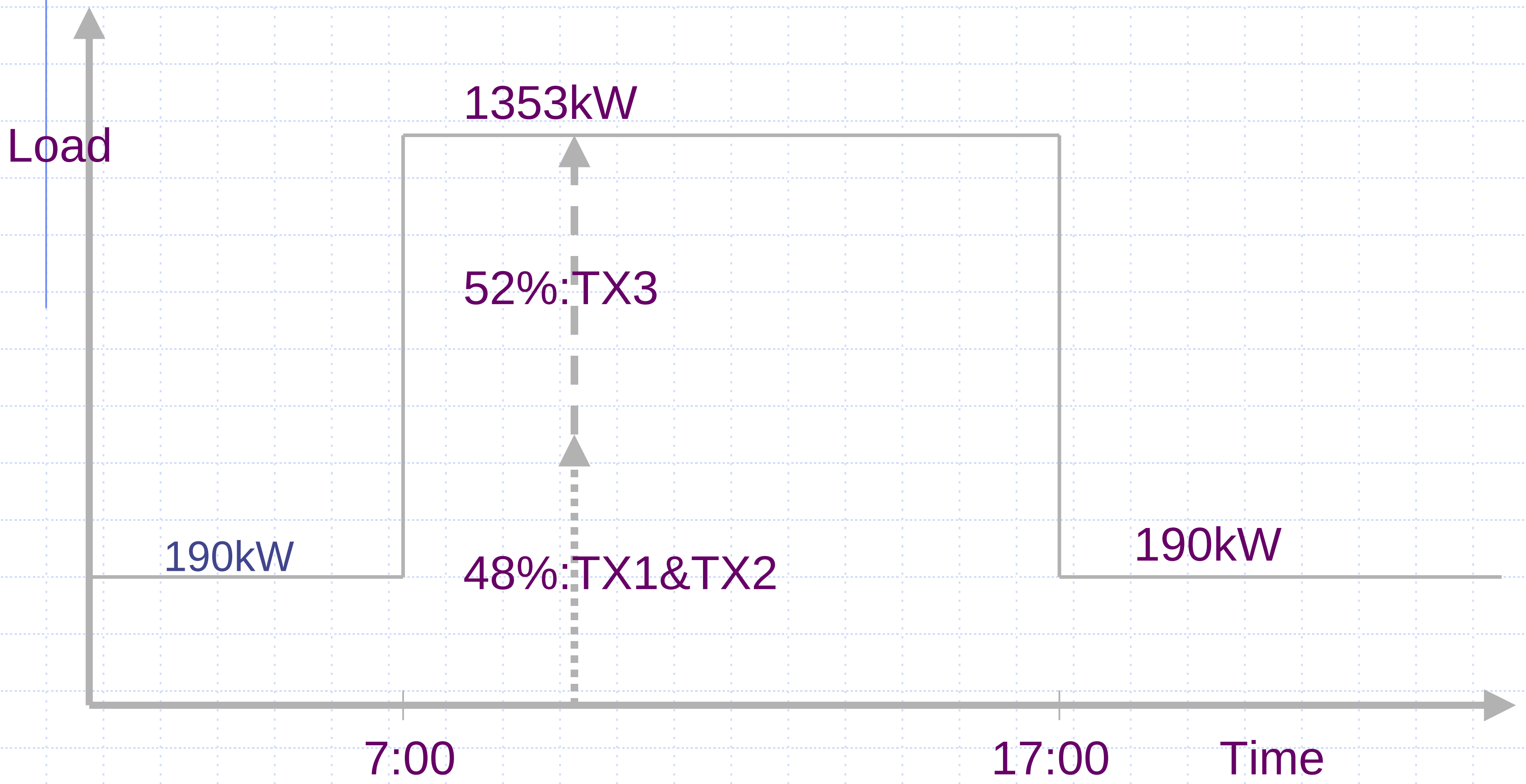
  - Load of the transformer TX2 (1500kVA)

    — 355 KVA (23.7%)

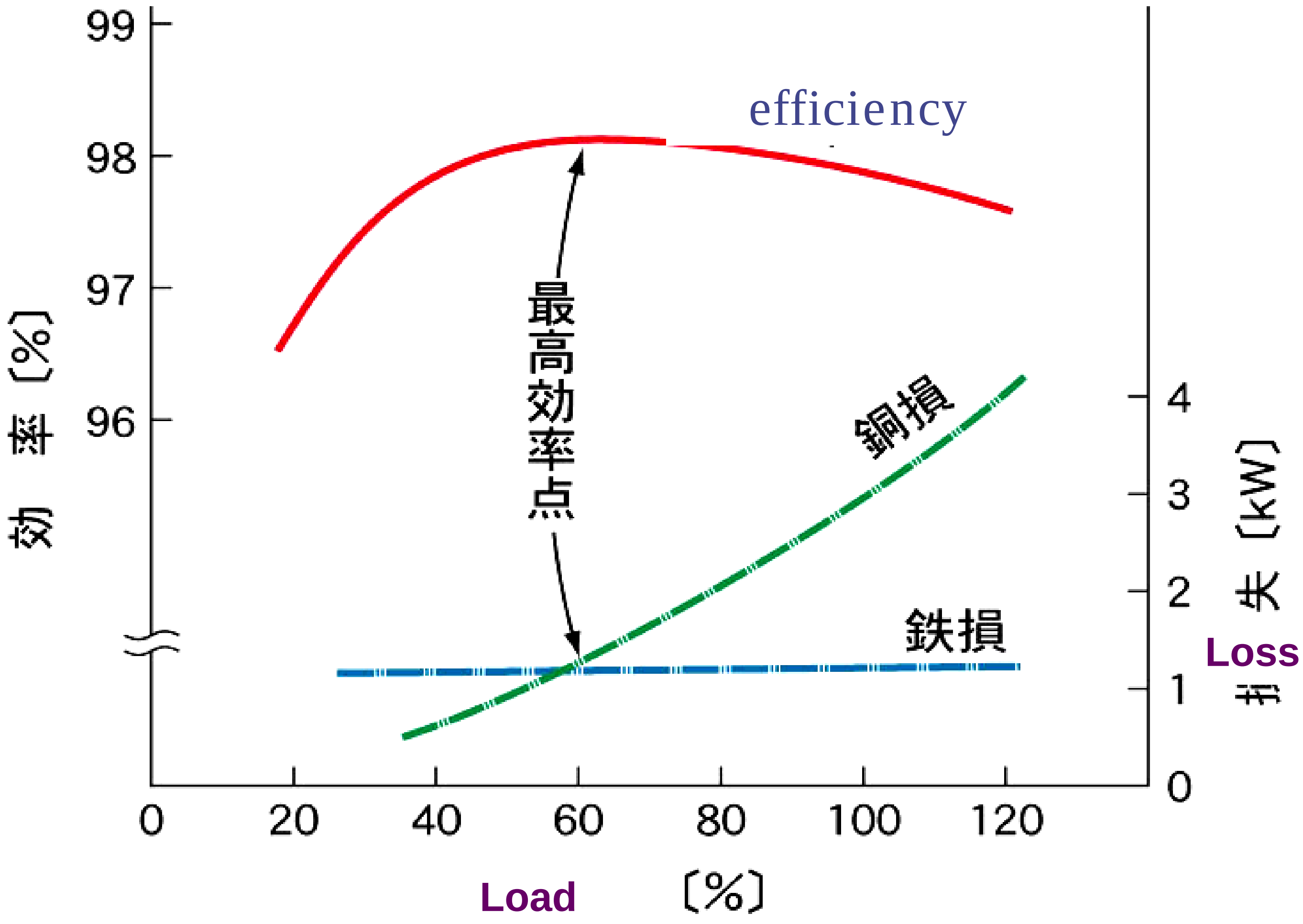
  - Load of the transformer TX3 (2000 kVA)

    — 876 KVA (43.8%)

Projected Load Curve of Transformers (2002)

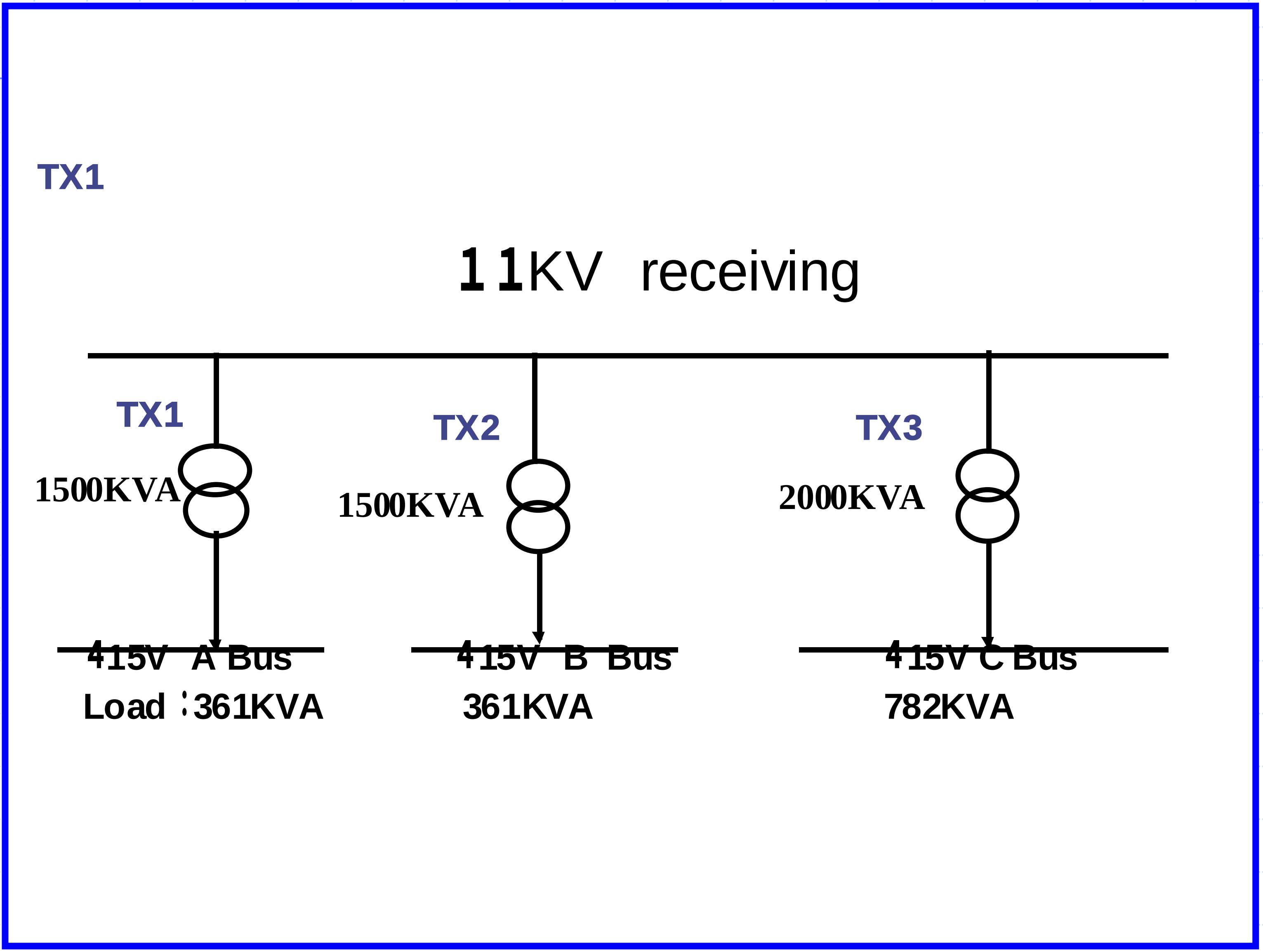


Recommended Improvement plan

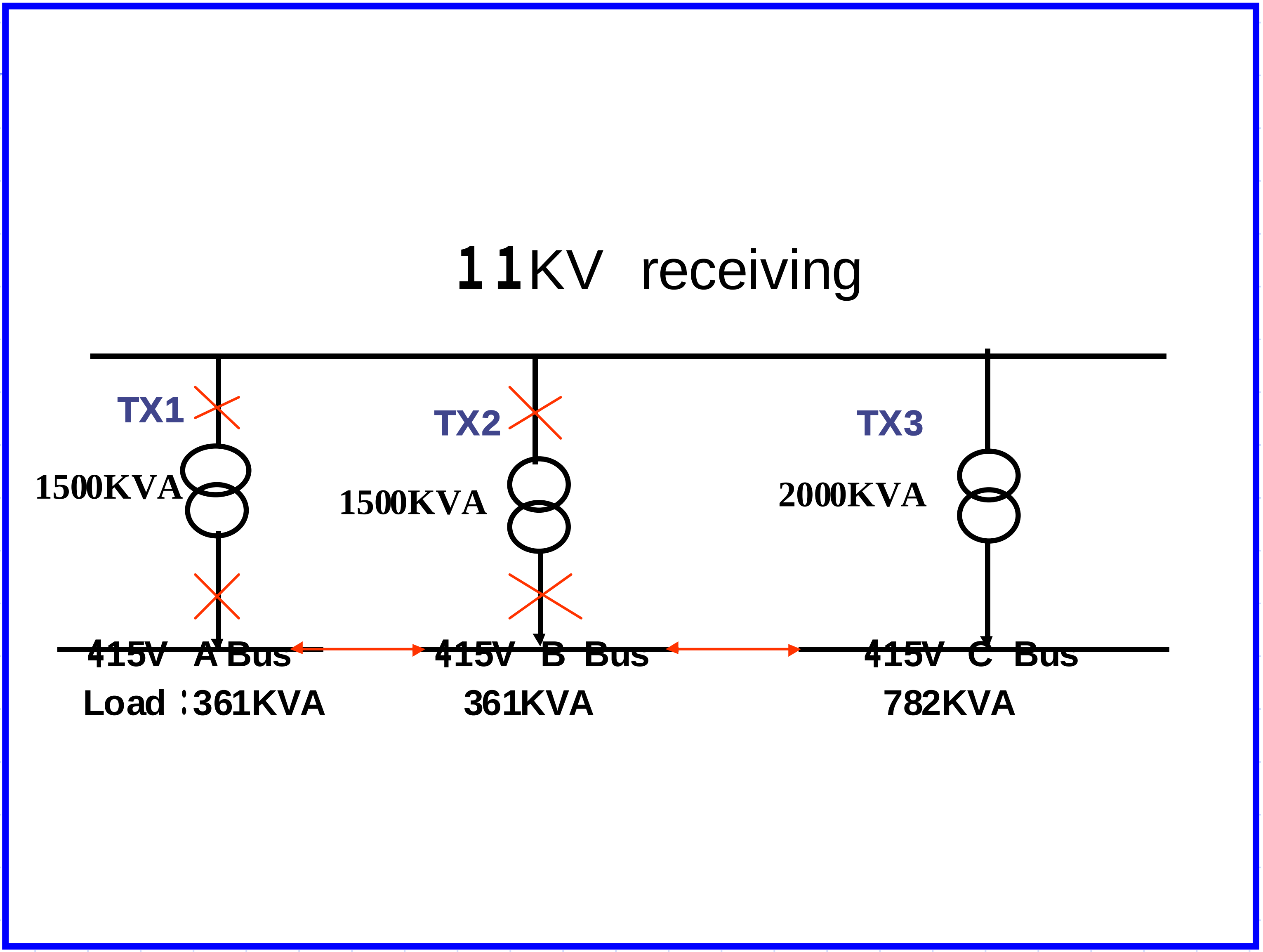


注 3φ 200〔kVA〕、6,600/210〔V〕50〔Hz〕

Diagram of Transformer Load



Recommended Improvement plan



Potential Savings

- Estimated load (calculated from power factors 90%).
- TX1&TX2：Working time-361ｋVA/transformer

  Day off time-106kVA /transformer
- TX3 : Working time- 782kVA
- Formula of loss calculation: Wt (total loss) = Wi (non-load loss) + Wc (load loss) x $(Pe)^2$

  Pe: Load ratio

Calculation

- Loss using 3 transformers TX1 , TX2, & TX3

  Wt1＝2380W＊8760h＊2+15910W（361／1500)^2＊10h＊272d＊2+15910W（106／1500)^2＊14h＊272d＊2+15910W（106／1500)^2＊(365－272)d＊24h＊2

  +3040W＊8760h+18170W(782／2000)^2＊10h＊272d

  ＝81,856　kWh／year

Potential Savings

Loss using one transformer TX3:

- $W_{t2} = 3040W * 8760h + 18170W(1504/2000)^2 * 272d * 10h + 18170W(211/2000)^2 * \{272d * 14h + (365-272)d * 24h\}$

  $= 55{,}800$ kWh/year

- $W_{t1} - W_{t2} = 81{,}856kWh - 55{,}800kWh$

  $= 26{,}056$ kWh/year or **0.5%** of total electricity consumption

Summary of Improvement Points (in kWh/year and Malaysian Ringgit)

No	Improvement Item	Reduction electricity [kWh]	Reduction cost [RM]	%
1	In-door setting of temperature	273,621	77,708	5.7
2	Adjustment of fresh air volume from outside	213,466	60,624	4.4
3	Full shut down of the VAV	42,366	12,032	0.9
4	Optimization of chiller operation	115,546	32,815	2.4
5	Optimization of transformer	26,056	7,400	0.5
	Total	671,055	190,580	13.9
	Electricity consumption /year	4,830,876		
	Average electricity cost	RM/kWh	0.284	

THANK YOU
FOR YOUR
KIND ATTENTION

The Energy Conservation Center, Japan

Additional Part

Akira Kobayashi

The Energy Conservation Center, Japan

20 January 2004

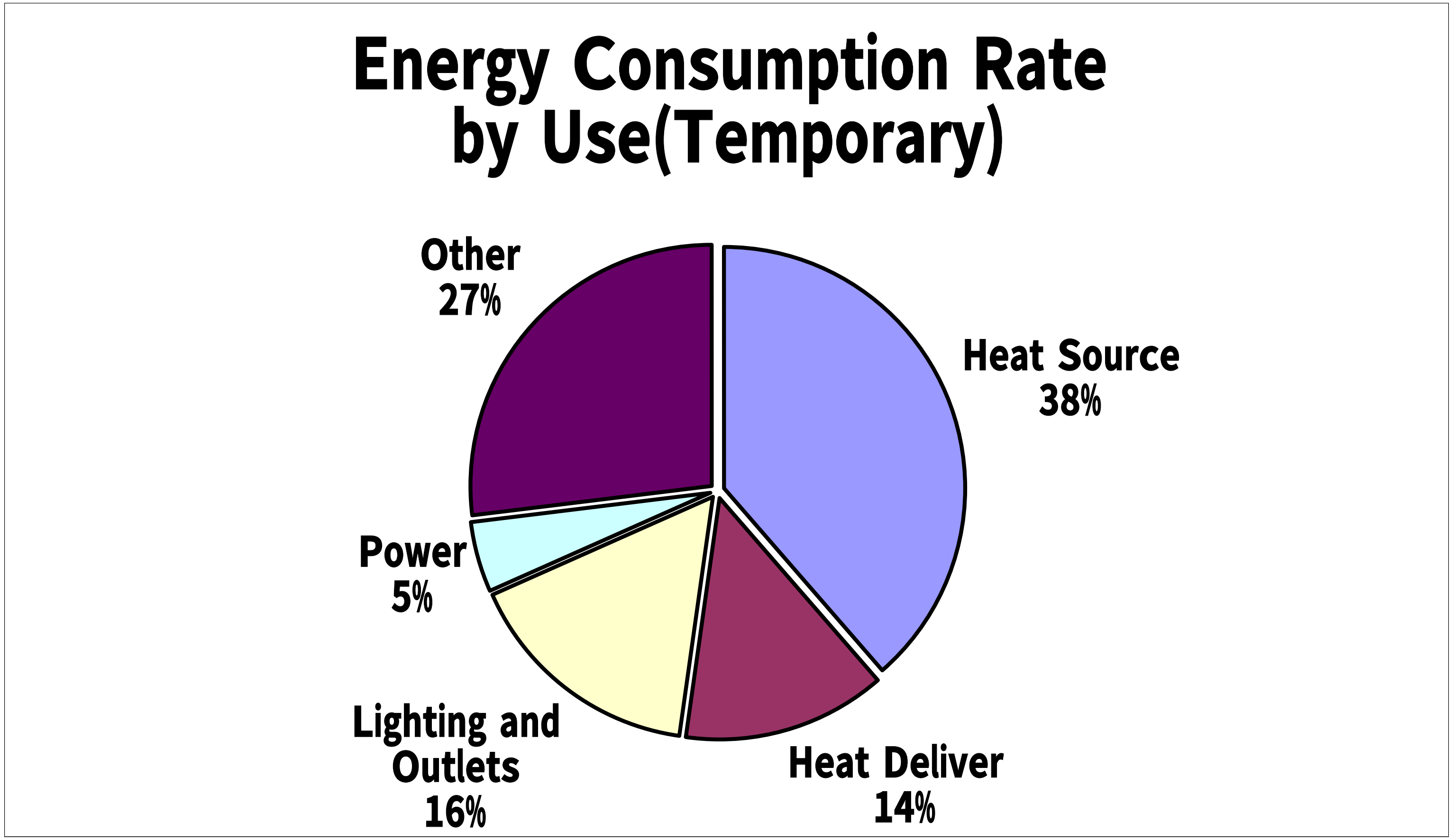
Contents

- Method of calculating :

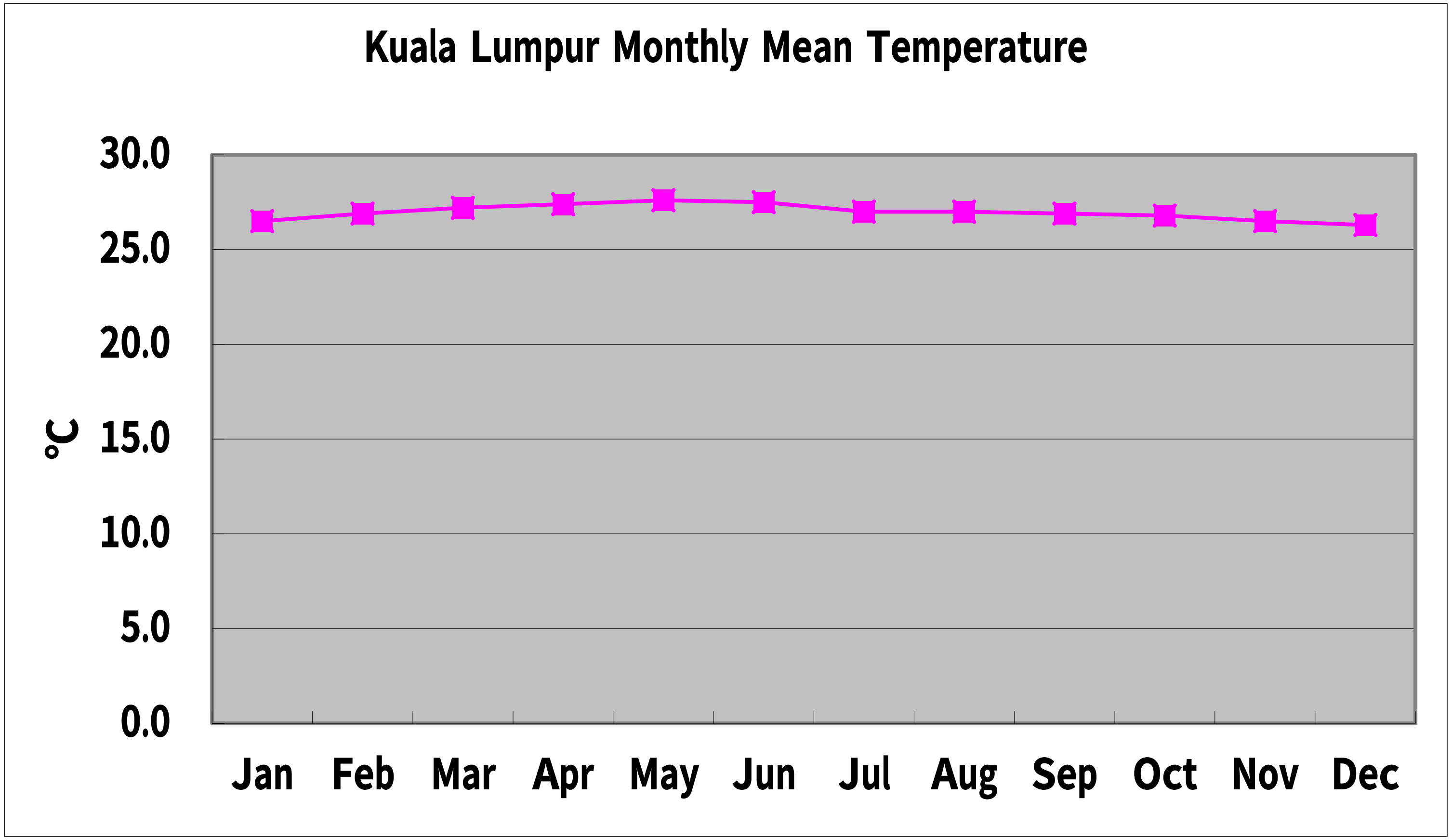
  Energy composition classified by use
- Importance of fresh air control

Method of calculating :
Energy composition classified by use

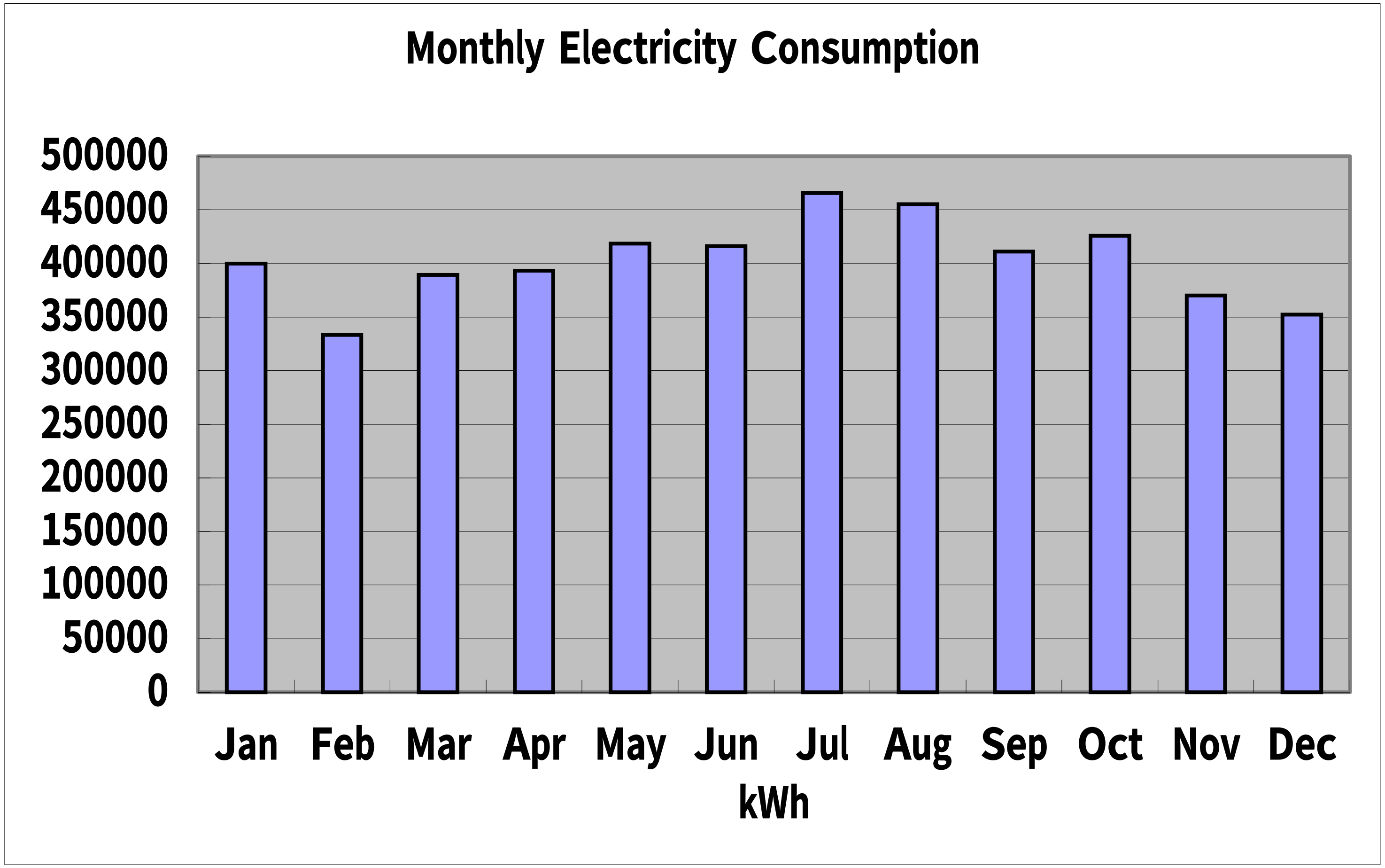
Calculation Result



Understanding of Situation (1)



Understanding of Situation (2)



Result Table

	kWh/d	%
Heat Source	6,872	38.7%
Heat Delivery	2,426	13.7%
Lighting and Outlets	2,859	16.1%
Power	837	4.7%
Other	4,766	26.8%
Total	17,761	100.0%
1day average	17,761	kWh/d
Annual Electricity	4,830,876	kWh
days	272	d

Calculation of Heat source energy

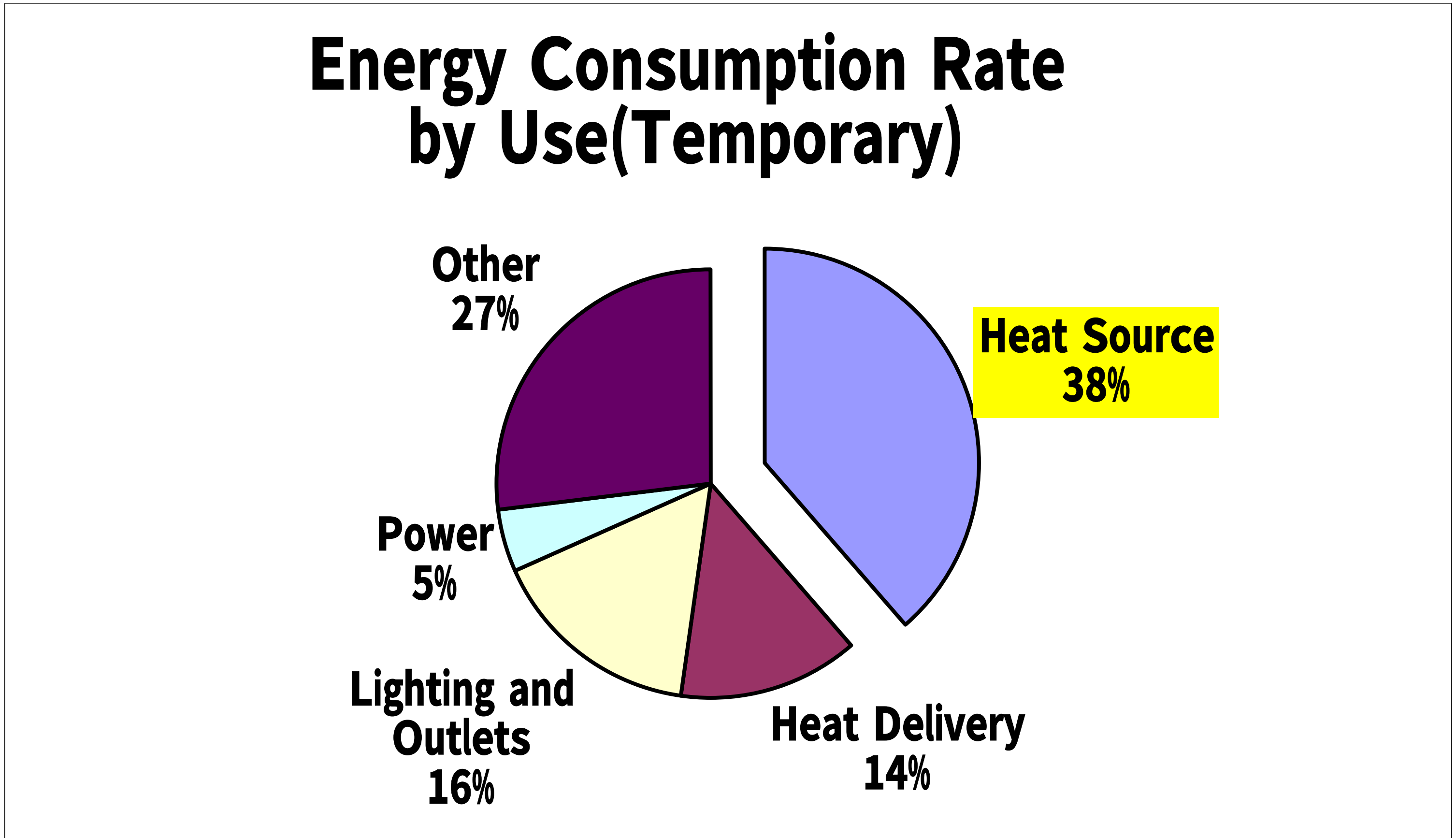
	Qty	kW	h	Load Rate	kWh/D	
Chiller	2	327	10	0.8	5,232	29.5%
Cooing Tower	2	22	10	0.8	352	
Condenser Water Pump	2	37	10	0.8	592	
Split Unit	29	3	10	0.8	696	
Total					6,872	38.7%

Calculation of Heat Transfer Equipment energy

	Qty	kW	h	Load Rate	kWh/D	
Chilled Water Pump	2	55	10	0.8	880	
AHU total (18Units)	1	180.2	10	0.8	1441.6	5F exclude
FCU	20	0.65	10	0.8	104	
Total					2425.6	

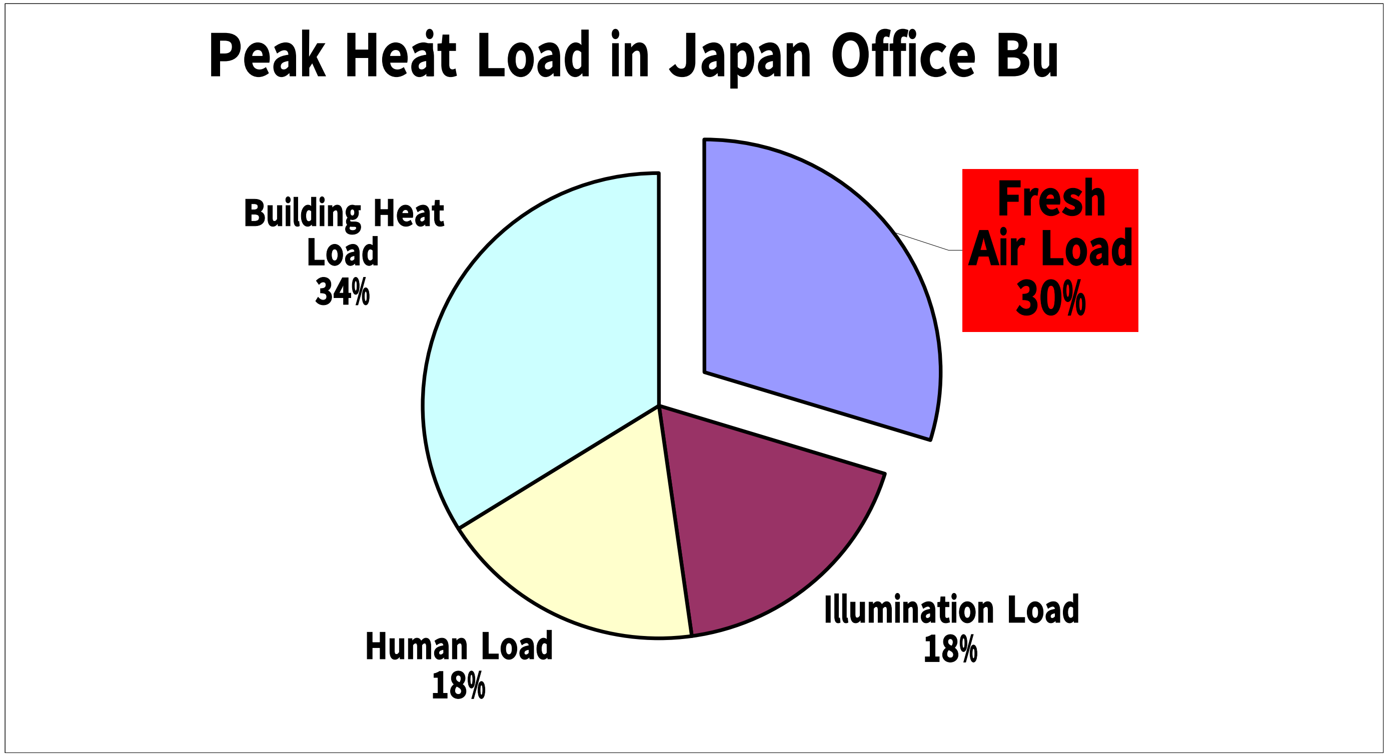
Importance of fresh air control

Heat Source Rate



Heat Load of Fresh Air

- Japan : 30〜40% Air-conditioning



Proper Amount of Fresh Air

- Japan's Room Environment Standard

  CO_2 Density : Below 1,000ppm

Measurement CO2 density

Indoor :

3points all 600ppm

Outside :400ppm

Calculation

- Outside air CO_2 density :400ppm
- Present indoor CO_2 density :600ppm
- Goal indoor CO_2 density : 800ppm
- Present ventilation value :V1m^3/h
- Ventilation value after improvement :V2m3m3/h

$400V1+X=600V1$

$400V2+X=800V2$

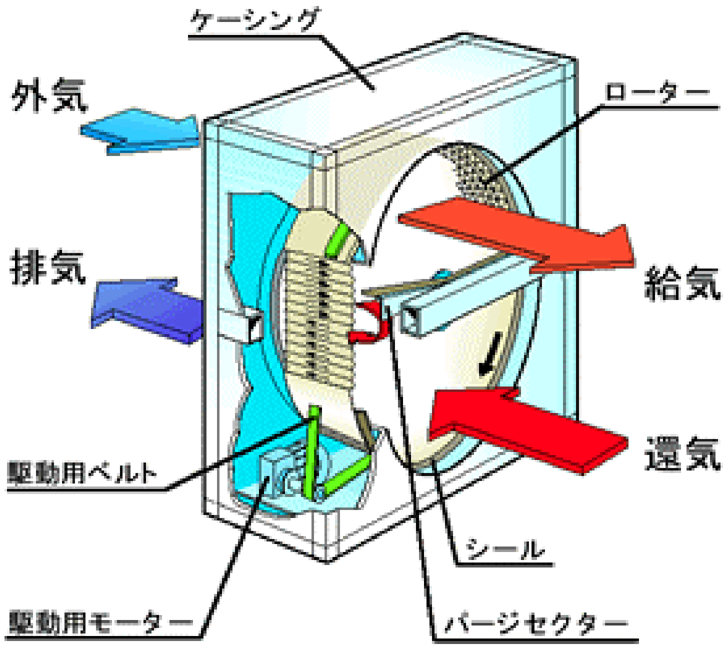
$V2/V1=(600-400)/(800-400)=0.5$

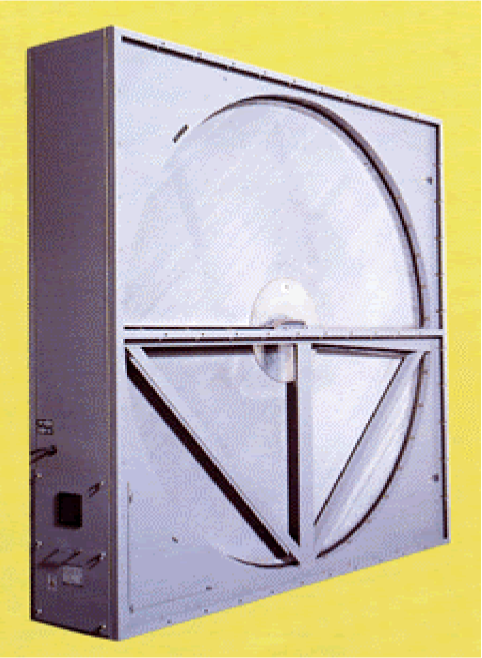
Method of Fresh Air Volume control

1 Manual Damper Control

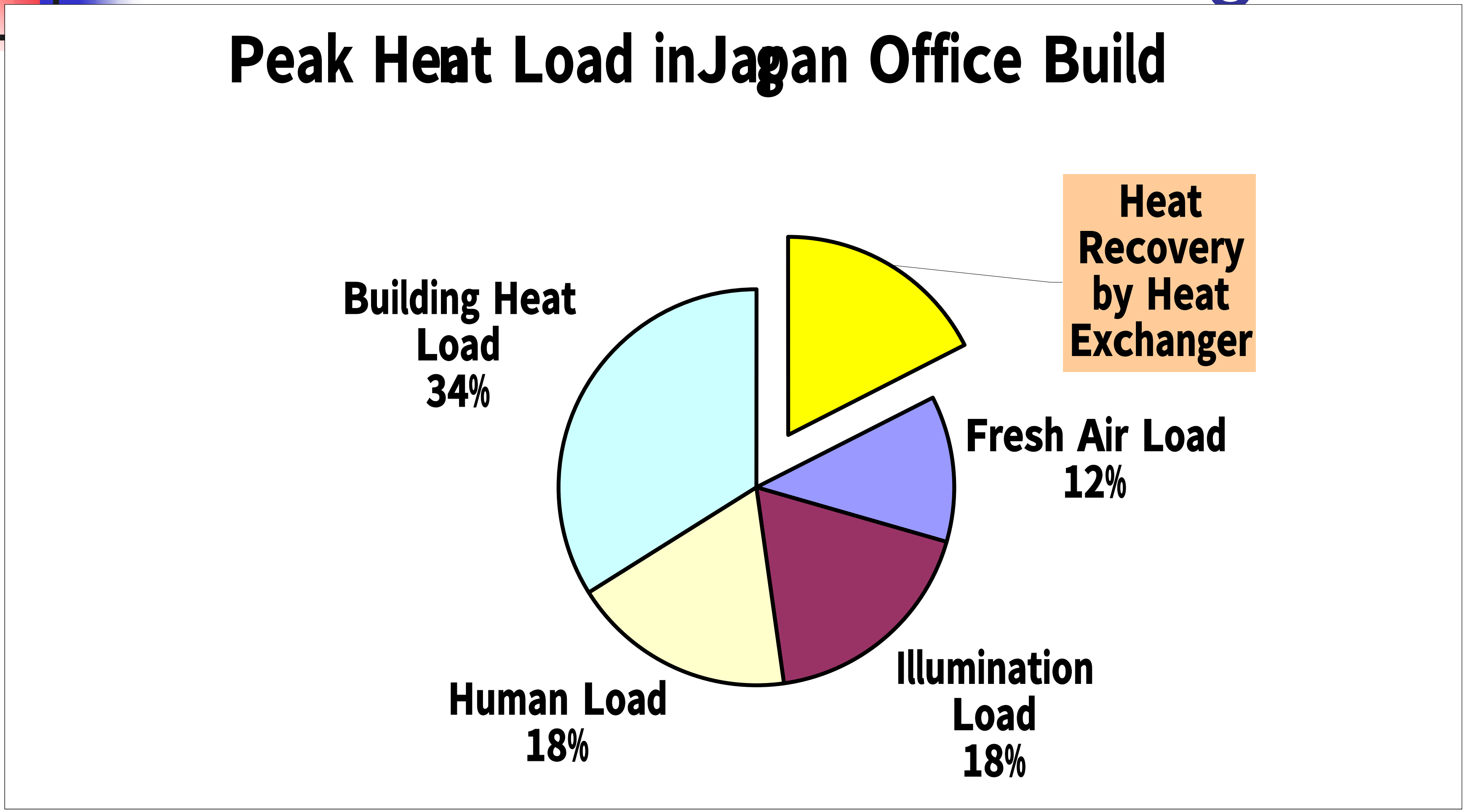
2 Automatic Operation through CO_2 Monitoring

Heat Exchanger





Effective of Heat Exchanger



Fresh Air Interception When Starting

- 30min〜1hour
- Difference：

  AHU operate start time，

  Business start time

Summary : Attention to Fresh Air

- **Fresh Air Heat Load :**

  Big Weight of Building Energy

- **Technique :**

  Control of Fresh Air

  1. Reduce Fresh Air Volume

  2. Reduce Fresh Air Heat Load

- **Useful for ASEAN Countries**

Thank you

The Energy Conservation Center, Japan

Preliminary Report
Building Energy Audit –
Orchid Garden Hotel
Brunei Darussalam

24 January, 2004

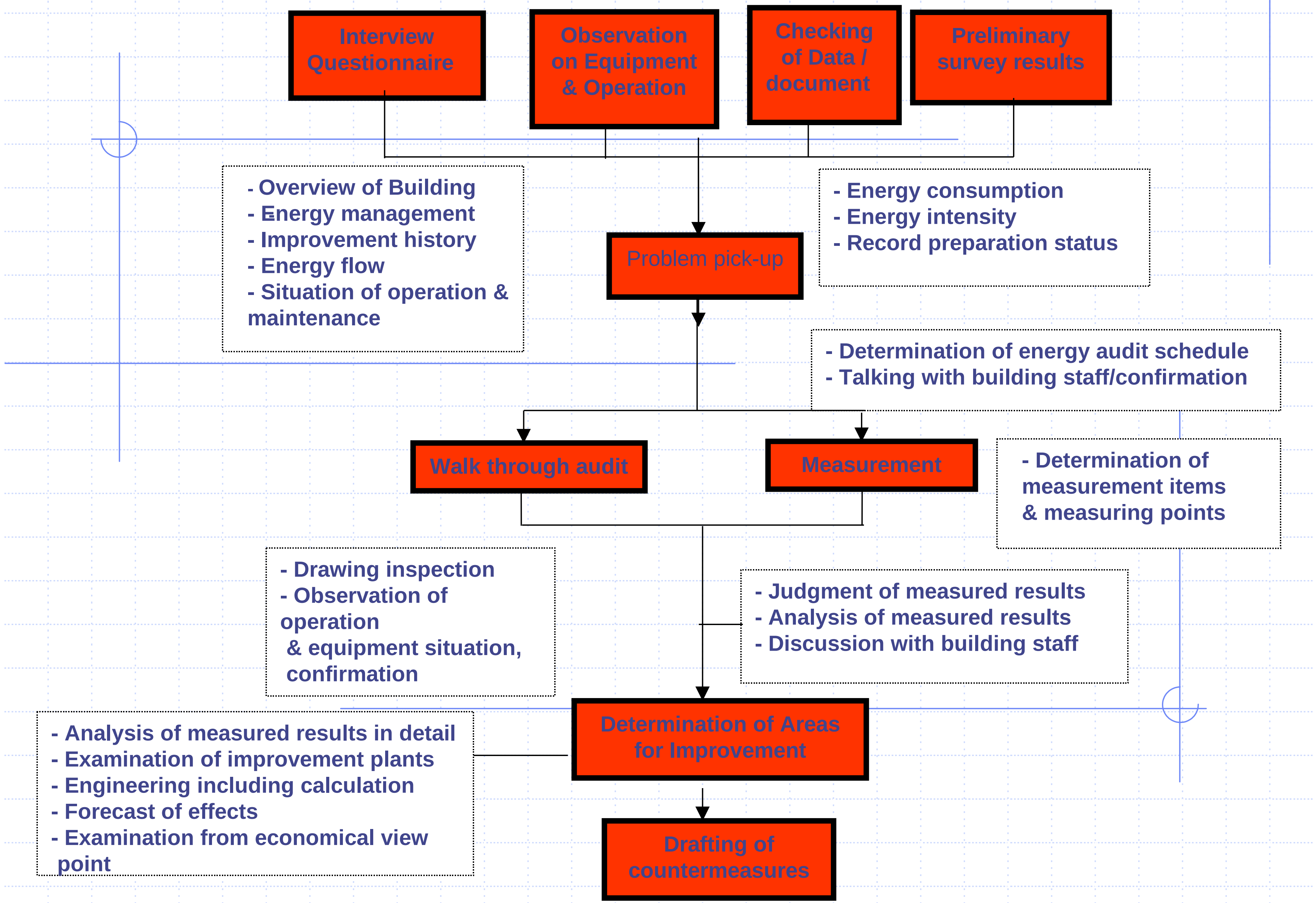
Akira Kobayashi and Takashi Kato
The Energy Conservation Center, Japan

Outline of Presentation

- Building energy audit flow chart
- Results of Audit in Orchid Garden Hotel
  - General building information
  - Overview of electrical facilities
  - Overview of air-conditioning facilities
  - Utility consumption
  - Energy intensity
  - Improvement points and potential savings
- Summary

Building Energy Audit Flow Chart

Building Energy Audit Flow-chart



Preliminary Results of Energy Audit in Orchid Garden Hotel, Brunei Darussalam

1.1 General Building Information

- Name of Building: Orchid Garden Hotel
- Category of Usage: Hotel
- Number of Storeys: 10
- Total Gross Floor Area: 20,121.18 m^2
- Age of Building : 4 years
- Energy Management System : Building Automation System (BAS)

1.2 Overview of Electrical Facilities

- Receiving Voltage: 11 kV
- Transformer capacity: 1,000kVA × 2 units
- Generator for emergency: 800 kVA x 1 unit
- Elevators : 2 units x 14 kW
- Service lifts : 1 units x 14 kW

1.3 Overview of Air-conditioning Facilities

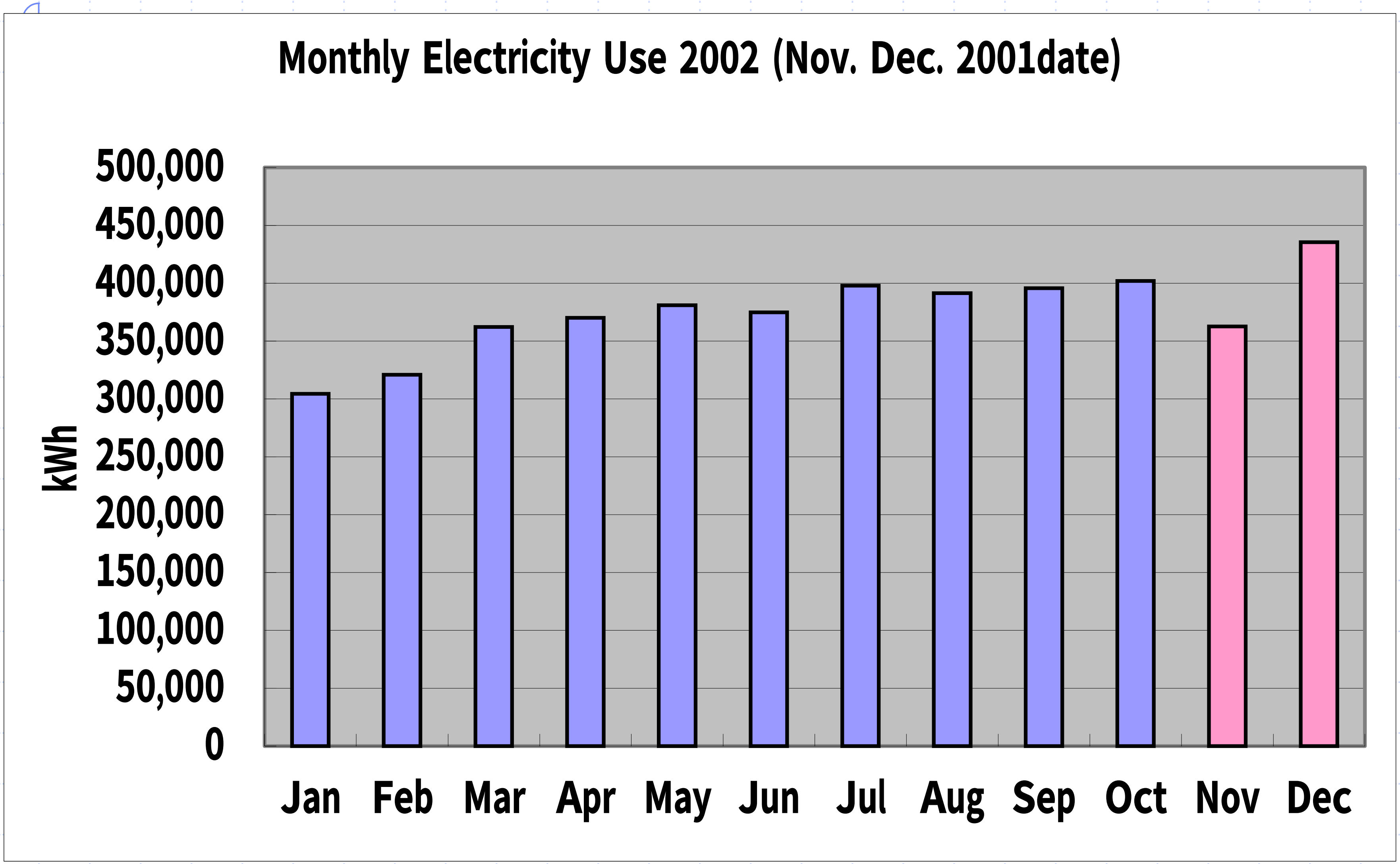
- Chiller capacity :
  - 3 units x 300 Refrigerant ton (205 kW)
- Air handling units (AHU＊7 units)
- Fan coil units (FCU＊ 207 units)

1.4 Sanitary facility

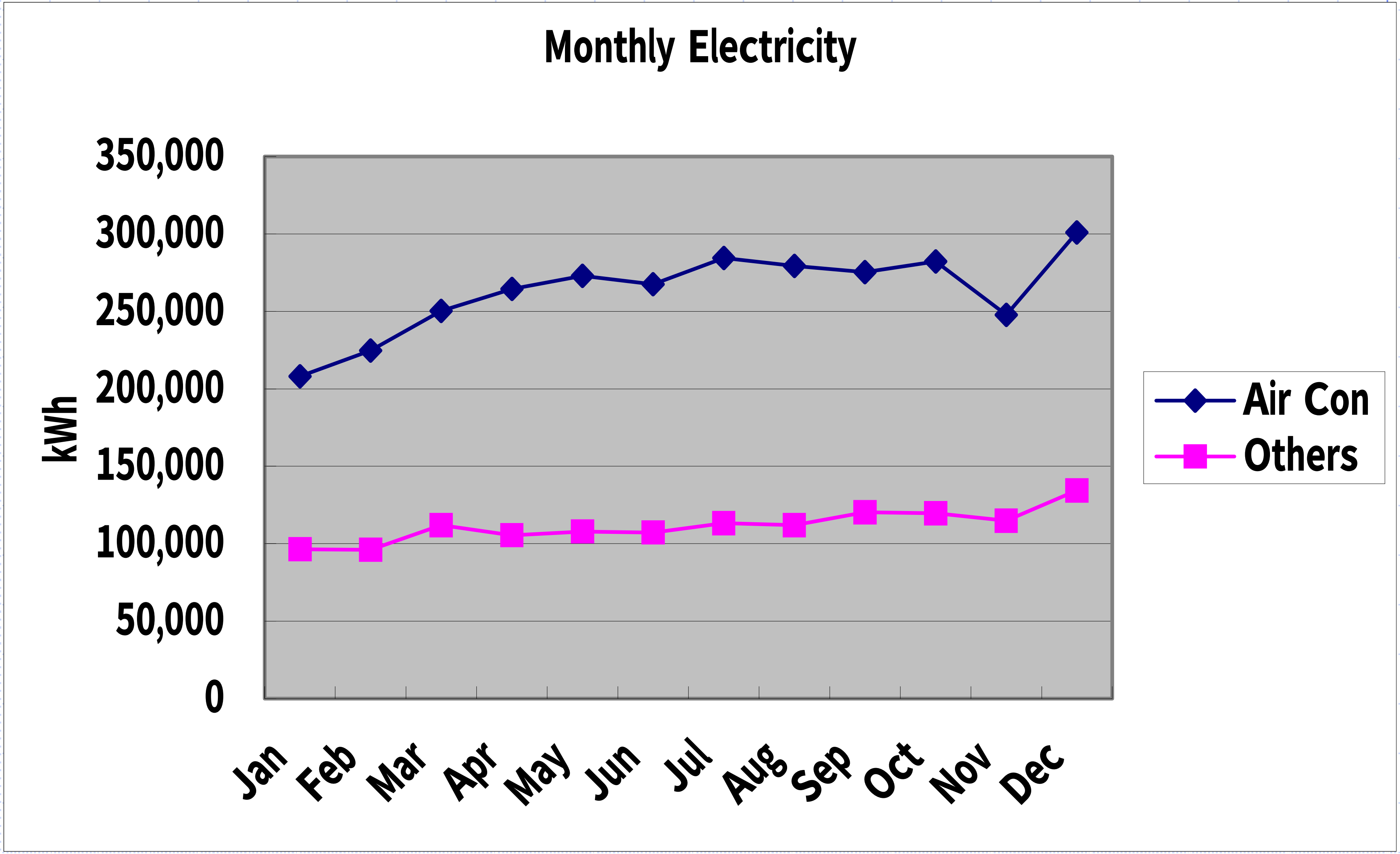
- Hot Water Boiler(electric):
  340 l/h , 46kW×12 units
- Receiving water tank
- Storage pump 4kW×2 units
- Booster pump 3kW×3 units
- Water tank on the top

2 Analysis of Current Situation

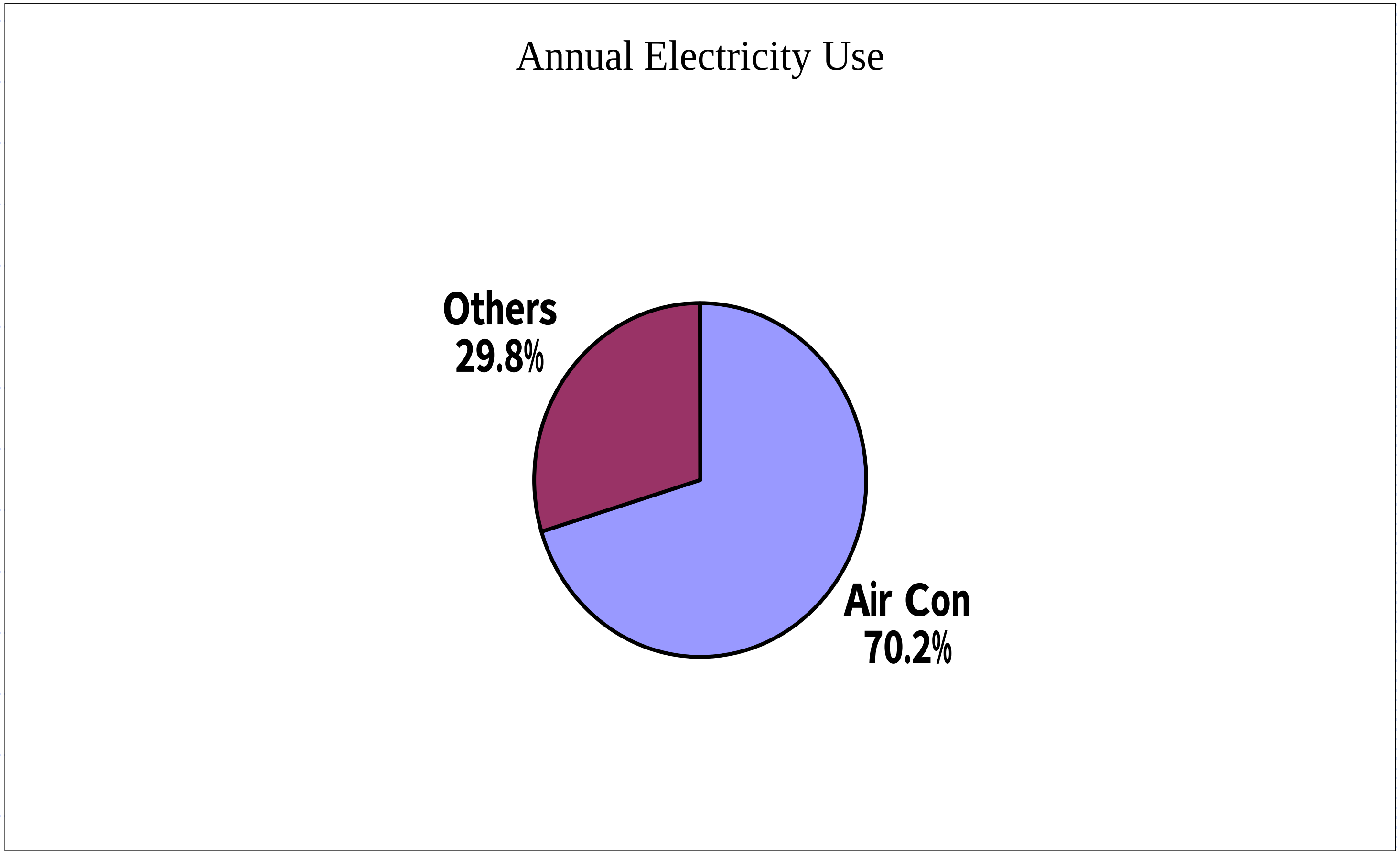
2.1 Monthly Energy Consumption (2002)



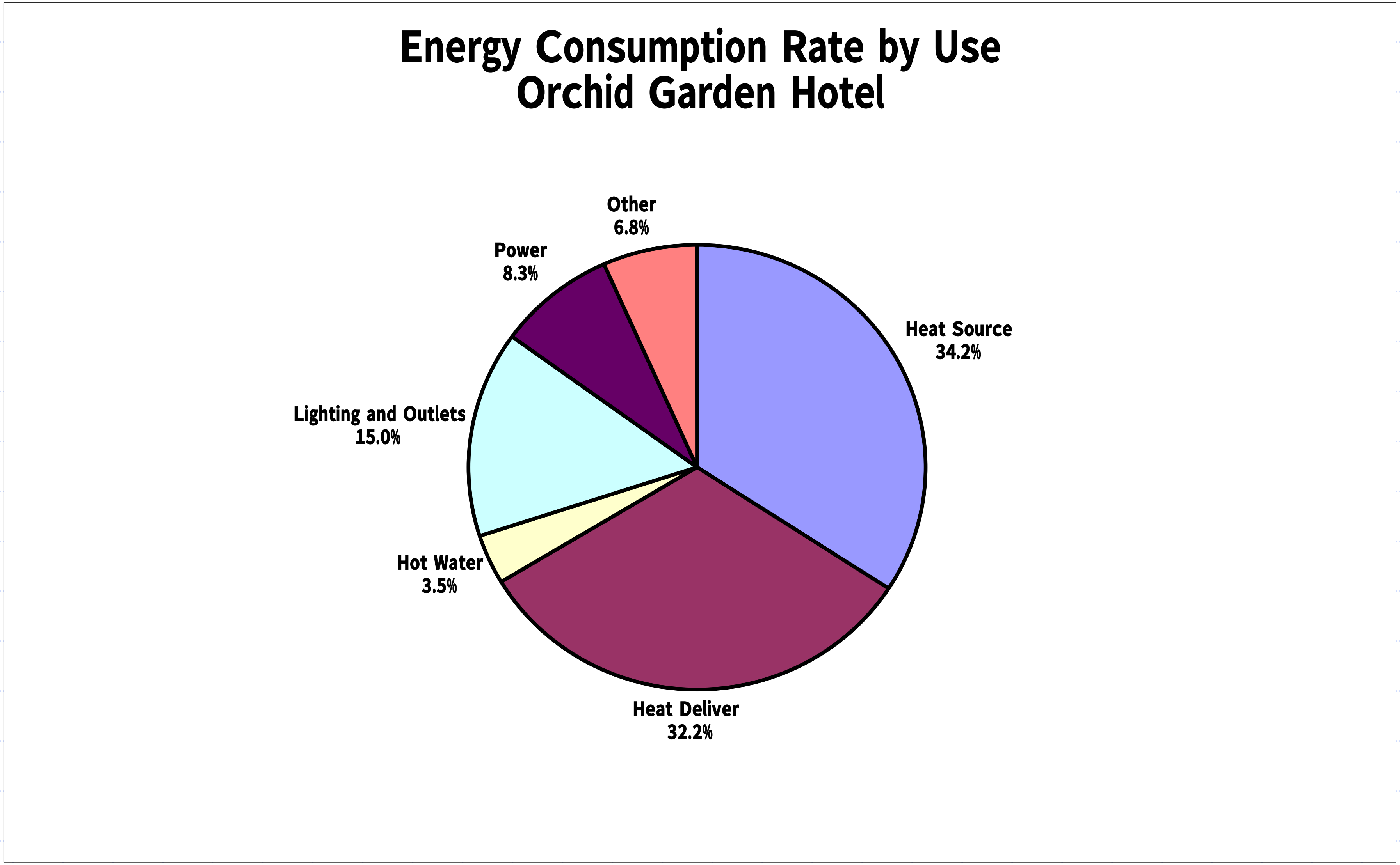
2.2 Electricity Consumption, by type of use



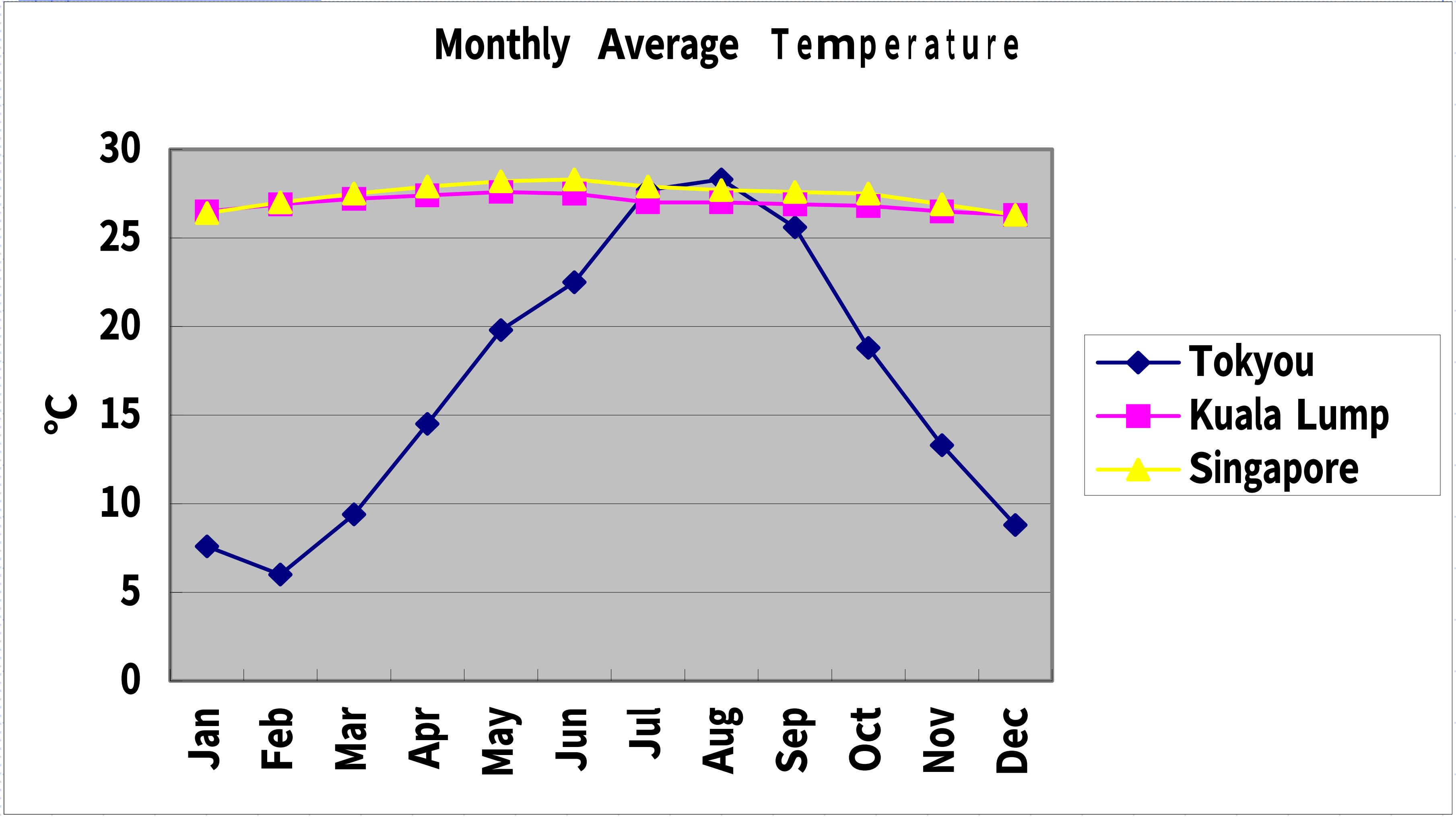
Annual Electricity Consumption (in %)



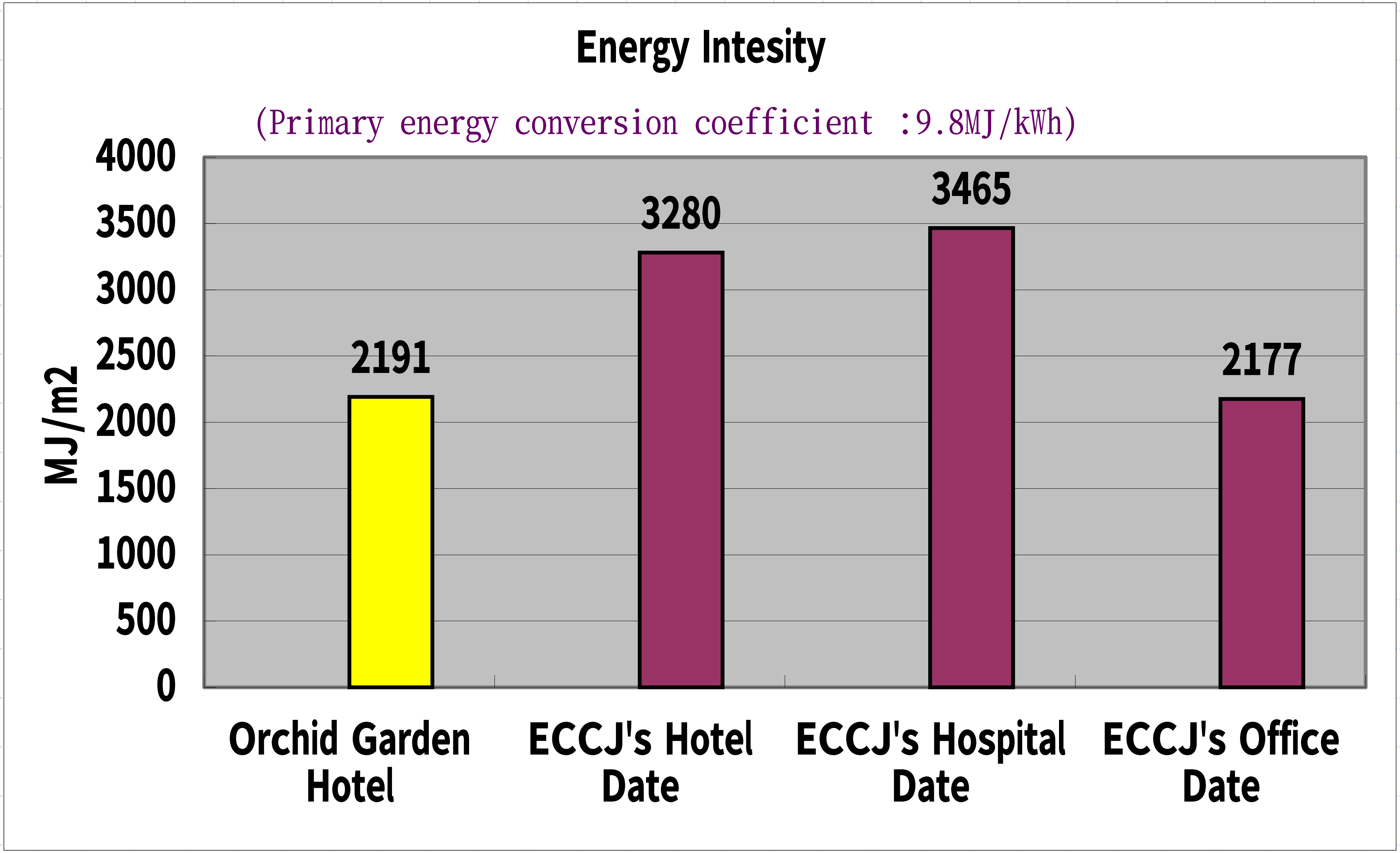
2.3 Energy Consumption by End-use (in %)



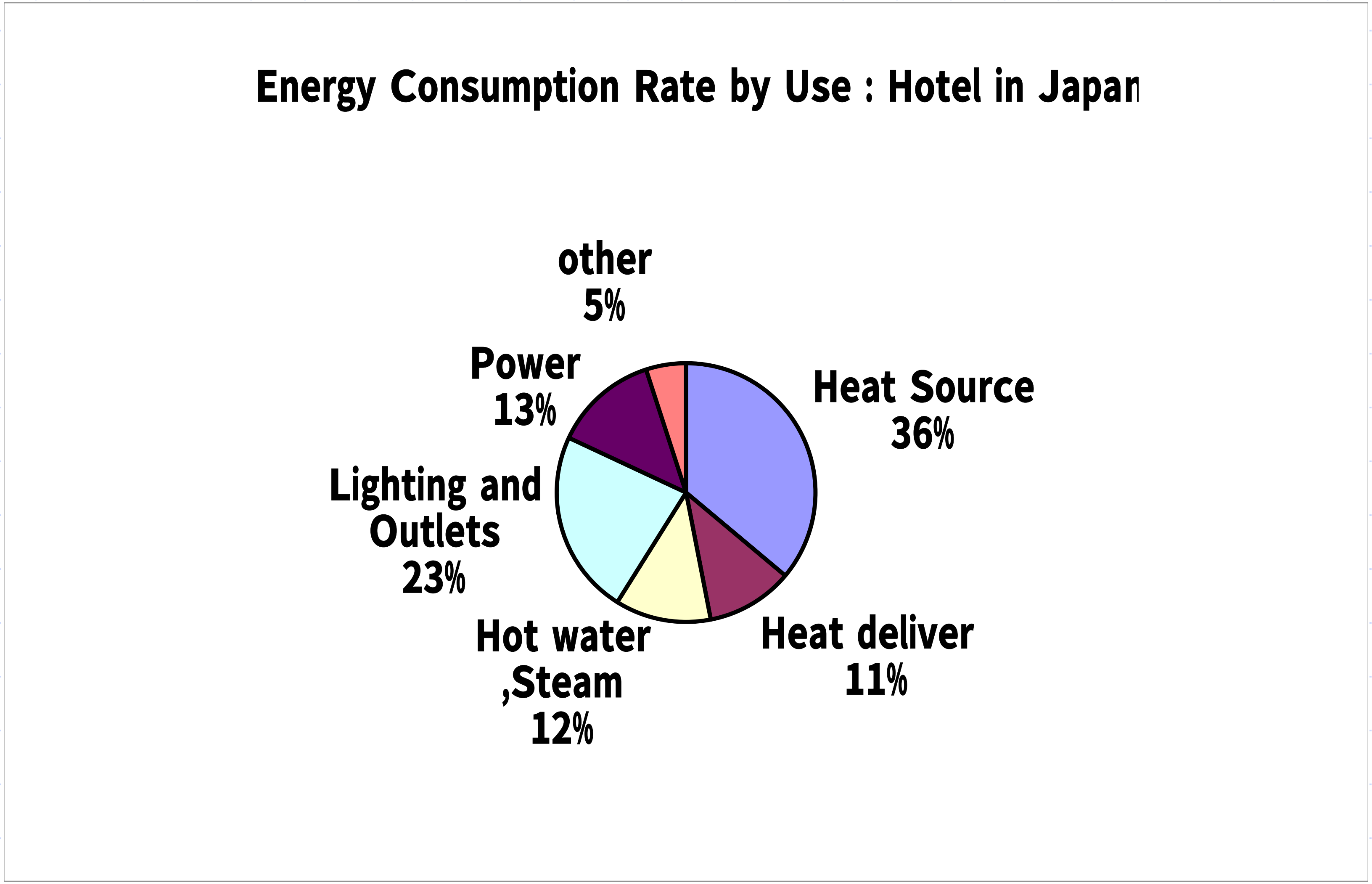
2.4 Mean Temperature : Japan vs. Kuala Lumpur & Singapore



• **Building Energy Intensity: Orchid Garden H. vs. ECCJ Data**

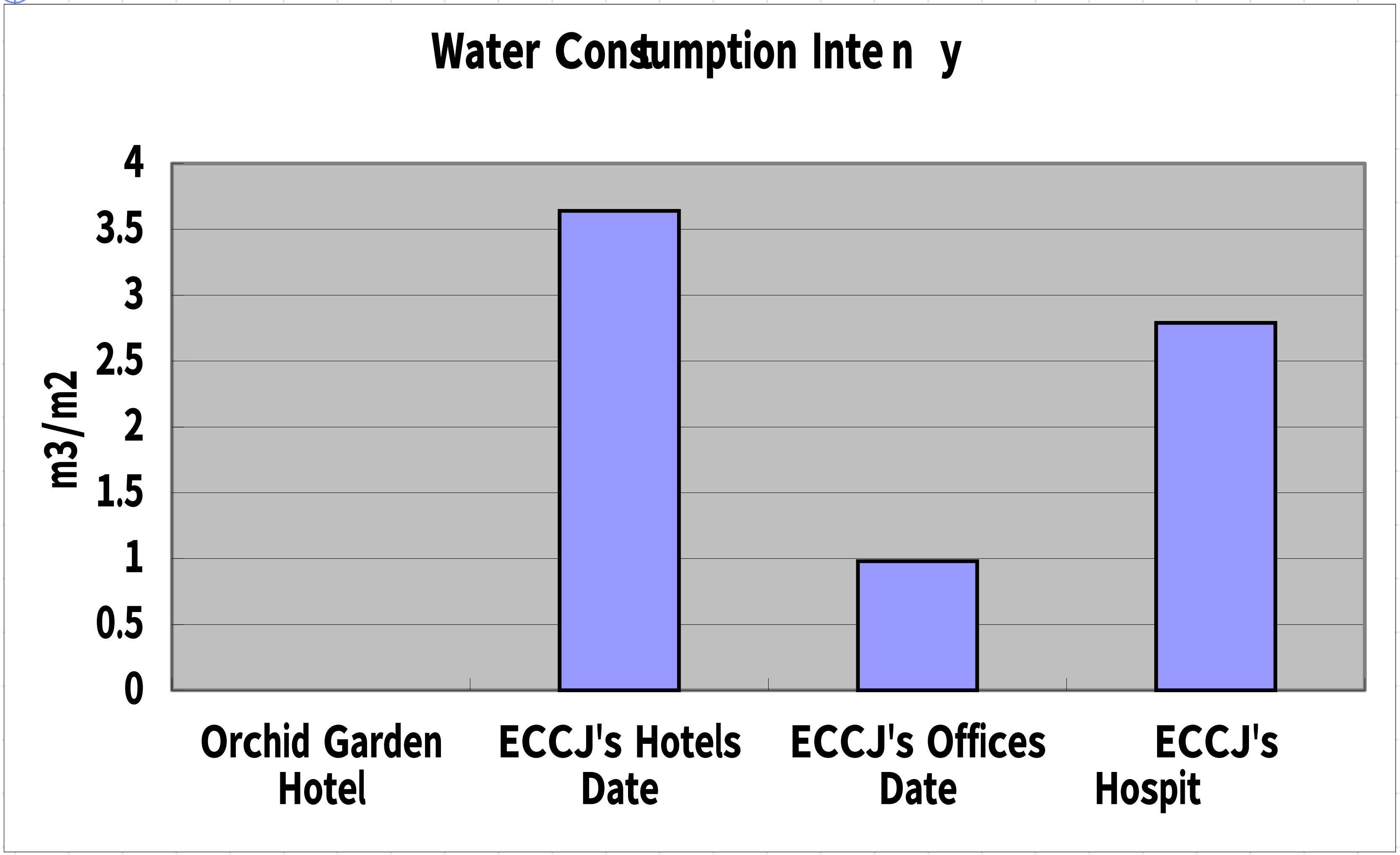


• Energy Consumption by End-use of Japan's Hotel (in %)



2.5 Water Consumption

Water Consumption Intensity



Improvement Items and Potential Savings

Improvement Point 1.
Repair of the BAS system

- **Current situation**

  BAS system is not operating normally.

- **Recommended Improvement Plan**

  Immediate repair of BAS

- **Potential Savings**

  Significant

Improvement Point 2.
Optimization of AHU operating time

- **Current situation**

  Air conditioning is operating 24 hours, even though the 1F restaurants and conference rooms are not used.

- **Recommended Improvement Plan**

  Drive the AC intermittently and stop the in-take of fresh air volume completely.

Improvement Point 3.
Intermittent use of FCU

- Current situation

  FCU at guest room is operating 24 hours

- Improvement plan

  Use of FCU intermittently

Improvement Point 4.
In-door Setting of Temperature

- **Current situation**

  In-door temperature setting of OGH: 22℃ ～ 23℃

- **Recommended Improvement Plan**

  Decrease the electric power of the chiller by raising the in-door temperature setting by 2℃

- **Potential Savings** – 145,322 kWh/yr or 3.2 % of total electricity consumption

Improvement Point 5.
Thermal insulation of hot water pipes

- **Current situation**

  Hot water supply pipe in the boiler room is not insulated.

- **Recommended Improvement Plan**

  Insulate the hot water supply pipe.

- **Potential Savings** – 9,855 kWh/yr or 0.2 % of total electricity consumption(6.2%/hot water supply energy)

Improvement Point 6.
Optimization of the Receiving Transformer

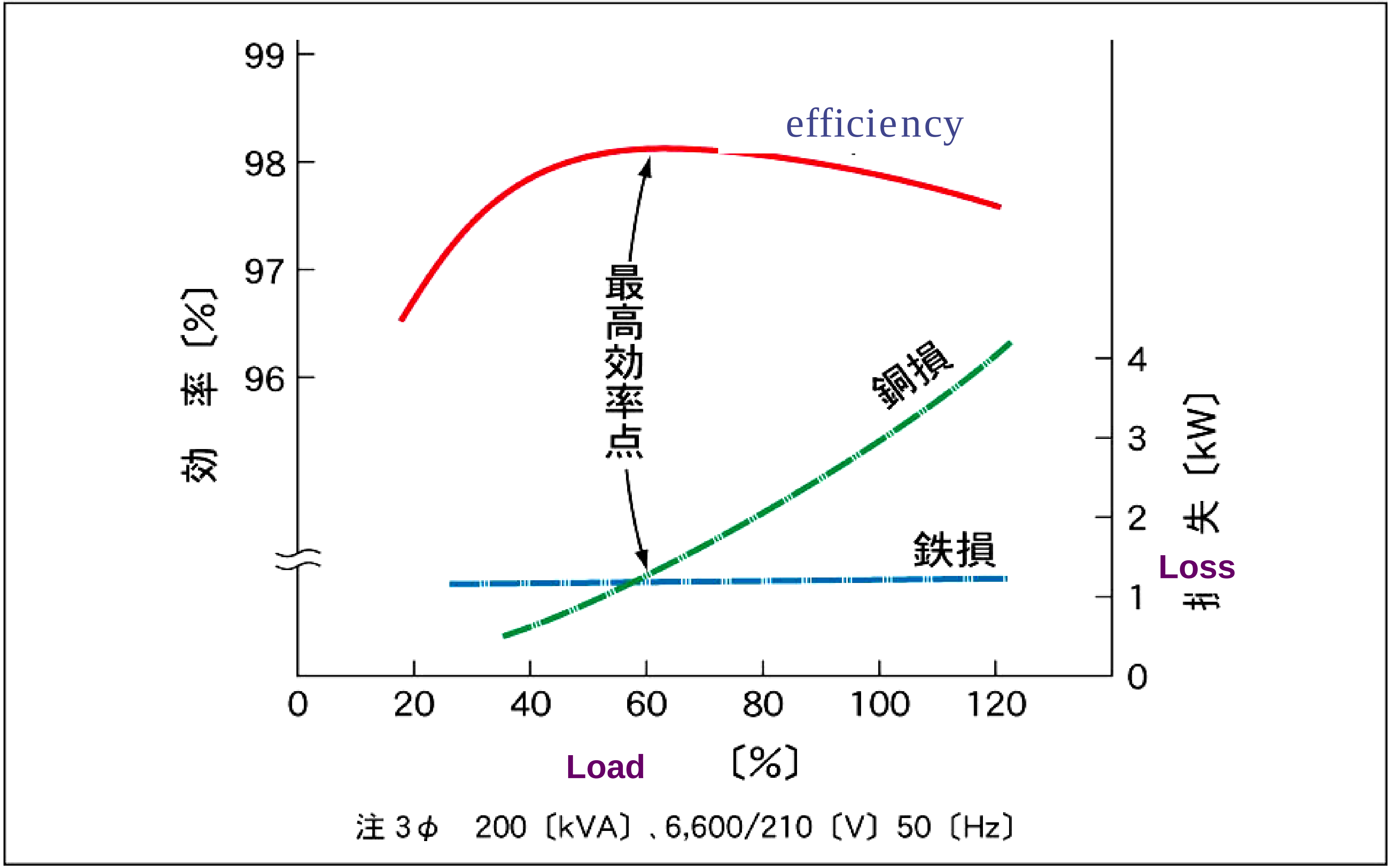
- Current situation

  - Load of the transformer TX1 (1000 kVA for AC.)
    — 390 KVA (39.0%)
  - Load of the transformer TX2 (1000kVA)
    — 213 KVA (21.3%)

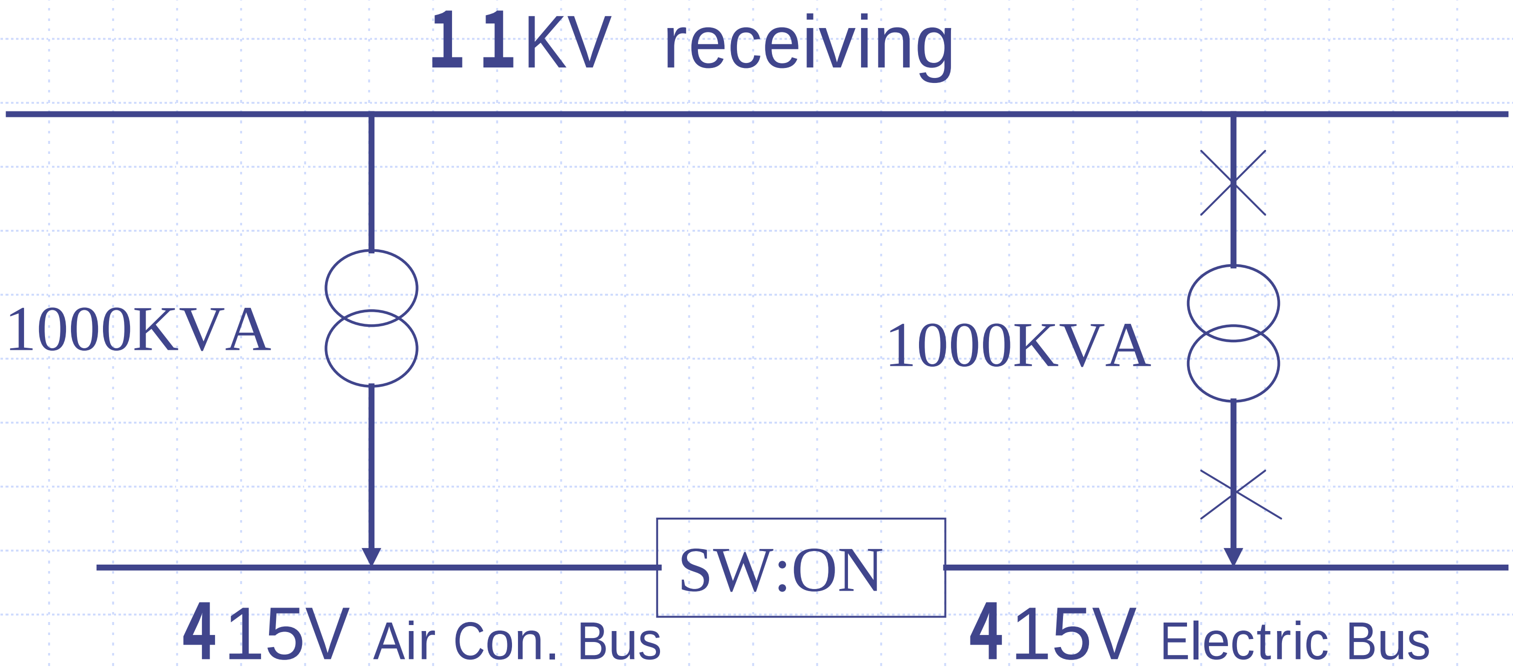
And

- TX1－384kVA &TX2－177kVA is calculated from electric power use (TX1－3,027,861kWh、TX2－1,392,682kWh) for the year in 2001 (calculated using power factors 90%).

Recommended Improvement plan



Reduction of the transformer loss



Total load : 561 KVA

Potential Savings

- TX1　384 kVA/transformer
- TX2：177 kVA /transformer
- Characteristic of the transformer（Example）

	1000kVA
Non-load loss(Wi)	1,880W
Load loss(Wc) (At the Rating load)	11,890W

- Formula of loss calculation: Wt (total loss) = Wi (non-load loss) + Wc (load loss) x $(Pe)^2$

Pe: Load ratio

Calculation

- Loss using 2 transformers TX1 & TX2

  Wt1＝1880W＊8760h+11890W（384／1000)^2＊8760h+1880W＊8760h+11890W（177／1000)^2＊8760h

  ＝51,559 kWh／year

- Loss using one transformer TX1:

  Wt2＝1880W＊8760h＋11890W（561／1000)^2＊8760h＝49,249 kWh／Y

Wt1 －Wt2＝51,559kWh －49,249kWh

＝2,310 kWh／Y or 0.1% of total electricity consumption

Improvement Point 7.
Adoption of Efficient Lamps

- **Current condition**

  Incandescent lamps (25W*2) are used in the guest room floor corridors.

- **Recommended Improvement Plan**

  Use fluorescent lamps

- **Examination of condition**

Corridor incandescent lamps: 25W＊2＊16 receptacles/Fl

Burning hours : 8,760 hours

Savings (W) : 25W＊２→13W/1 receptacle

- Calculation
- Electric power reduction:

(25W＊２－13W)＊16places＊5floors＊8760ｈ＝25,930 kWh／year or **０．6%** of total electricity consumption

- Electricity cost reduction:

25,930kWh ＊0.13B＄／kWh＝3,371B＄／year

Another merit is longer burning hours of lamps from 1,000 hrs to 8,000 hrs

Improvement Point 8.
Reduction of filter pump's operating time (swimming pool)

- **Current condition**

  Filter pump is driven for 24 hours even though the swimming pool is not used by guest.

- **Recommended Improvement Plan**

  Cut operating time to 8 hours a day.

Examination of Effect

- Current condition

  Water pump capacity :　1.1kW

  Operating time　　　:　8 hrs/day, 365 days

- Calculation
- Electric power reduction:

  1.1kW＊(24－8)h＊365d＝6,424 kWh/year

  or 0．1% of total electricity consumption

- Electricity cost reduction:

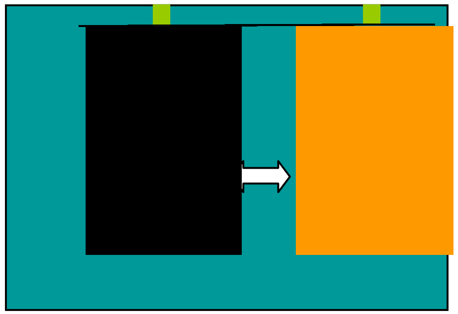
  6,424 kWh ＊0.13B＄／kWh＝835 B＄／year

4 Introduction of New Technology

4.1 Human sensor

When the person enters the area, the human sensor automatically turns on the light. When the person leaves the area, the sensor turns off the light. A reduction of 35% is achieved with the use of human sensor.

Automatic human sensor



Sensor can be used in kitchens, rest rooms etc.

Summary of Improvement Points (in kWh/year and Brunei $)

No	Improvement Item	Reduction electricity [kWh]	Reduction cost [B$]	%
1	Repair of the BAS System			
2	Optimization of AHU operating time	Depend on the time		
3	Intermittent use of FCU	Depend on the time		
4	In-door setting of temperature	145322	18892	3.2%
5	Thermal insulation of hot water pipes	9855	1281	0.2%
6	Optimization of the Receiving transformer	2310	300	0.1%
7	Adoption of Efficient lamps	25930	3371	0.6%
8	Reduction of filter pomp's operating time (swimming pool)	6424	835	0.1%
	Total	189841	24679	4.2%
	Electricity consumption /year	4498145		
	Average electricity cost B$/kWh		0.13	

Improvement Items Implemented by OGH after the First Energy Audit held in November 2003

- Shutting down of exhaust fan at car park at midnight.
- Switching off of AHU at Vanda Restaurant at midnight.
- Reduction of swimming pool filter pump operation to 6 hours daily.
- Switching off of 1 & 2 AHU at Level 8 Cesar Grand Hall, Cesar 1 and 2. Only switched on when there is a function.
- Increased of lifts temperature setting from 20 to 24℃.
- Shut down of heaters at the lobby, back office, and restaurants.

Summary of Improvements made by OGH maintenance staff after the recommendation

	kW	Load Rate	unit	h	d	kWh/y	
Car park fan	0.33	0.8	2	16	365	3084	
Vanda Restaurant AHU	4	0.8	1	8	365	9344	
Vanda Toilet Fan	0.15	0.8	1	8	365	350	
Goldiana Exhaust fan	0.32	0.8	1	8	365	748	
Swimming pool	1.1	0.8	1	6	365	1927	
Level 8 Grand Hall AHU	11	0.8	1	24	265	55968	
Level 8 Cesar 1AHU	11	0.8	1	24	265	55968	
Level 8 Cesar 2 AHU	5.5	0.8	1	24	265	27984	
Lobby Reheater	18	0.4	1	24	365	63072	
Back office Reheater	7	0.4	1	24	365	24528	
Restarants Reheater	35	0.4	1	24	365	122640	8.1%
					Total	365613	
					Annual Consumption	4498145	0.13
Average electricity cost 0.13 B$/kWh				Reduction cost		47530	

THANK YOU FOR YOUR KIND ATTENTION

The Energy Conservation Center, Japan

Additional Part

Akira Kobayashi

The Energy Conservation Center, Japan

24 January 2004

Contents

1 Calculation Method ：

Energy composition according to usage

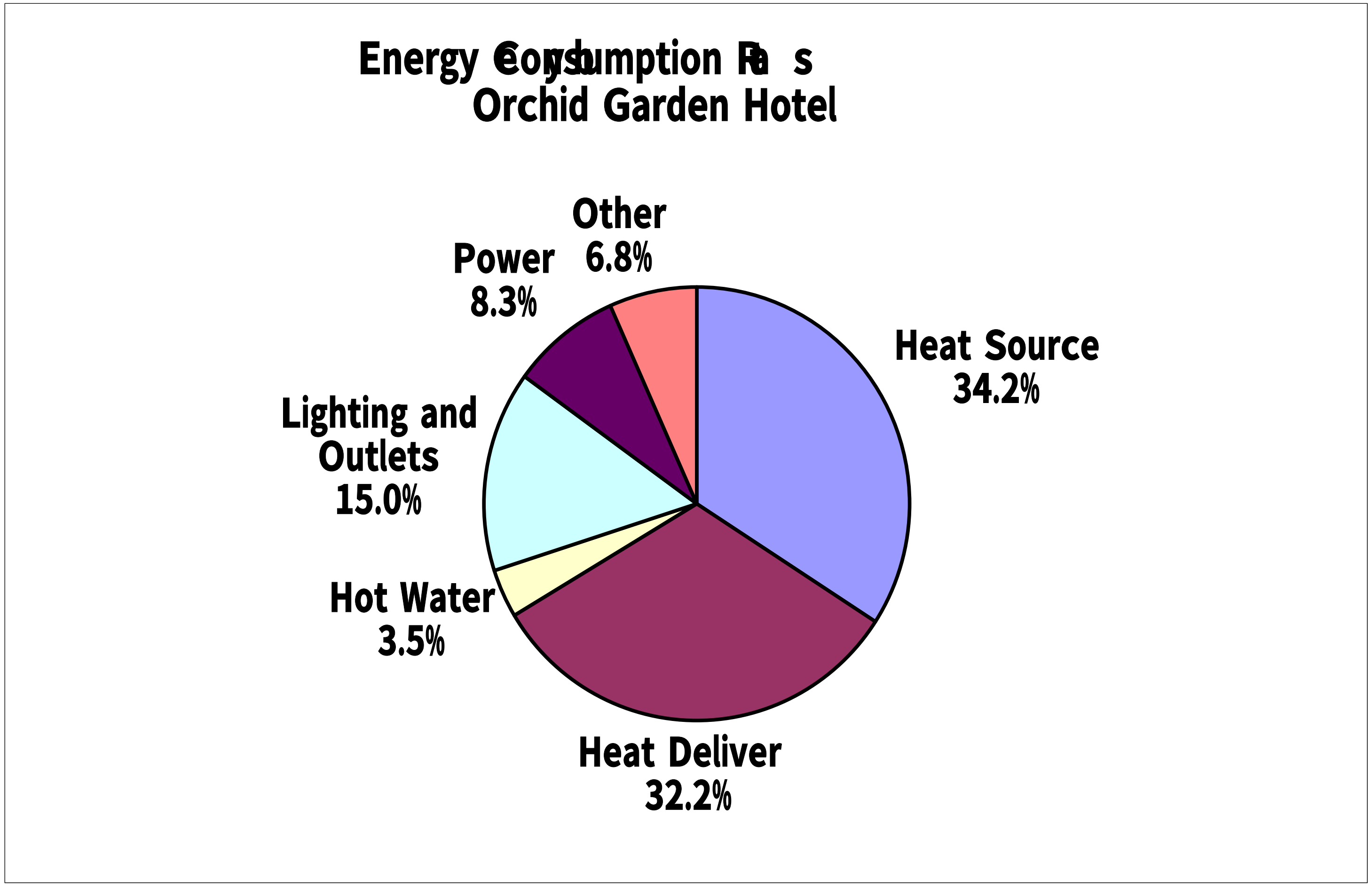
2 Improvement of Reheat system

3 Importance of fresh air control

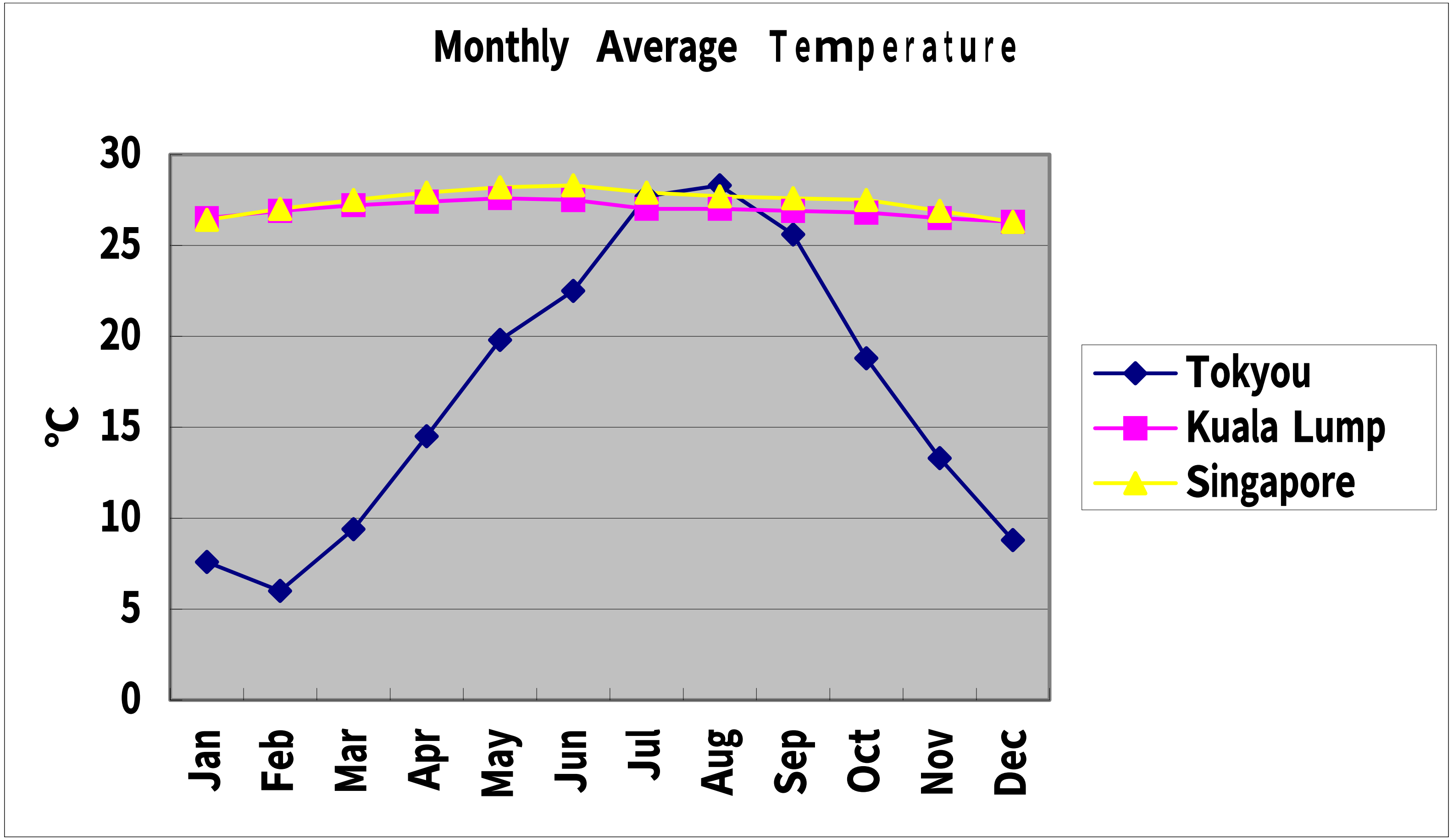
Calculation Method ：

Energy composition according to usage

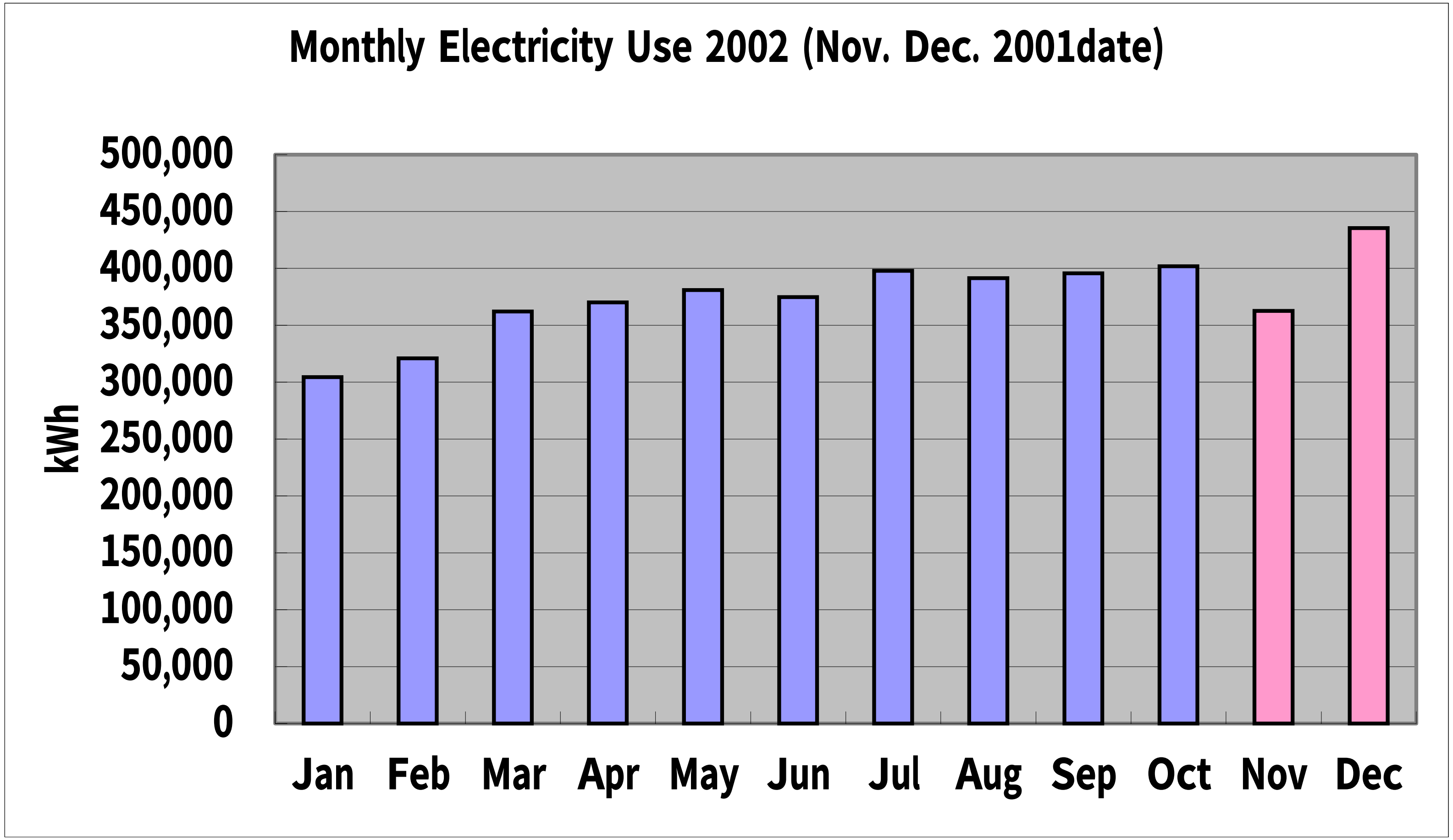
Calculation Result



Understanding of Situation (1)



Understanding of Situation (2)



Result Table

1 Day Composition		
	kWh/d	%
Heat Source	4,214	34.2%
Heat Delivery	3,965	32.2%
Hot Water	436	3.5%
Lighting and Outlets	1,848	15.0%
Power	1,027	8.3%
Other	833	6.8%
Total	12,324	100.0%
Annual Total kWh/y	4,498,145	
1 Day Average kWh/d	12,324	

Calculation of Heat source energy

	kW	h	Load Rate	Occupancy	kWh/D
Chiller	196	24	0.7	1	3,293
Cooing Tower	11	24	0.8	1	211
Condenser Water Pump	37	24	0.8	1	710
Total					4,214

Calculation of Heat Transfer Equipment energy

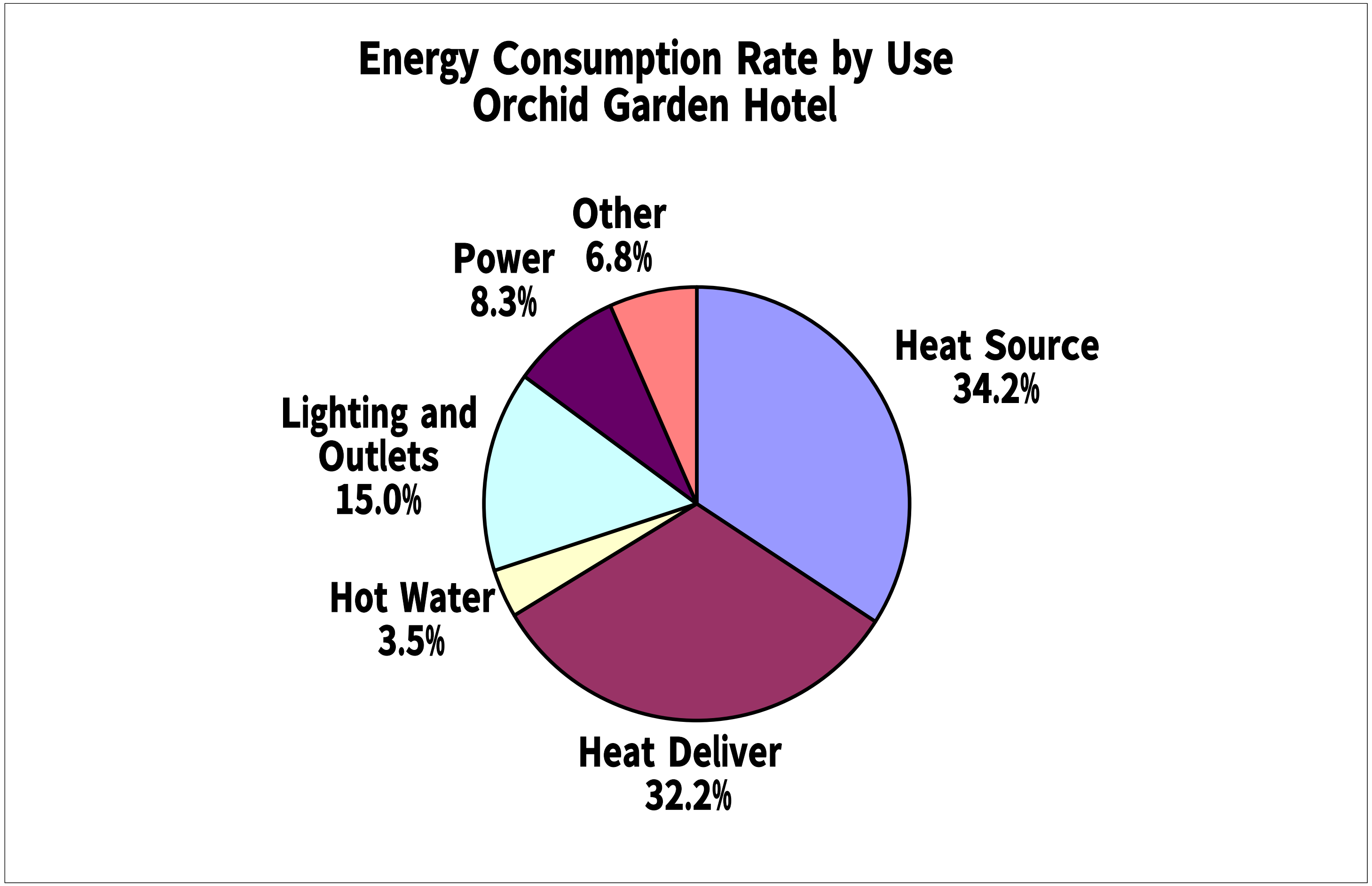
	kW	h	Load Rate	Occupancy	kWh/D
AHU Fan	50.2	24	0.8	1	964
AHU Heater	220	24	0.4	1	2,112
FCU Fan	9.315	24	0.8	1	179
Chilled Water Pump	37	24	0.8	1	710.4
Total					3,965

AHU Heater Load Ratio

AHU	Fan	Heater 1	Heater 2	Heater 3	Total	8 Nov Operating
	kW	kW	kW	kW	kW	kW
Function Room 1	11	5	10	20	35	
Function Room 2	5.5	5	10	20	35	
Fresh Air	11	10	15	30	55	55
Office	2.2	1	2	4	7	3
Lobby	5.5	3	5	10	18	
Restaurant	4	5	10	20	35	35
Coffee House	11	5	10	20	35	
Total	50.2	34	62	124	220	93

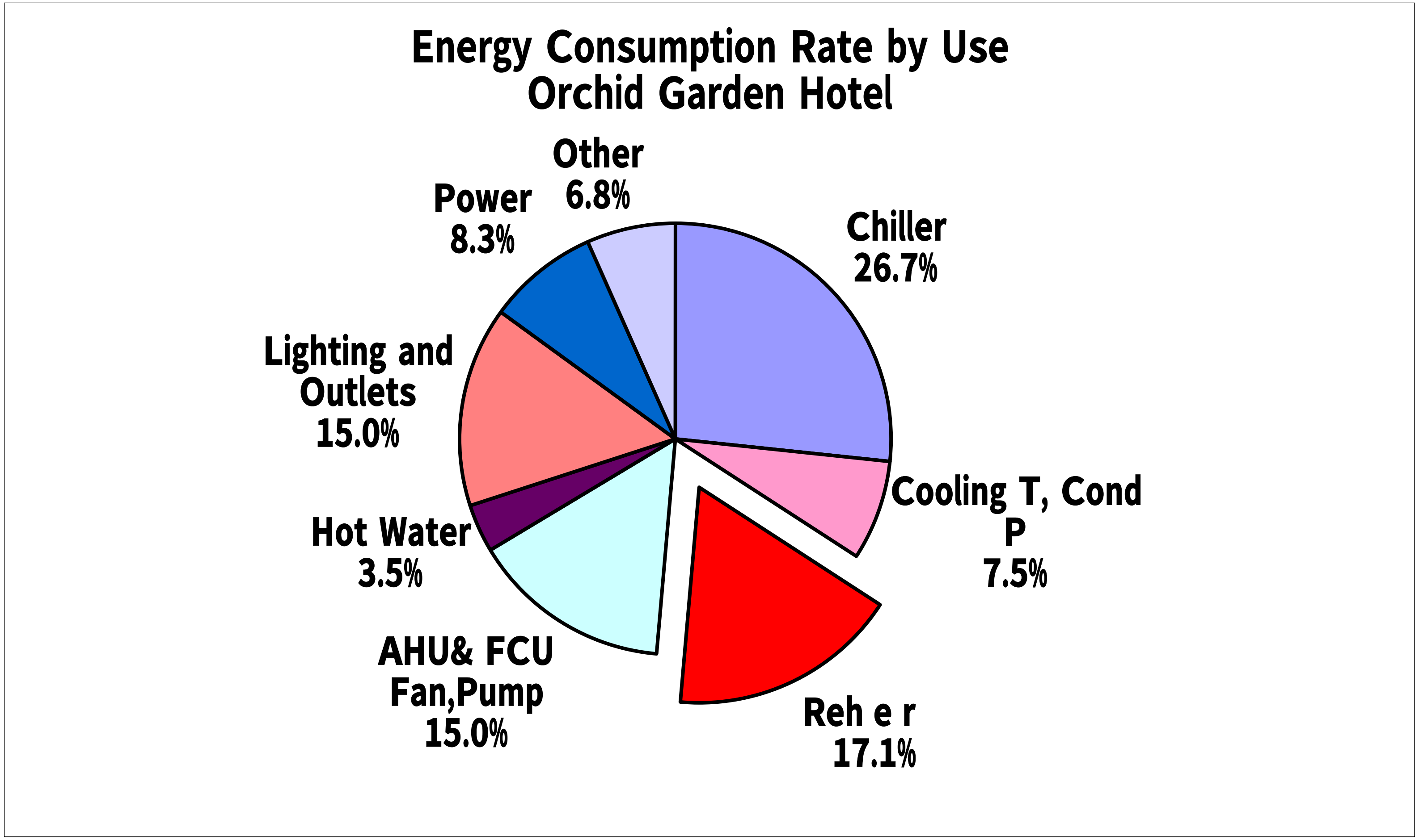
42%

Calculation Result

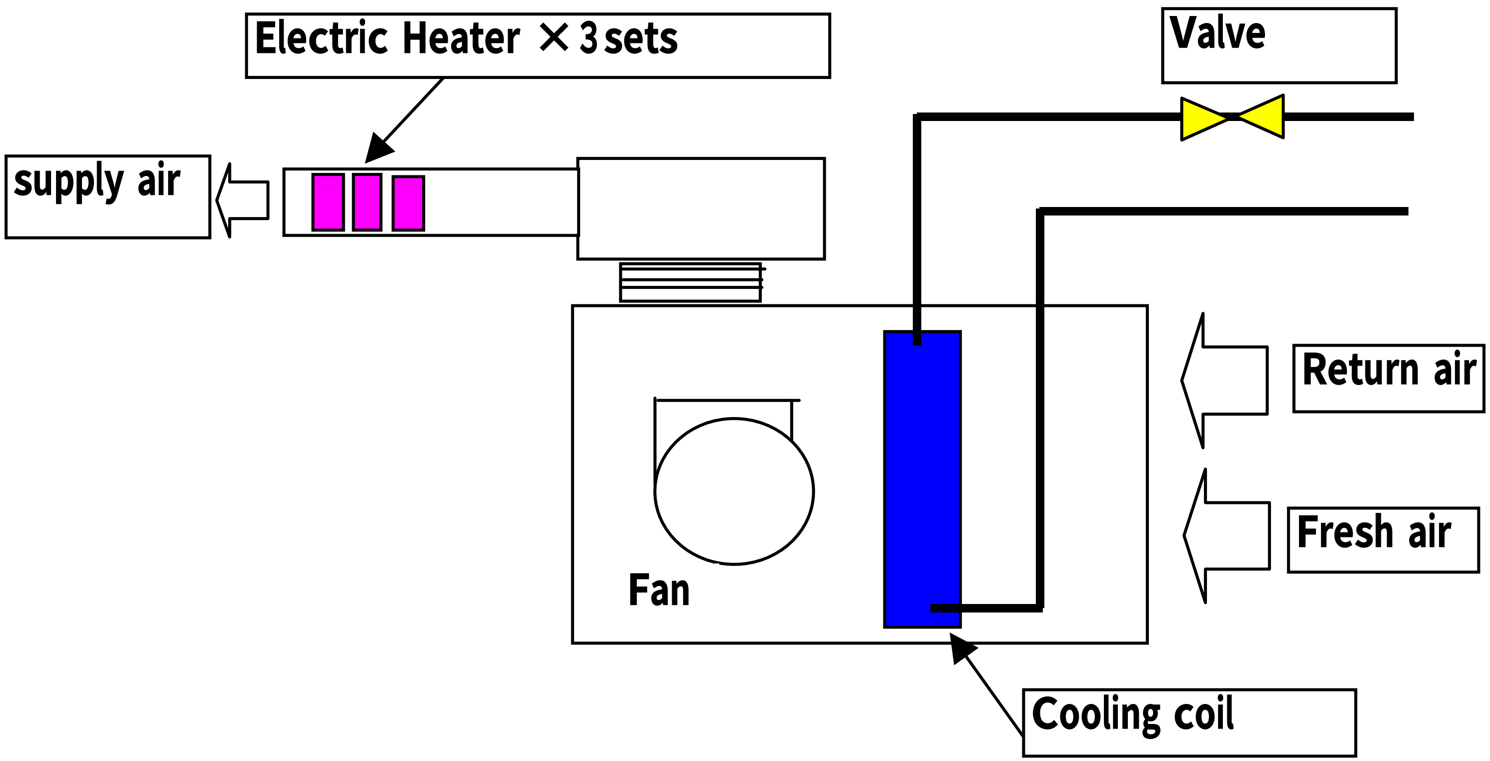


Improvement of Reheat system

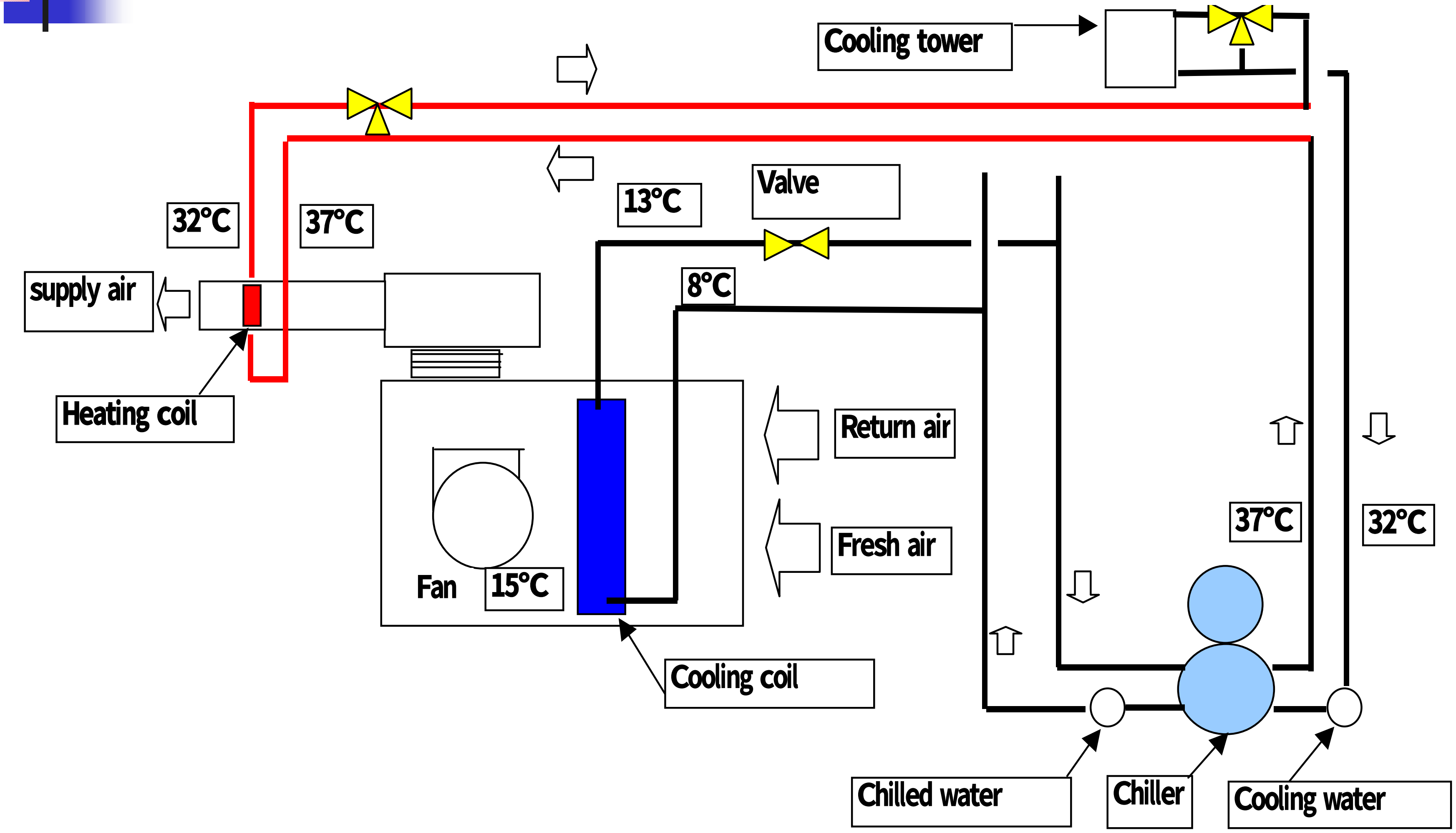
Reheater Energy Weight



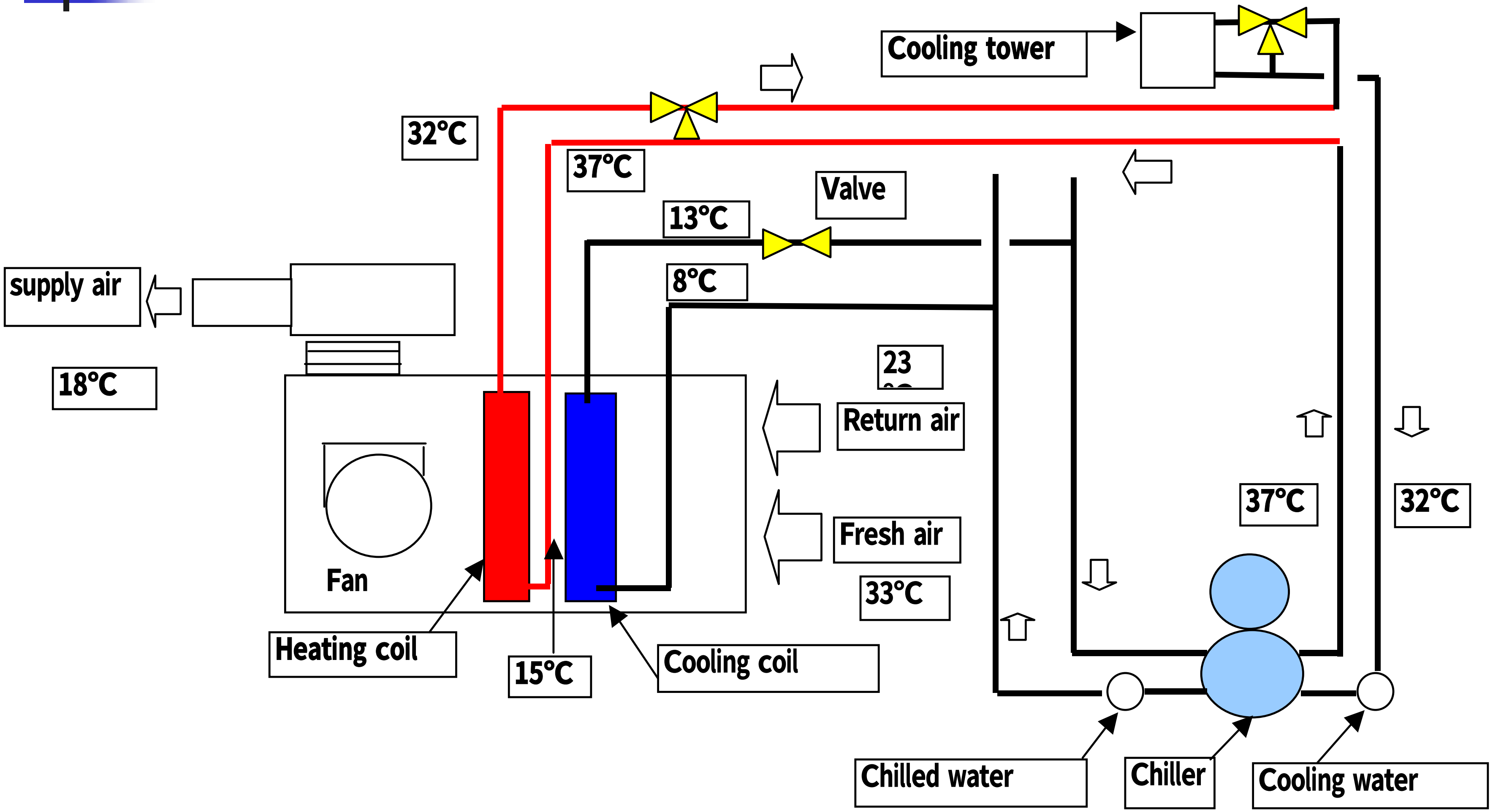
Present System



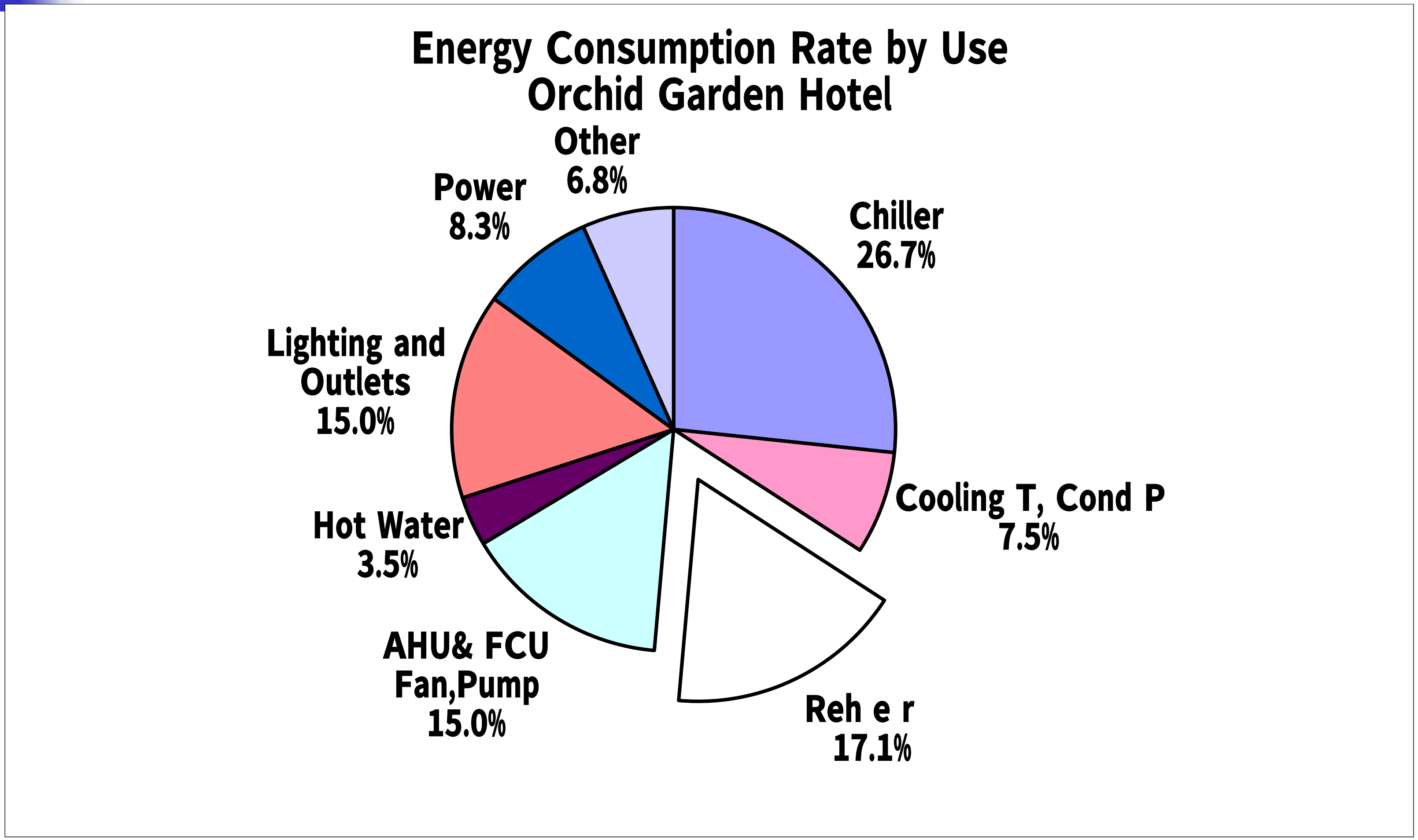
New System Image



New System :
Brunei Darussalam Method

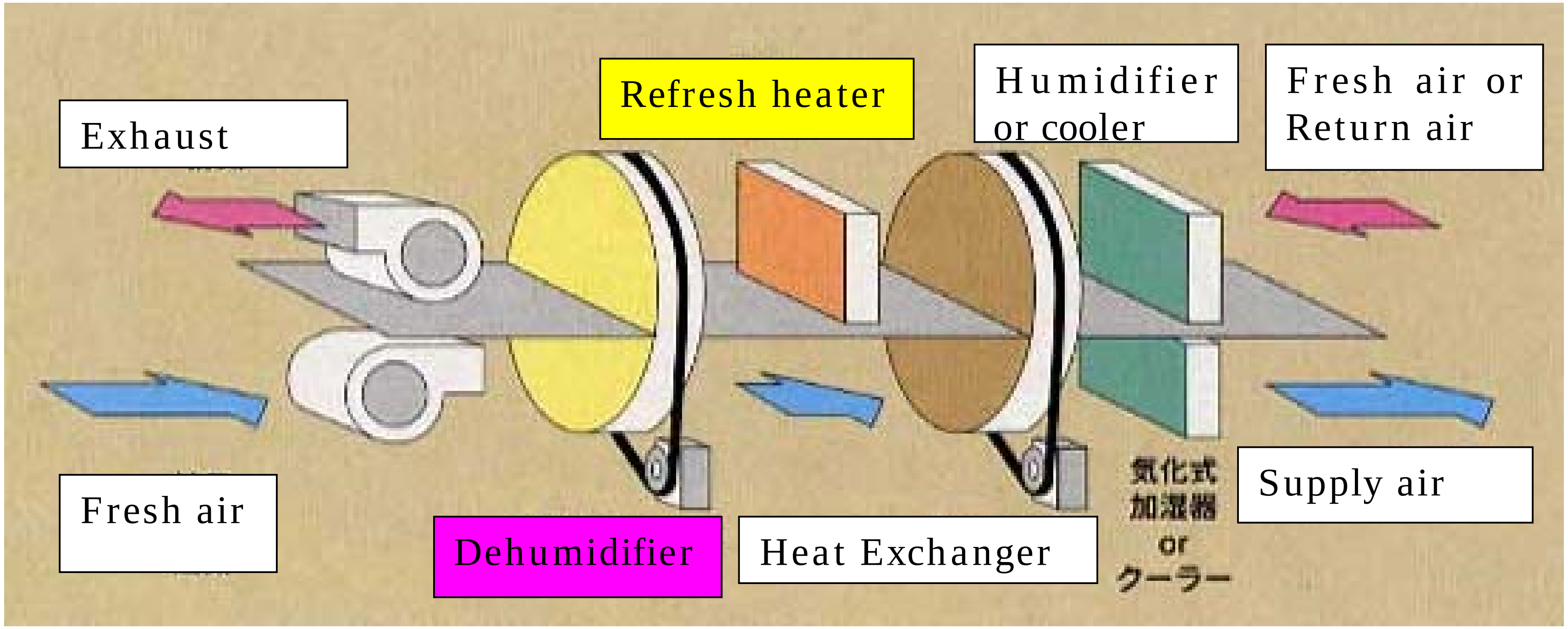


Cut Reheater Energy



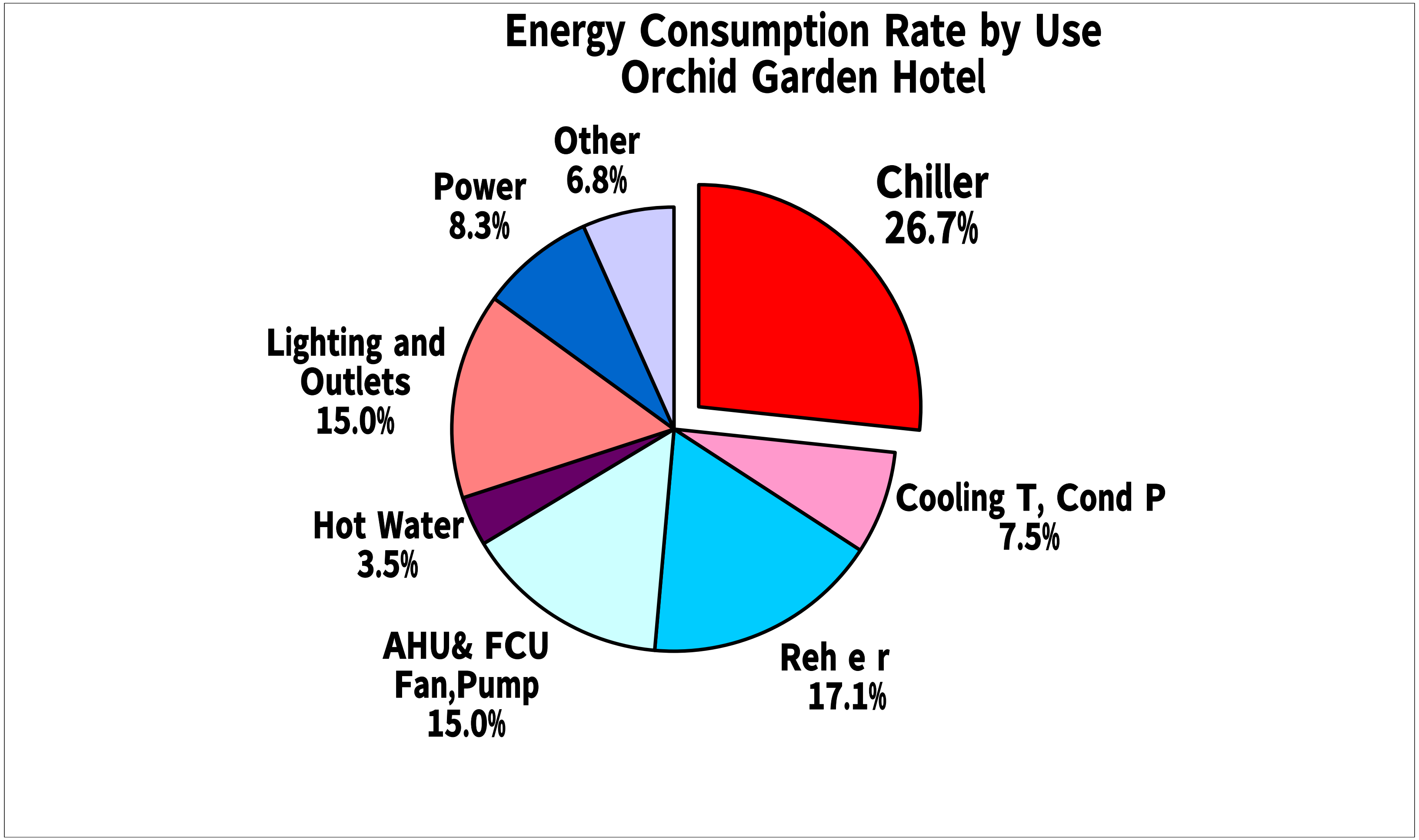
Introduction of Another System

- Desicant Air Conditioning System



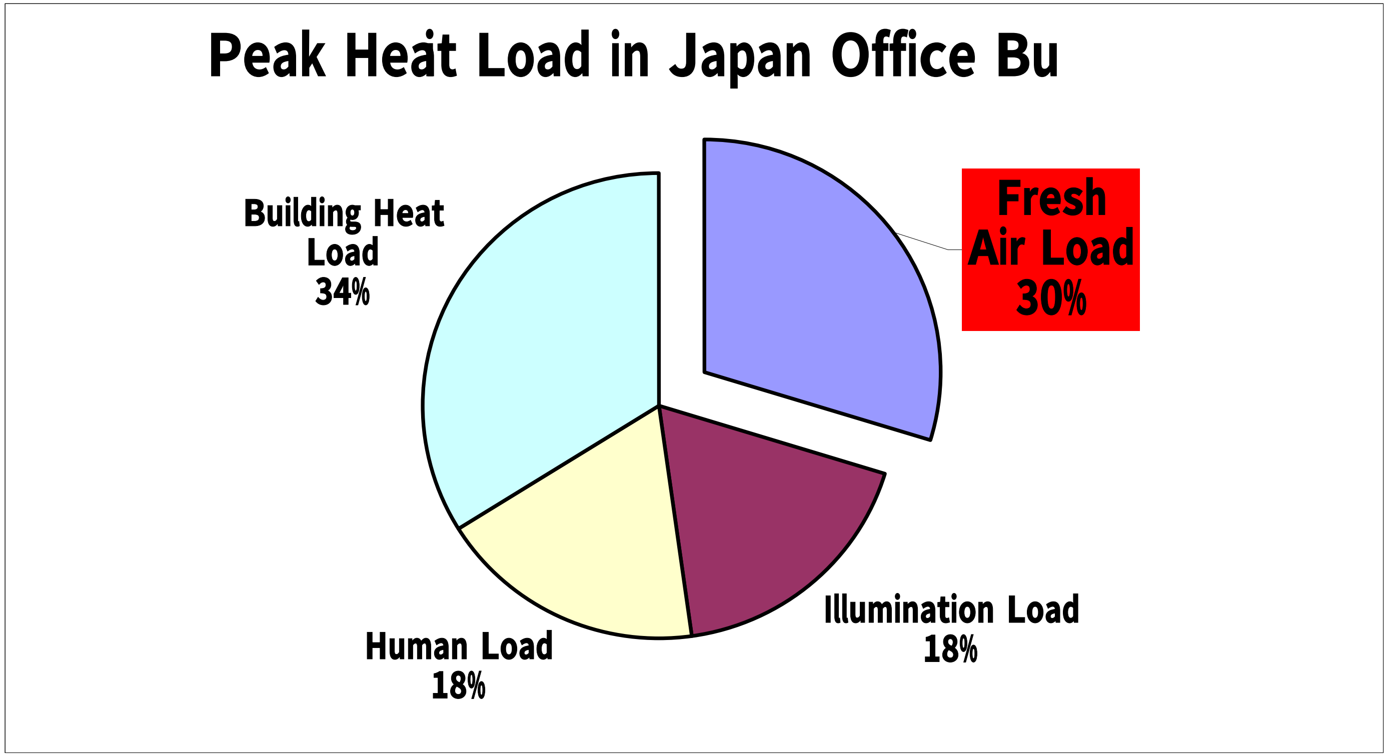
Importance of fresh air control

Chiller Rate



Heat Load of Fresh Air : Office Building

- Japan : 30〜40% Air-conditioning



Proper Amount of Fresh Air

- Japan's Room Environment Standard

  CO_2 Density : Below 1,000ppm

Measurement CO_2 density

Indoor :

3points 500,500,650

600ppm

Outside :400ppm

Calculation

- Outside air CO_2 density :400ppm
- Present indoor CO_2 density :600ppm
- Goal indoor CO_2 density : 800ppm
- Present ventilation value :V1m3/h
- Ventilation value after improvement :V2m3m3/h

$400V1+X=600V1$

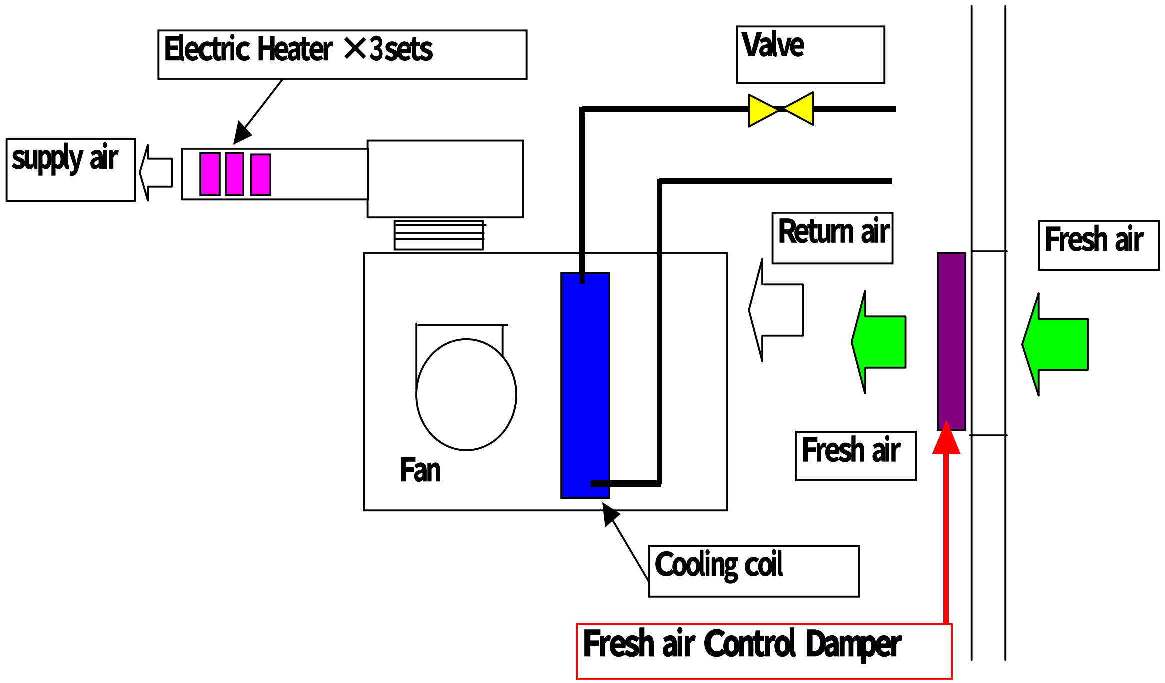
$400V2+X=800V2$

$V2/V1=(600-400)/(800-400)=0.5$

Method of Fresh Air Volume control

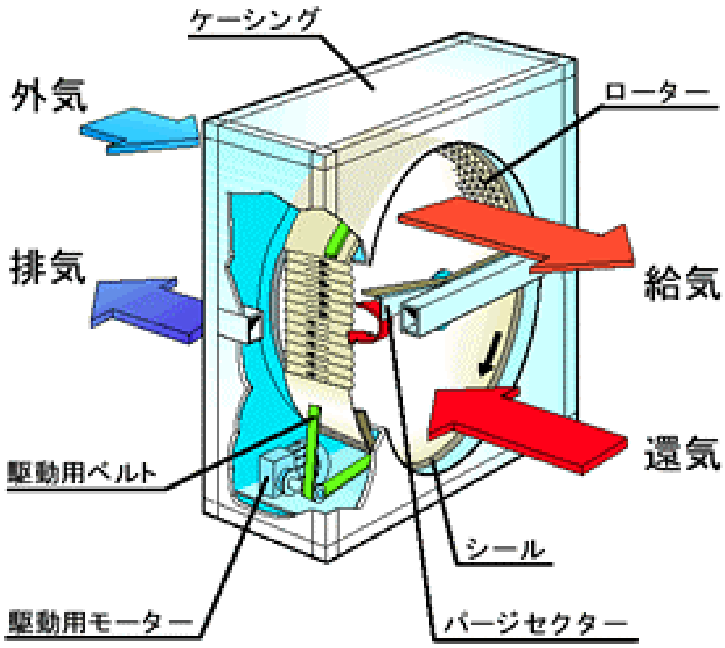
1 Manual Damper Control

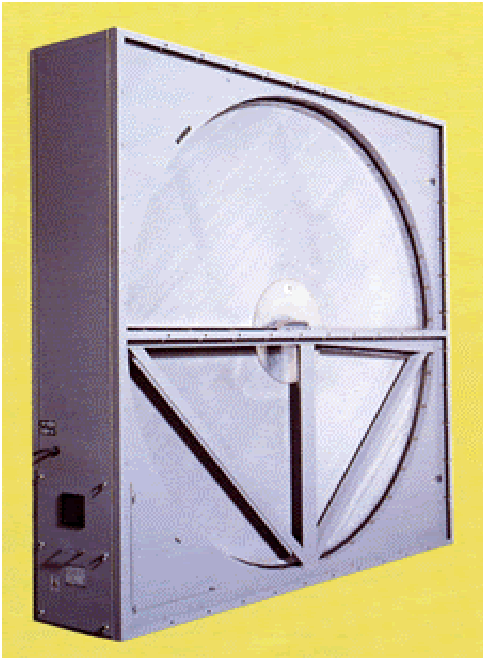
2 Automatic Operation through CO2 Monitoring



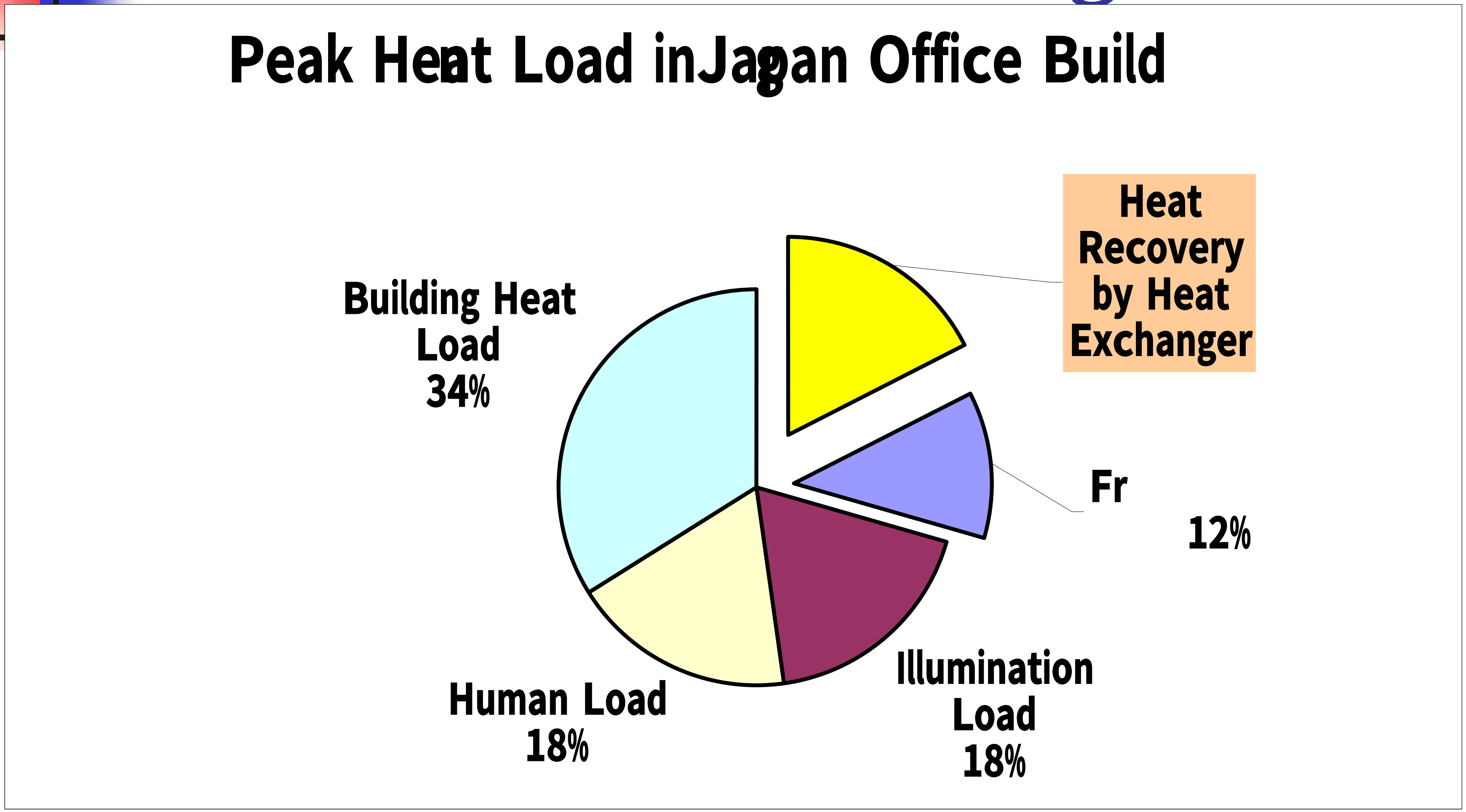
Fresh Air Volume control Example

Heat Exchanger : To Reduce Heat Load





Effect of Heat Exchanger



Fresh Air Stop : When Starting

- 30min～1hour
- Difference :

  AHU operate start time ,

  Business start time

Summary : Attention to Fresh Air

- **Fresh Air Heat Load :**

  Big Weight of Building Energy
- **Technique :**

  Control of Fresh Air

  1. Reduce Fresh Air Volume

  2. Reduce Fresh Air Heat Load
- **Useful for ASEAN Countries**

Thank you

The Energy Conservation Center, Japan

Preliminary Report
Building Energy Audit –
Lao Plaza Hotel
LAO PDR

27 January, 2004

Akira Kobayashi and Takashi Kato

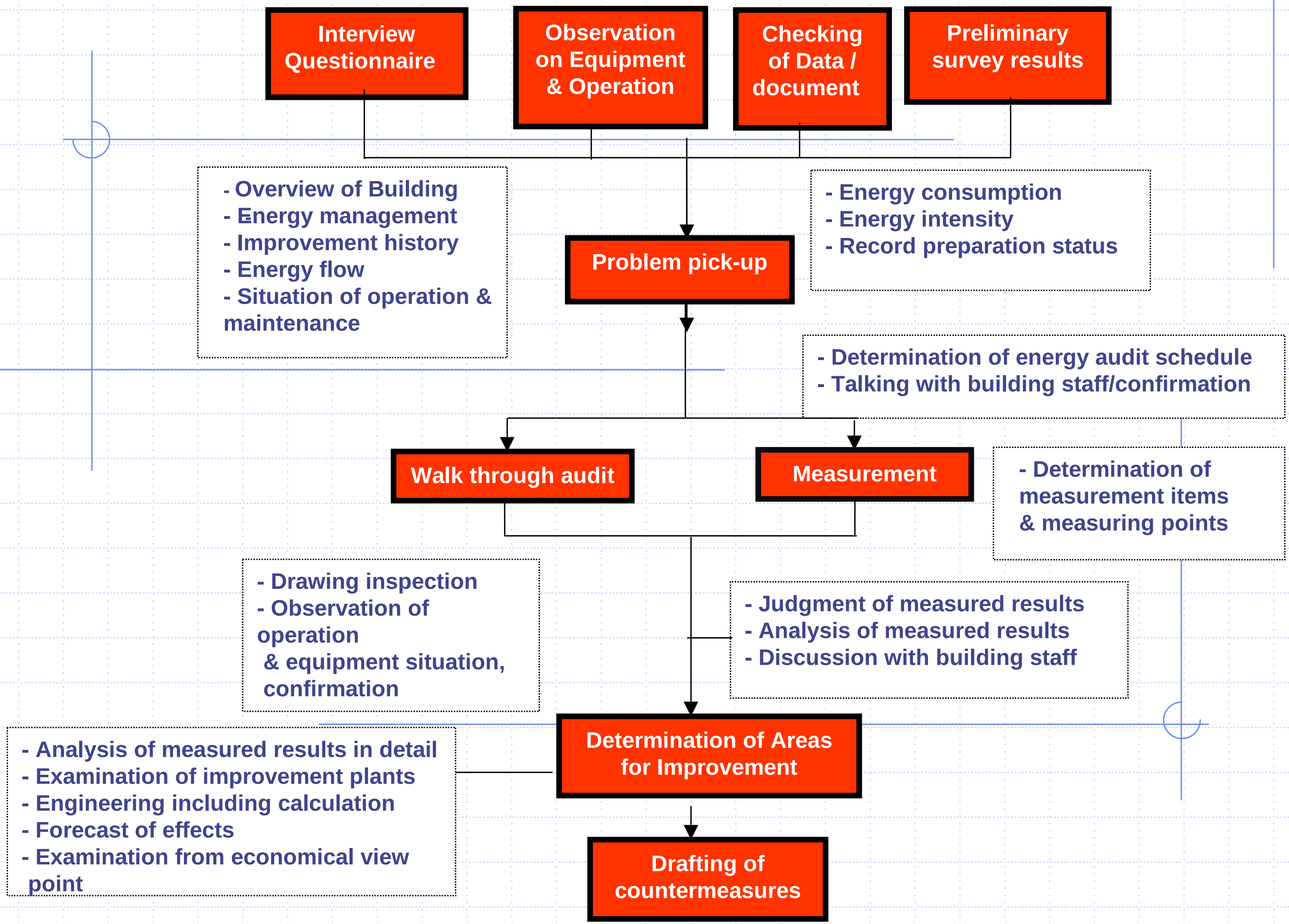
The Energy Conservation Center, Japan

Outline of Presentation

- Building energy audit flow chart
- Results of Audit in Lao Plaza Hotel
  - General building information
  - Overview of electrical facilities
  - Overview of air-conditioning facilities
  - Utility consumption
  - Energy intensity
  - Best energy management practices
  - Improvement points and potential savings
- Summary

Building Energy Audit Flow Chart

Building Energy Audit Flow-chart



Preliminary Results of Energy Audit in Lao Plaza Hotel, Lao PDR

1.1 General Building Information

- Name of Building: Lao Plaza Hotel
- Category of Usage: Hotel
- Number of Storeys: 7 & Basement - 1 Floor
- Total Gross Floor Area : 14,972.25 m^2
- Age of Building : 7 years
- Air conditioning : Air conditioner +Fan coil unit system
- Building management : mostly manually

1.2 Overview of Electrical Facilities

- Receiving Voltage: 22 kV
- Transformer capacity: 1,000kVA × 2 units
- Generator for emergency: 275 kVA x 1 unit
- Elevators : 2 units x 10 kW
- Service lift : 1 units x 11 kW

1.3 Overview of Air-conditioning Facilities

- Chiller capacity :

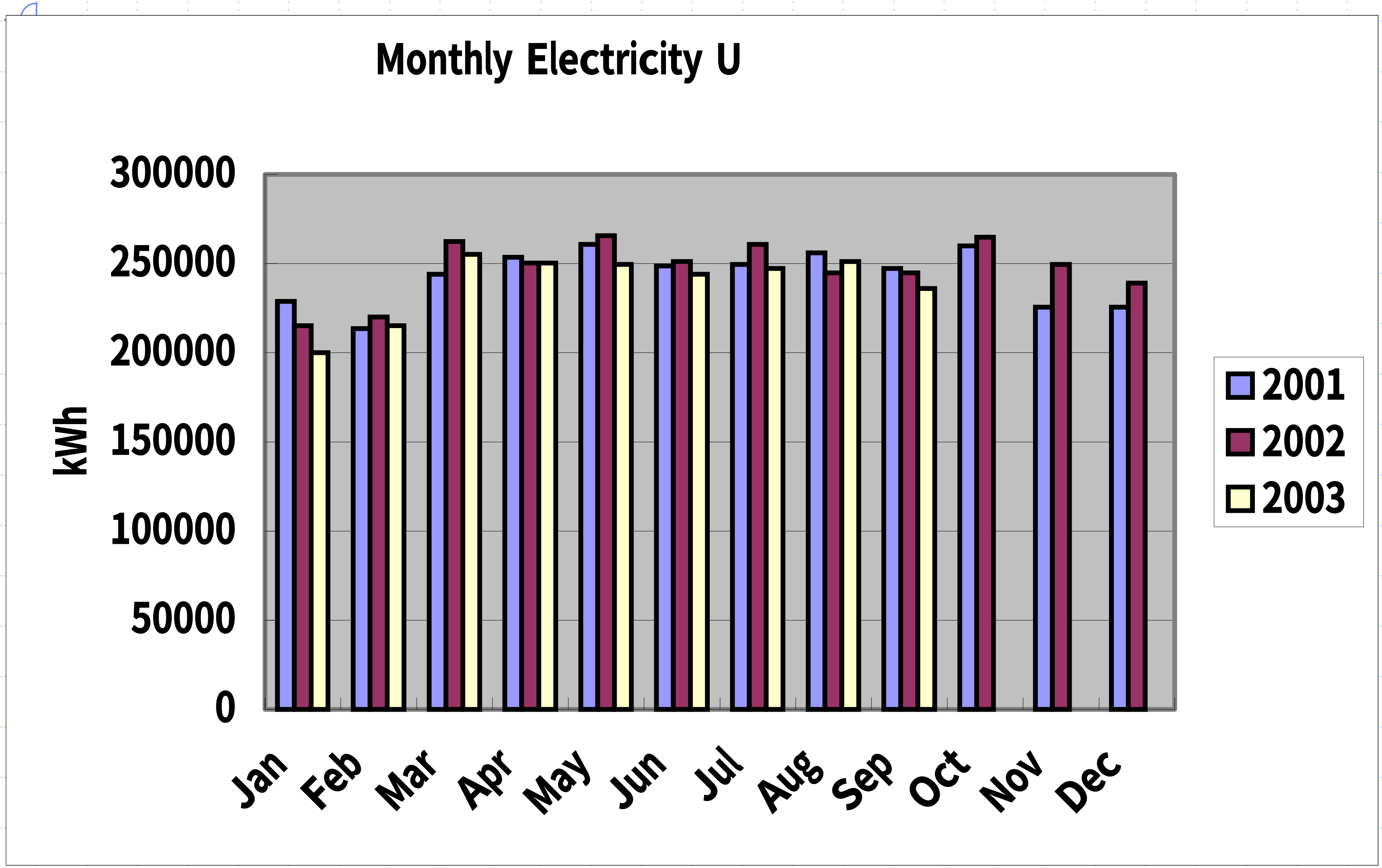
  - 2 units x 300 Refrigerant ton (210 kW)
- Air handling units (AHU＊10 units)
- Fan coil units (FCU＊201 units)

1.4 Sanitary facility

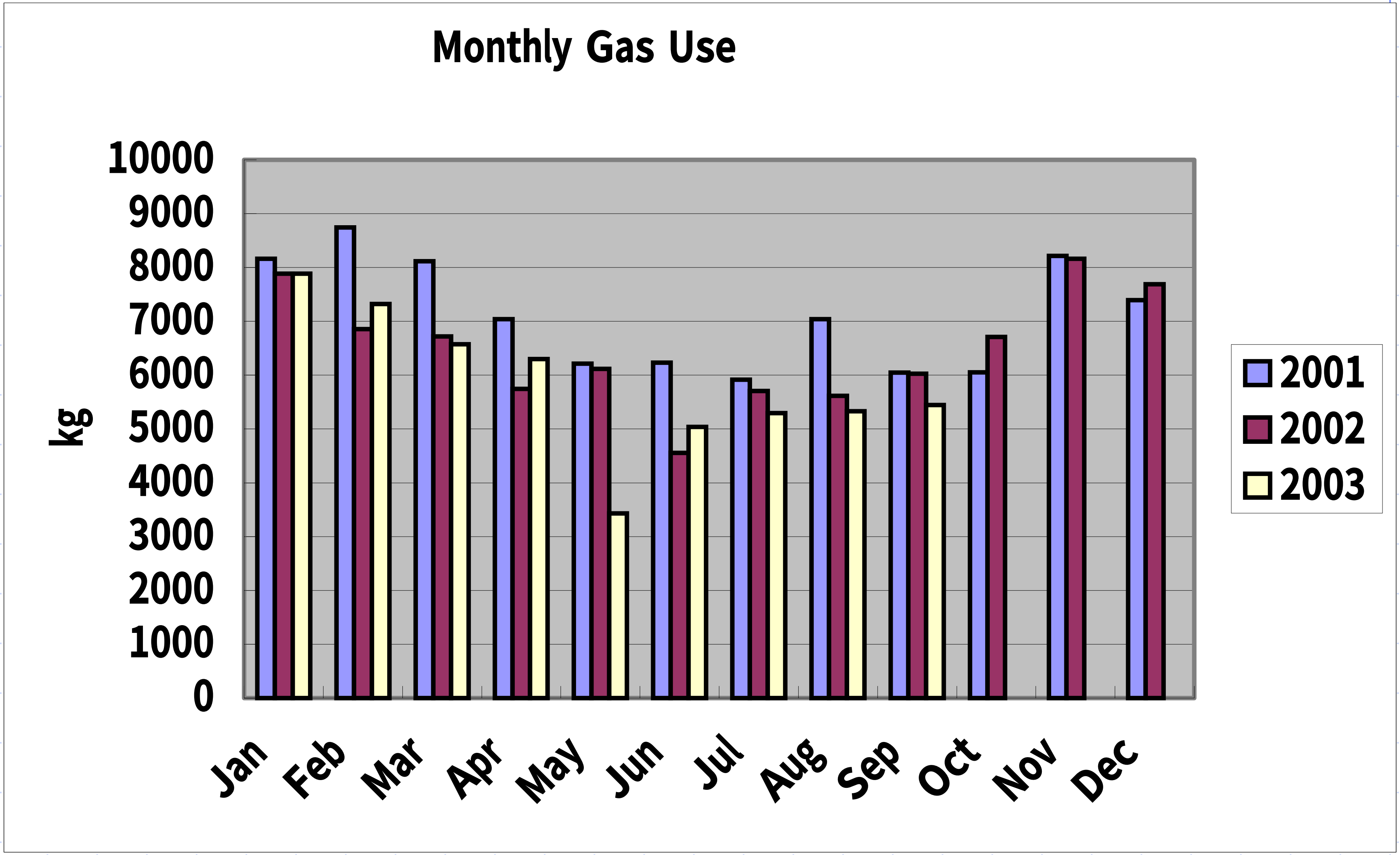
- Hot Water Boiler(LPG): 625,000BTU/hour × 2 units
- Receiving water tank
- Storage pump : 7.5 kW × 2 units
- Booster pump : 7.5 kW × 2 units
- Water tank at the rooftop

2 Analysis of Current Situation

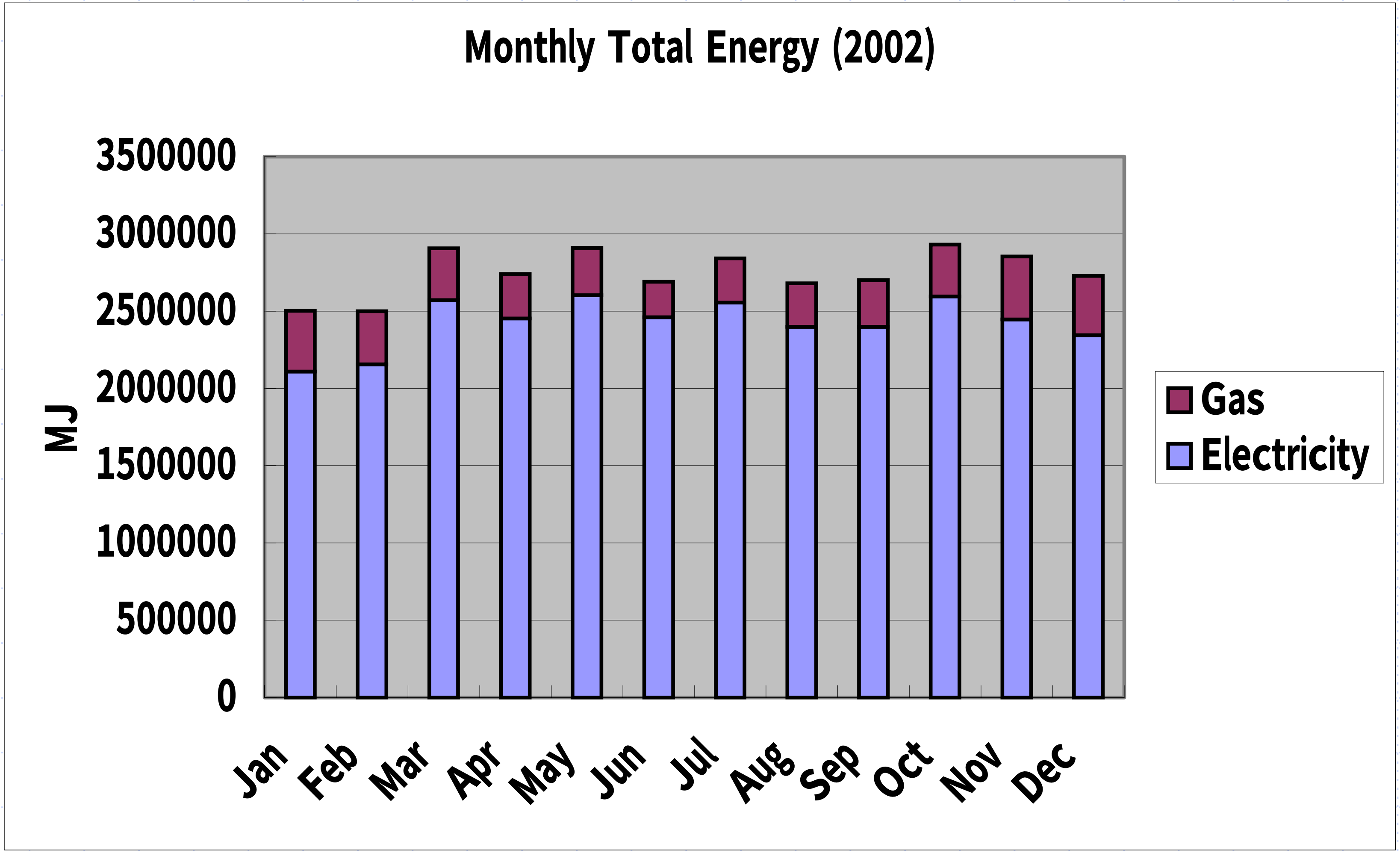
2.1 Monthly Energy Consumption (2002)



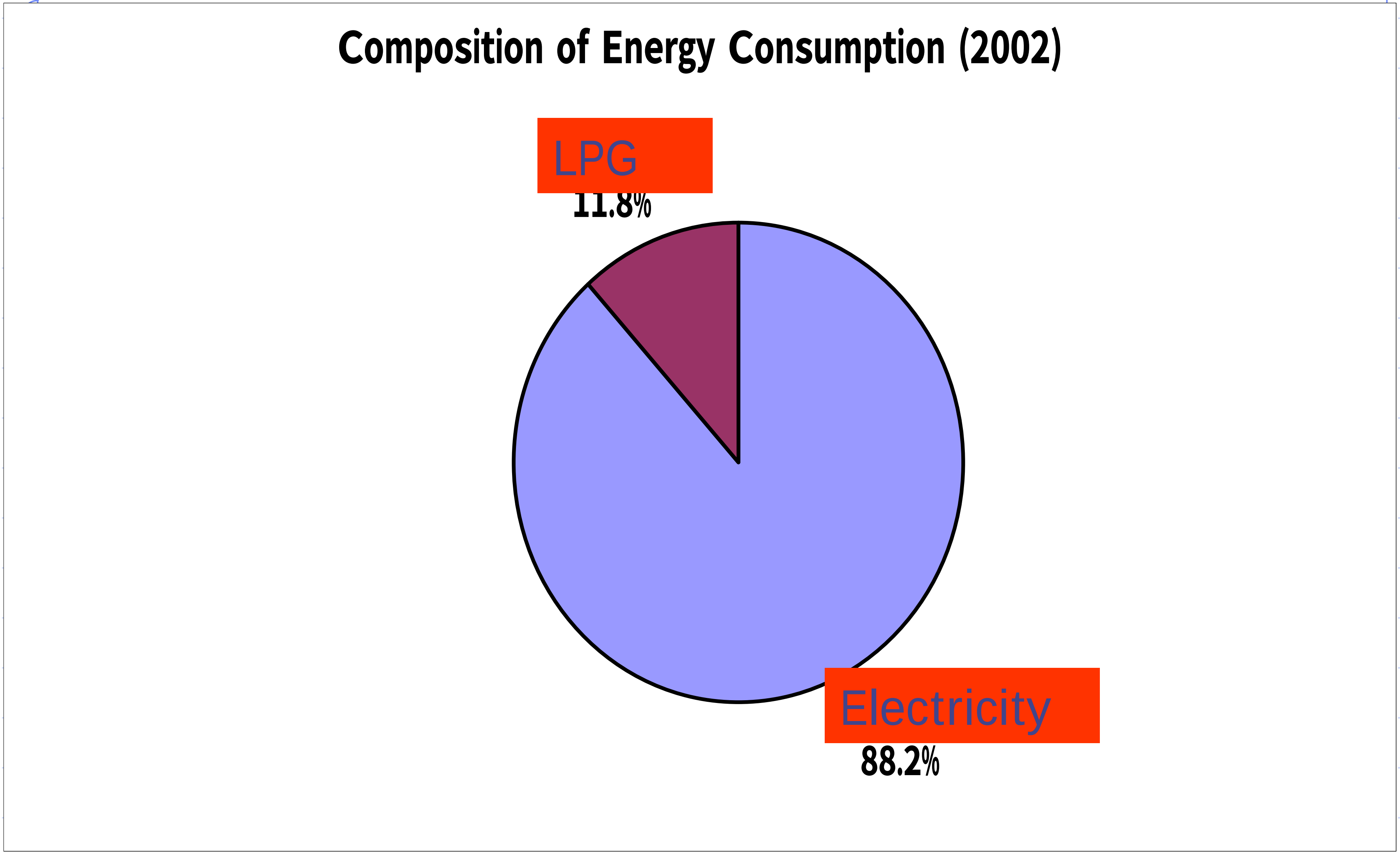
2.2 LPG Consumption(2001-2003)



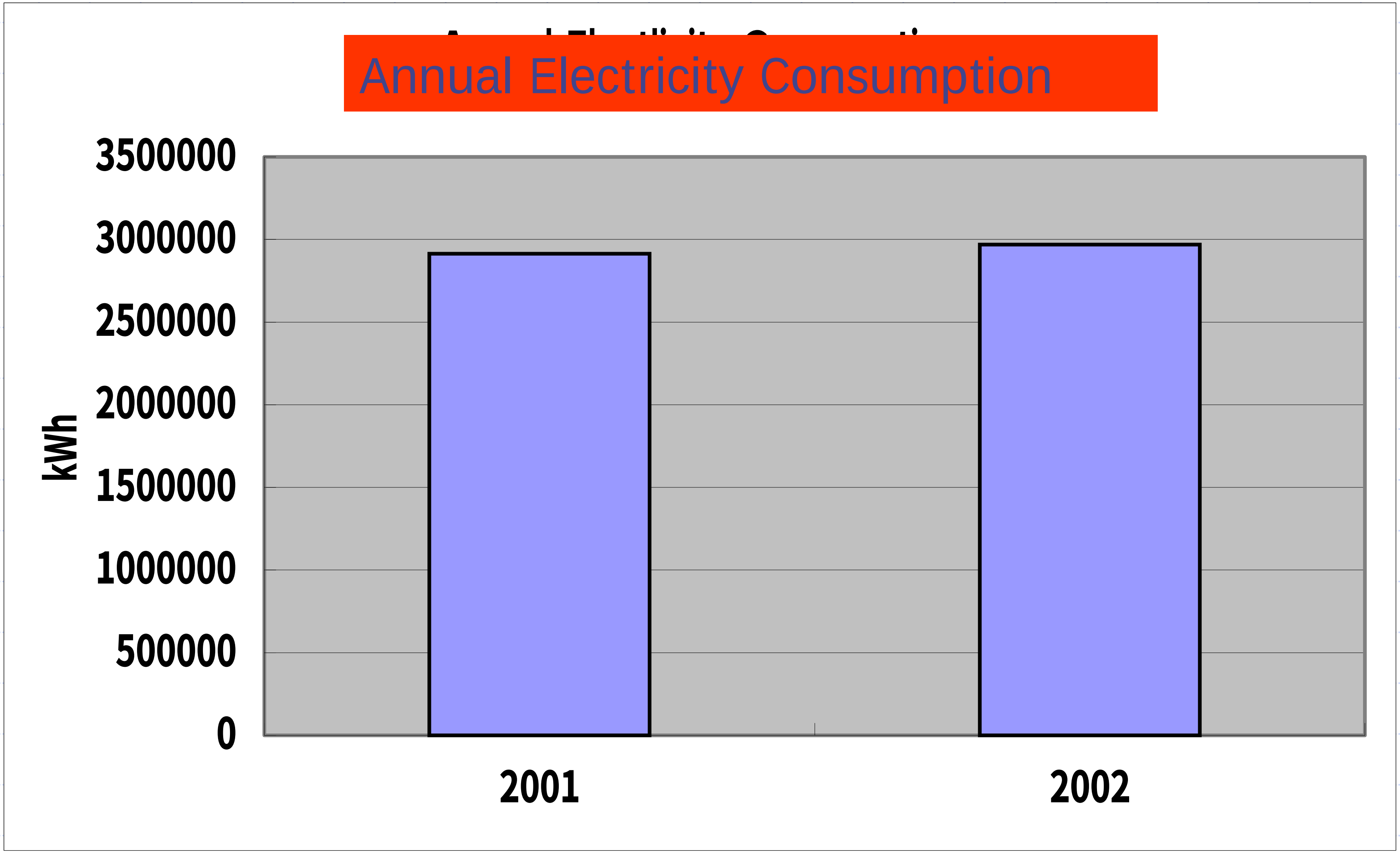
2.3 Total energy consumption (2002)



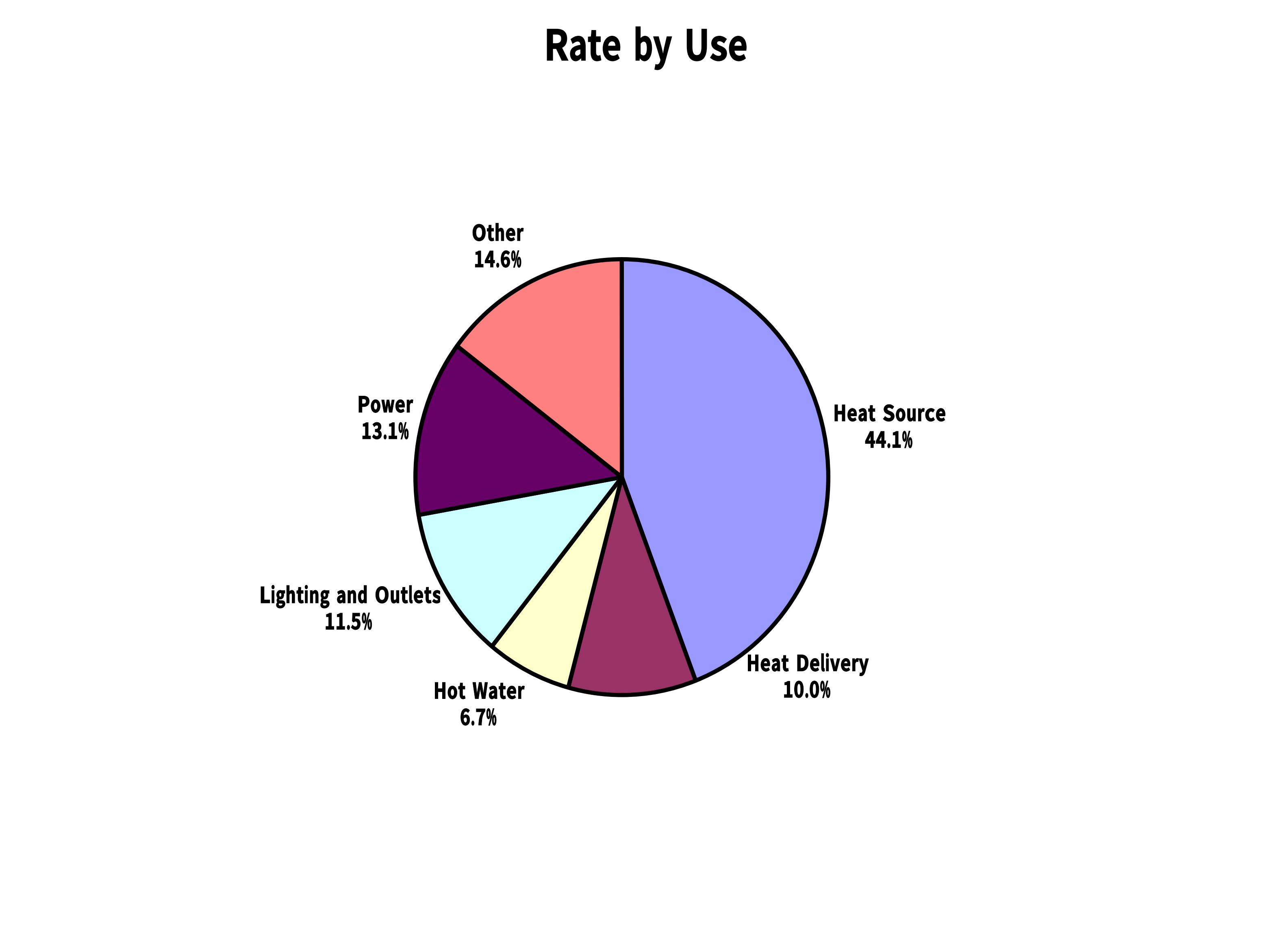
2.4 Share of Electricity and Gas (in %)



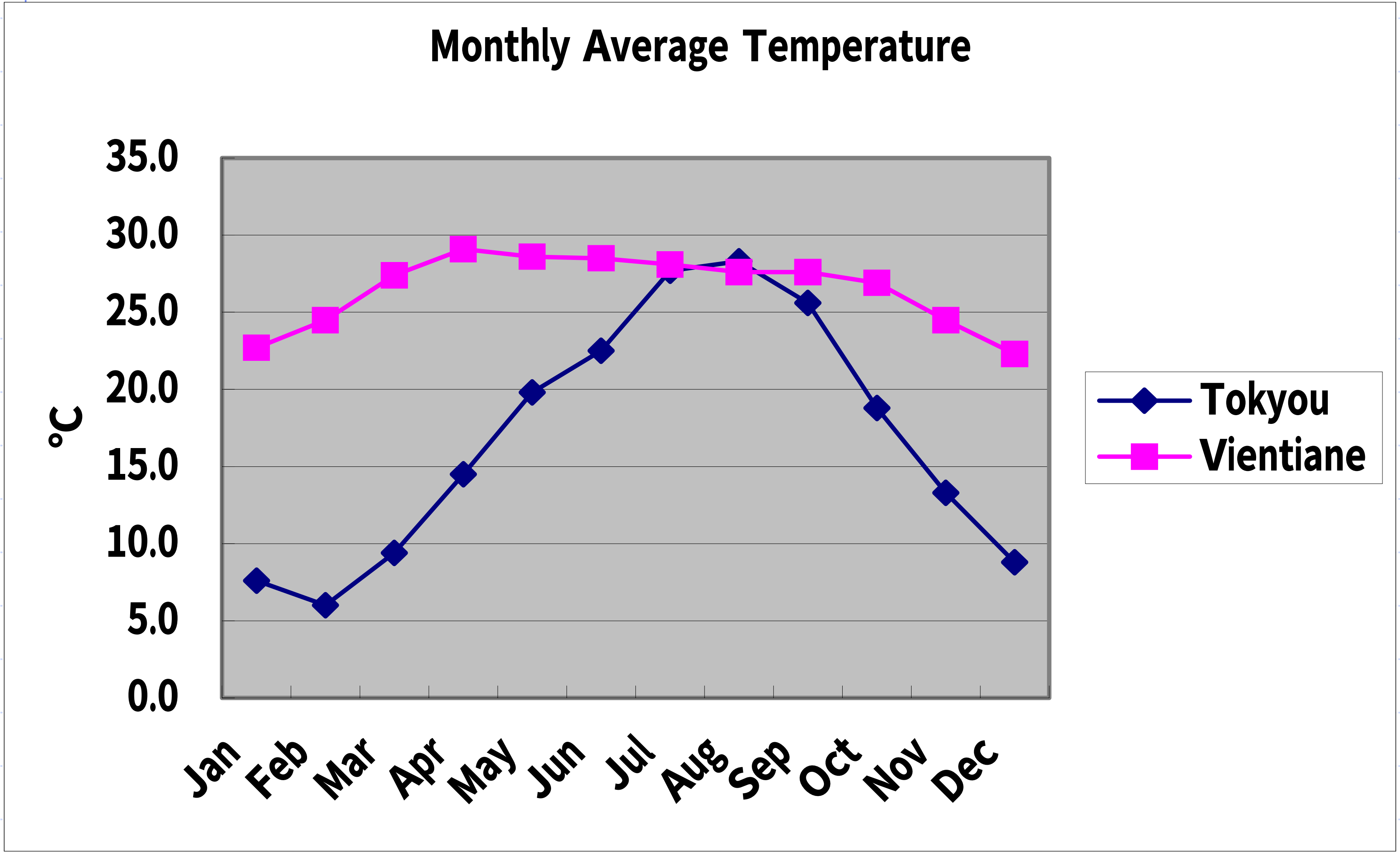
2.5 Annual Energy Consumption (in kWh)



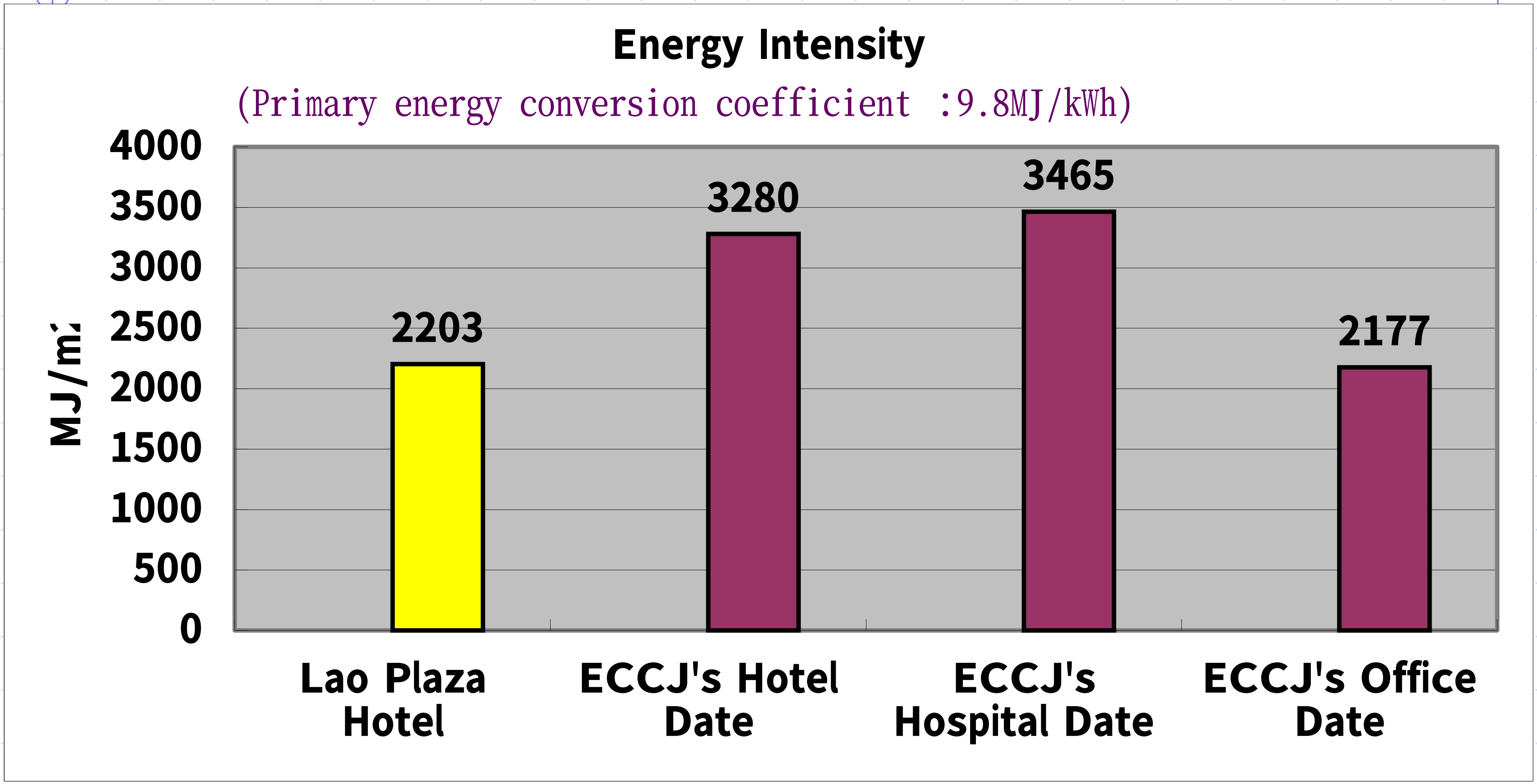
2.6 Energy Consumption by End-use (in %)



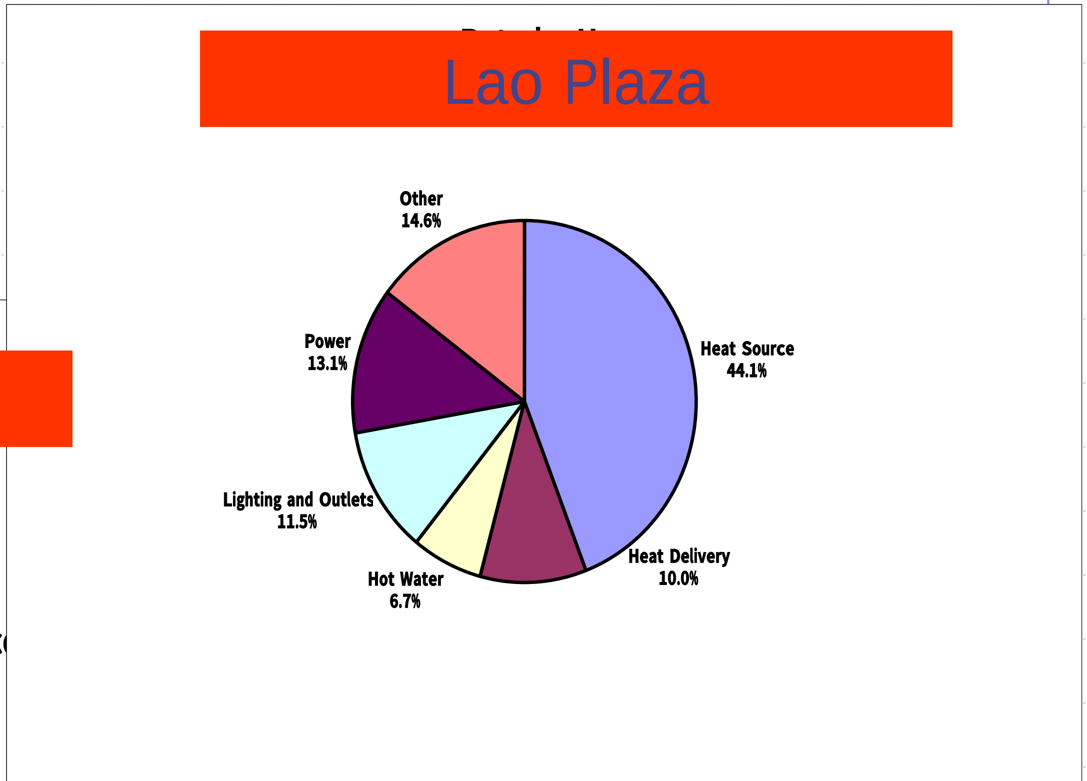
2.7 Mean Temperature : Japan vs Vientiane

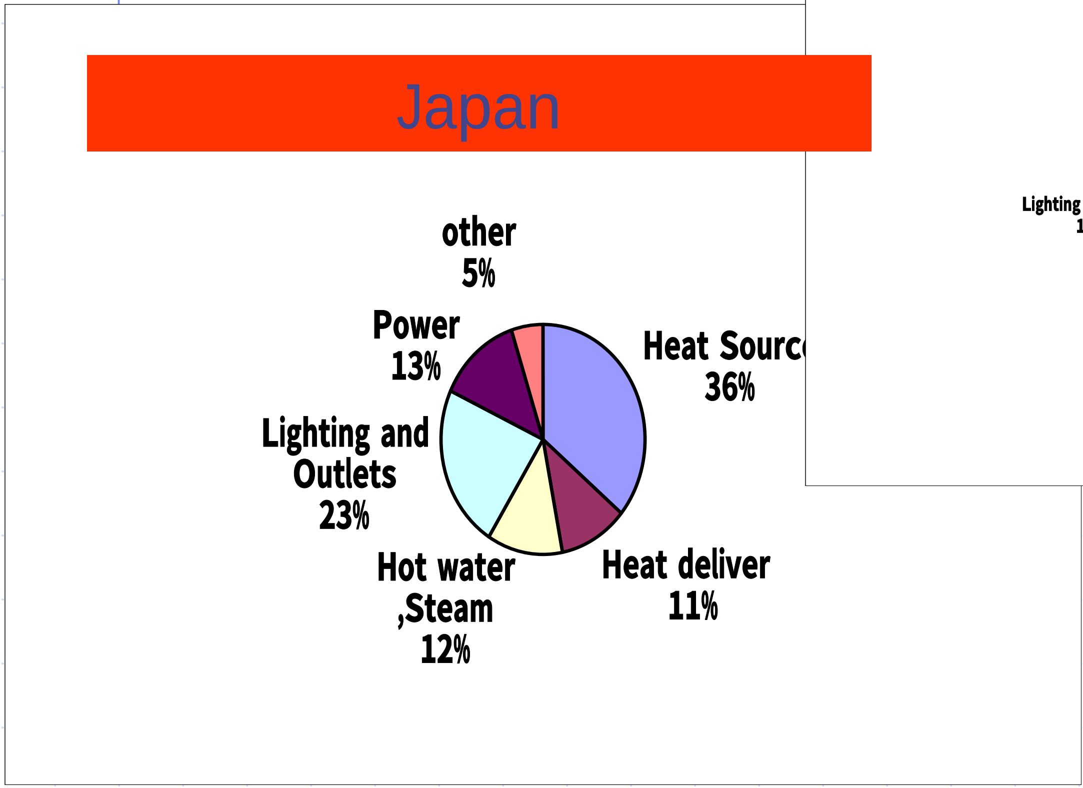


2.8 Building Energy Intensity: Lao Plaza H. vs. ECCJ Data



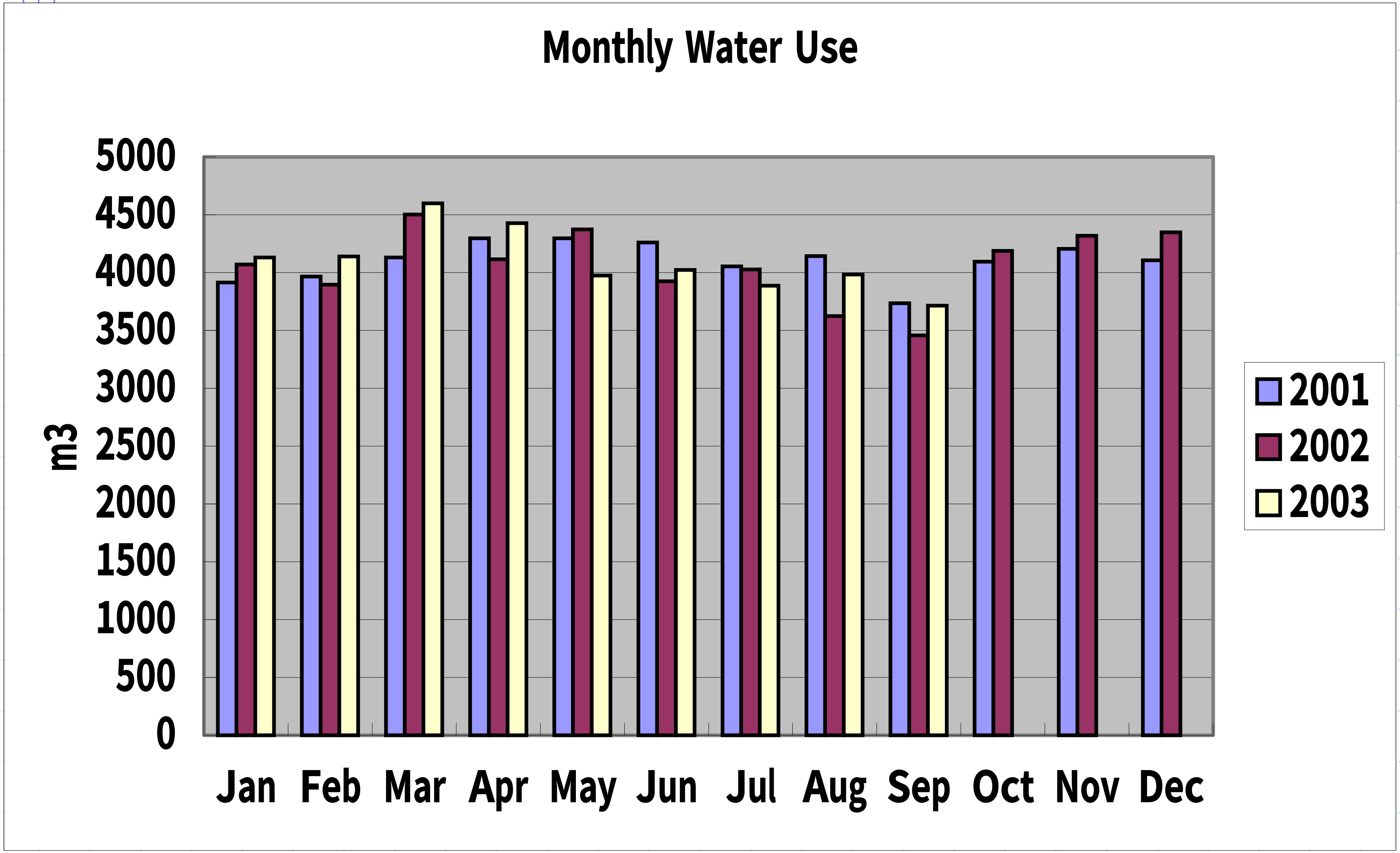
2.9 Energy Consumption by End-use: Lao Plaza vs. Japan's Hotel (in %)



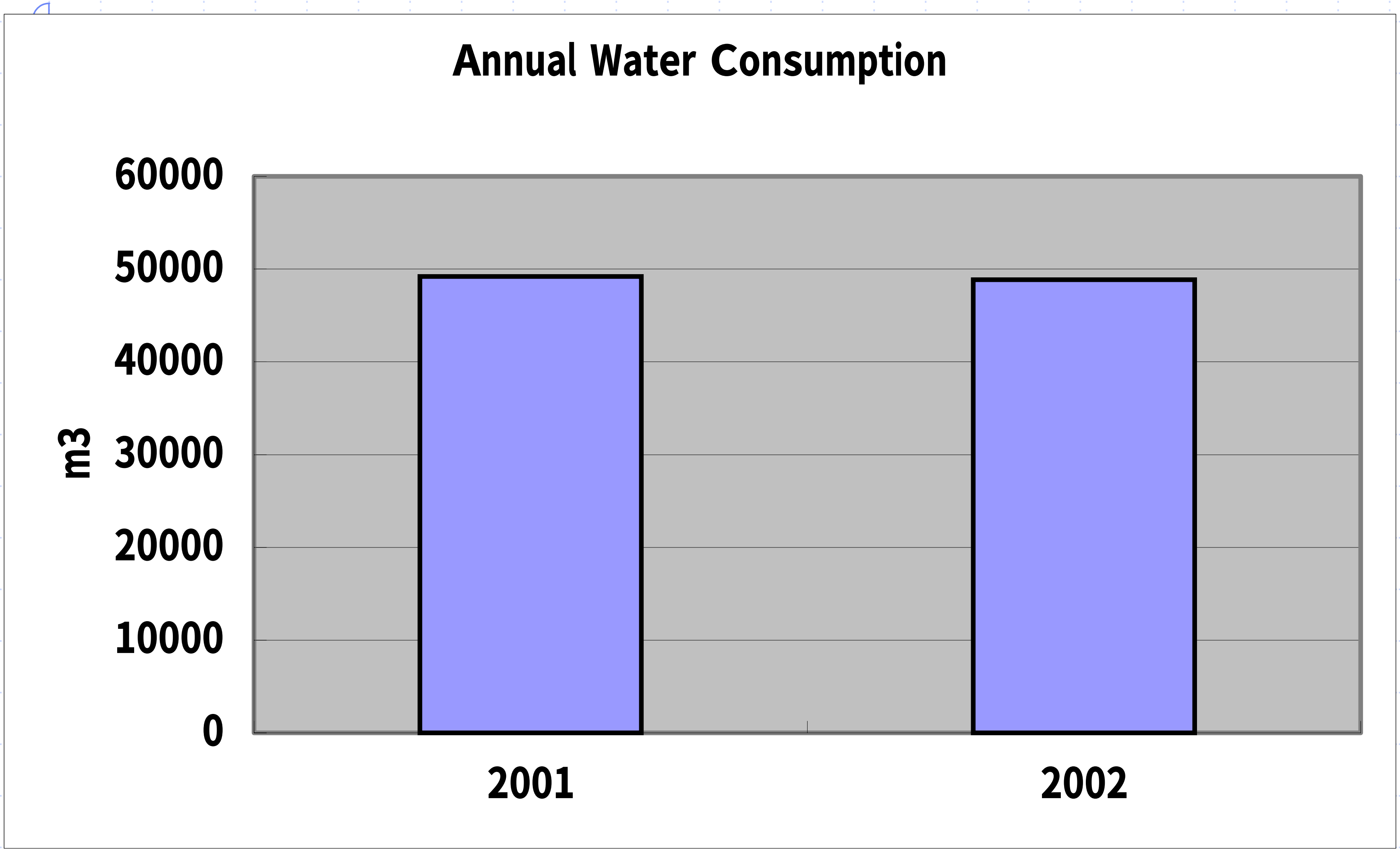


2.10 Water Consumption

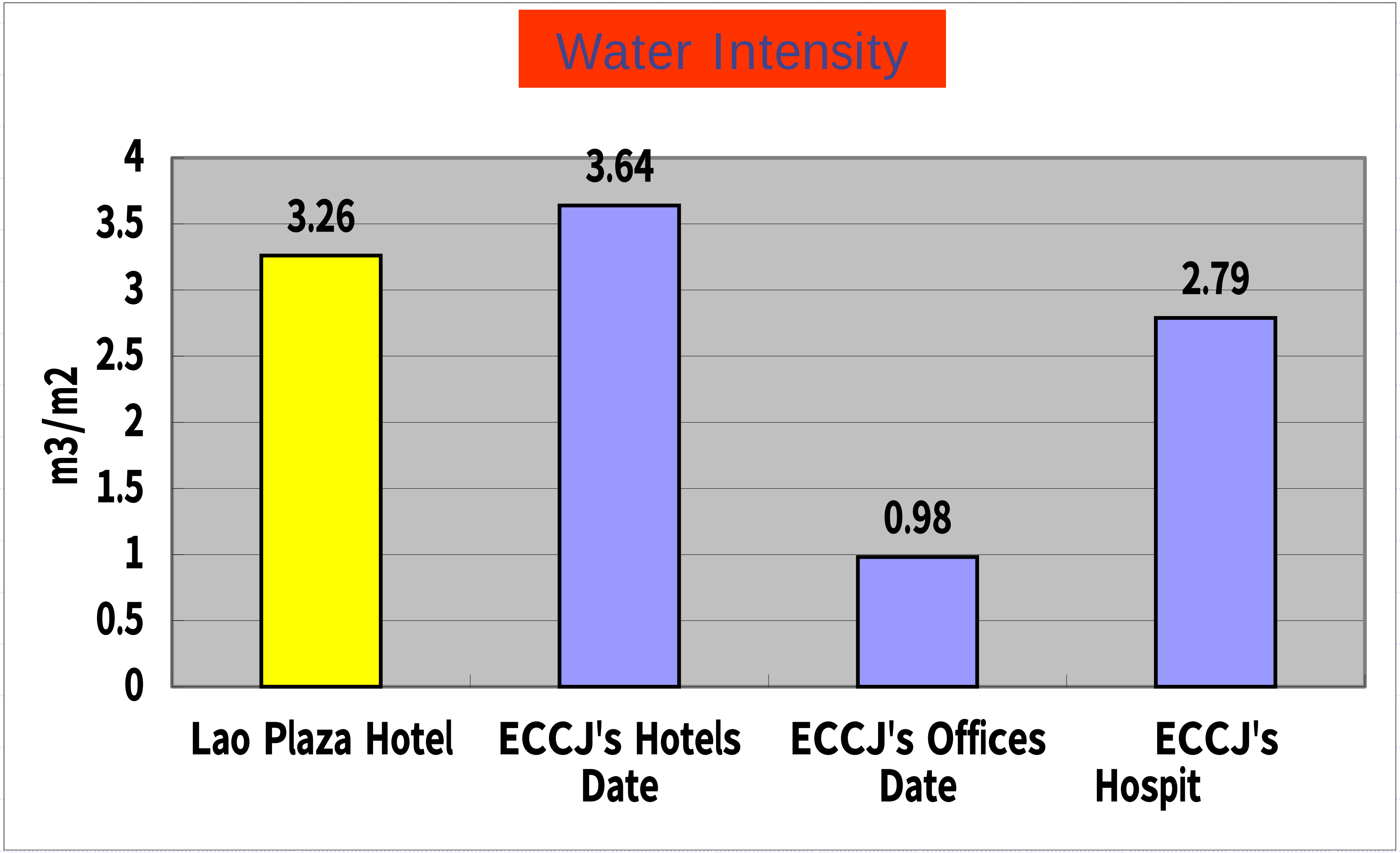
(1) Monthly Water Consumption Intensity



(2) Annual water consumption



(3) Water Intensity : Lao Plaza vs. Other Buildings (in m^3/m^2)



3. Good Energy Management Practices of Lao Plaza Hotel

3.1 Good management of the chiller outlet temperature and cooling water temperature corresponding to the load condition.

- The turbo chiller outlet temperature is set up when cooling load is low. And the operation of cooling tower is controlled according to the load condition.
- By raising the chilled water temperature by 2℃, about 5 % of motor output is reduced.
- By reducing the cooling water temperature by 2℃, about 5 % reduction of motor output is also achieved.

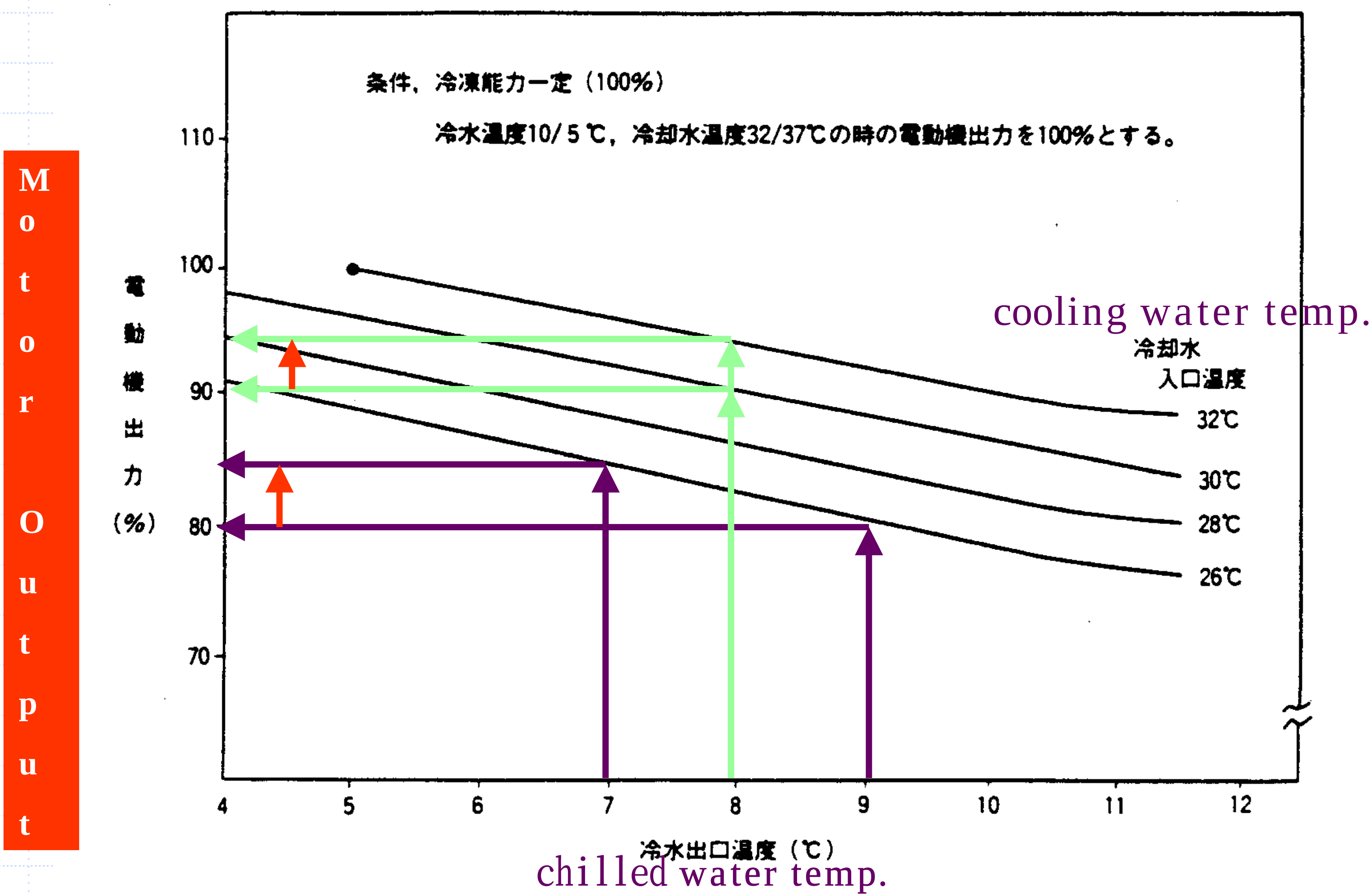


図３．３　電動ターボ冷凍機

冷水温度、冷却水温度と電動機出力の関係

3.2 Proper setting of machine room temperature.

The elevator machine room is 30°C.

3.3 Proper operation of the air conditioning machine, ventilation fan

- Two chillers for AC lobby are used during daytime; and one chiller is used during night time.
- Ventilation fan of guest rooms is operated only for 7 hours during nighttime and morning time.

3.4 Complete consumption of LPG

LPG gas in cylinder is completely consumed. When full, the cylinder is in upright position and when nearly empty, the cylinder is laid down.

3.5 Complete blockade of fresh air intake from outside

Due to the frequent opening and closing of doors at the main lobby, the fresh air intake outlet was completely blocked.

3.6 Employees awareness of hotel's energy management system

Bulletin board is strategically placed in the staff area to inform the employees of the hotel's day to day energy consumption and cost. This appeals to the employees cooperation to save energy and cost.

Improvement Items and Potential Savings

Improvement Point 1.
Optimization of the Receiving Transformer

- Current situation

  - Load of the transformer TX1 (1000 kVA for AC.)

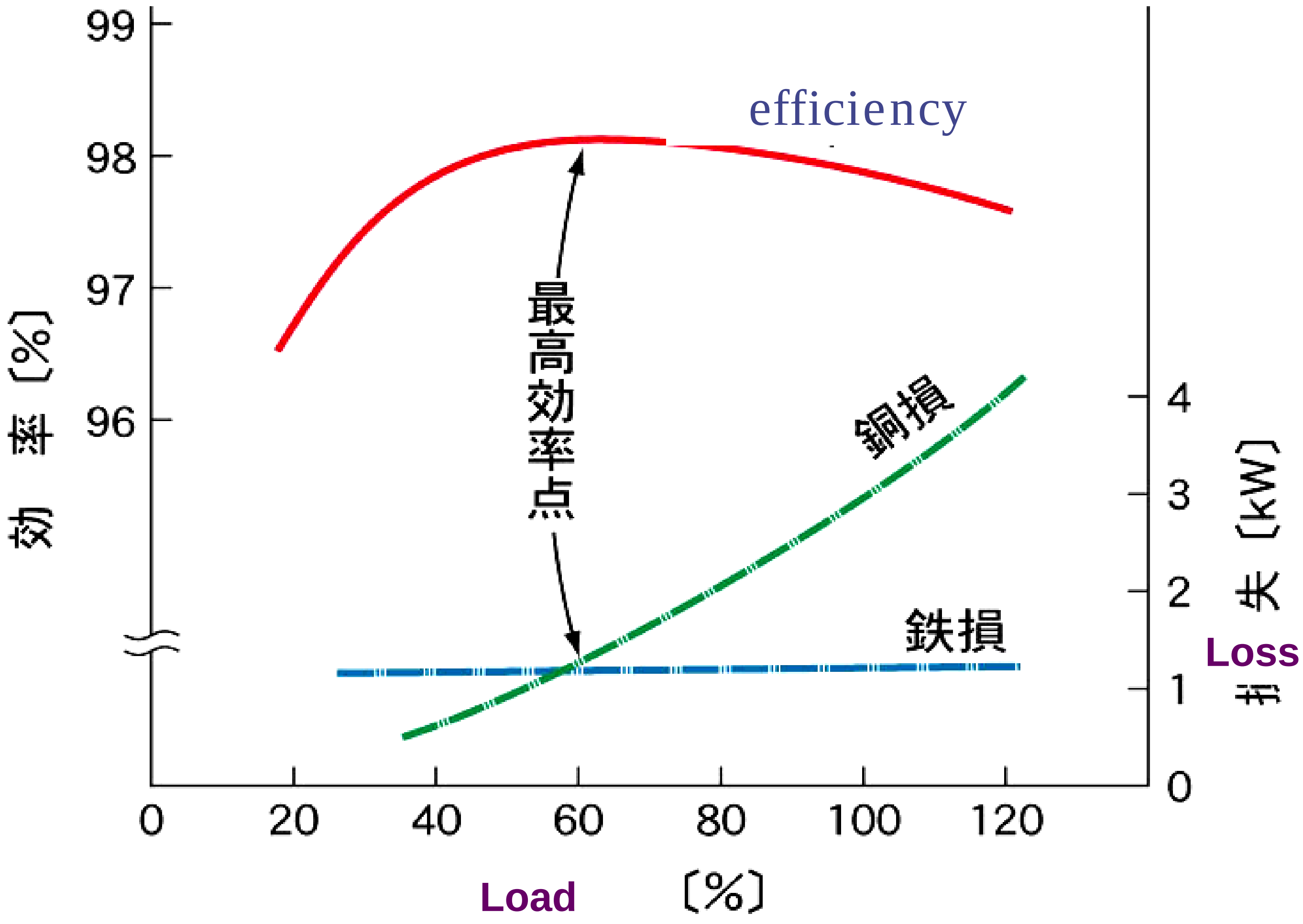
    — 283 KVA (28.3%)

  - Load of the transformer TX2 (1000kVA)

    — 94KVA (9.4%)

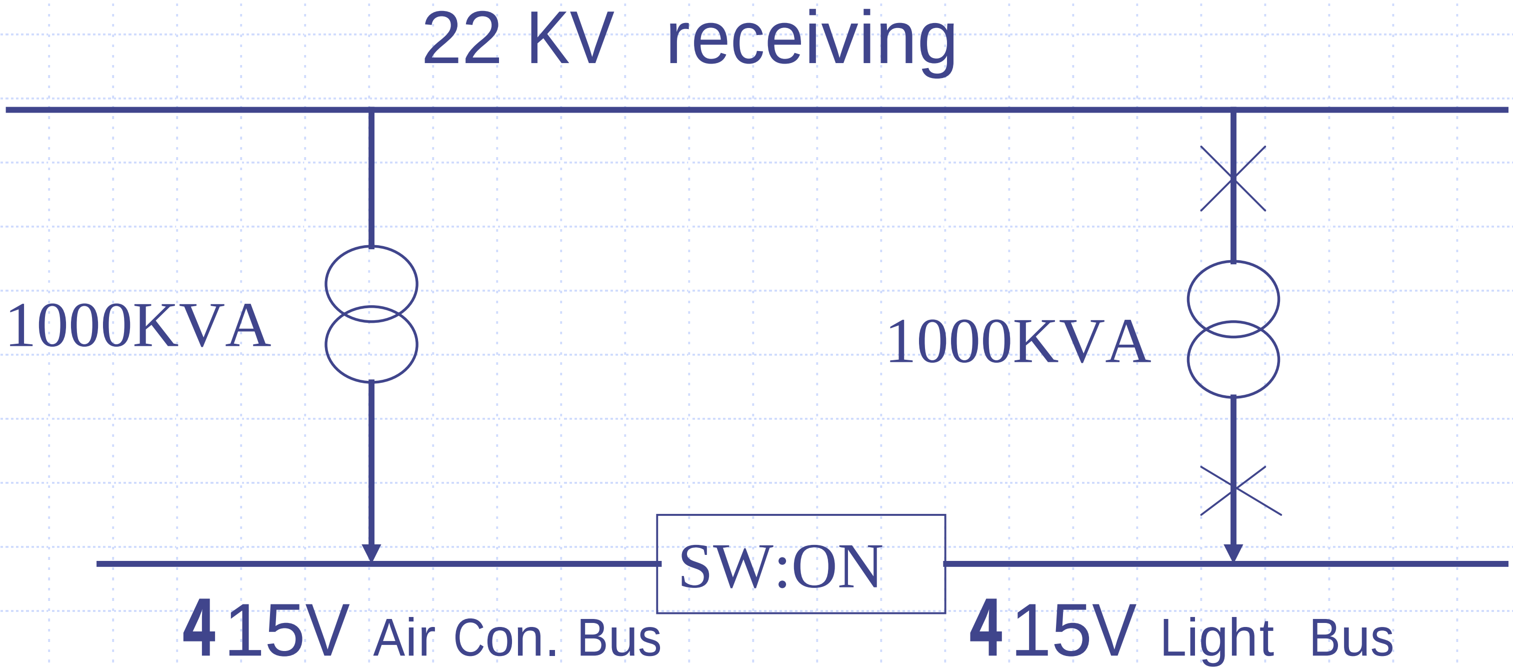
377kVA(238+94KVA) is calculated from electric power use (2,968,800kWh) for the year in 2002 (calculated using power factors 90%).

Recommended Improvement plan



注 3φ　200〔kVA〕、6,600/210〔V〕50〔Hz〕

Reduction of the transformer loss



Total load : 377 KVA

Potential Savings

- TX1 283 kVA/transformer
- TX2： 94 kVA /transformer
- Characteristic of the transformer（Example）

	1000kVA
Non-load loss(Wi)	1,880W
Load loss(Wc) (At the Rating load)	11,890W

- Formula of loss calculation: Wt (total loss) = Wi (non-load loss) + Wc (load loss) x $(Pe)^2$

Pe: Load ratio

Calculation

- Loss using 2 transformers TX1 & TX2

Wt1＝1880W＊8760h+11890W（283／1000)^2＊8760h+1880W ＊8760h+11890W(94／1000)^2＊8760h

＝42,200 kWh／year

- Loss using one transformer TX1:

Wt2＝1880W＊8760h＋11890W（377／1000)^2＊8760h＝ 31,273 kWh／Y

Wt1 －Wt2＝42,200 kWh －31,273 kWh

＝10,927 kWh／Y or **0．4％** of total electricity consumption

- Electricity cost reduction:

10,927kWh ＊0.0564US＄／kWh＝616 US＄／year

Improvement Point 2.
Adoption of Efficient Lamps

- **Current condition**

  Incandescent lamps (25W*2) are used in the guest room .

- **Recommended Improvement Plan**

  Use fluorescent lamps

- **Examination of condition**

Guest room incandescent lamps: 25W＊2＊3 receptacles/1room

Burning hours : 7 hours /day

Savings (W) : 25W＊2 →11 W/1 receptacle

- Calculation
- Electric power reduction:

(25W＊２-11W)＊3places＊142room＊0.65(occupancy rate)＊7h＊365day＝27,592 kWh／year or 0.9% of total electricity consumption

- Electricity cost reduction:

25,930kWh ＊0.0564US＄／kWh＝3,371B＄／year

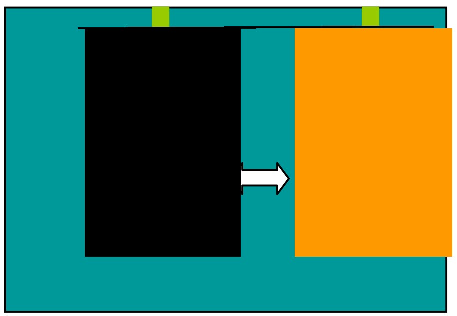
Another merit is longer burning hours of lamps from 1,000 hrs to 8,000 hrs

4 Introduction of New Technology

4.1 Human sensor

When the person enters the area, the human sensor automatically turns on the light. When the person leaves the area, the sensor turns off the light. A reduction of 35% is achieved with the use of human sensor.

Automatic human sensor



Sensor can be used in kitchens, rest rooms etc.

Summary of Improvement Points (in kWh/year and Lao PDR)

No	Improvement Item	Reduction electricity [kWh]	Reduction cost [US$]	%
1	Optimization of transformer	10,927	618	0.4
2	Adoption of Efficient lamps	27,592	3,371	0.9
	Total	38,519	3,987	1.3
	Electricity consumption /year	4,830,876		
	Average electricity cost	US$/kWh	0.0564	

Summary of Improvement Points (in kWh/year and Malaysian Ringgit)

No	Improvement Item	Reduction electricity [kWh]	Reduction cost [RM]	%
1	In-door setting of temperature	273,621	77,708	5.7
2	Adjustment of fresh air volume from outside	213,466	60,624	4.4
3	Full shut down of the VAV	42,366	12,032	0.9
4	Optimization of chiller operation	115,546	32,815	2.4
5	Optimization of transformer	26,056	7,400	0.5
	Total	671,055	190,580	13.9
	Electricity consumption /year	4,830,876		
	Average electricity cost	RM/kWh	0.284	

Summary of Improvement Points (in kWh/year and Brunei $)

No	Improvement Item	Reduction electricity [kWh]	Reduction cost [B$]	%
1	Repair of the BAS System			
2	Optimization of AHU operating time	Depend on the time		
3	Intermittent use of FCU	Depend on the time		
4	In-door setting of temperature	145322	18892	3.2%
5	Thermal insulation of hot water pipes	9855	1281	0.2%
6	Optimization of the Receiving transformer	2310	300	0.1%
7	Adoption of Efficient lamps	25930	3371	0.6%
8	Reduction of filter pomp's operating time (swimming pool)	6424	835	0.1%
	Total	189841	24679	4.2%
	Electricity consumption /year	4498145		
	Average electricity cost B$/kWh		0.13	

THANK YOU FOR YOUR KIND ATTENTION

The Energy Conservation Center, Japan

Additional Part

Akira Kobayashi

The Energy Conservation Center, Japan

27 January 2004

Contents

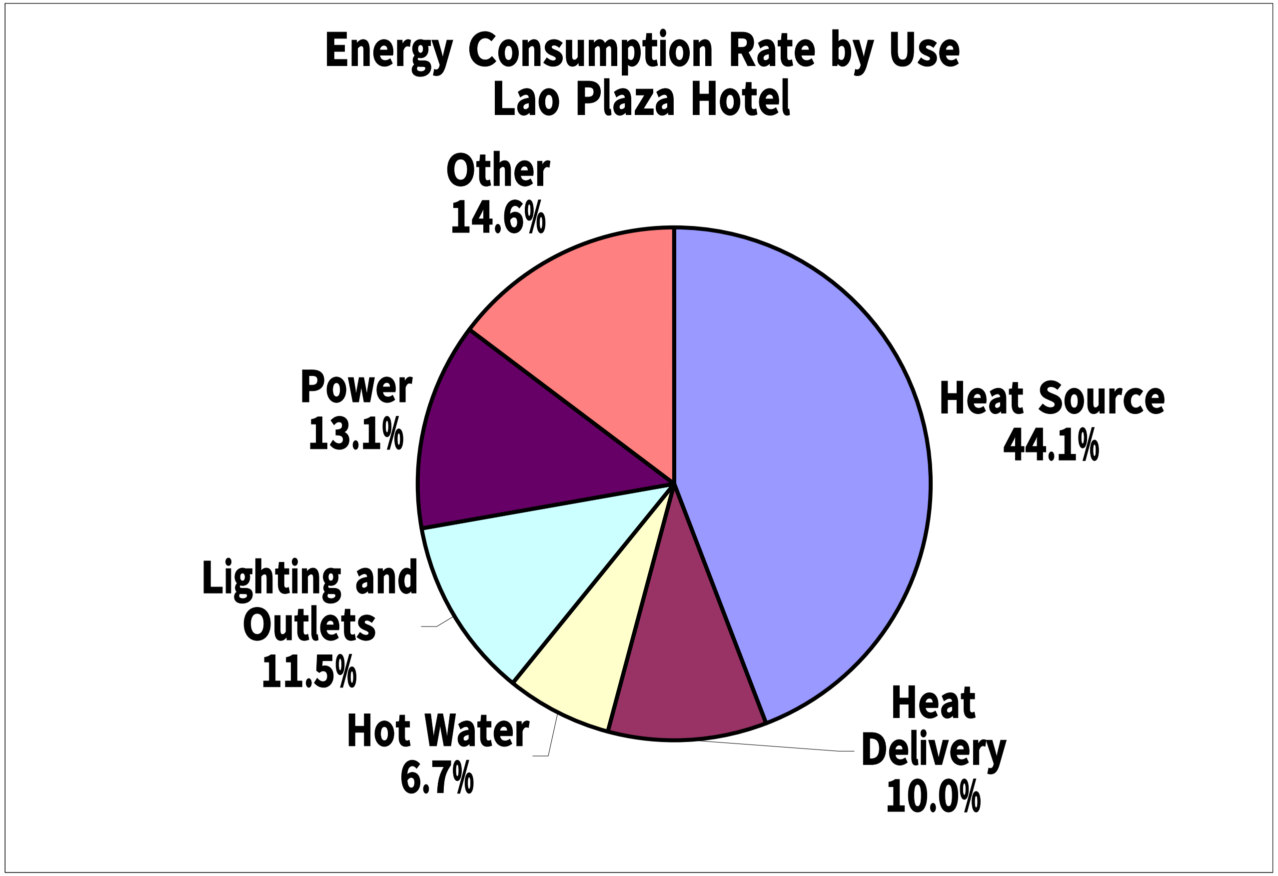
1 Calculation Method ：

Energy structure according to usage

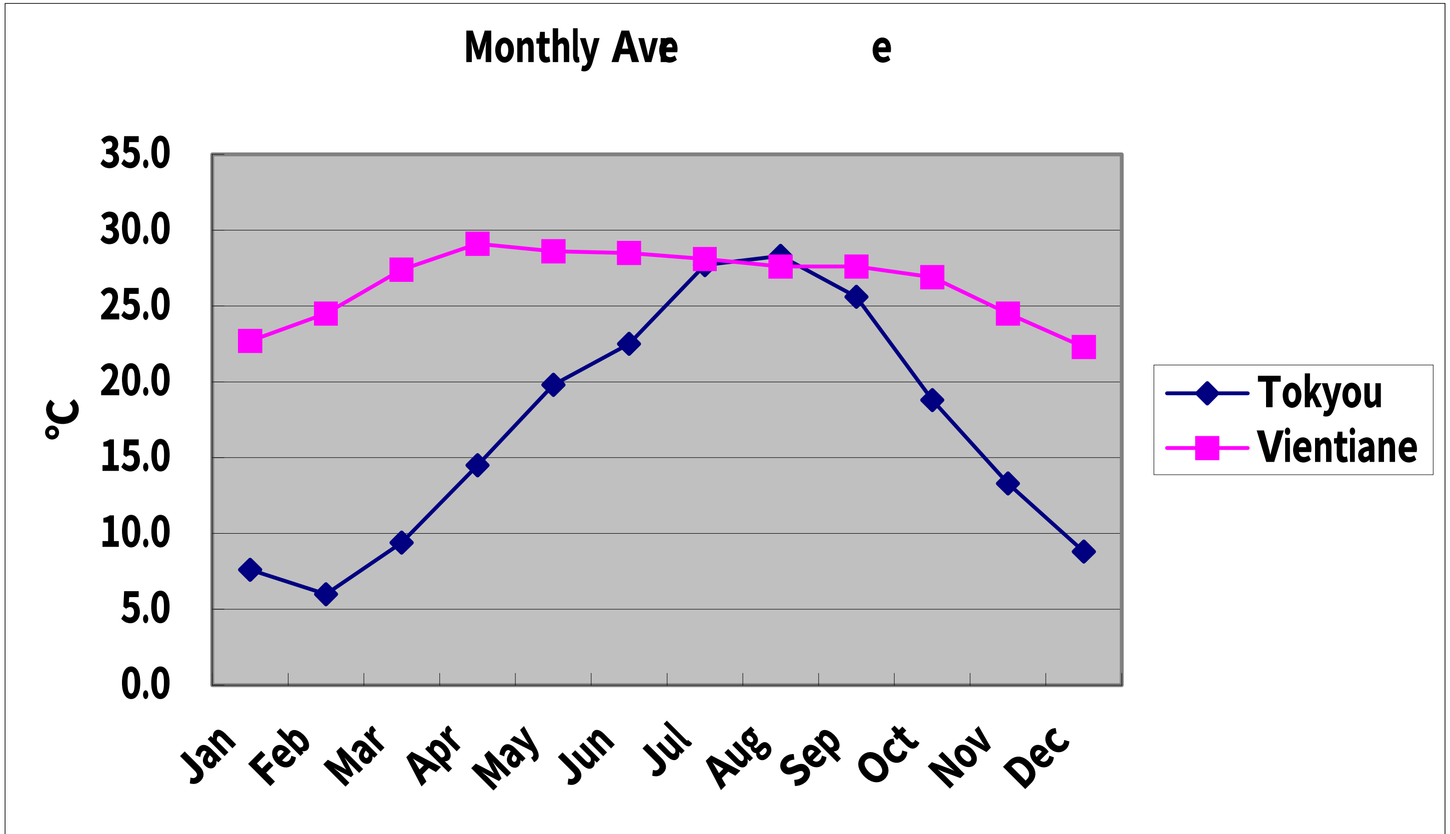
2 Importance of fresh air control

Calculation Method ：
Energy structure according to usage

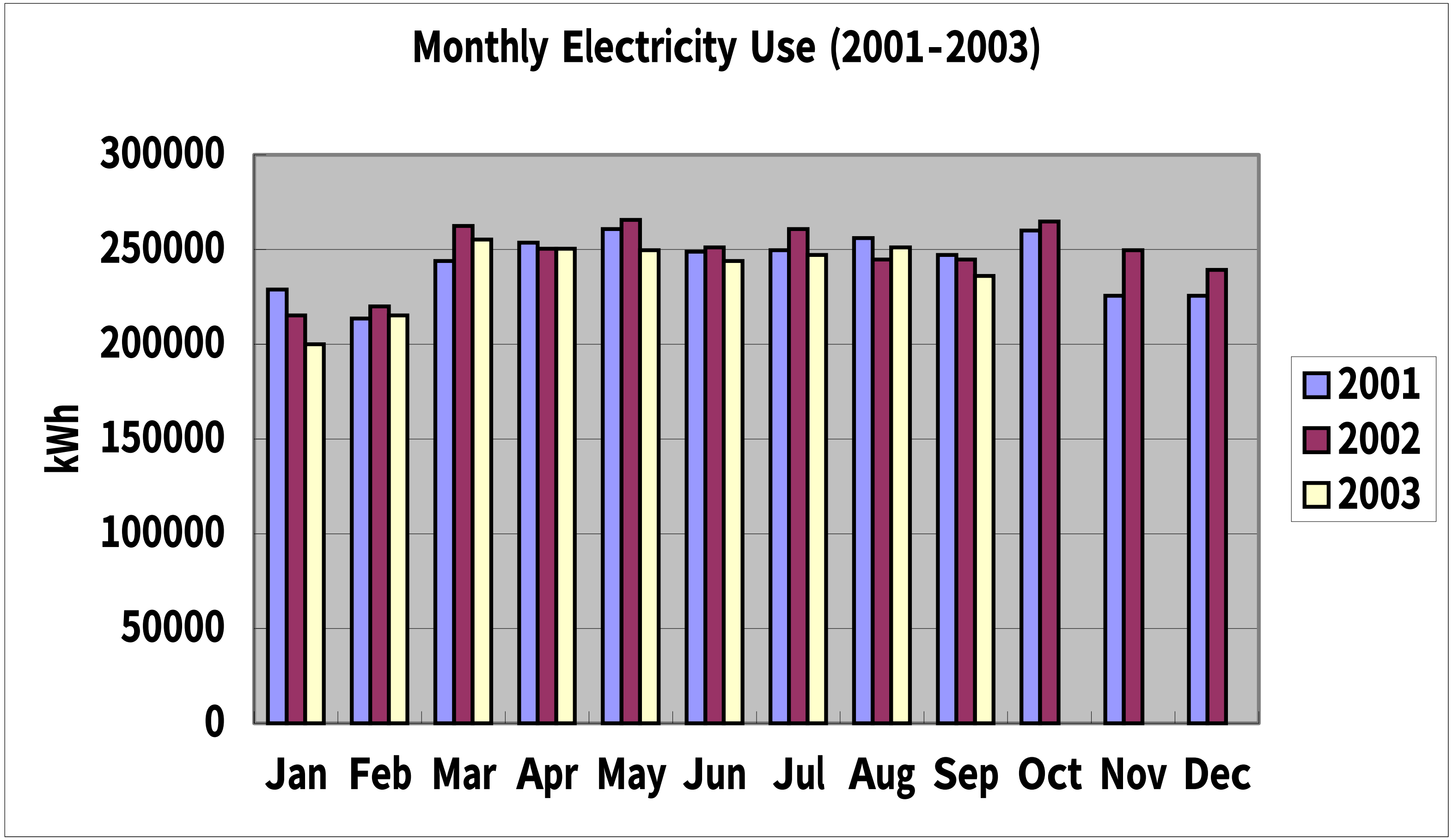
Calculation Result



Understanding of Situation (1)



Understanding of Situation (2)



Result Table

	Elec	Elec	Gas	Elec	Total	Total
	kWh/d	%	MJ	MJ	MJ	%
Heat Source	4,063	50.0%		39,819	39,819	44.1%
Heat Delivery	919	11.3%		9,005	9,005	10.0%
Hot Water	10	0.1%	5,966	99	6,065	6.7%
Lighting and Outlets	1,062	13.1%		10,404	10,404	11.5%
Power	1,209	14.9%		11,851	11,851	13.1%
Other	871	10.7%	4,690	8,532	13,223	14.6%
Total	8,134	100.0%	10,656	79,710	90,367	100.0%
Annual consumption	2,968,800	kWh/y	77,792	kg		
1 day Average	8134	kWh/d	213	kg		
LPG 1kg=50MJ			10,656	MJ		

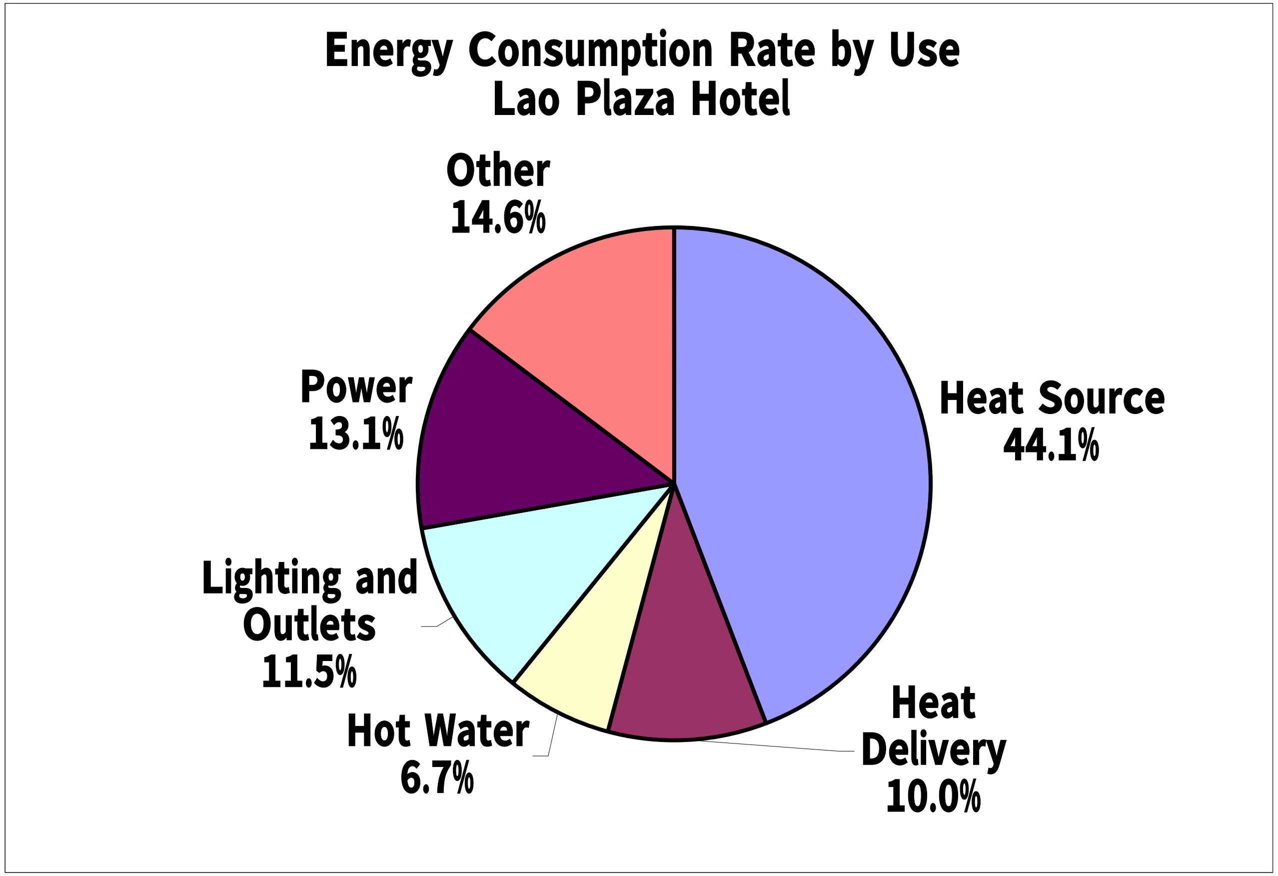
Calculation of Heat source energy

Heat source	Qty	kW	h	Load Rate	kWh/D	%
Chiller	1	210	24	0.7	3,528	43.4%
Cooing Tower	1	7.5	24	1	180	2.2%
Condenser Water Pump	1	18.5	24	0.8	355	4.4%
Total					4,063	50.0%
Electricity	2,968,800			kWh/y		
Electricity (Average)	8,134			kWh/d		

Calculation of Heat Transfer Equipment energy

	kW	h	Load Rate	Occupancy	kWh/D	%
AHU Fan	40.4	10	0.8	1	323	4.0%
AHU Fan	11	24	0.8	1	211	2.6%
FCU Fan	8.04	7	0.8	0.65	29	0.4%
Chilled Water Pump	18.5	24	0.8	1	355	4.4%
Total					919	11.3%
Electricity	2,968,800			kWh/y		
Electricity (Average)	8,134			kWh/d		

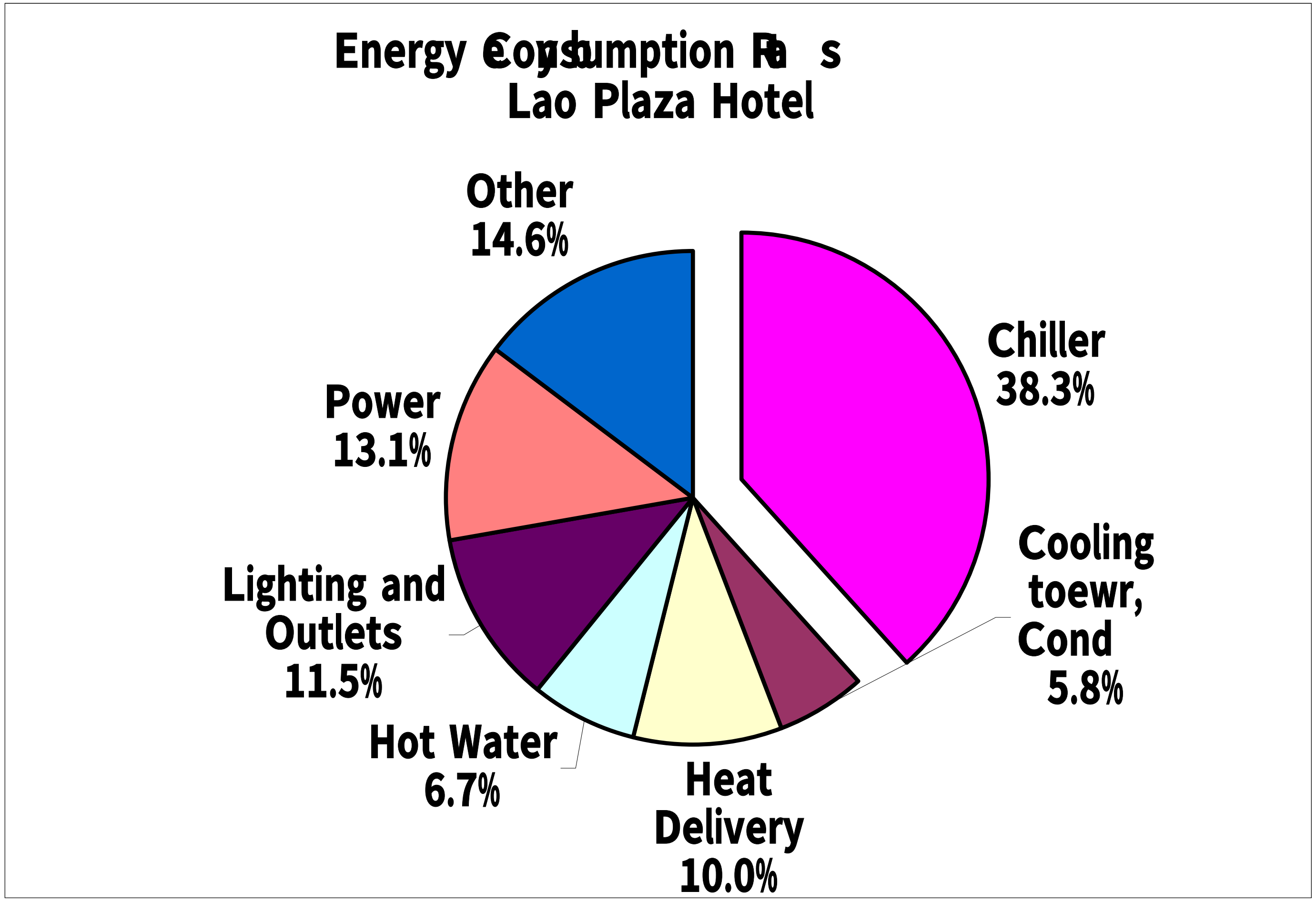
Calculation Result



Importance of fresh air control

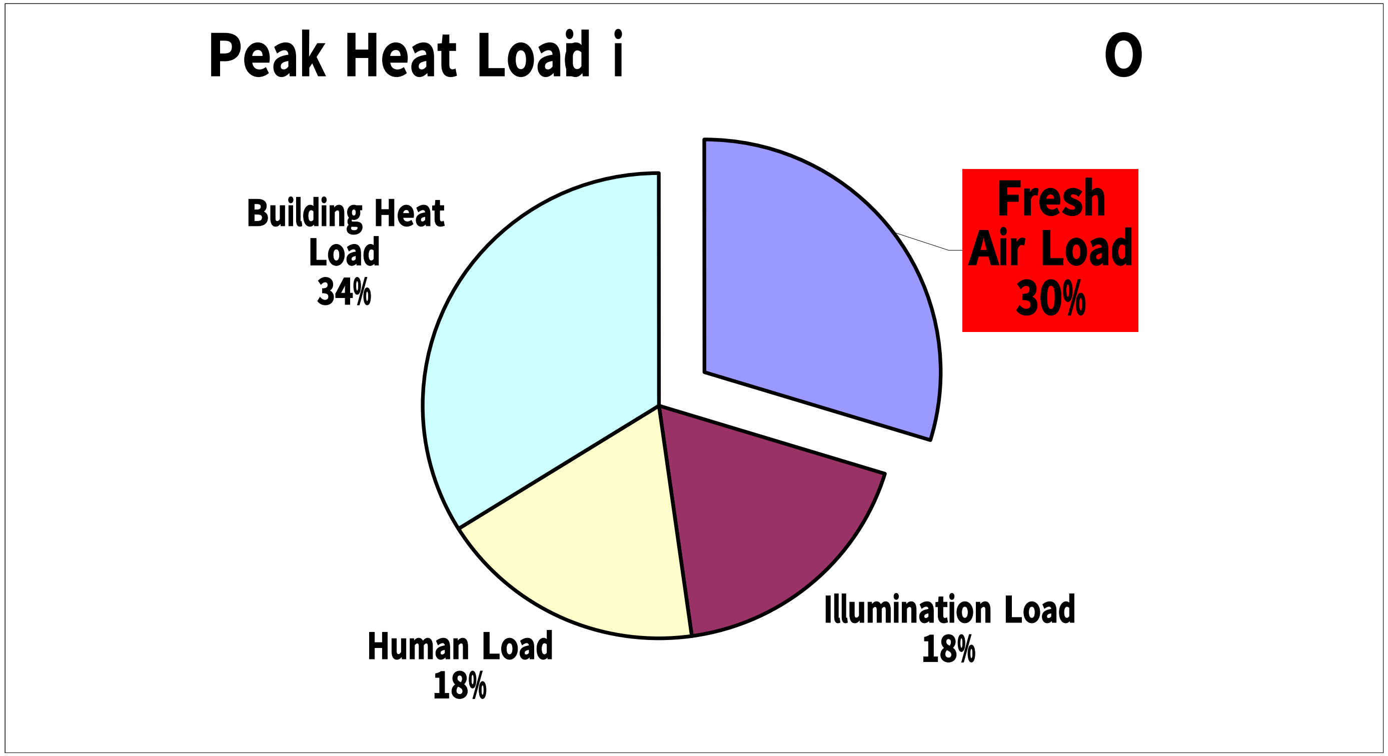
	Elec	Elec	Gas	Elec	Total	Total
	kWh/d	%	MJ	MJ	MJ	%
Chiller	3,528	43.4%		34,574	34,574	38.3%
Cooling toewr, Cond P	535	6.6%		5,243	5,243	5.8%
Heat Delivery	919	11.3%		9,005	9,005	10.0%
Hot Water	10	0.1%	5,966	99	6,065	6.7%
Lighting and Outlets	1,062	13.1%		10,404	10,404	11.5%
Power	1,209	14.9%		11,851	11,851	13.1%
Other	871	10.7%	4,690	8,534	13,225	14.6%
Total	8,134	100.0%	10,656	79,710	90,367	100.0%

Chiller Rate :
Let's Consider the Root of the Reason



Heat Load of Fresh Air : Office Building

- Japan : 30〜40% Air-conditioning



Proper Amount of Fresh Air

- Japan's Room Environment Standard

  CO_2 Density : Below 1,000ppm

Measurement CO2 density

Indoor : 3points meeting room 550ppm

Small meeting room 950ppm Lobby 500ppm

Measurement CO2 density

- Outside :400ppm

Calculation

- Outside air CO_2 density :400ppm
- Present indoor CO_2 density :(600ppm)
- Goal indoor CO_2 density : 800ppm
- Present ventilation value :V1m3/h
- Ventilation value after improvement

  :V2m3m3/h

$400V1+X=600V1$

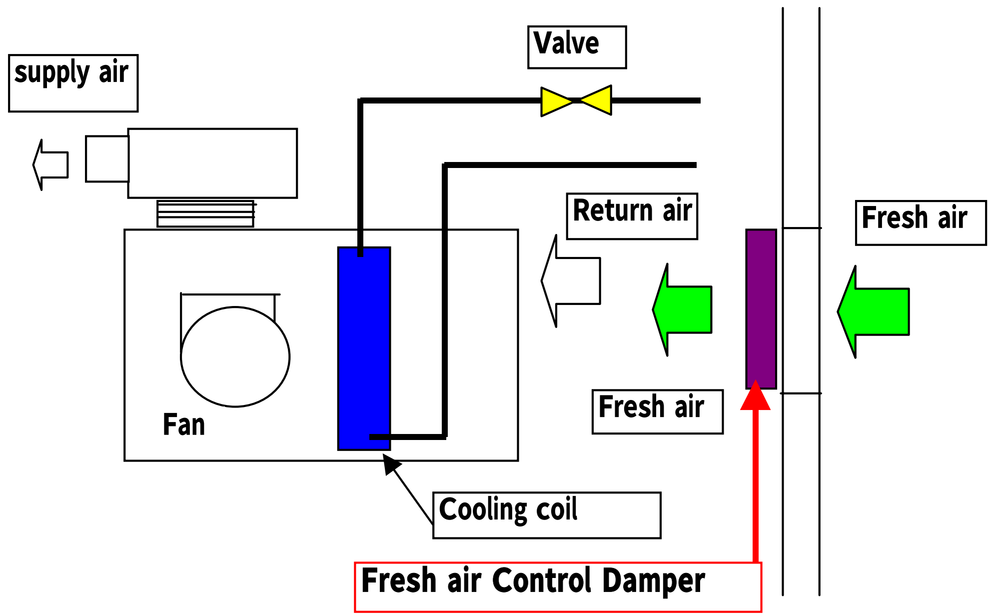
$400V2+X=800V2$

$V2/V1=(600-400)/(800-400)=0.5$

Method of Fresh Air Volume control

1 Manual Damper Control

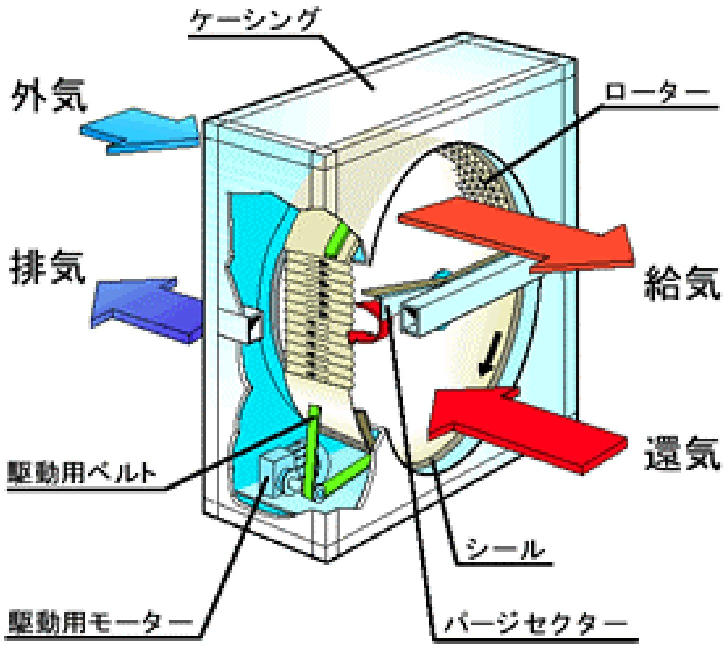
2 Automatic Operation through CO_2 Monitoring

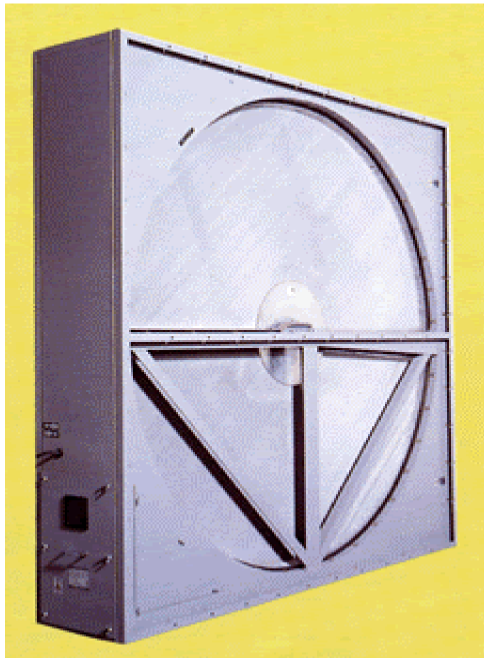


Fresh Air Volume control Example

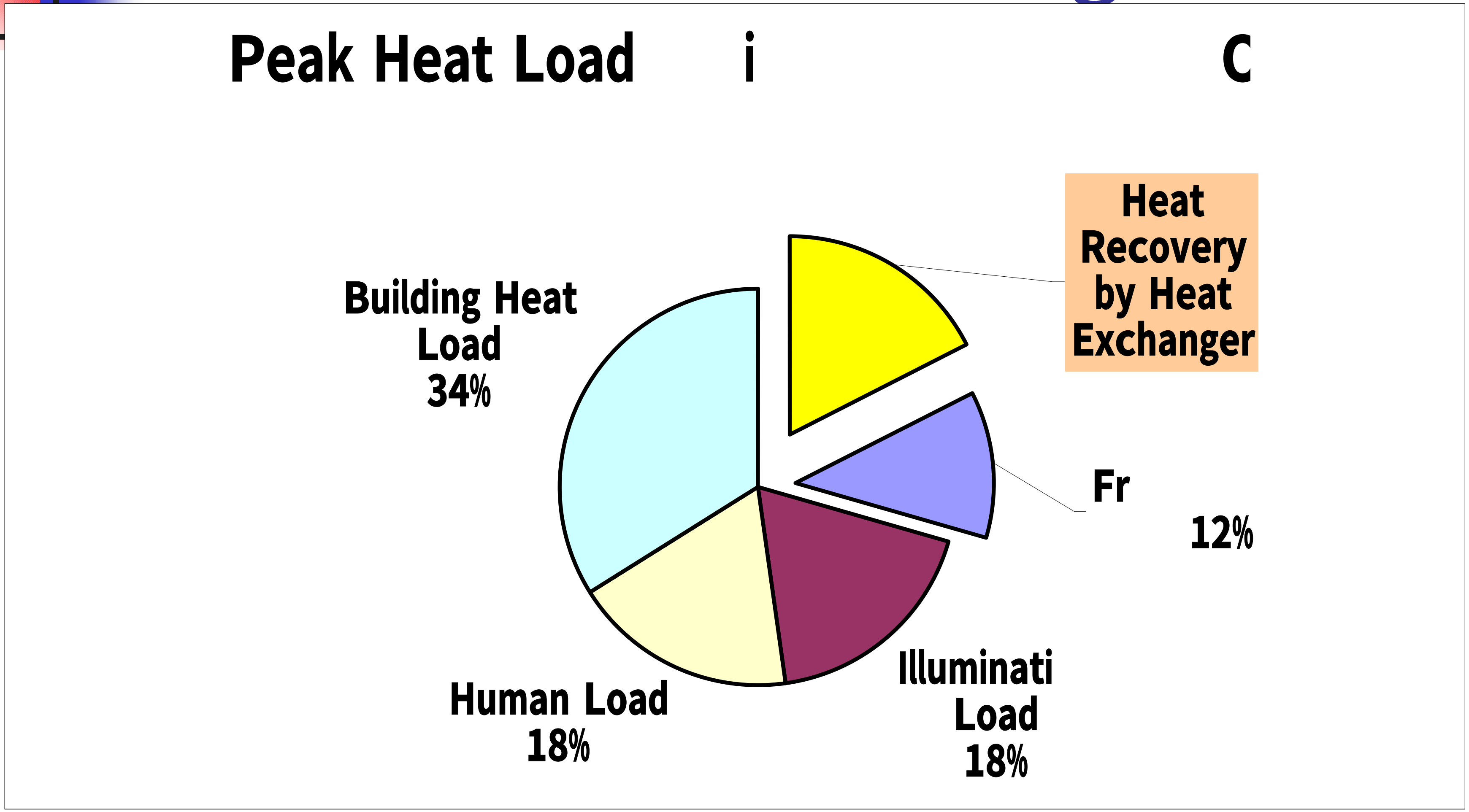
Lao Plaza Hotel

Heat Exchanger : To Reduce Heat Load





Effect of Heat Exchanger



Fresh Air Stop : When Starting

- 30min～1hour
- Difference :

  AHU operate start time ,

  Business start time

Summary : Attention to Fresh Air

- **Fresh Air Heat Load :**

  Big Weight of Building Energy

- **Technique :**

  Control of Fresh Air

  1. Reduce Fresh Air Volume

  2. Reduce Fresh Air Heat Load

- **Useful for ASEAN Countries**

Thank you

The Energy Conservation Center, Japan

Reference Material - 2: Materials for Workshops held in respective countries
Database/Benchmark/Guideline (Japan)

Database/Benchmark/ Guideline Development in Japan

PROMEEC – BUILDING

SOME-METI WORK PROGRAMME 2003-2004

Akira Kobayashi
The Energy Conservation Center, Japan
27 January 2004

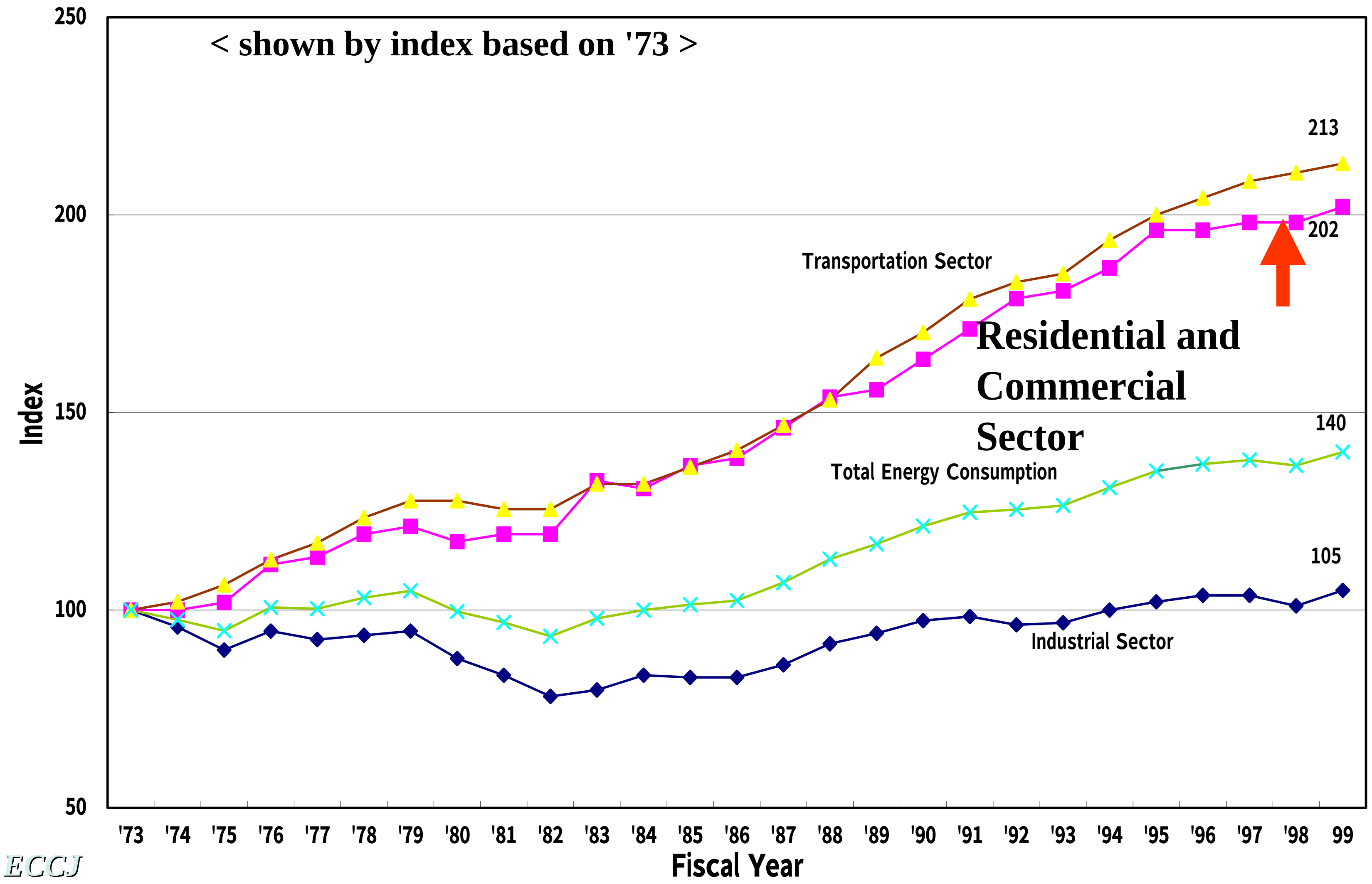
Outline of Presentation

- Introduction
- Energy Audit
- Database and Benchmarking
- Guidelines for Energy Efficient Buildings
  - Guidelines of equipment in Japan
  - Operating guidelines for factories and buildings
- Approach of Energy Conservation of Present Japan

Introduction

Trend in Final Energy Consumption by Sector

(1999)

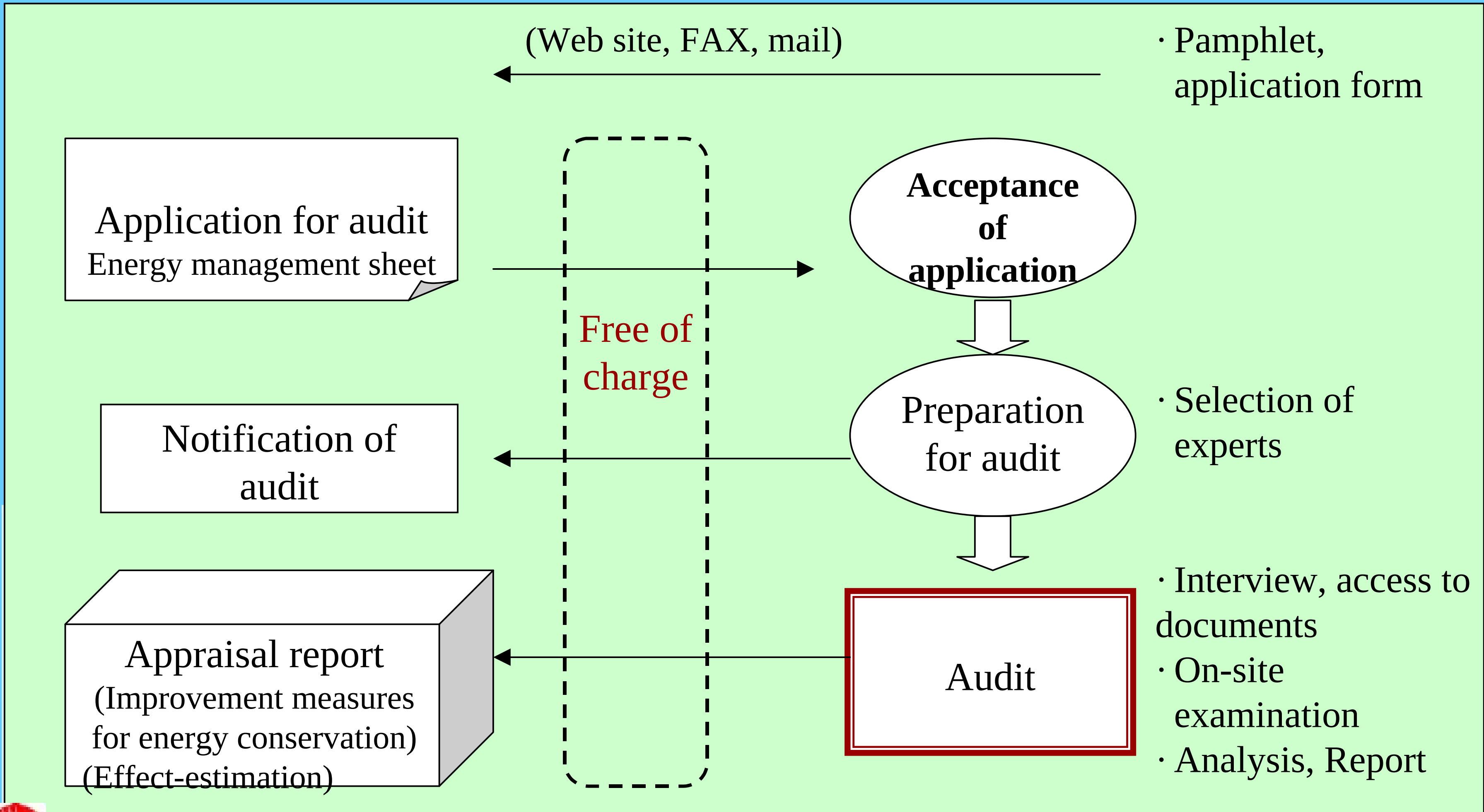


ECCJ

Energy Audit

Application and Process of Energy Audit in Japan

- **one-day on-site examination by thermal and electric experts**
- **free of charge ----- subsidized by Japanese Government**



ECCJ

Energy Audit

- Improvement Guidance
  - Building Owner's Merit
  - Free of Charge
- Data Gathering

Improvement Guidance Points

1. Elimination of waste
2. Energy saving while maintaining comfortable condition
3. Reduction in energy losses from buildings and facilities
4. Waste heat recovery
5. Demand-based flexible supply contract energy suppliers
6. Enhancement of equipment and facilities efficiency
7. Active use of natural energy

Check Lists for Energy conservation measures for buildings : Large Items

1. General management
2. Heat source, Heat transmitting equipment
3. Air-conditioning & Ventilation
4. Hot water feeding, Water Feeding and Exhausting, Refrigerating, Kitchen Equipment
5. Power receiving & transformation, Lighting and Electric Equipment
6. Lifts, Buildings
7. Load leveling

Medium Item

2. Heat source, Heat transmitting equipment

1 Combustion equipment performance management
2. Refrigerating equipment performance management
3. Operation management, efficiency management
4. Operation management for auxiliary equipment
5. Operation management for heat transmitting equipment
6. Exhaust gas temperature, exhaust heat recovery
7. Steam leakage and hot insulation management
8. Management for heat storing tanks

Small Items

2. Refrigerating equipment performance management

- **Coefficient of Performance (COP)**
- **Setting of outlet temperature of chilled water**
- **Setting of cooling water temperature**
- **Scale removing for heat exchangers**
- **Temperature efficiency of heat exchanger**

Number of check Point

Check Point Number			
Large Item		Medium Item	Small Item
7	No1	6	22
	No2	8	30
	No3	4	22
	No4	3	17
	No5	6	26
	No6	3	15
	No7	4	14
Total	7	34	146

Format of Report

1 Outline of Building

2 Outline of Audit

3 Energy Use State of Recent One Year

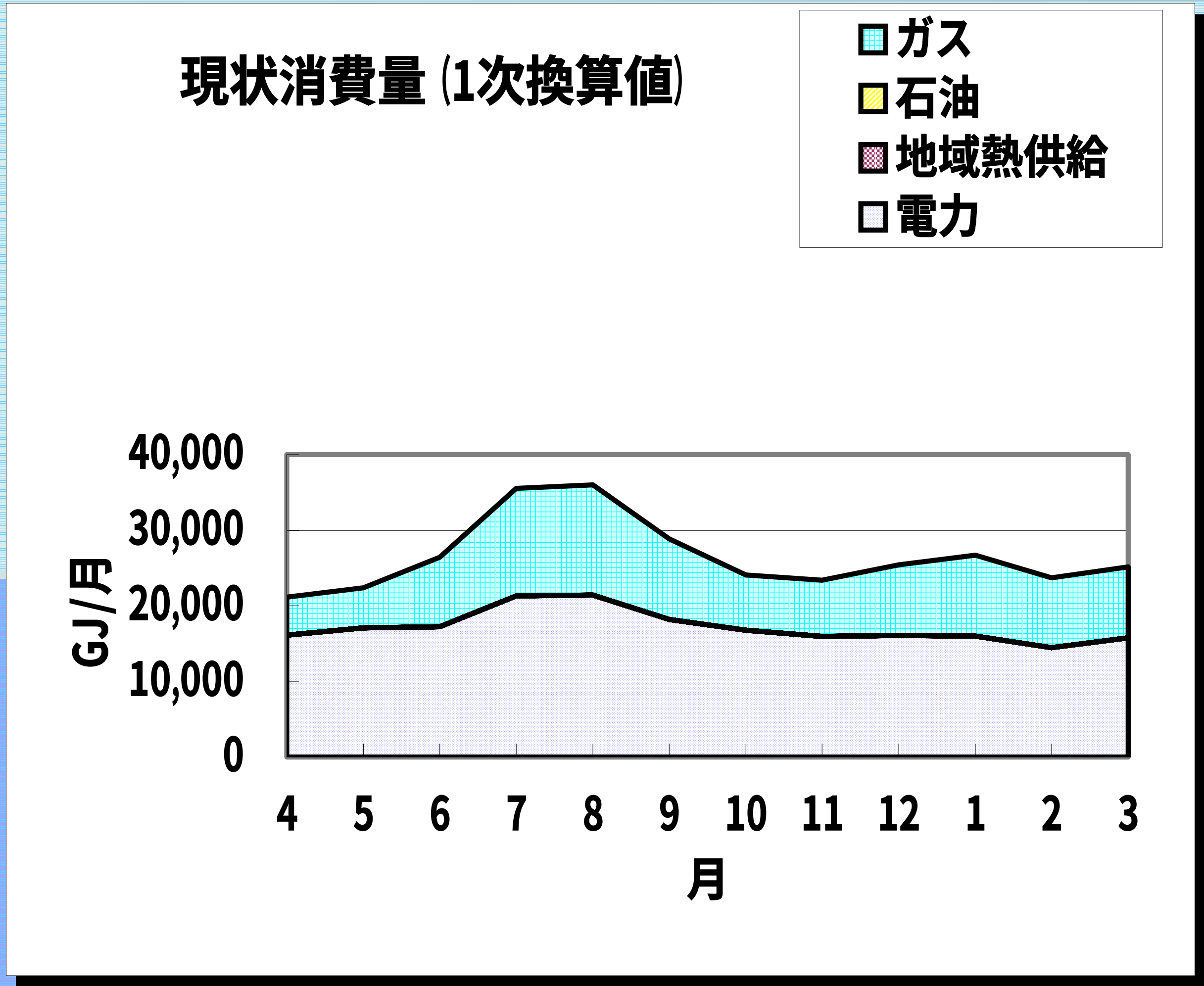
3.1 Energy Use State Graphs

3.2 Electric use State Graphs

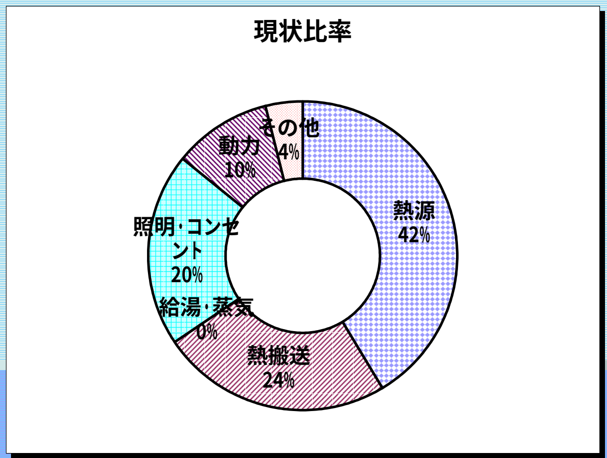
4 Energy Conservation Audit Result

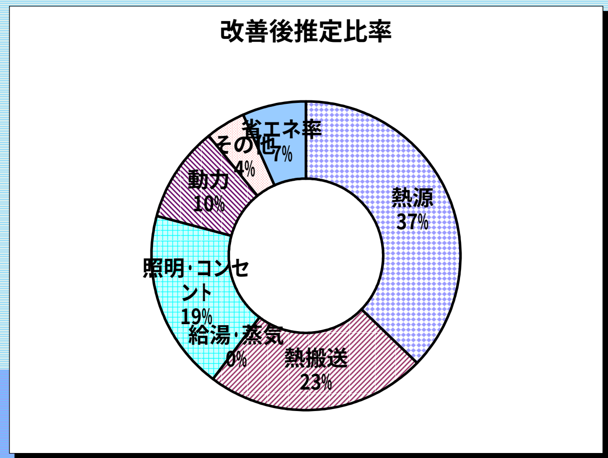
5 Opinion list (1)～(7)Items

Energy Use State Graphs 1

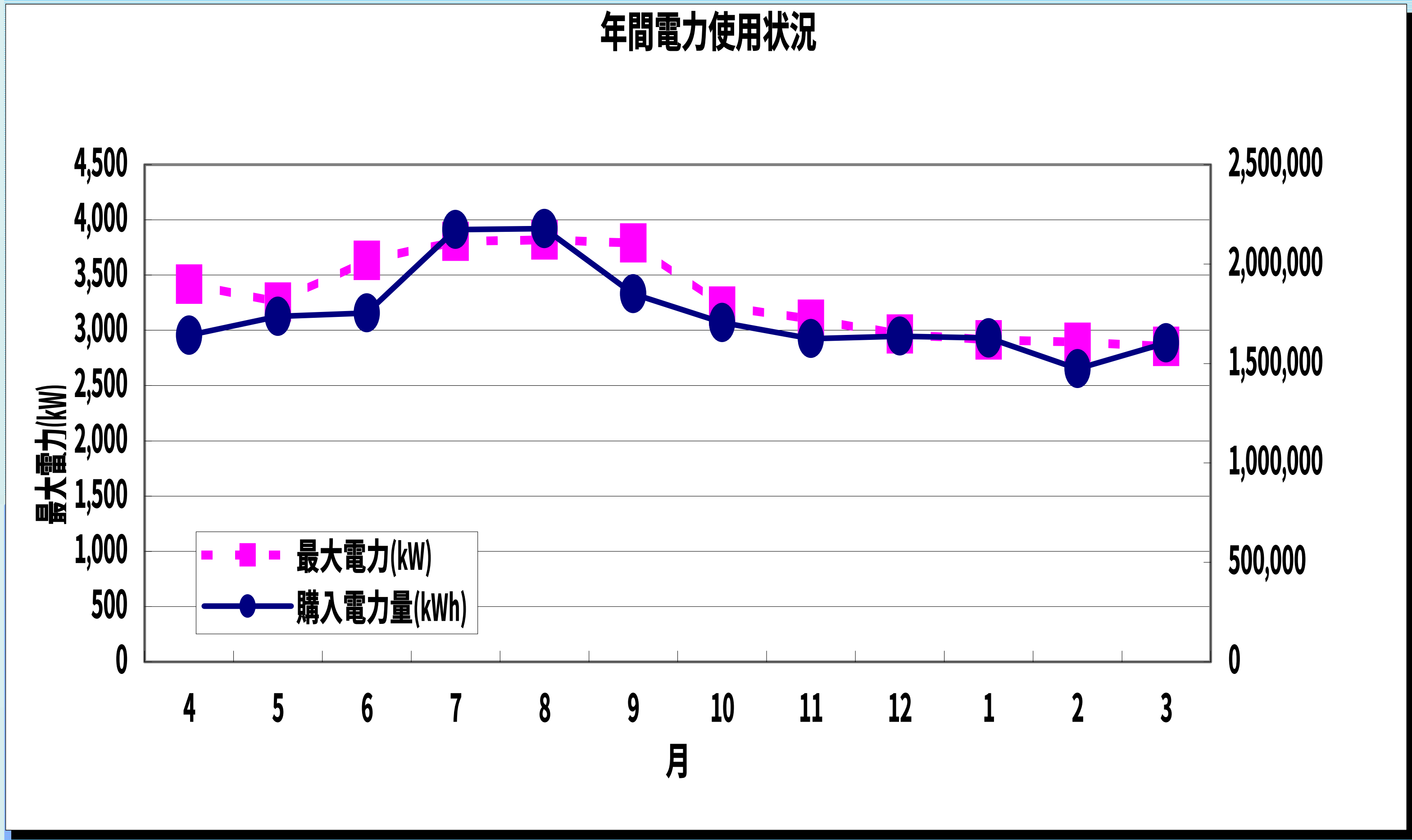


Energy Use State Graphs 2

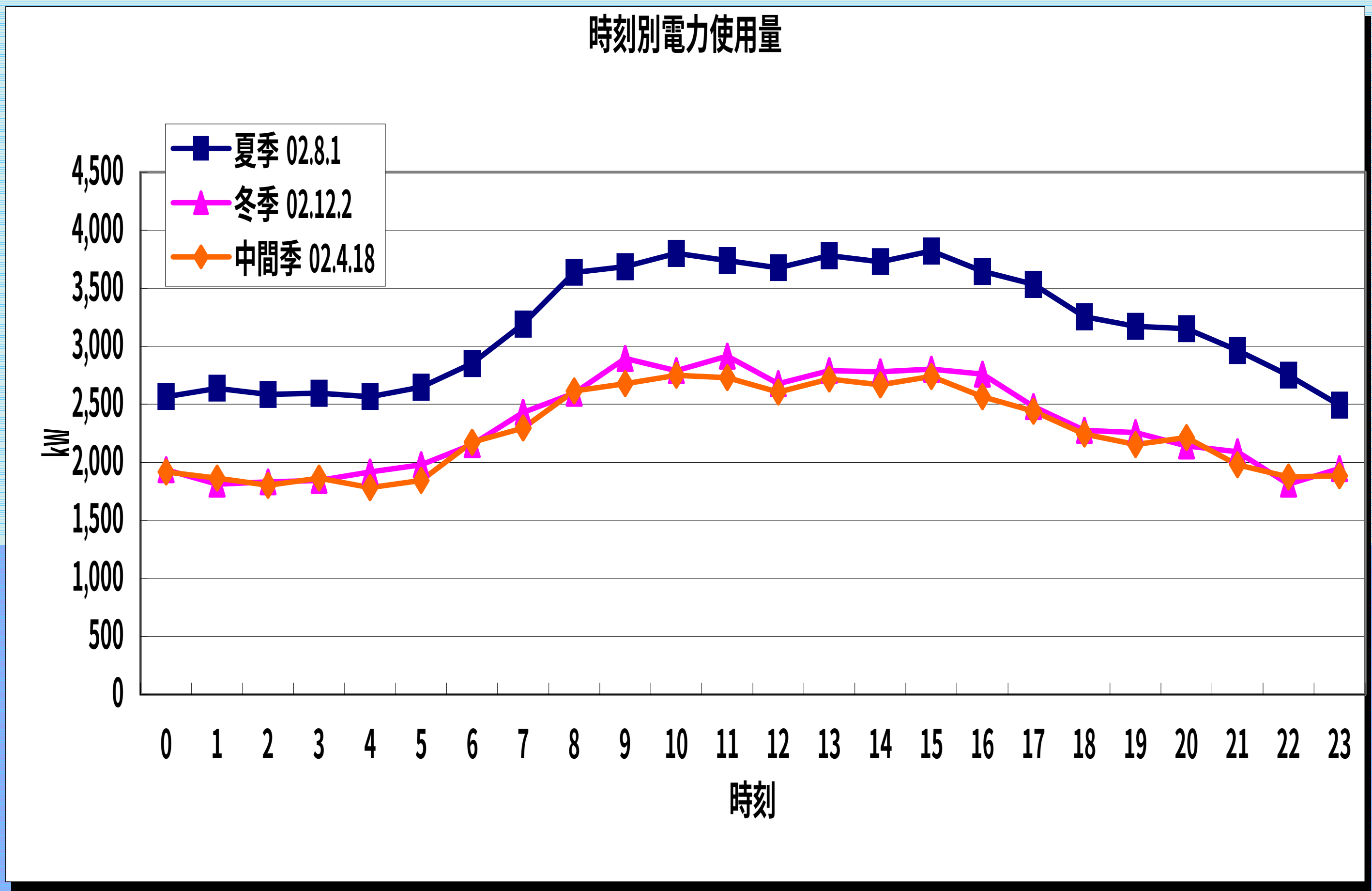




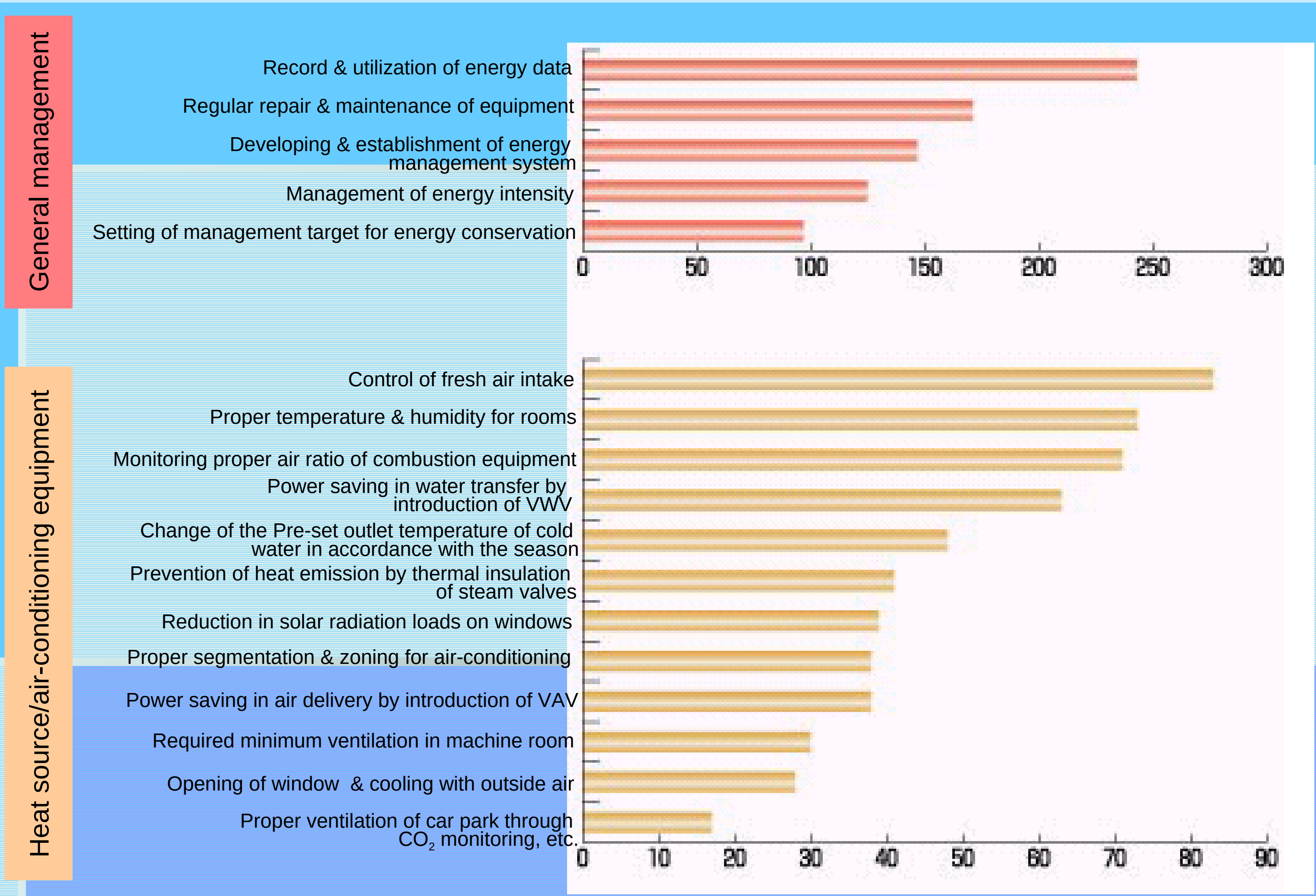
Electric use State Graphs 1



Electric use State Graphs 2



Proposed items for energy conservation by audit service (1/2)



Points to Focus in Energy Saving for Buildings

1) General management

1. Record and utilization of energy data
2. Regular repair and maintenance of equipment
3. Developing and establishment of energy management system
4. Management of energy intensity
5. Setting of management target for energy conservation

Points to Focus in Energy Saving for Buildings
2) Heat source/air-conditioning equipment

Heat source/air-conditioning equipment

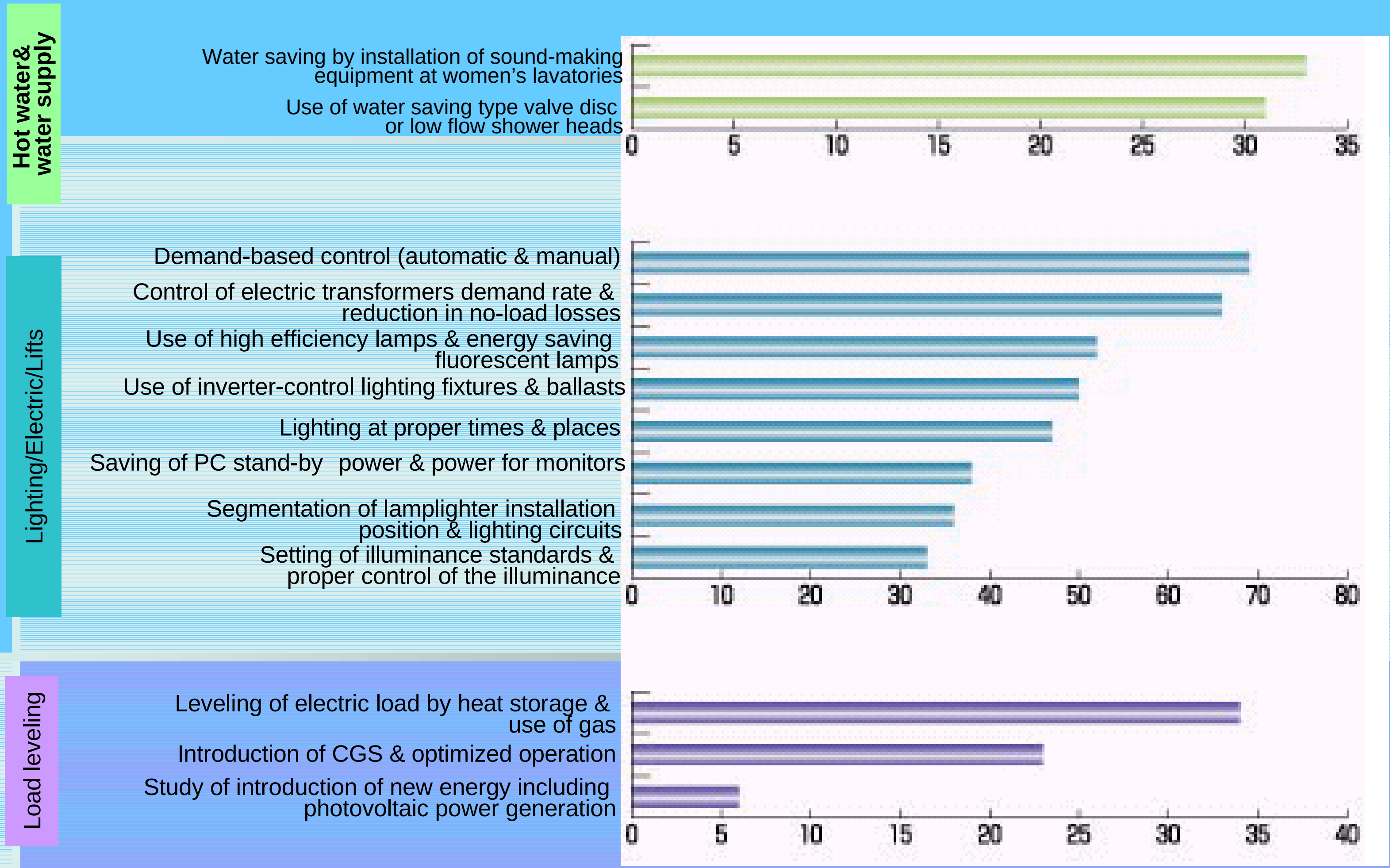
1 Control of fresh air intake

2 Proper temperature and humidity for rooms

3 Monitoring proper air ratio of combustion equipment

- etc

Proposed items for energy conservation by audit service (2/2)



Points to Focus in Energy Saving for Buildings
3) Hot water and water supply/ Lighting/ Electricity/Lifts/Load leveling

- **Lighting/Electricity/Lifts**

1 Demand-based control(automatic and manual)

2 Control of electric transformers demand rate and reduction in no-load losses

3 Use of high efficiency lumps and light

4 Use of inverter-control lighting fixtures and ballasts

5 Lighting at proper times and places

6 Segmentation of lamplighter insulation positions and lighting circuits

7 Setting of illuminance standard and proper control of the illuminance

Energy Conservation Audit Result

1 Improvement by Operation

2 Improvement by good Investment

3 Renewal improvement

- Improvement theme
- Amount of Reduction Energy
- Amount of Money of Decrease

Energy Conservation Audit Result

1	Improvement by Operation		
	Theme	Energy Reduction Volume	Reduction Cost
	aaaa	eeee kWh/y	\\\\\\\\ en/y
	bbbb	cccc kWh/y	\\\\\\\\ en/y
2	Improvement by good Investment		
	Theme	Energy Reduction Volume	Reduction Cost
	dddd	ffff kWh/y	\\\\\\\\ en/y
3	Renewal Improvement		
	Theme	Energy Reduction Volume	Reduction Cost
	eeee	ggg kWh/y	\\\\\\\\ en/y

Database & Benchmarking System

Number of data by Type of Buildings

Type of Building	Number
•Government Office	173
•Office	194
•Department Stores	109
•Supermarket	109
•Hotel	109
•Hospitals	143
•Assembly Hall	27
•School	46

Total	910

Type of Data Collected

1) Building Information

Building Information Sheet

- Name As s e : e
- Category of Usage:
  Landload building or Tenant building
- Age of Building:
- Size：
  Total gross floor area m2
  Number of stories ・Basement Stories
- Electrical facilities:
  Receiving voltage、 Agreement capacity
  Transformer capacity
- Air conditioning facility:
  Heat source capacity for cooling
  Main equipment
  Heat source capacity for heating and hotwater
  Main equipment
  Air conditioning system
- Sanitary facility:
  Water supply system Hot water spply system
- Air conditioner setting temperature and humidity:
  Summer ℃ %, Winter ℃ %
- Working hour:
  Week day , Sata day , Sun day

Type of Data Collected:
2) Energy Consumption

	Electricity				City gas	LPG	Oil	District heat and cooling		Water service	
	Maximum	Daytime	Nighttime	generator				Cold water	Steam	Water supply	Well
month	kW	kWh	kWh	kWh	m3	kg	kL	GJ	GJ	M3	m3
Apr											
May											
Jun											
Jul											
Aug											
Sep											
Oct											
Nov											
Dec											
Jan											
Feb											
Mar											
Total											

Calculation of Building Energy Efficiency Index (in MJ/m2)

Calculation of Energy Intensity

Energy			Annual consumption		Heat equivalent			
Kind	Classification	Unit			MJ/unit		MJ/year	
Electricity		kWh		×	9.8	=		
City gas	13A	m2		×	46	=		
	12A	m2		×	42	=		
LPG		kg		×	50	=		
Heavy oil	A	kL		×	39,100	=		
	B	kL		×	41,700	=		
Total consumed							A	MJ/year
Total gross floor area							B	m2
Energy consumption intensity (annual bassis):				=	A/B	=	C	MJ/m2 year

Standardization of Units
conversion factors

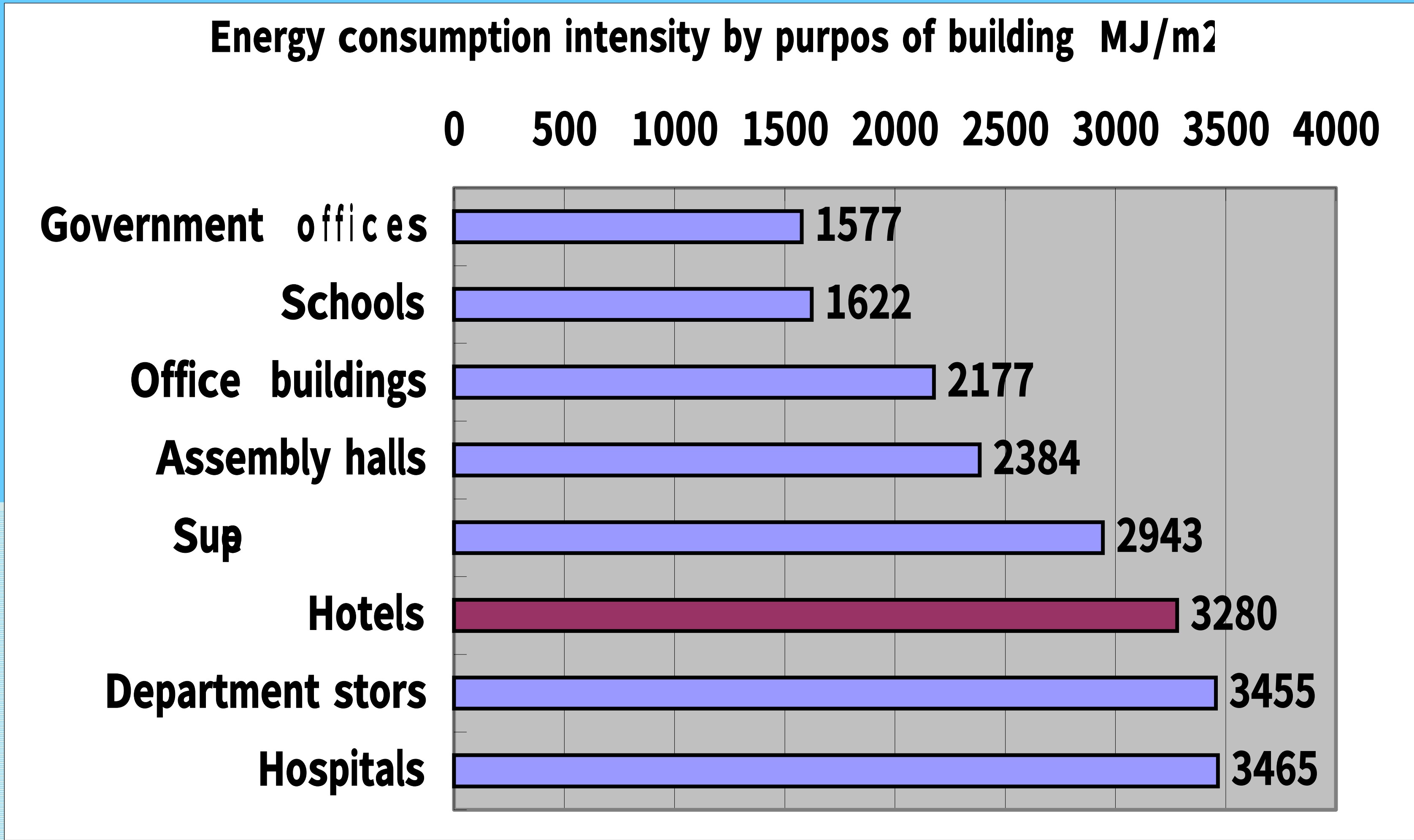
	unit	conversion coefficient [MJ/unit]
Electricity	kWh	9.8
City gas 13A	m3	46
City gas 12A	m4	42
City gas 6A	m5	29
City gas 6B	m6	19
LPG	kg	50
Heavy oil A	kl	39100
Heavy oil B	kl	41700

Database & Benchmarking System

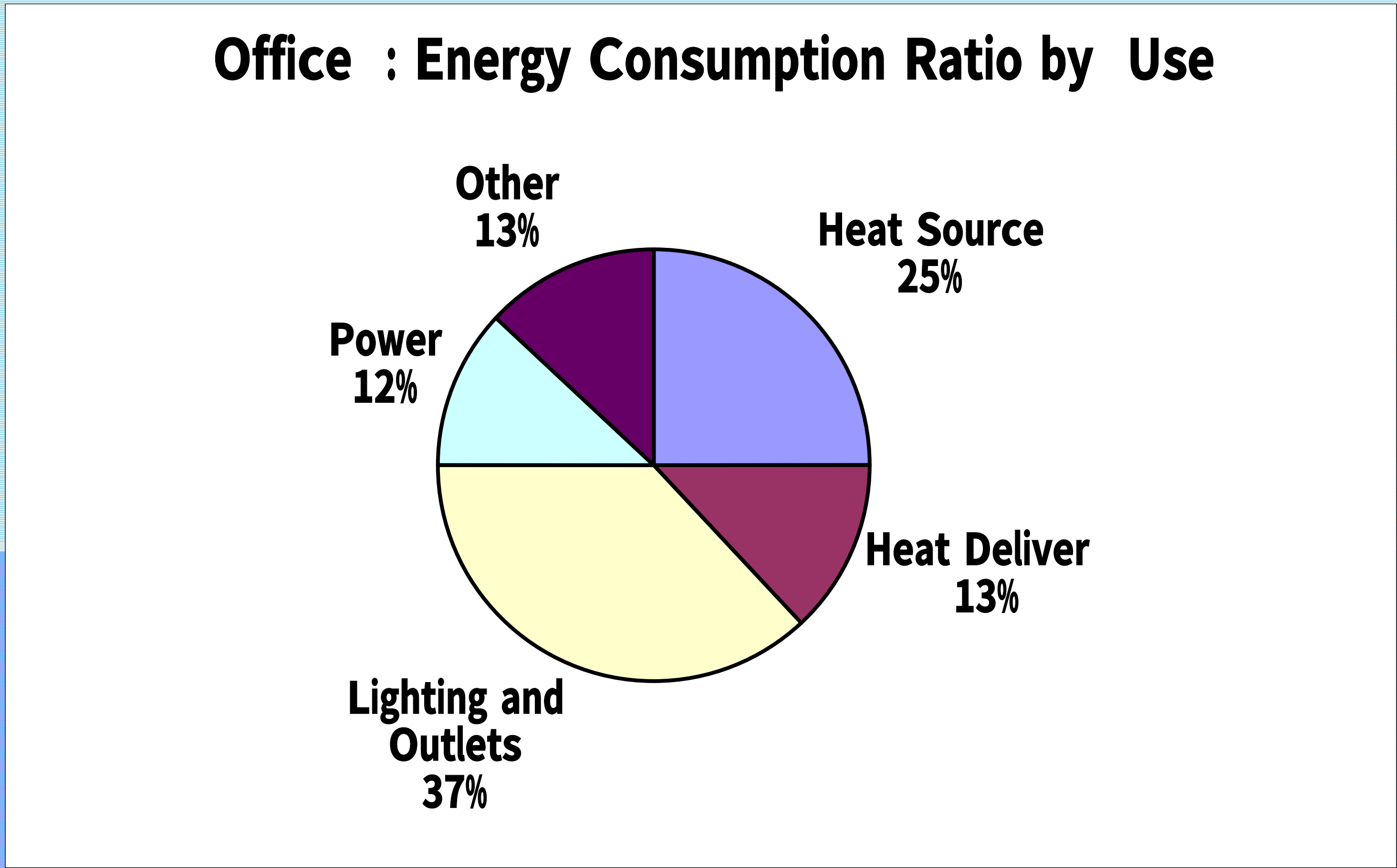
What is a Benchmark?

- It is the average of building energy efficiency indices of audited buildings, expressed in terms of MJ/m2.
- It also serves as the reference point to indicate energy efficient buildings

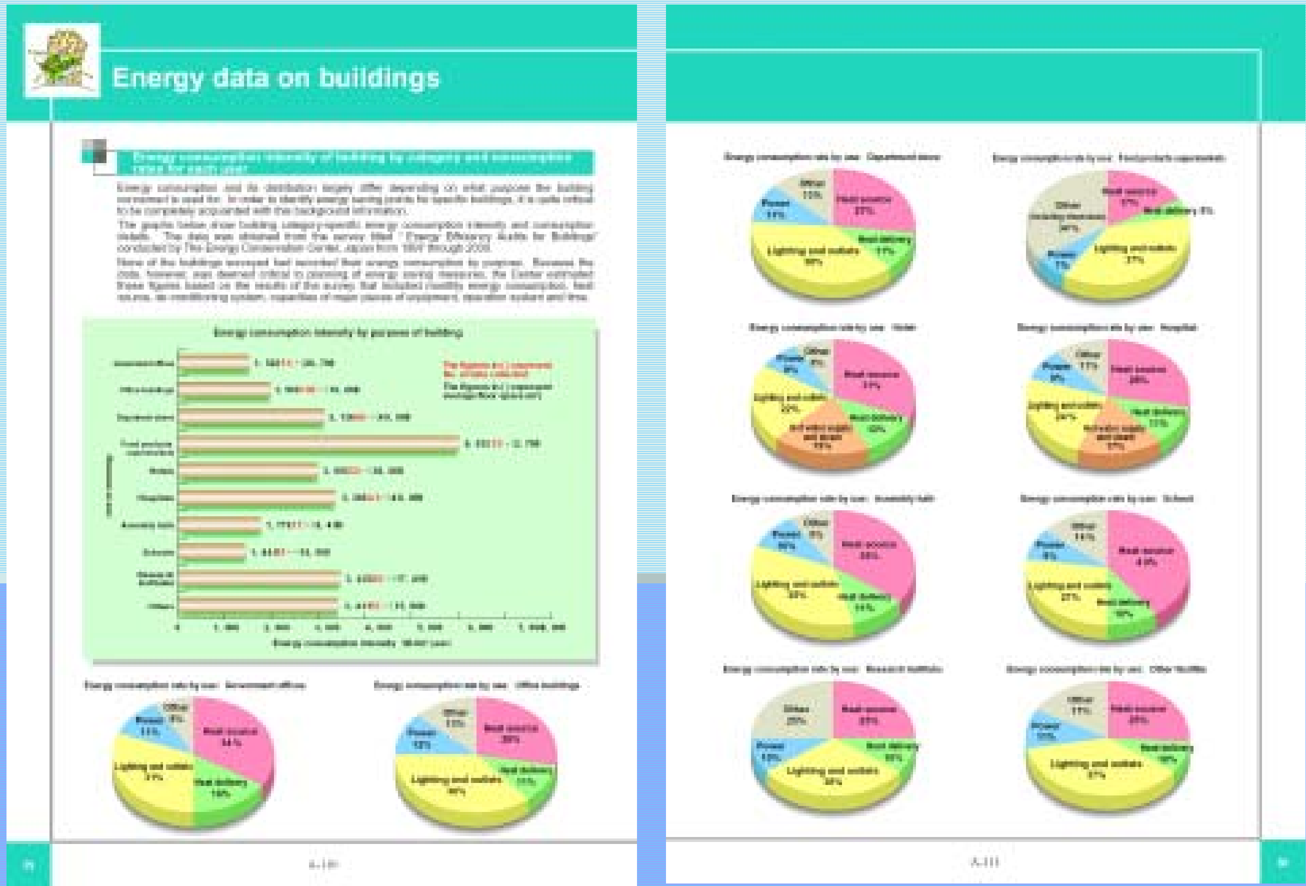
Benchmarks in Various Types of Buildings in Japan



Average Energy Consumption ratio by Use



Information Dissemination of Database and Benchmarks



Energy Efficient Buildings：Guidelines in Japan

Energy Efficient Buildings：Guidelines in Japan

- Standard when building is constructed
- The indoor environmental standard

Obligations of Building Owners

1) Prevention of heat loss through external walls、windows, etc. of a building:
2) Efficient use of air conditioners;
3) Efficient use of mechanical ventilating equipment;
4) Efficient use of lighting facilities;
5) Efficient use of hot water supply systems;
6) Efficient use of elevators

1) Prevention of heat loss through external walls, etc. of a building

- **Annual thermal load of the perimeter zone (MJ/year)**
  Total floor area of the perimeter zone (m2)

  → [(Virtual load)/(Area)]
  (PAL) : Perimeter Annual Load
- *Thermal load of the ambient indoor space:
  Heat lost through external walls, windows, etc. for a year, total of heating and cooling load generated by heat generated in the ambient space.
  The quantity of open air taken in is presumed to be a constant calculated on the basis of the area, etc.

2) Efficient use of air conditioners

- **Quantity of energy consumed for air conditioning (MJ/year)**

  Virtual air-conditioning load (MJ/year)

→[Actually consumed energy/(Virtual load)]

(CEC/AC): Coefficient of Energy Consumption for Air Conditioning

*Quantity of energy consumed for air-conditioning:

Quantity of energy of given air conditioner consumed to treat air conditioning loud for a year

Virtual air-conditioning load (Unit: MJ/year):

The quantity of open air taken in is presumed to be a constant calculated on the basis of the area, etc.

Decrease in load by using exhaust heat recovery is not taken into account.

Standard value of energy conservation for buildings

	Hotels	Hospitals	Stores	Offices	Schools	Restaurant
1)PAL	420	340	380	300	320	550
2)CEC/AC	2.5	2.5	1.7	1.5	1.5	2.2
3)CEC/V	1.0	1..0	0.9	1.0	0.8	1.5
4)CEC/L	1.0	1.0	1.0	1.0	1.0	1.0
5)CEC/HW	1.5	1.7	1.7	-	-	-
6)CEC/EV	1.0	-	-	1.0	-	-

Note) In the case of 1), values obtained by multiplying the above values by the scale correction factor shall be standard ones. (Scale correction factor: a factor for correcting standard values to relax controls of small scale buildings, etc)

Illumination Standard of Office

Office Building

LX	location (some examples)
1500-	
1000-	office room (a), business room, design room, drawing room
750-	office room (b), executive room, meeting room, printing room, computer room, control room
500-	
300-	

Room Environment Standard

Temperature	17℃～28℃
Humidity	40%～70%
Wind velocity	Below 0.5m/s
Suspended solid	Below 0.15mg/m3
CO	Below 10ppm
CO2	Below 1000ppm

Room Environment Measurement

Guidelines for the Use of Energy Efficient Equipment in Japan

Air conditioner

1) Target range

Both cooling systems and heating and cooling systems

2) Target Value

Classsification		Target standared value (COP)				
(Cooling ability; kW)		～2.5	～3.2	～4.00	～7.10	～28.00
Cooling	Wind-wall type	2.67				
	Separate type	3.64	3.64	3.08	2.91	2.81
	Direct blowing type and others	2.88			2.85	2.85
	Duct typ	2.72			2.71	2.71
	Multi typ e	3.23			3.23	2.47

Fluorescent lamp

d. Fluorescent lamp

1) Target rang

Lighting equipment with fluorescent lamps as the main

2) Target value

Classificat			Target standard value (lm/w)
Straight tube ty	One with 110-type		79.0
	40-type	One with high-frequency lighting	86.5
		One with rapid start fluorescent	71.0

Operating Guidelines for Factories and Buildings

Areas for Rational Use of Energy

1) Fuel combustion
2) Heating, cooling, heat transfer, etc.
3) Prevention of heat loss due to radiation, conduction, etc.
4) Recovery and utilization of waste heat
5) Rationalization in the conversion of heat to power, etc
6) Prevention of electricity loss due to resistance, etc
7) Rationalization of conversion from electricity to mechanical power, heat, etc.

Standard values and target values of air ratios

Standard values and target values of air ratios

Classification				Air ratio	
Boiler	Item			Liquid Fuel	Gas fl
	Standard	For electric utility		1.05-1.20	1.05-1.10
		Other (quantity of ev p	30t/h or more	1.10-1.30	1.10-1.20
			10 to less than 30th	1.15-1.30	1.15-1.30
			5 to less than 10t/h	1.20-1.30	1.20-1.30
			less than 5t/h	1.20-1.30	1.20-1.30
	Target	For electric utility		1.05-1.10	1.05-1.20
		Other (quantity of	30t/h	1.10-1.15	1.10-1.15
			10 to less than 30th	1.15-1.25	1.15-1.25

Approach of Energy Conservation of Present Japan

Activity Flow for Buildings

- 2003.4 : New Classification by Energy Consumption
- 2003.5 : New Regular Report System
- 2004.5 : Submitting of mid/long-term plan

- 2006 : “Management Standards” Execution Situation Investigation

Obligation of Building Owners

Annual Energy Consumption		Classification	
Heat (Fuel)	Power		
3,000 kL	12 Million kWh	1st Category	1.Obligation to report the status of energy consumption every year 2.Obligation to submit medium-to-long term improving plan under the supervision of energy manager
1,500 kL	6 Million kWh	2nd Category	1.Obligation to report the status of energy consumption every year
0 kL	0 kWh		

By the law

- Building data will gather

  1st Category : about 1000

  2nd Category : about 1000

  total : 2000

- 1st Category

  The reduction plan of 1% or more is made by the period average (From 2004.5)

Activity of ECCJ Energy Conservation Promotion Committee of Building **Team B**

Office Buildings

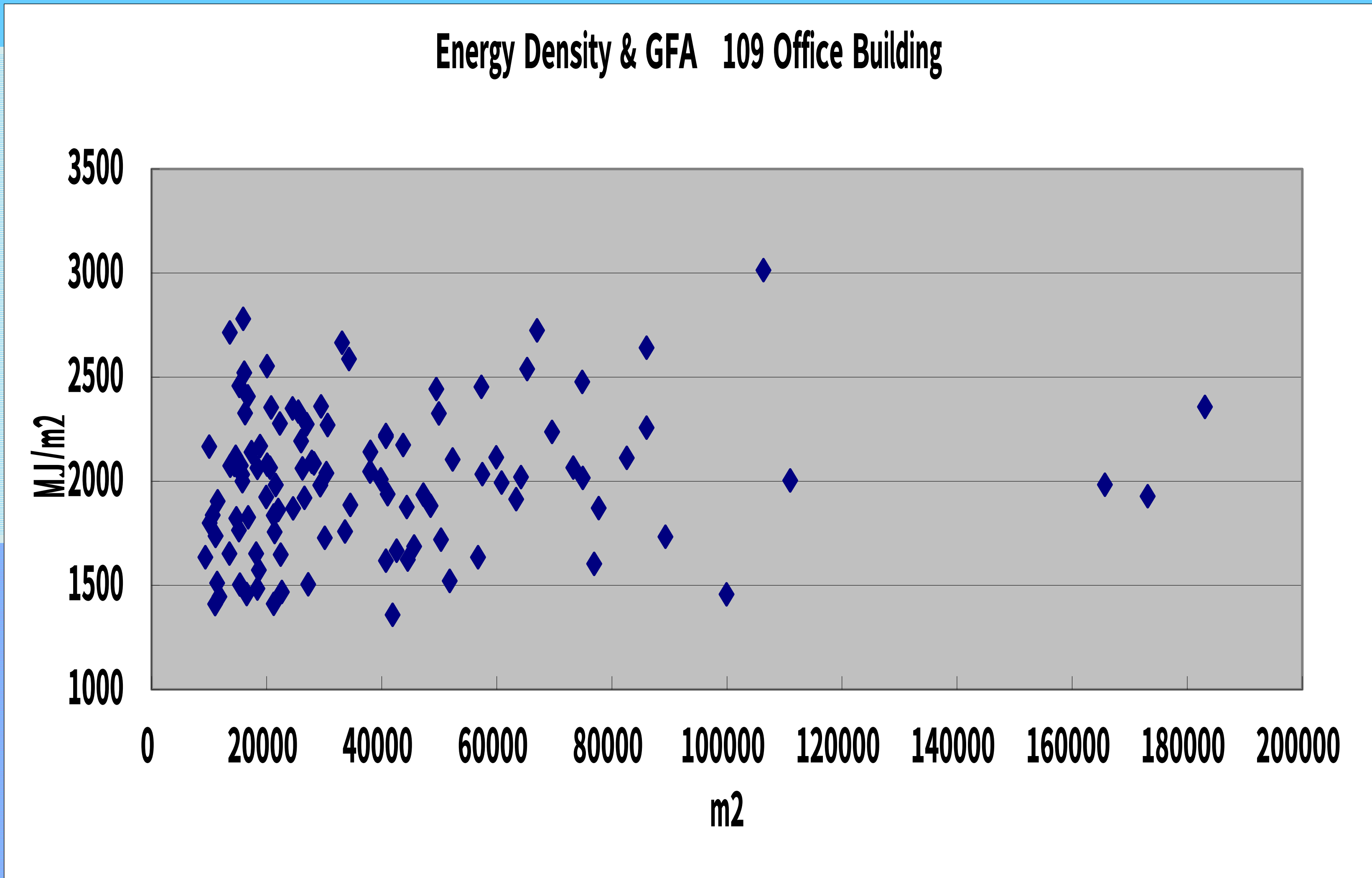
- Detailed Analysis ～150 buildings

  GFA: 15,000m2 or more

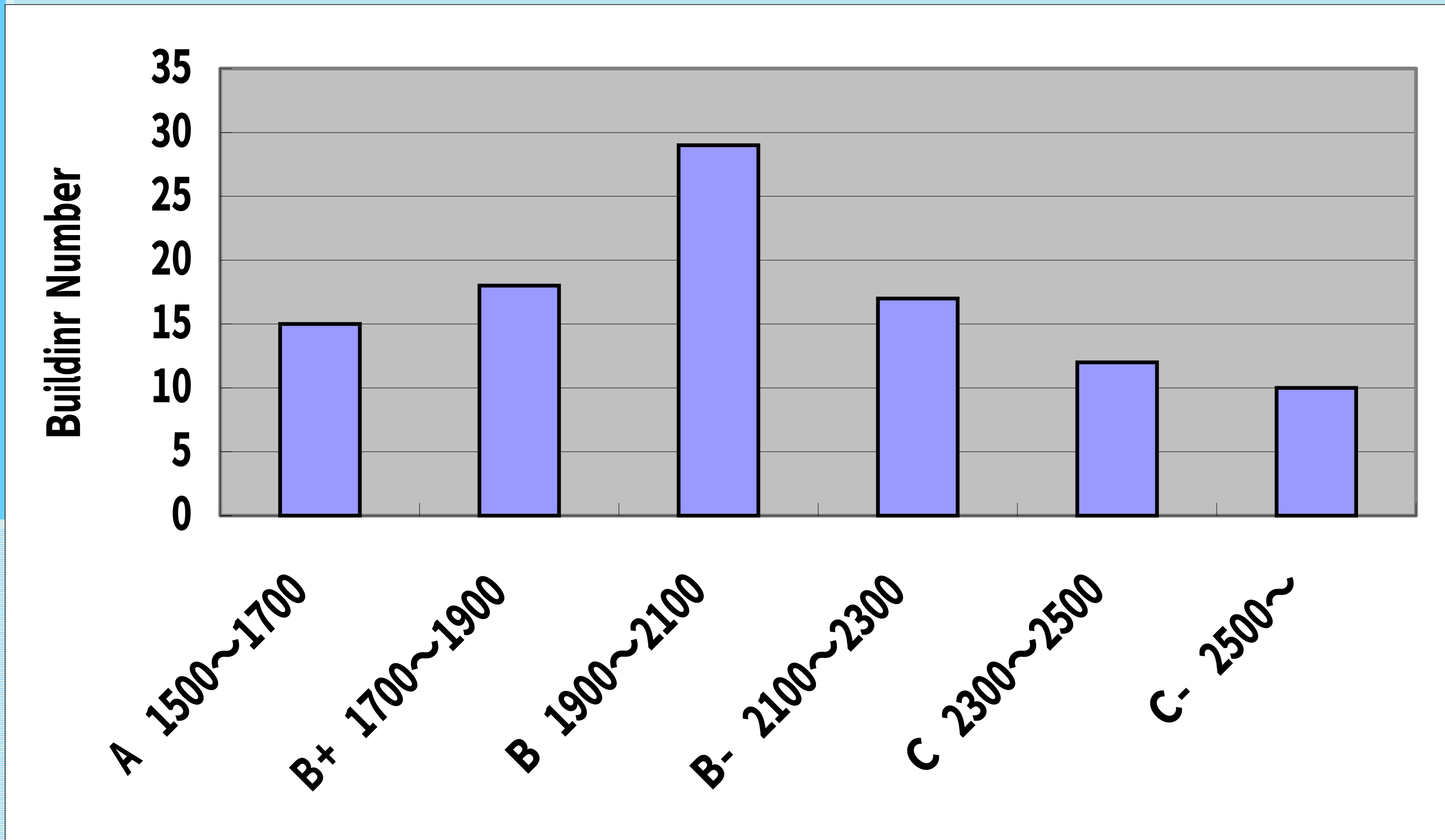
- Measurement of Effective of Improvement by Operation ～ 9 buildings

  8 themes

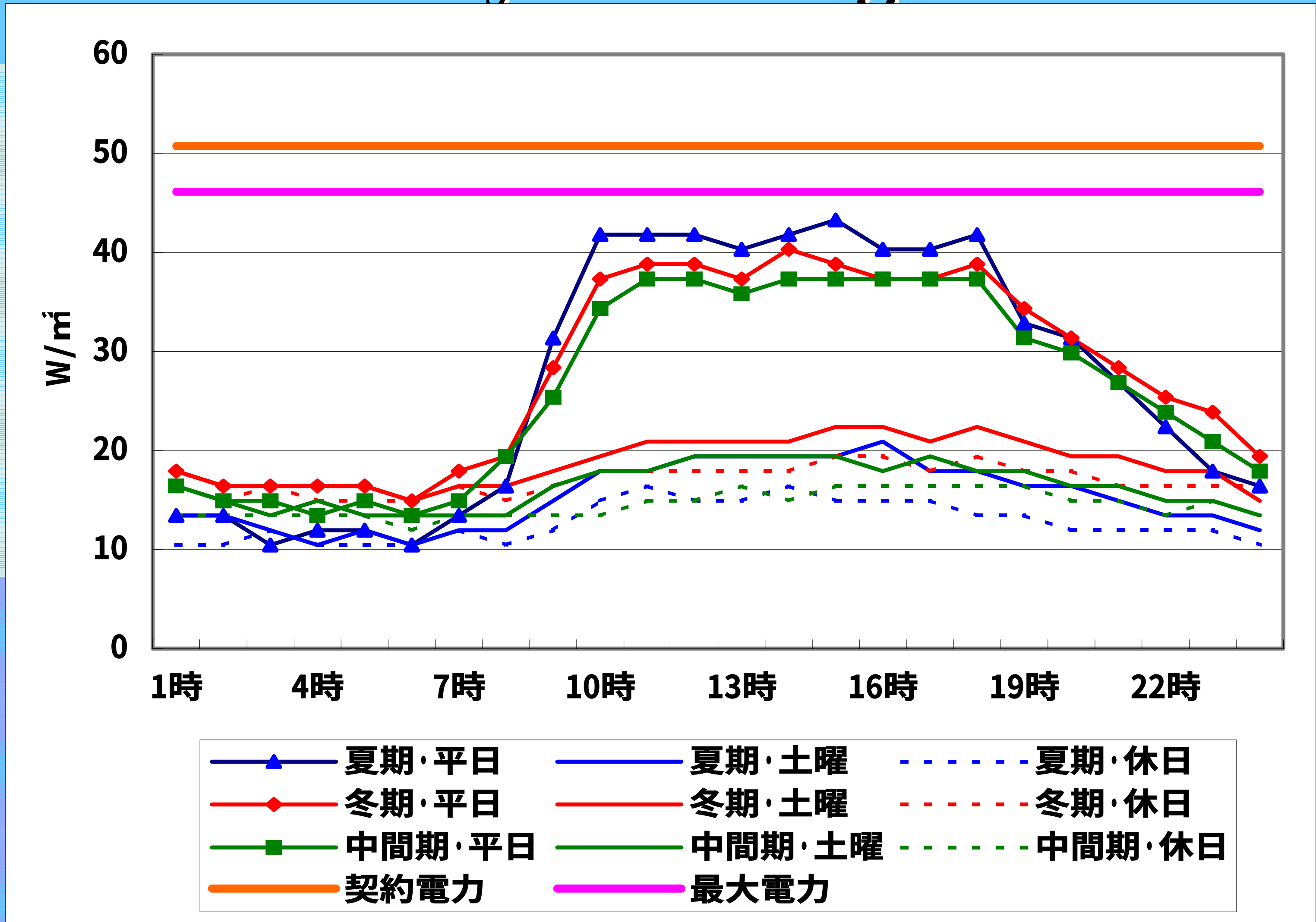
Energy Density & Gross Floor Area



Number of Classified Building (Total 109)



Electrical Power Consumption
Representative day according to season



Measurement of Amount of Effect of Improvement by Operation

- **8 themes:**

1 Proper temperature and humidity for rooms
2 Control of fresh air intake
3 Change the Chilled Water Temperature
4 Change the Cooling Water Temperature
5 Power Saving in Water by VWV
6 Power Saving by VAV
7 Intermittent drive of Ventilation Fan
8 Water Saving with imitation sound device

Activity of ECCJ
Energy Conservation Promotion Committee of Building Team A

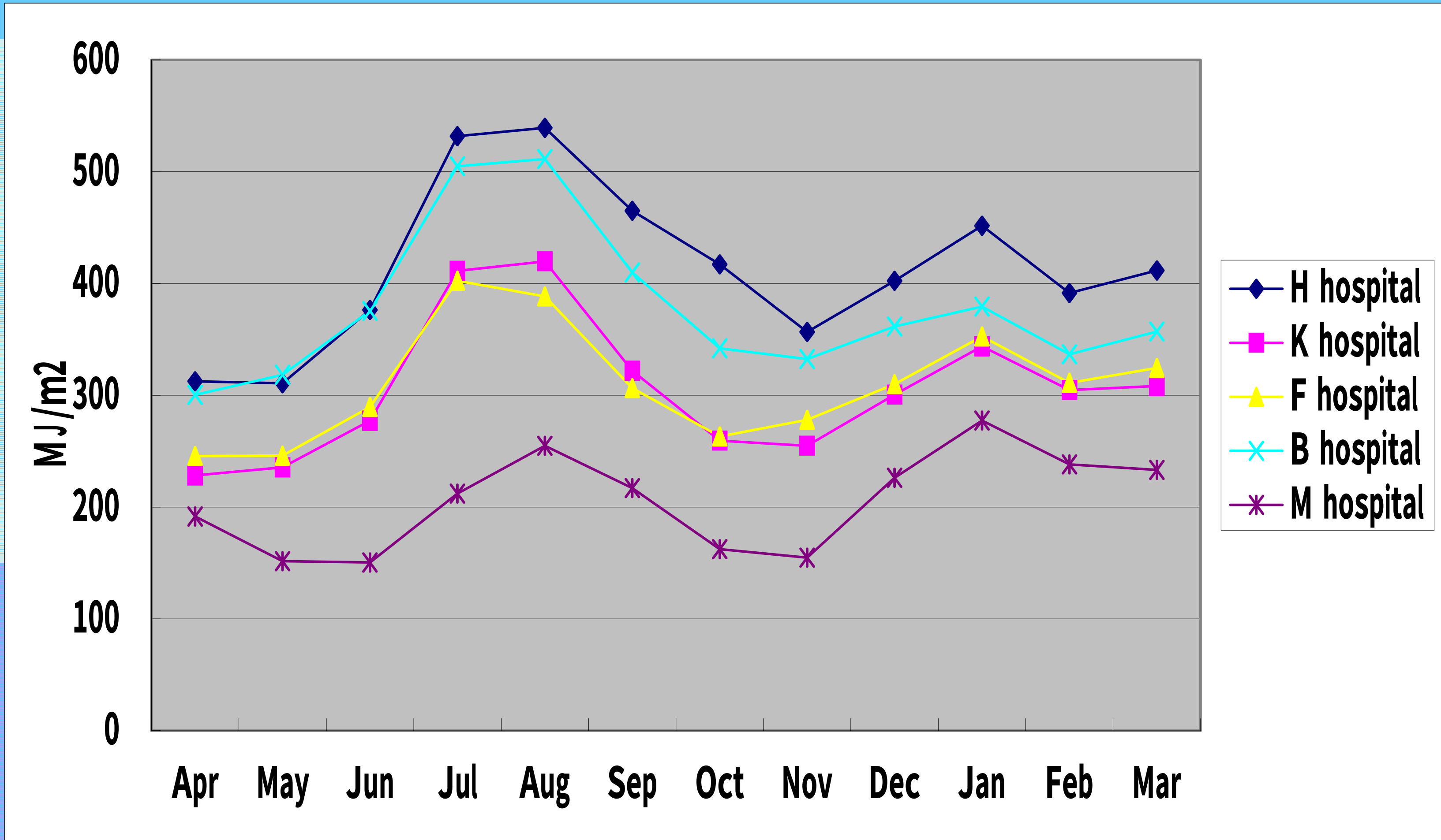
Measurement /Interview Investigation

- **Hotels : 60**
- **Hospitals:50**
- **Department sores :40**
- **Purpose～**

To Understand the Realities in Detail

To make the management standards

Monthly Energy Consumption Intensity



Activity of ECCJ

Energy Conservation Promotion Committee of Building Team C

- **Development of Energy Consumption Forecast Program**

  -Calculation of Air-conditioning Load

  -Calculation of Total Amount of Building Energy

The Future

- Detail Data & New Program

↓

- Effective, New Benchmark
- New Guideline for Energy Reduction

↓

Joint Development of ASEAN Countries & Japan

Thank you

The Energy Conservation Center, Japan

Reference Material - 3:   Materials for Post Workshop

PROMEEC - Building Activities in Malaysia, Brunei Darussalam and Lao PDR

Takashi Kato

The Energy Conservation Center, Japan

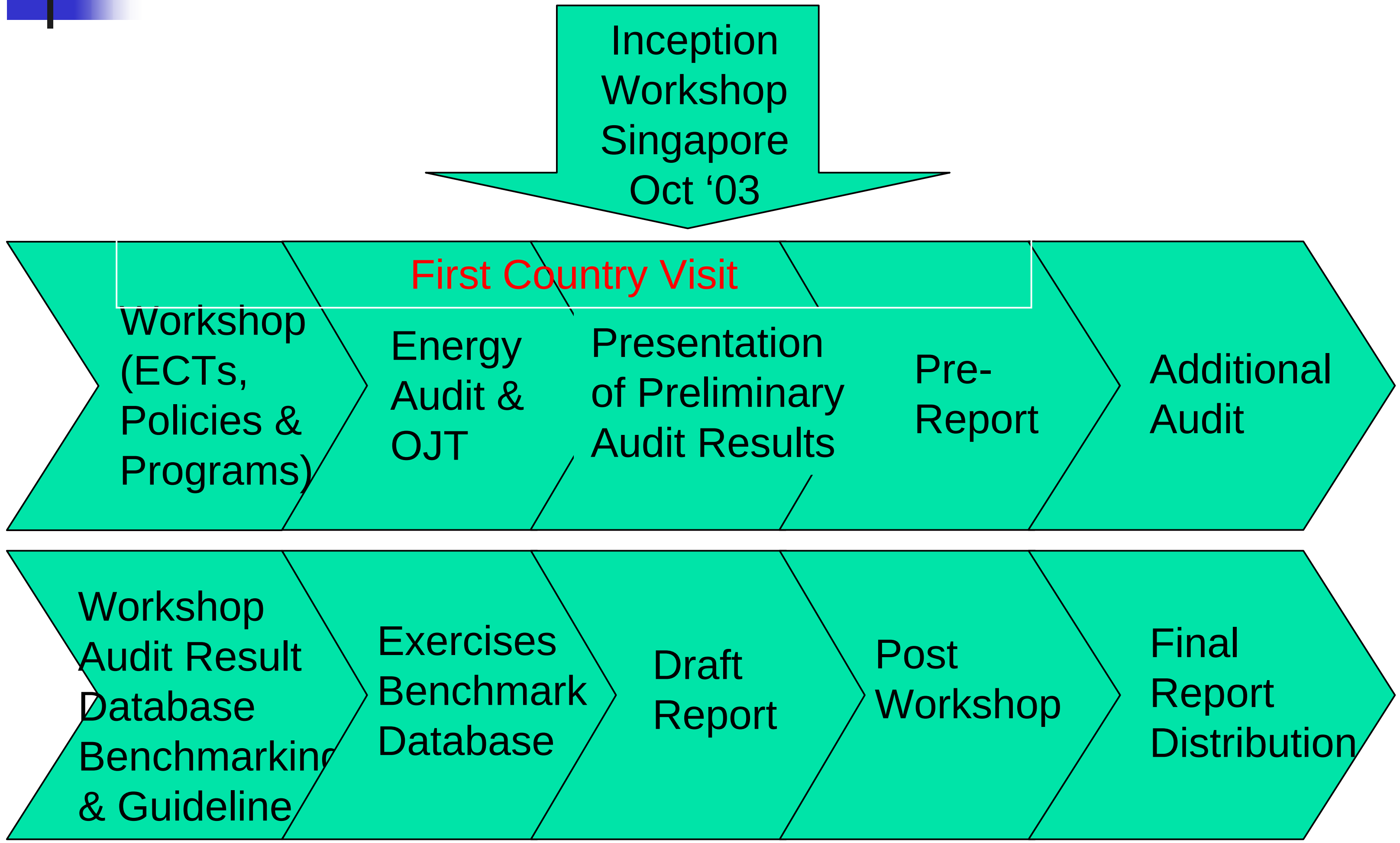
29 January 2004

Outline of Presentation

- Overview of Activities
- National Workshops on Energy Efficiency and Conservation in Buildings
  - Objectives
  - Highlights of the First National Workshop
  - Highlights of the Second National Workshop
- Energy Audit and On-the-Job Training
- Improvement Plan and Recommendation
- Good Management Practices

Overview of Activities

Snapshot of PROMEEC–Building Project Activities in Malaysia, Brunei Darussalam, and Lao PDR



National Workshops on Energy Efficiency and Conservation in Buildings

Objectives of National Workshops

- *To enhance awareness on ASEAN programs on energy efficiency and conservation*
- *To share Japan's energy efficiency and conservation policies, regulations, programs & activities.*
- *To introduce energy conservation technologies adopted in buildings in Japan to the ASEAN countries.*
- *To develop national capacities through on-the-job training in conducting energy audit in buildings.*
- *To introduce techniques and procedures in energy auditing, benchmarking, and database development*
- *To present Japan's guidelines for energy conservation in buildings*

Highlights of First National Workshop

- *Participated by more than 20 local members in each country*
- *Presentation of ASEAN programs on energy efficiency and conservation*
- *Discussion on Japan's policies and programs on energy efficiency and conservation*
- *Discussion on energy conservation law of Japan*
- *Discussion on regulations for buildings*
- *Discussion on energy manager system of Japan*
- *Discussion on energy conservation technologies*
- *Discussion on support programs and subsidy schemes for buildings*
- *Discussion on top runner program, TQM and TPM, & awards system for buildings*
- *Audit procedures and techniques*

Highlights of 2nd National Workshop

- *Participated by more than 20 local members in each country*
- *Presentation on results of energy audit*
- *Discussion on establishment of database*
- *Discussion on development of benchmark*
- *Discussion on Japan's guidelines for energy conservation in buildings*
- *Exercises on benchmarking and database development*
- *Discussion on future activities on energy efficiency and conservation*

Typical National Workshop

Building Energy Audit and On-the-Job Training

The Audited Buildings

Malaysia

Brunei Darussalam

Lao PDR

Office Building
11 Storeys
GFA - 51,282 m^2
5 years
Energy Consumption:4,830,876kWh
Energy Intensity:1,503MJ/m^2
Building Automation System

155 Rm Hotel
1 BF
10 Storeys
20,121.18 m^2
4 years
Energy Consumption: 4,498,145kWh
Energy Intensity: 2,191MJ/m^2
BAS – not functioning

142-Rm Hotel
1 BF
7 Stories
14,972.25 m^2
7 years
Energy Consumption: 3,365,986kWh
Energy Intensity:2, 203MJ/m^2
Semi-control

The Audit Approach

1. DISCUSSION WITH KEY STAFF OF BUILDINGS, ENGINEERS & PLANNERS

Data gathered:

- Building Data
- Equipment Data
- Energy Data
- Drawings
- Operation & Maintenance Data
- Others

The Audit Approach

2. ON-SITE INVESTIGATION & SIMPLE MEASUREMENT

To check condition of equipment, facilities, and lay-out

To verify accuracy of records and data

To explain to the trainees the key points of audit

The Audit Approach

3. CALCULATION OF ENERGY SAVINGS

- ANALYSIS
- FORMULATION OF IMPROVEMENT PLAN
- WRAP – UP MEETING Presentation of Results
- REPORT

Summary of Improvement Points and Calculation of Savings

Summary of Improvement Points in Malaysia (in kWh/year and Malaysian Ringgit)

No	Improvement Item	Electricity Reduction [kWh]	Reduction cost [RM]	%
1	In-door setting of temperature	273,621	77,708	5.7
2	Adjustment of fresh air volume from outside	213,466	60,624	4.4
3	Full shut down of the VAV	42,366	12,032	0.9
4	Optimization of chiller operation	115,546	32,815	2.4
5	Optimization of transformer	26,056	7,400	0.5
	Total	671,055	190,580	13.9
	Electricity consumption /year	4,830,876		
	Average electricity cost	RM/kWh	0.284	

Improvement Point 1.
In-door Setting of Temperature

- **Current situation** : In-door temperature setting: 22℃ ～ 23℃
- **Recommended Improvement Plan**

 Decrease the electric power of the chiller by raising the in-door temperature setting by 2℃

Potential Savings – 273,621 kWh/yr or 5.7% of total electricity consumption

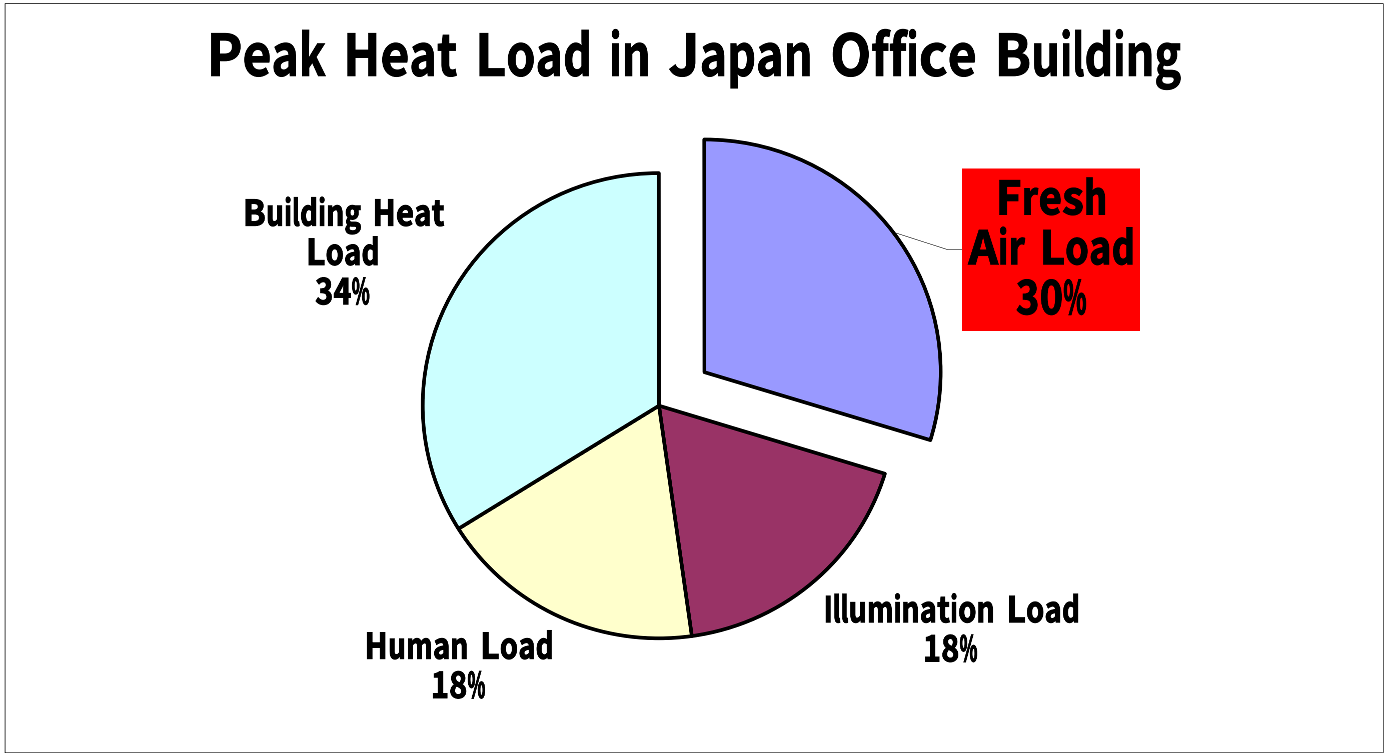
Improvement Point 2.
Adjustment of Fresh Air Volume from Outside

- **Current situation** : In-take of fresh air volume not quantified
- **Recommended Improvement plan**

  To decrease the in-take of fresh air volume by 50% of the current volume.
- Measurement of carbon dioxide (CO_2) density outside 400 ppm, inside 600 ppm, recommendation - increase to 800 ppm
- **Potential savings** : 213,466 kWh or 4.4% of total electricity consumption

Heat Load of Fresh Air

- Japan : 30〜40% Air-conditioning Load



Proper Amount of Fresh Air

- Japan's Room Environment Standard

  CO_2 Density : Below 1,000ppm

Measurement CO2 density

Indoor :

3points all 600ppm

Outside :400ppm

Improvement Point 3.
Full shut down of the Variable Air Volume (VAV) of unused rooms

- Current Situation : 8th Floor South West Wing are air-conditioned and ventilated
- Recommended Improvement plan

  Full closure of VAV, cut off chiller power and ventilation.
- Potential Savings:

  Chiller : 23,217 kWh/yr

  AHU : 19,149 kWh/yr

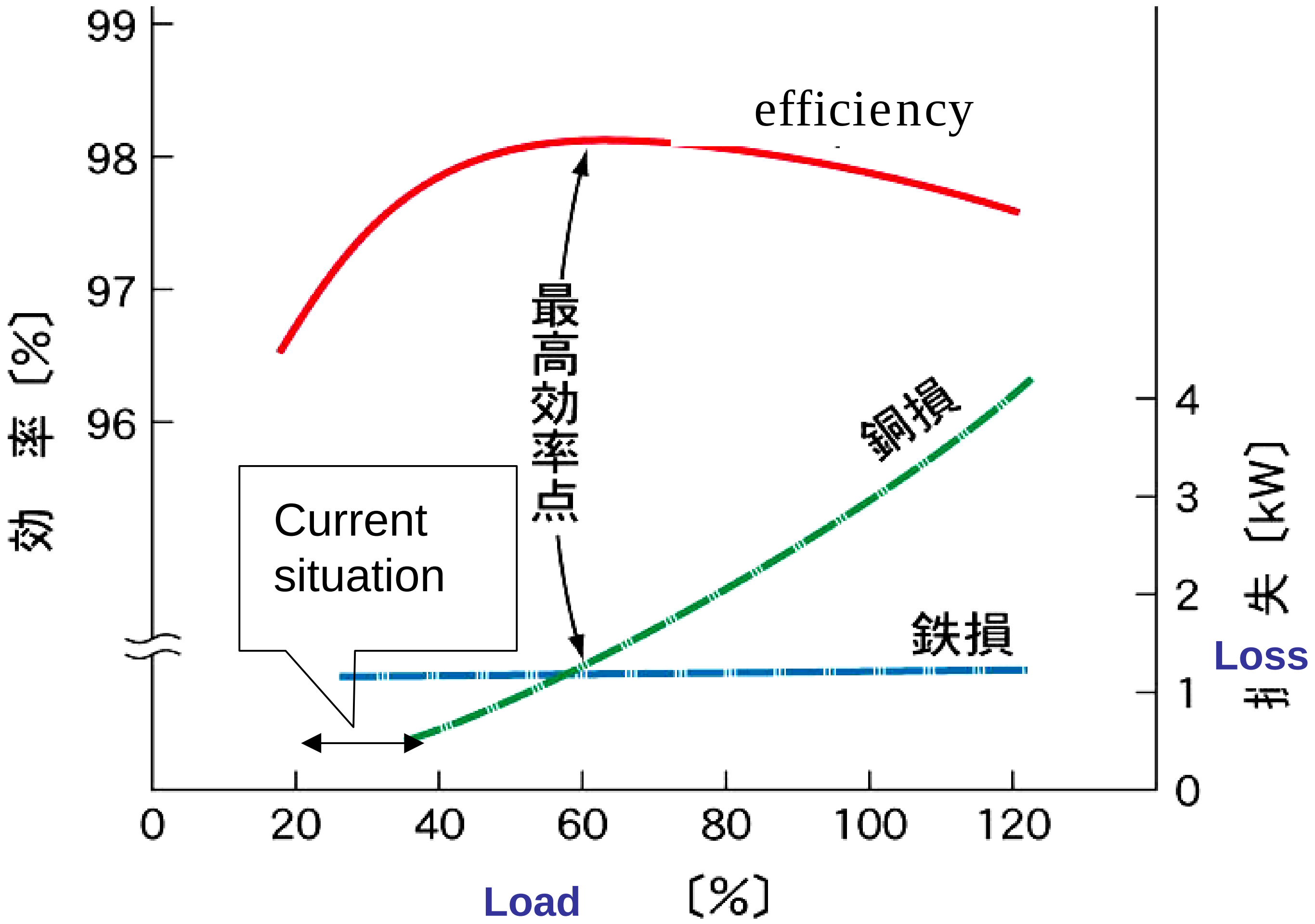
  Total : 42,366 kwh/yr or 0.9% of total electricity consumption

Improvement Point 4. Optimization of Chiller Operation

- Current situation : 2 units of 500RT chiller are operated even when the cooling load density is low.
- 500 RT×3 units chiller and 150 RT×1 unit chiller are currently installed.
- Recommended Improvement plan

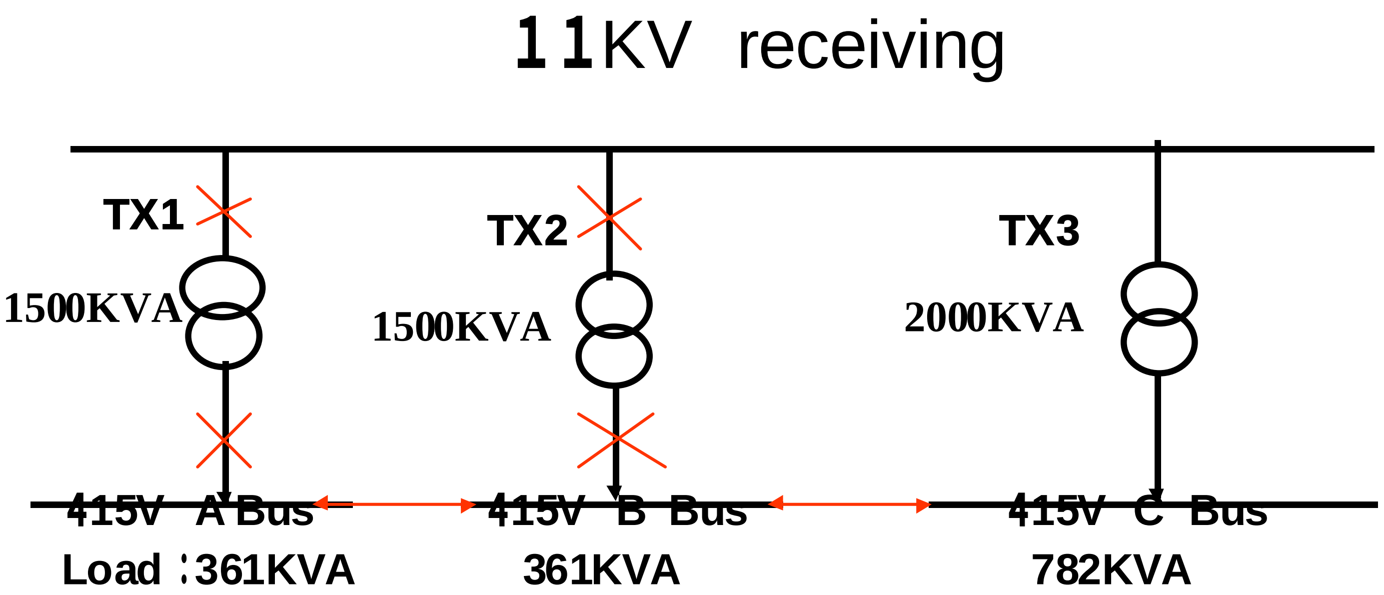
  When cooling load demand is low, only use 1 unit of 150 RT chiller.
- Potential Savings : 59,274 kwh/yr or 1.2% of total electricity consumption

Improvement Point 5.
Optimization of the Receiving Transformer



注 3φ 200〔kVA〕、6,600/210〔V〕50〔Hz〕

Recommended Improvement plan



Potential Savings

Loss using one transformer TX3:

- Wt1 －Wt2＝81,856kWh－55,800kWh

  ＝ 26,056 kWh／year or **0.5%** of total electricity consumption

Summary of Improvement Points in Brunei Darussalam (in kWh/year and Brunei $)

No	Improvement Item	Reduction electricity [kWh]	Reduction cost [B$]	%
1	Repair of the BAS System			
2	Optimization of AHU operating time	Depend on the time		
3	Intermittent use of FCU	Depend on the time		
4	In-door setting of temperature	145322	18892	3.2%
5	Thermal insulation of hot water pipes	9855	1281	0.2%
6	Optimization of the Receiving transformer	2310	300	0.1%
7	Adoption of Efficient lamps	25930	3371	0.6%
8	Reduction of filter pomp's operating time (swimming pool)	6424	835	0.1%
	Total	189841	24679	4.2%
	Electricity consumption /year	4498145		
	Average electricity cost B$/kWh		0.13	

Improvement Point 1.
Repair of the BAS system

- **Current situation**

  BAS system is not operating normally.

- **Recommended Improvement Plan**

  Immediate repair of BAS

- **Potential Savings**

  Significant

Improvement Point 2. Optimization of AHU operating time

- **Current situation**

Air conditioning is operating 24 hours, even though the 1F restaurants and conference rooms are not used.

- **Recommended Improvement Plan**

Drive the AC intermittently and stop the in-take of fresh air volume completely.

Improvement Point 3.
Intermittent use of FCU

- Current situation

FCU at guest room is operating 24 hours

- Improvement plan

Use of FCU intermittently

Improvement Point 4.
In-door Setting of Temperature

- **Current situation**

  In-door temperature setting of OGH: 22℃ ～ 23℃

- **Recommended Improvement Plan**

  Decrease the electric power of the chiller by raising the in-door temperature setting by 2℃

- **Potential Savings** – 145,322 kWh/yr or 3.2 % of total electricity consumption

Improvement Point 5.
Thermal insulation of hot water pipes

- **Current situation**

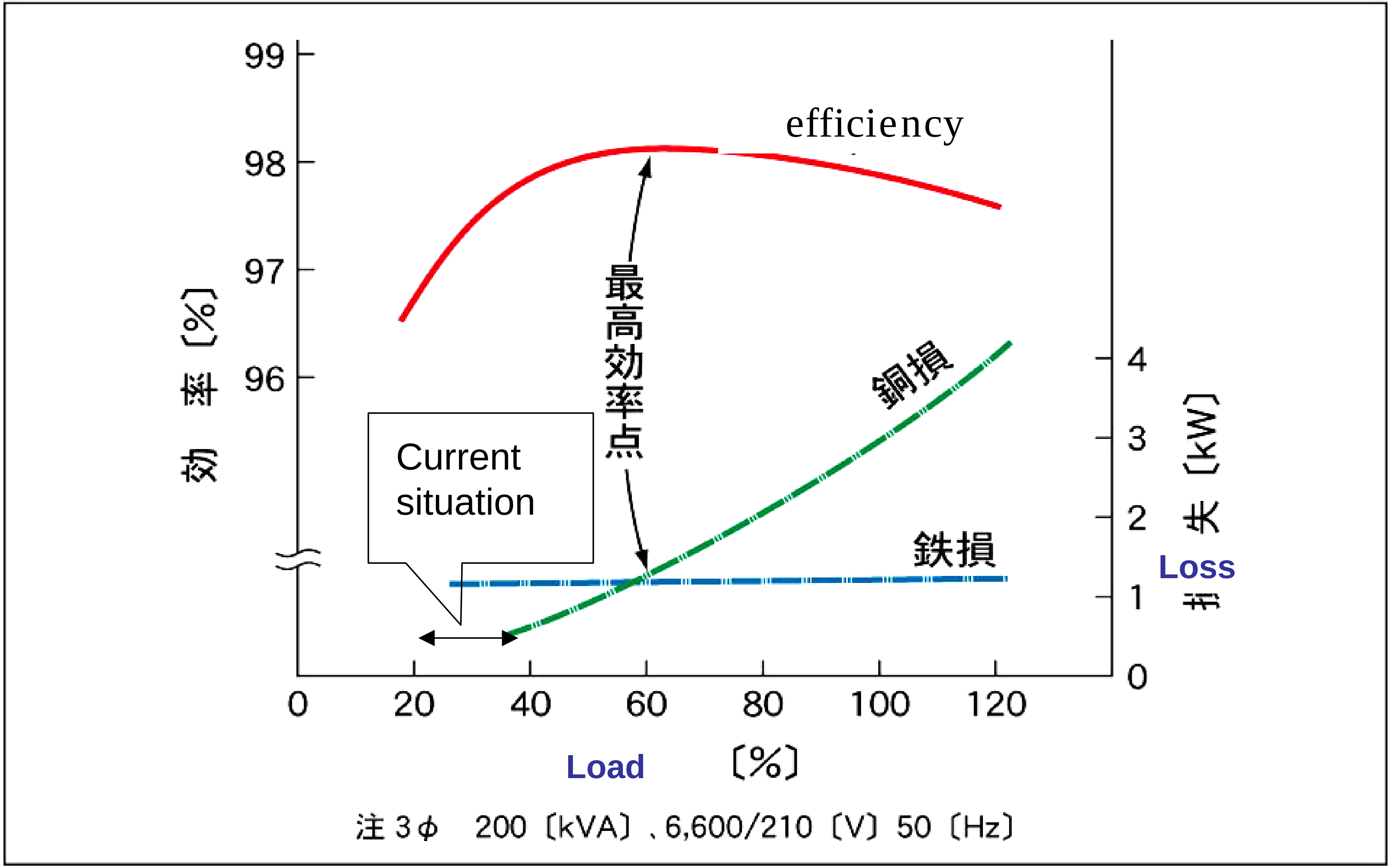
  Hot water supply pipe in the boiler room is not insulated.

- **Recommended Improvement Plan**

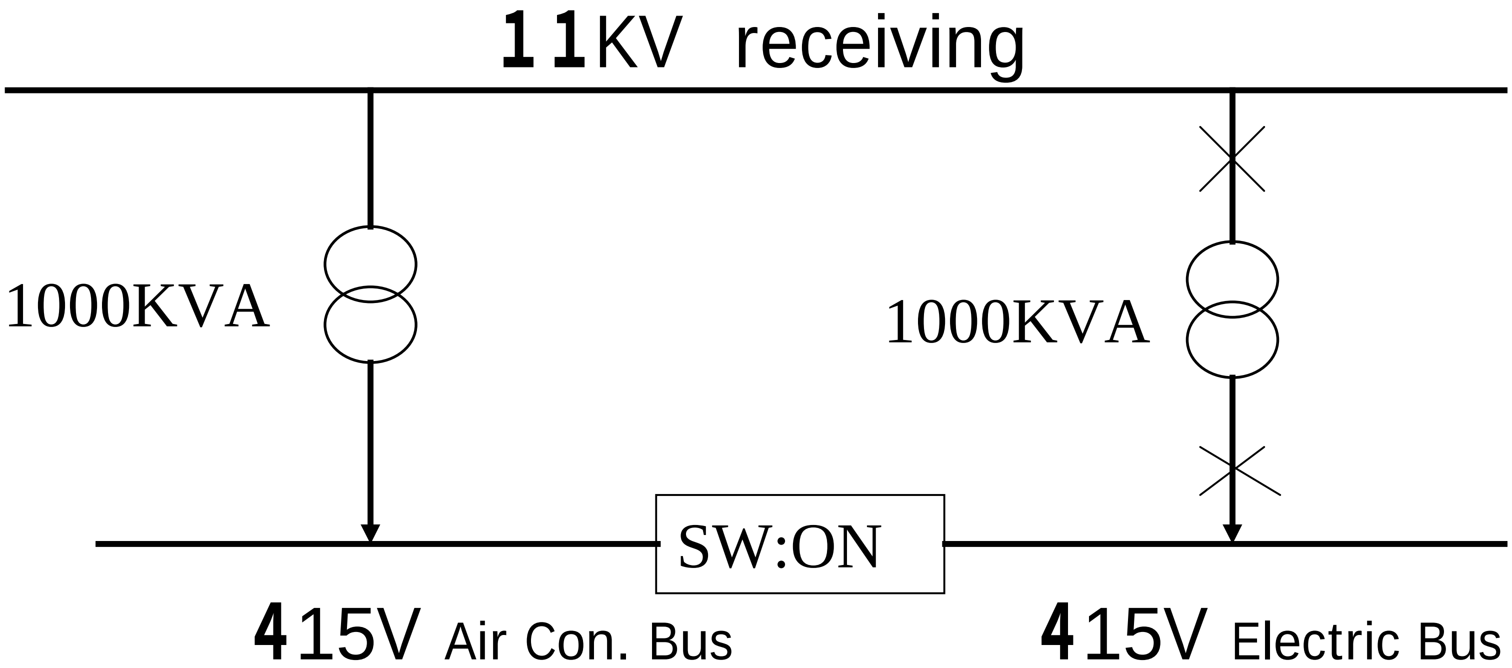
  Insulate the hot water supply pipe.

- **Potential Savings** – 9,855 kWh/yr or 0.2 % of total electricity consumption(6.2%/hot water supply energy)

Improvement Point 6.
Optimization of the Receiving Transformer



Recommended Improvement plan



Total load : 561 KVA

Potential Savings

- Loss using one transformer TX1:

Wt1 －Wt2＝51,559kWh －49,249kWh

＝2,310 kWh／Y or 0.1% of total electricity consumption

Improvement Point 7.
Adoption of Efficient Lamps

- **Current condition**

  Incandescent lamps (25W*2) are used in the guest room floor corridors.

- **Potential Savings**

(25W＊２－13W)＊16places＊5floors＊8760ｈ＝ 25,930 kWh／year or ０．6% of total electricity consumption

Improvement Point 8.
Reduction of filter pump's operating time (swimming pool)

- **Current condition**

  Filter pump is driven for 24 hours even though the swimming pool is not used by guest.

- **Recommended Improvement Plan**

  Cut operating time to 8 hours a day.

- **Potential Savings**

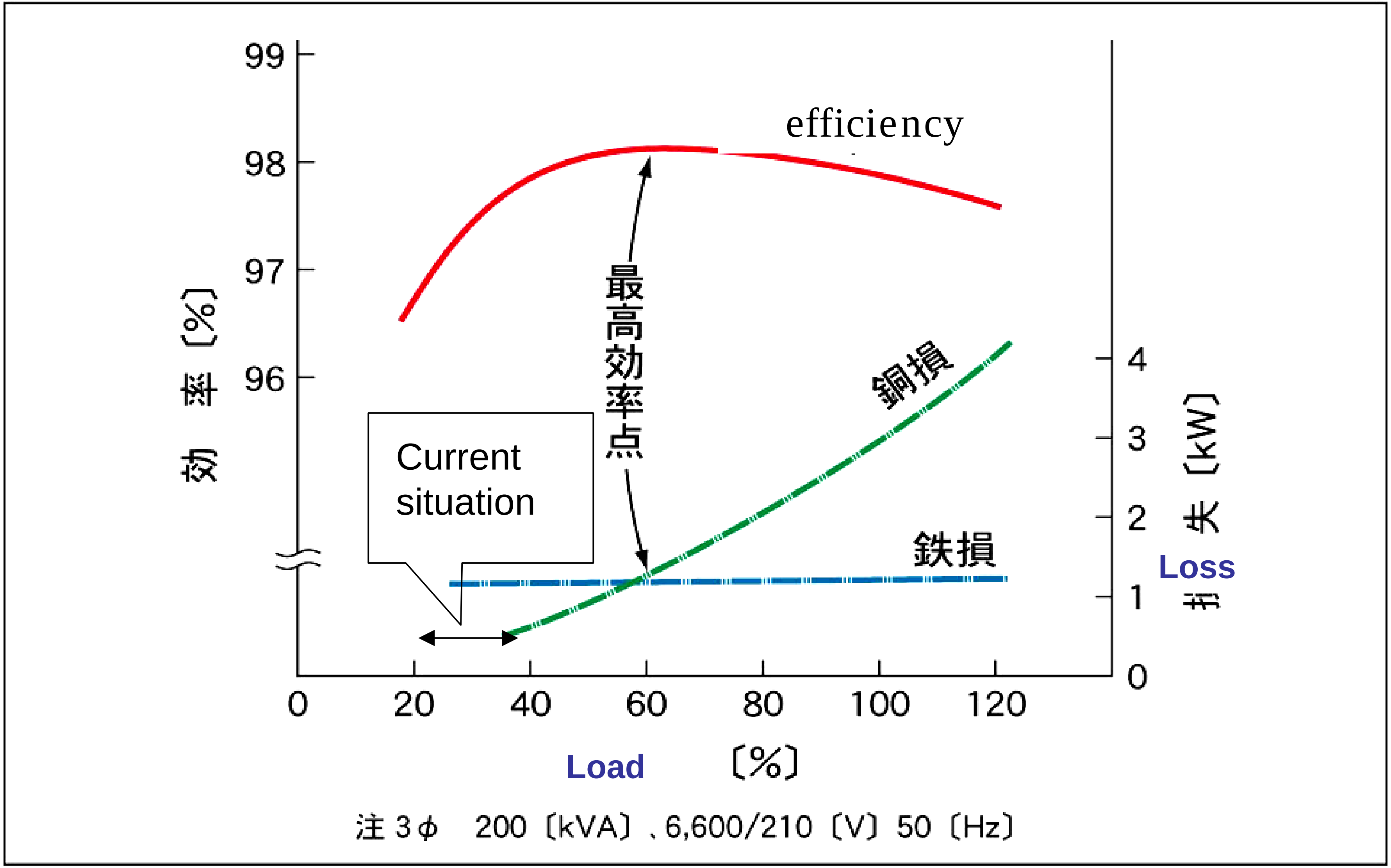
  1.1kW＊(24－8)h＊365d＝6,424 kWh/year

  or 0．1**%** of total electricity consumption

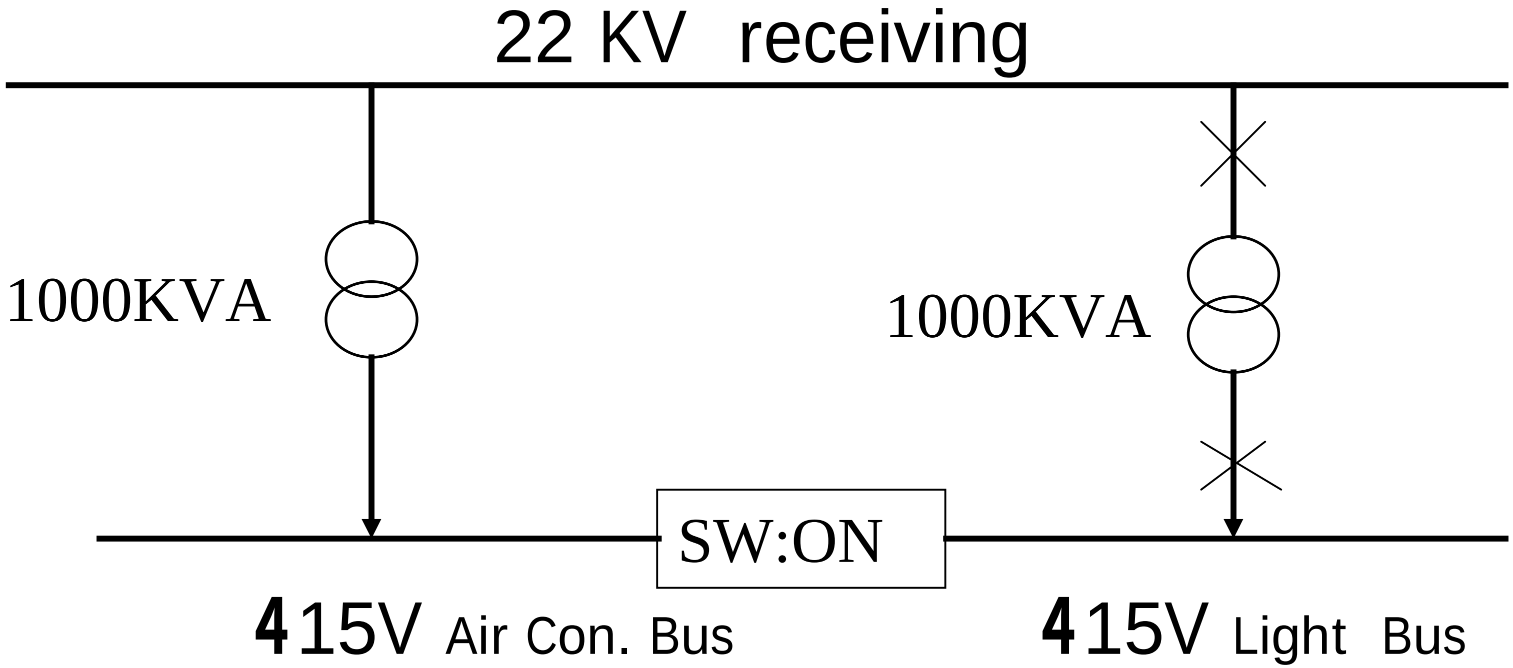
Summary of Improvement Points in Lao PDR (in kWh/year and in US dollars

No	Improvement Item	Reduction electricity [kWh]	Reduction cost [US$]	%
1	Optimization of transformer	10,927	618	0.4
2	Adoption of Efficient lamps	27,592	3,371	0.9
	Total	38,519	3,987	1.3
	Electricity consumption /year	4,830,876		
	Average electricity cost	US$/kWh	0.0564	

Improvement Point 1.
Optimization of the Receiving Transformer



Recommended Improvement plan



Total load : 377 KVA

Potential Savings

Wt1 －Wt2＝42,200 kWh －31,273 kWh

＝10,927 kWh／Y or ０．4 **%** of total electricity consumption

Improvement Point 2.
Adoption of Efficient Lamps

- **Current condition**

  Incandescent lamps (25W*2) are used in the guest room .

- **Recommended Improvement Plan**

  Use fluorescent lamps

- **Potential Savings**

  (25W＊２-11W)＊3places＊142room＊0.65(occupancy rate)＊7ｈ＊365day＝27,592 kWh／year or **０．９%** of total electricity consumption

Improvements Made After the Audit / Current Practices: Good case

Improvements Made by Brunei Building

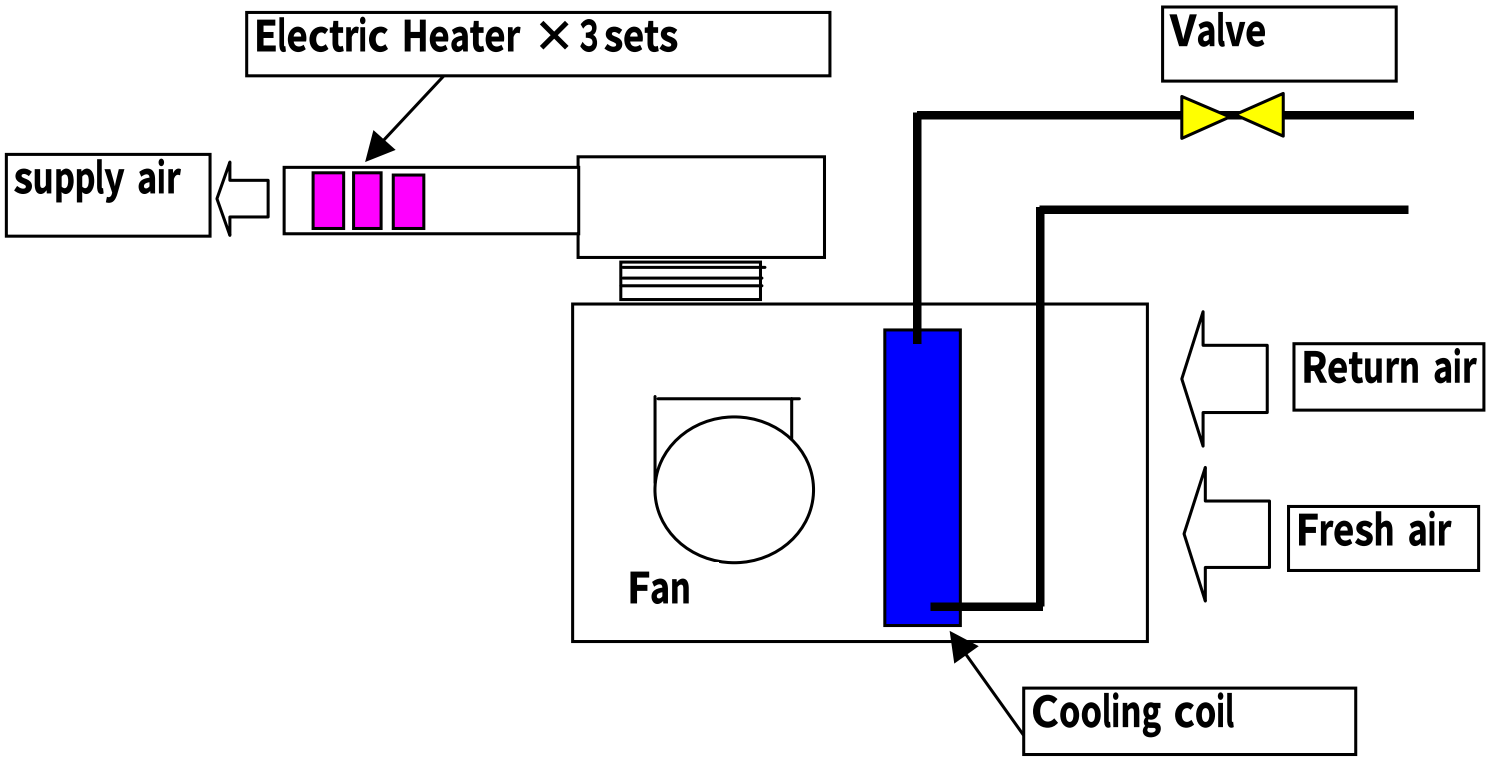
- Shutting down of exhaust fan at car park at midnight.
- Switching off of AHU at Vanda Restaurant at midnight.
- Reduction of swimming pool filter pump operation to 6 hours daily.
- Switching off of 1 & 2 AHU at Level 8 Cesar Grand Hall, Cesar 1 and 2. Only switched on when there is a function.
- Increased of lifts temperature setting from 20 to 24℃.
- Shut down of heaters at the lobby, back office, and restaurants.

Calculation of Savings – Brunei Building

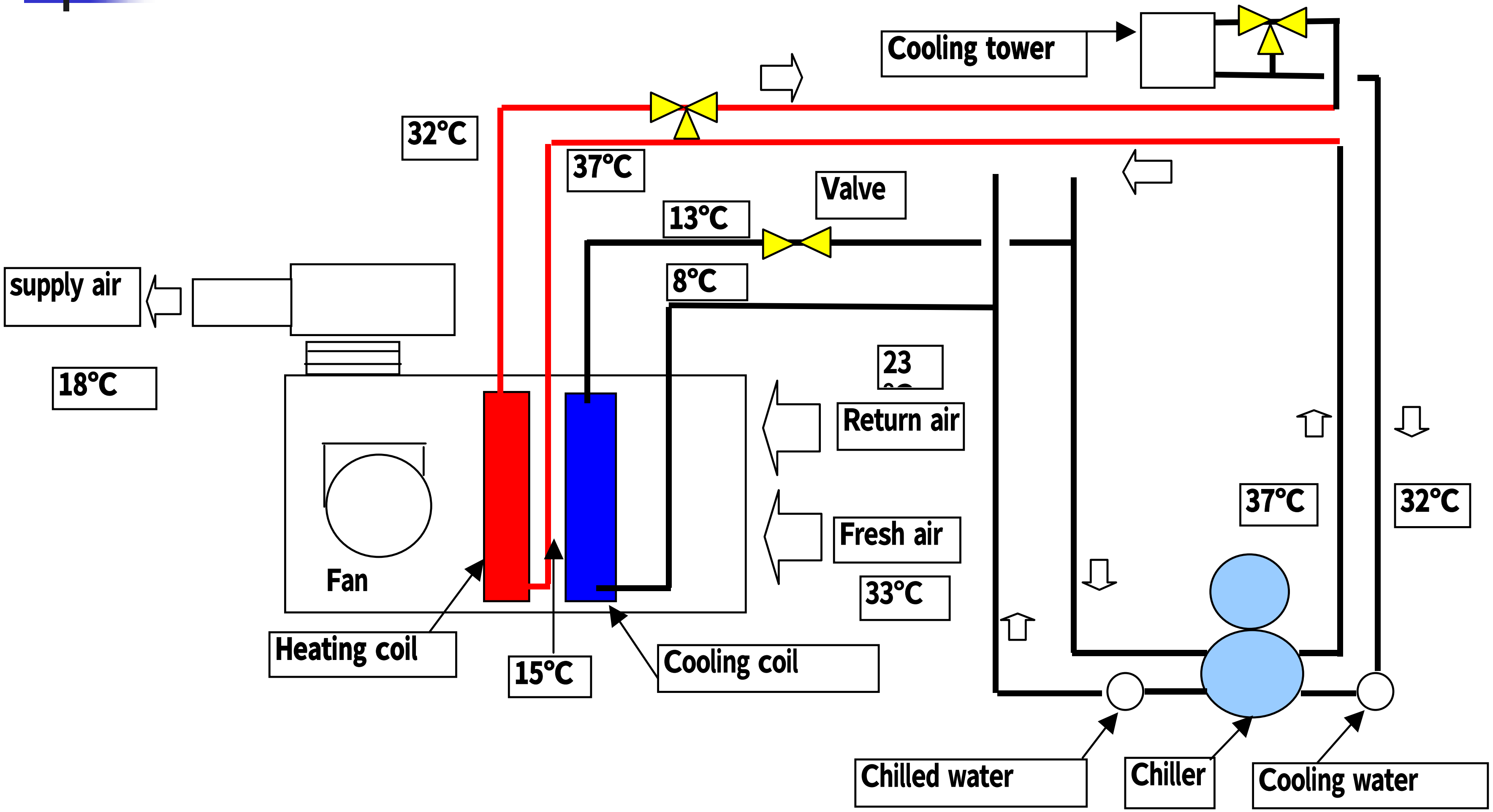
	kW	Load Rate	unit	h	d	kWh/y	
Car park fan	0.33	0.8	2	16	365	3084	
Vanda Restaurant AHU	4	0.8	1	8	365	9344	
Vanda Toilet Fan	0.15	0.8	1	8	365	350	
Goldiana Exhaust fan	0.32	0.8	1	8	365	748	
Swimming pool	1.1	0.8	1	6	365	1927	
Level 8 Grand Hall AHU	11	0.8	1	24	265	55968	
Level 8 Cesar 1AHU	11	0.8	1	24	265	55968	
Level 8 Cesar 2 AHU	5.5	0.8	1	24	265	27984	
Lobby Reheater	18	0.4	1	24	365	63072	
Back office Reheater	7	0.4	1	24	365	24528	
Restarants Reheater	35	0.4	1	24	365	122640	8.1%
					Total	365613	
					Annual Consumption	4498145	0.13
Average electricity cost 0.13 B$/kWh				Reduction cost		47530	

Saving the reheat energy

Present system



New System : Brunei Darussalam Method



Good Energy Management Practices

Lao Building

1. Good management of the chiller outlet temperature and cooling water temperature corresponding to the load condition.

- The turbo chiller outlet temperature is set up when cooling load is low. And the operation of cooling tower is controlled according to the load condition.
- By raising the chilled water temperature by 2℃, about 5 % of motor output is reduced.
- By reducing the cooling water temperature by 2℃, about 5 % reduction of motor output is also achieved.

2 Proper setting of machine room temperature.

The elevator machine room is 30℃.

3 Proper operation of the air conditioning machine, ventilation fan

- Two chillers for AC lobby are used during daytime; and one chiller is used during night time.
- Ventilation fan of guest rooms is operated only for 7 hours during nighttime and morning time.

3.4 Complete consumption of LPG

- LPG gas in cylinder is completely consumed. When full, the cylinder is in upright position and when nearly empty, the cylinder is laid down.

5 Complete blockade of fresh air intake from outside

Due to the frequent opening and closing of doors at the main lobby, the fresh air intake outlet was completely blocked.

6 Employees awareness of hotel's energy management system

Bulletin board is strategically placed in the staff area to inform the employees of the hotel's day to day energy consumption and cost. This appeals to the employees cooperation to save energy and cost.

Thank you

The Energy Conservation Center, Japan

Database, Benchmark & Guideline

Malaysia, Brunei Darussalam & Lao PDR

PROMEEC – BUILDINGS

SOME-METI WORK PROGRAMME 2003-2004

Akira Kobayashi
The Energy Conservation Center, Japan
29 January 2004

Outline of Presentation

- Overview of Activities
- Guidelines for Energy Efficiency in Buildings
- Database
- Benchmarks
- Exercises
  - Malaysia
  - Brunei Darussalam
  - Lao PDR
- Recommendations
- Activity of Building Committee of ECCJ

Overview of Activities

- Introduction of Japan’s Case
- Introduction of Concerned Country’s Case
- Processing of Data Gathered by Participants
- Future Development

Guidelines for Energy Efficiency in Buildings

- Mandatory in Japan
- No existing guidelines in Malaysia, Brunei Darussalam, and Lao PDR.
- Malaysia will develop guidelines in the future
- Energy conservation measures prior to building construction are initiatives of owners

Important Guidelines in Japan

Obligations of Building Owners

1) Prevention of heat loss through external walls、windows, etc. of a building:
2) Efficient use of air conditioners;
3) Efficient use of mechanical ventilating equipment;
4) Efficient use of lighting facilities;
5) Efficient use of hot water supply systems;
6) Efficient use of elevators

Standard value of energy conservation for buildings

	Hotels	Hospitals	Stores	Offices	Schools	Restaurant
1)PAL	420	340	380	300	320	550
2)CEC/AC	2.5	2.5	1.7	1.5	1.5	2.2
3)CEC/V	1.0	1..0	0.9	1.0	0.8	1.5
4)CEC/L	1.0	1.0	1.0	1.0	1.0	1.0
5)CEC/HW	1.5	1.7	1.7	-	-	-
6)CEC/EV	1.0	-	-	1.0	-	-

Note) In the case of 1), values obtained by multiplying the above values by the scale correction factor shall be standard ones. (Scale correction factor: a factor for correcting standard values to relax controls of small scale buildings, etc)

Illumination Standard of Office

Office Building

LX	location (some examples)
1500-	
1000-	office room (a), business room, design room, drawing room
750-	office room (b), executive room, meeting room, printing room, computer room, control room
500-	
300-	

Room Environment Standard

Temperature	17°C～28°C
Humidity	40%～70%
Wind velocity	Below 0.5m/s
Suspended solid	Below 0.15mg/m3
CO	Below 10ppm
CO2	Below 1000ppm

Operating Guidelines for Factories and Buildings

Areas for Rational Use of Energy

1) Fuel combustion
2) Heating, cooling, heat transfer, etc.
3) Prevention of heat loss due to radiation, conduction, etc.
4) Recovery and utilization of waste heat
5) Rationalization in the conversion of heat to power, etc
6) Prevention of electricity loss due to resistance, etc
7) Rationalization of conversion from electricity to mechanical power, heat, etc.

Database

Brunei Darussalam

- Building data not available
- No database
- Collected 2 data for PROMEEC project

Malaysia

- Started collecting data through sending of survey questionnaires
- 55 building data collected
- Database to be established

Lao PDR

- Only 3 building data available
- No immediate plans to collect building data
- No immediate plans to establish building database

Japan's Case

- Building data were collected through energy audit
- Building data were entered into the database developed by ECCJ

Availability of Building Data : Collected Through Energy Audit

Type of Building	Number
Government Office	173
Office	194
Department Stores	109
Supermarket	109
Hotel	109
Hospitals	143
Assembly Hall	27
School	46

Total	910

Structure of the Database

1) Building Information

Building Information Sheet

- Name :
- Category of Usage:
  - Landload building or Tenant building
- Age of Building:
- Size：
  - Total gross floor area m2
  - Number of stories ・Basement Stories
- Electrical facilities:
  - Receiving voltage、 Agreement capacity
  - Transformer capacity
- Air conditioning facility:
  - Heat source capacity for cooling
  - Main equipment
  - Heat source capacity for heating and hotwater
  - Main equipment
  - Air conditioning system
- Sanitary facility:
  - Water supply system Hot water spply system
- Air conditioner setting temperature and humidity:
  - Summer ℃ %, Winter ℃ %
- Working hour:
  - Week day , Sata day , Sun day

Structure of the Database

2) Energy Consumption

	Electricity				City gas	LPG	Oil	District heat and cooling		Water service	
	Maximum	Daytime	Nighttime	generator				Cold water	Steam	Water supply	Well
month	kW	kWh	kWh	kWh	m3	kg	kL	GJ	GJ	M3	m3
Apr											
May											
Jun											
Jul											
Aug											
Sep											
Oct											
Nov											
Dec											
Jan											
Feb											
Mar											
Total											

Calculation of Building Energy Efficiency Index (in MJ/m2)

Calculation of Energy Intensity

Energy			Annual consumption		Heat equivalent			
Kind	Classification	Unit			MJ/unit		MJ/year	
Electricity		kWh		×	9.8	=		
City gas	13A	m2		×	46	=		
	12A	m2		×	42	=		
LPG		kg		×	50	=		
Heavy oil	A	kL		×	39,100	=		
	B	kL		×	41,700	=		
Total consumed							A	MJ/year
Total gross floor area							B	m2
Energy consumption intensity (annual bassis):				=	A/B	=	C	MJ/m2 year

Benchmarks

Brunei Darussalam

- **No immediate plans to establish benchmarks**

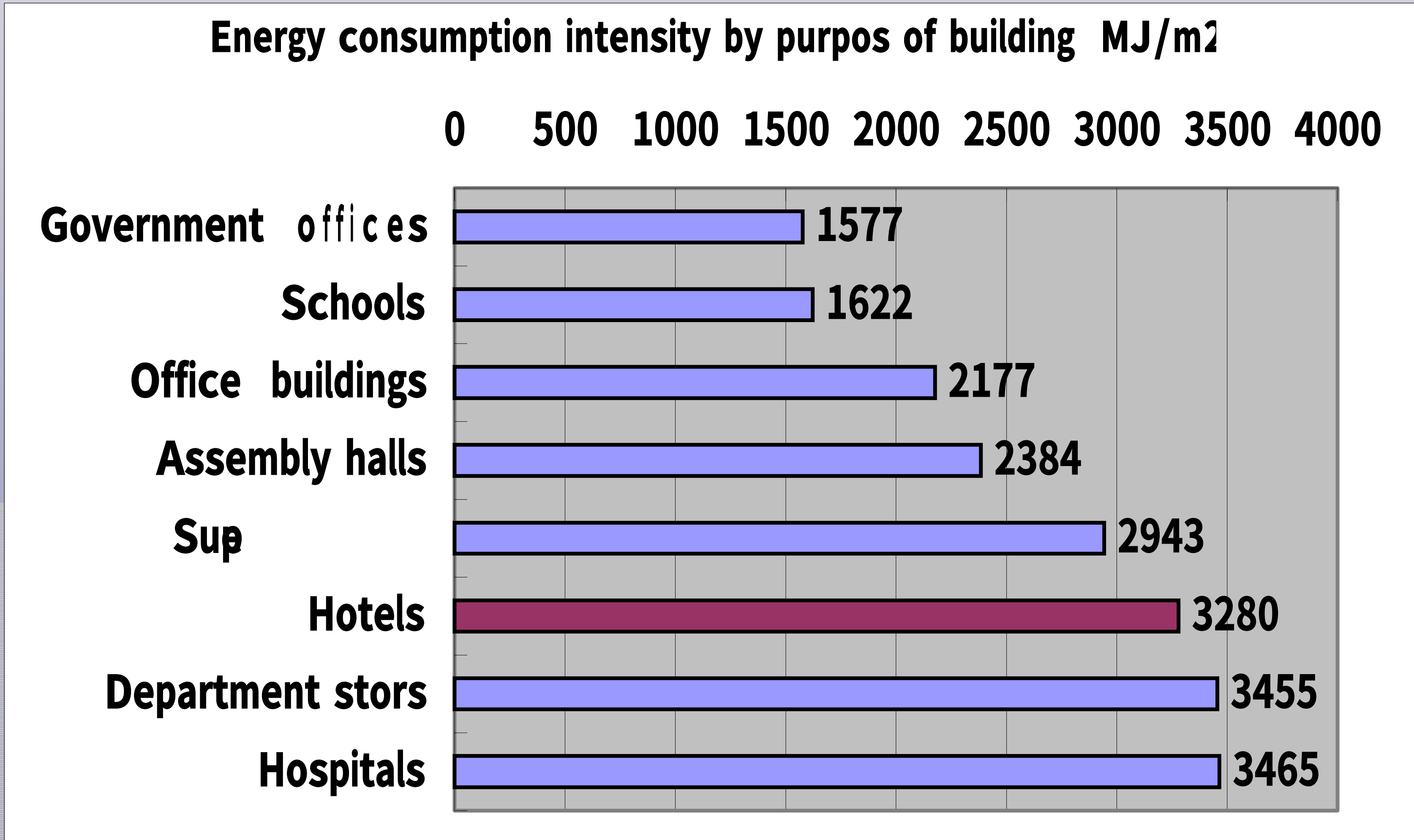
Malaysia

- **Government building energy index :Average 180.41kWh/m2/y**
- **From 55 office building data : BEI 166kWh/m2/y**

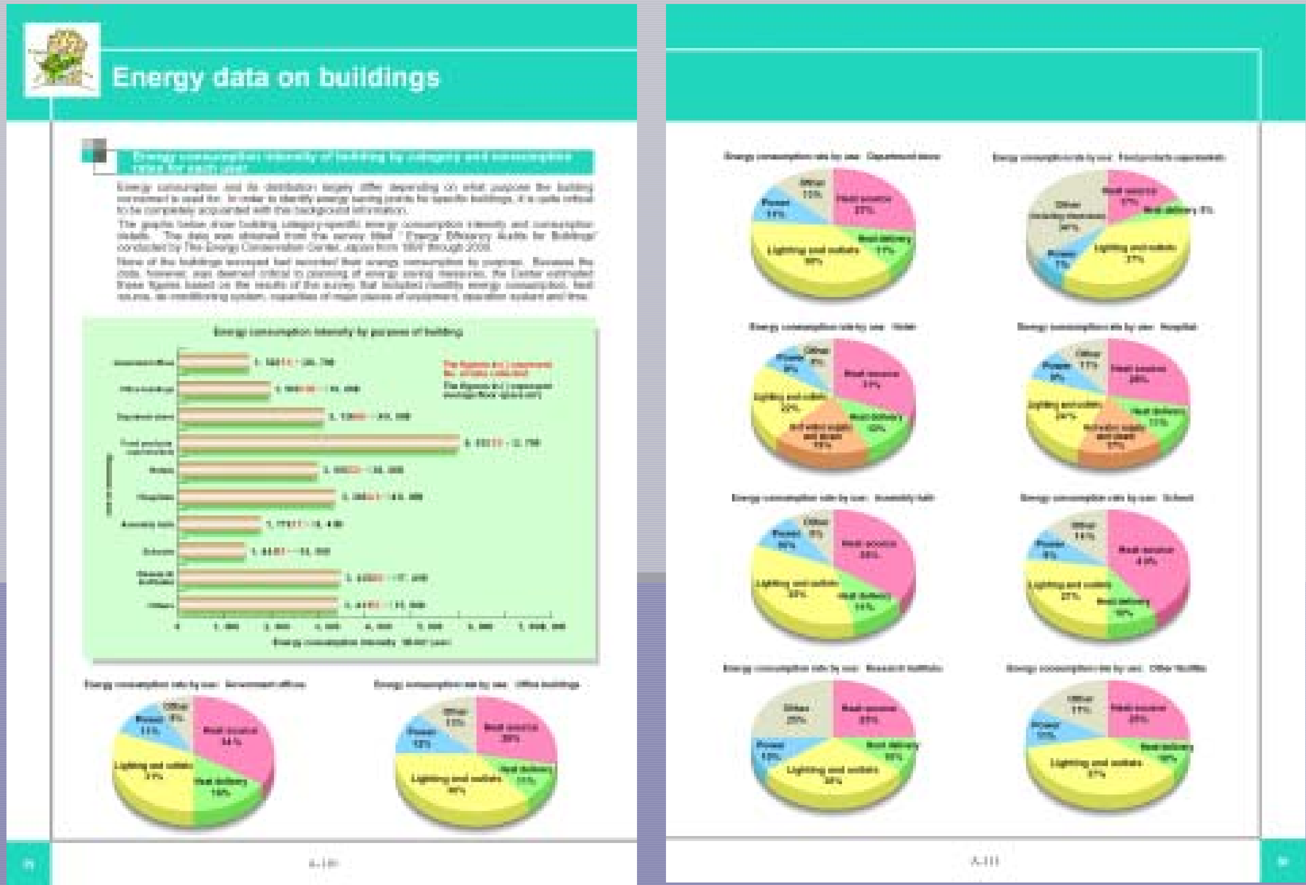
Lao PDR

- **No immediate plans to establish benchmarks**

Benchmarks in Various Types of Buildings in Japan



Information Dissemination of Database and Benchmarks

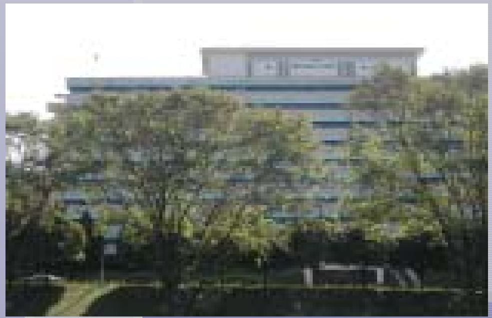


Exercise
- Malaysia

The Participants

From PTM Presentation

BUILDING ENERGY INDEX (BEI) FOR THE 12 BUILDINGS

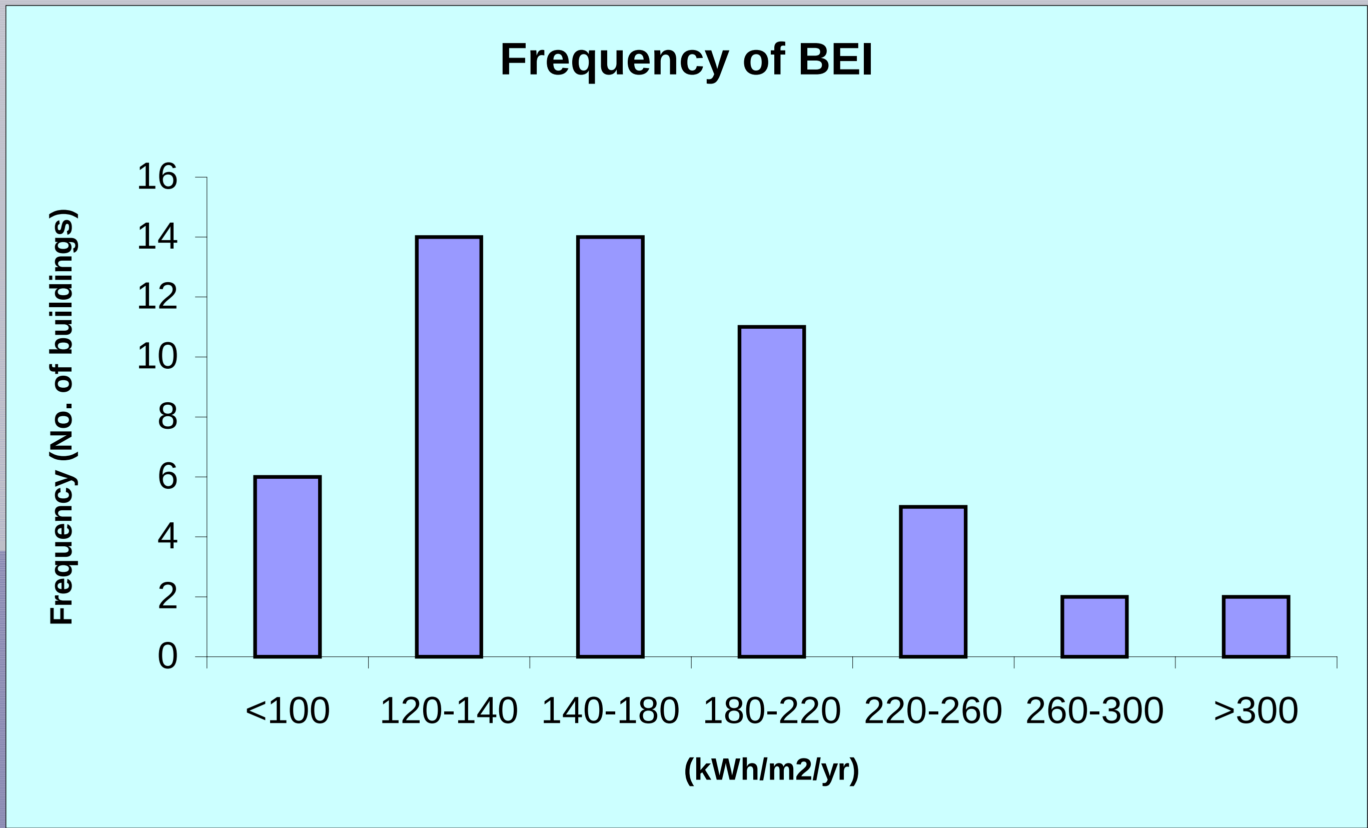


No.	Buildings	BEI (kWh/m²/yr)
1	Menara PKNS, S'gor	246.84
2	BSN HQ, KL	246.4
	Wisma	257
	Block A&B	385
3	M'sian Institute of Nuclear Technology (multiple)	211.29
	MINT Bangi	208.88
	MINT Dengkil	213.69
4	Kompleks Pej. Kerajaan Jln Duta, KL	168.36
	Block 8	184.85
	Block 8A	165.35
	Block 9	144.11
	Block 10	167.61
	Block 11	180.59
**5	National Science Centre	155.38
6	Wisma Persekutuan, KT	152.44
7	Kementerian Pertanian	149.45
8	Wisma Persekutuan, KB	133.72
9	Bang. Rumah Persekutuan, KL	132.73
10	JPS HQ, KL	121.64
**11	Kolej Universiti Teknologi Tun Hussein Onn (multiple)	85.4
12	Wisma Persekutuan, Kuantan	77.94
	Average	180.41

****BEI based on gross floor area, others – occupied area**

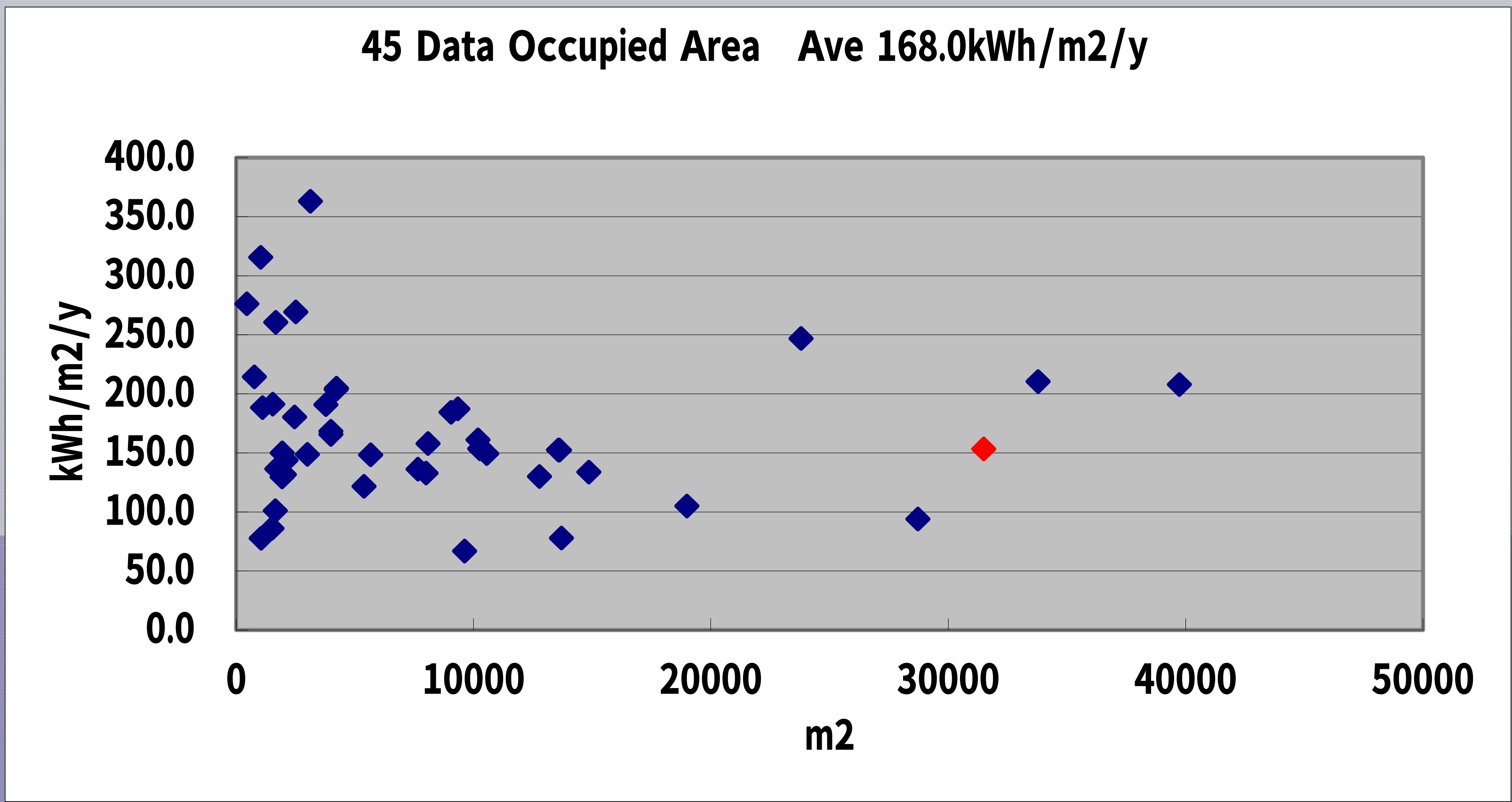
From PTM Presentation

BENCHMARK FOR 55 OFFICE BUILDINGS (as at Dec 2003)



Mean 166 kWh/m^{2}yr

45 Data (Processing by ECCJ)



Discussion

- Data Gathering Process
  - Energy Audit Method
  - Questionnaire Method
- Number of Data
- Hospital Energy Conservation
- Purpose of Bench Mark
- Others

Exercise
- Brunei Darussalam

The Participants

Building Energy Data

- **Institute Teknologi Brunei :**

267,641kWh/y 27,000m2 9.6kWh/m2/y

Discussion
FUTURE DIRECTION ACTIVITIES

1 ENERGY SURVEY OF BUILDING

2 SET UP NATIONAL COMMITTEE ON ENERGY EFFICIENCY AND CONSERVATION TASK FORCE.

3 UPDATING THE BUILDING BY-LAWS.

4 DATA GATHERING OF POWER CONSUMPTION AND GFAS FOR GOVERNMENT BUILDINGS, COMMERCIAL AND INDUSTRIES.

5 ESTABLISHMENT OF DATA BASE.

6 GUIDELINES FOR NEW BUILDINGS

7 POLICY FRAMEWORK ON ENERGY EFFICIENCY.

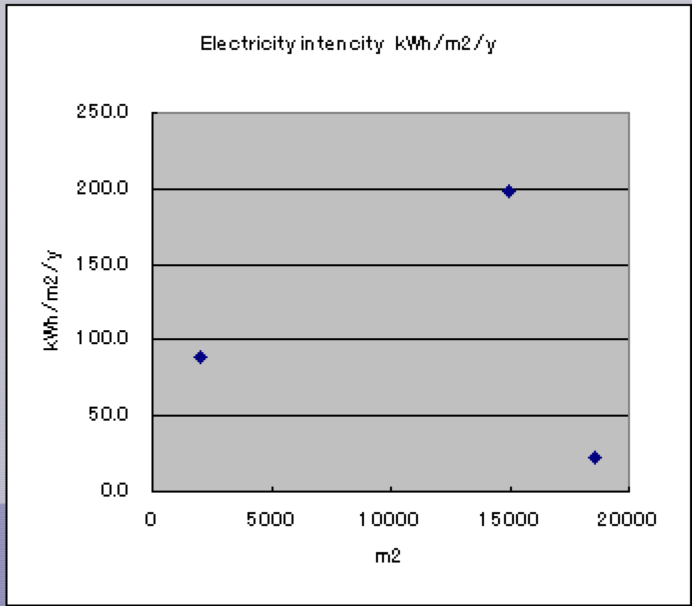
etc Total 26 Items

Exercise
- Lao PDR

The Participants

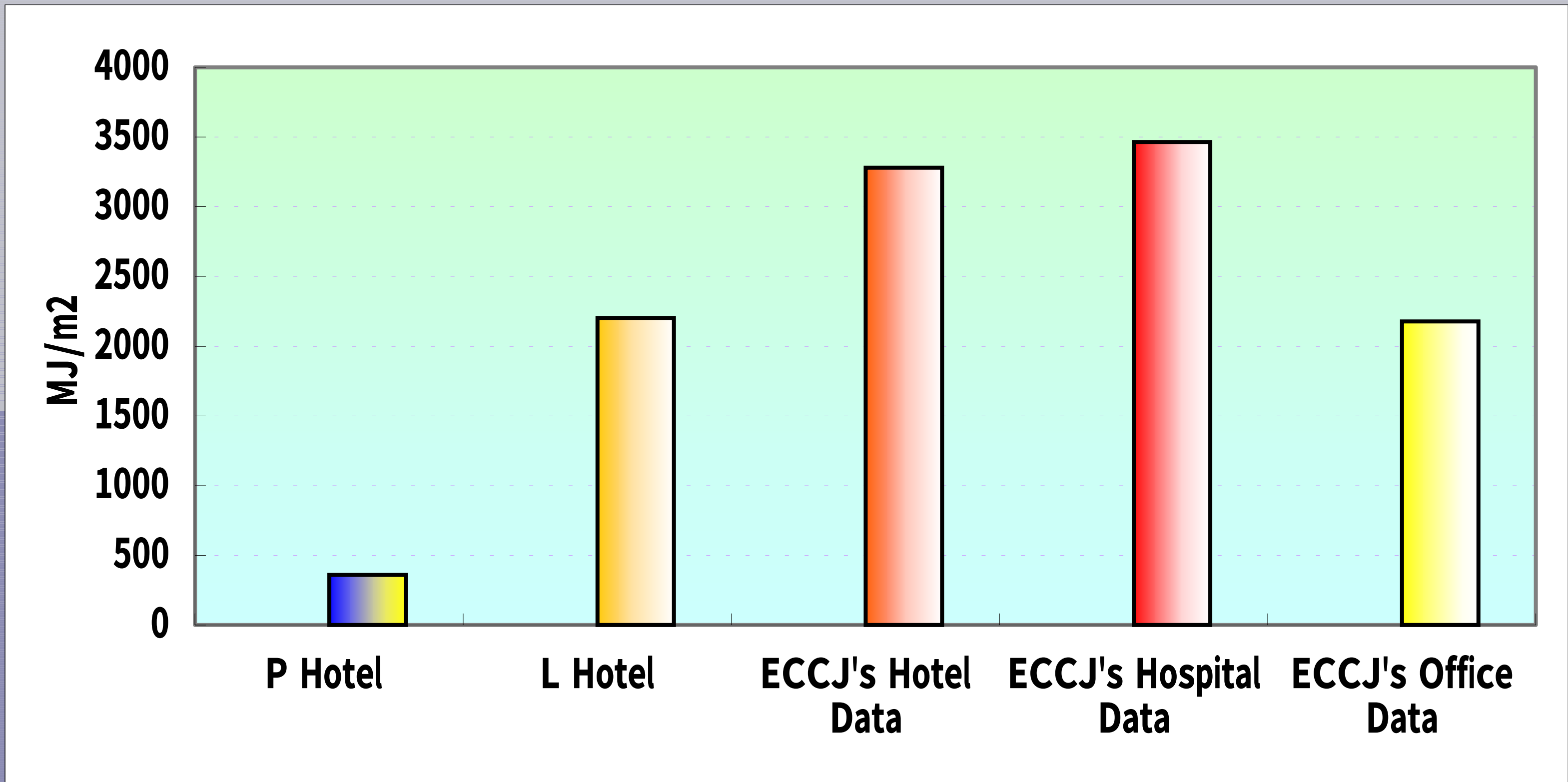
Participants DATA

		GFA	Electricity	Electricity intensity
		m2	kWh/y	kWh/m2/y
1	P Hotel	18534	410723	22.2
2	GV Office	1975	175489	88.9
3	L Hotel	14972	2968800	198.3



Participant's Presentation

Energy Consumption Intensity



Discussion

FUTURE DIRECTION ACTIVITIES

1 Data collection

2 Preparation of questionnaires to collect data

3 Establish guidelines, regulation and policy

4 Establishment of national working committee

5 Capacity building such as workshop, seminar etc

6 Promotion and awareness of EEC

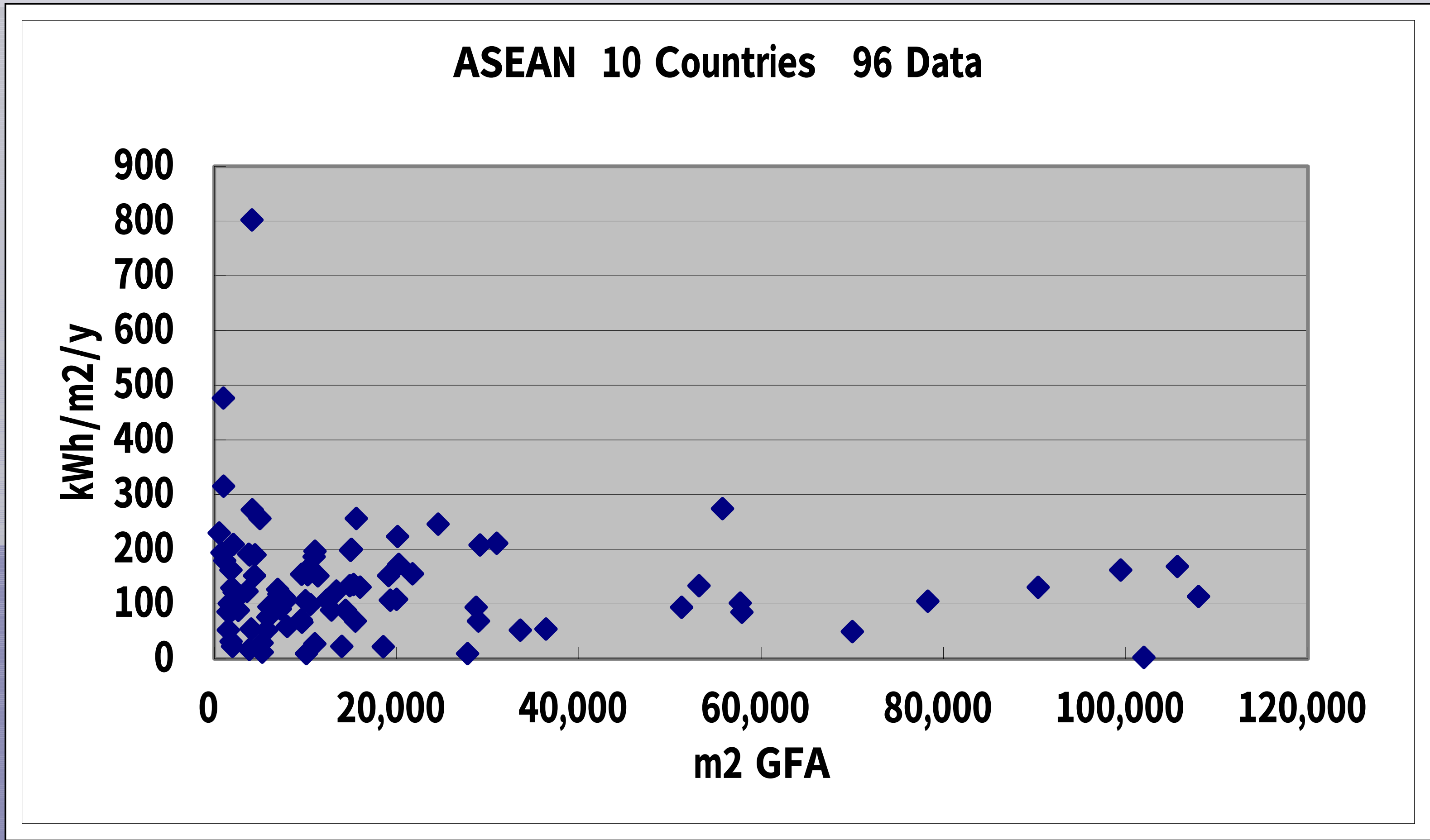
7 Procedures of data collection

etc Total 24 Items

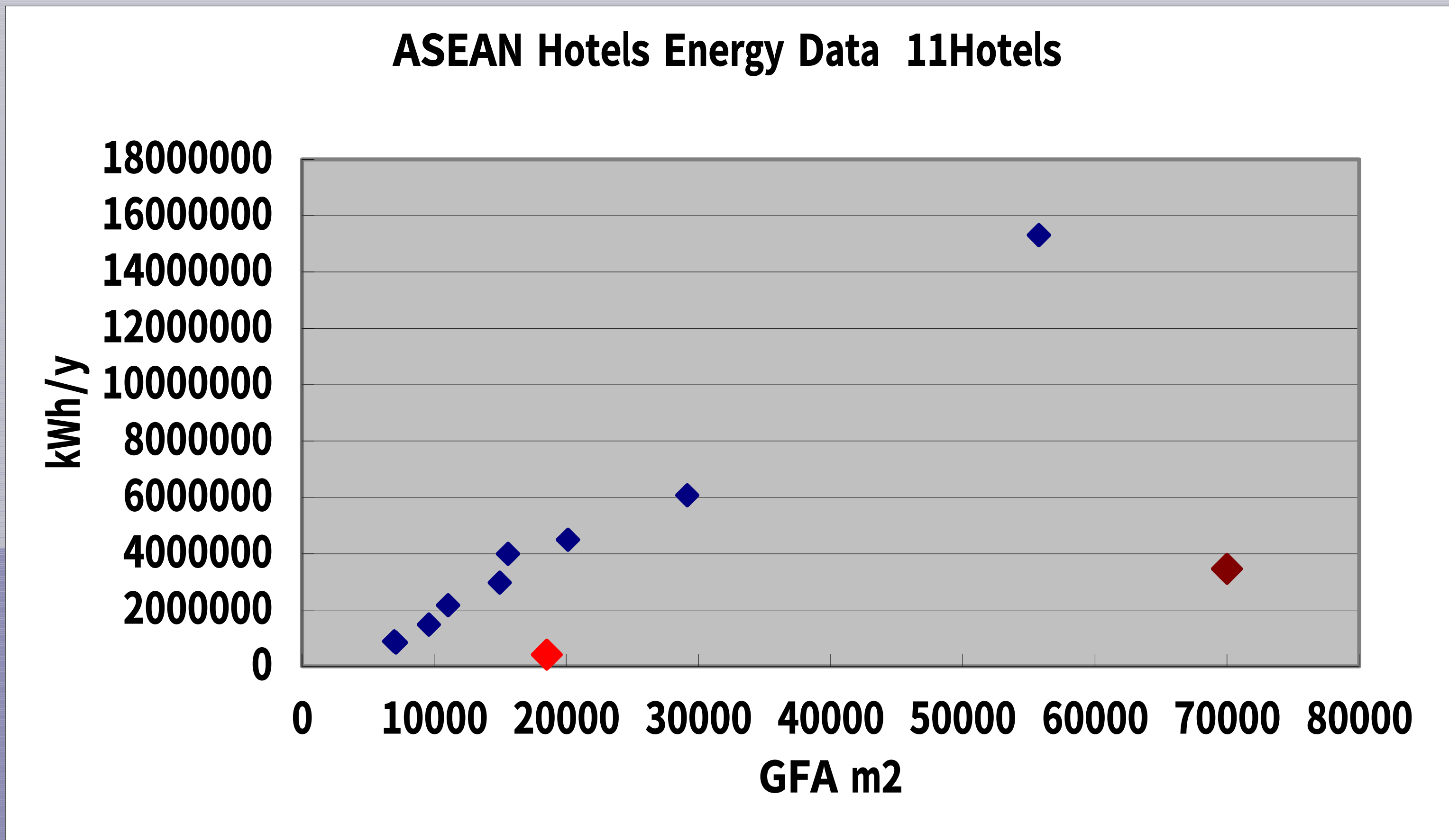
Building Data from ASEAN Countries

		Energy Audit		Data				Total
		Office	Hotel	Com.Office	Gov.office	Hotel	Others	
2000	Thailand	1		1				1
	Singapore	1		1				1
2001	Cambodia		1			1		1
	Indonesia	1		1				1
	Philippines	1		1				1
2002	Vietnam		2	2	2	6	6	16
	Myanmar	1	1	1	6	1	3	11
2003	Malaysia	1		(47)	12			(59)
	Brunei		1			1	1	2
	Lao PDR		1		1	2		3
Total		6	6	(54)	21	11	10	(96)

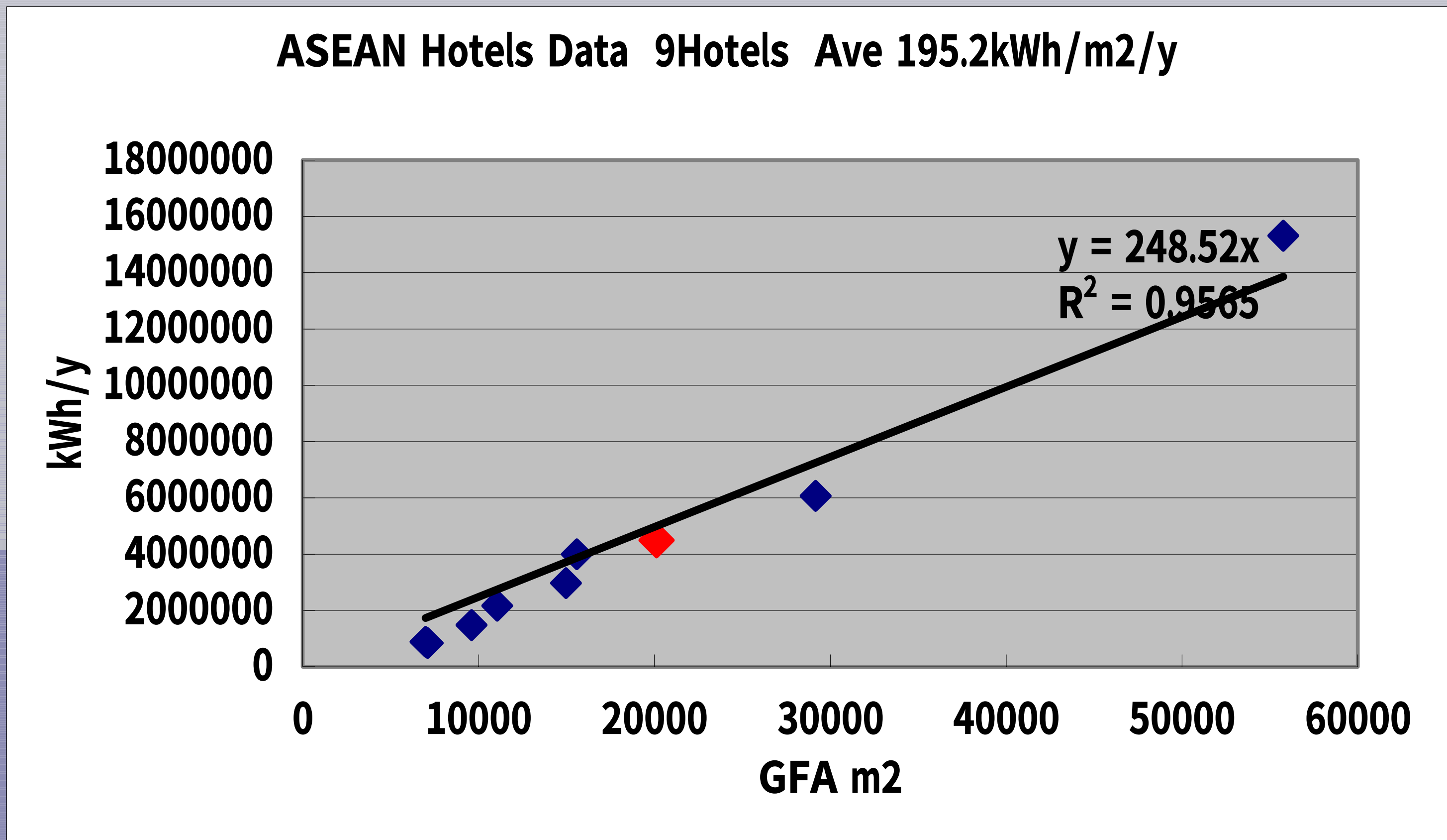
ALL Data


ASEAN 10 Countries 96 Data
kWh/m2/y
900
800
700
600
500
400
300
200
100
0
0
20,000
40,000
60,000
80,000
100,000
120,000
m2 GFA

Hotels Case (11Hotels)



Hotels Case (9 Hotels)



Recommendations

- ASEAN Building Energy Index: kWh/m2/y

  Gas ,Oil : MJ ⇨ kWh

  1kWh=3.6MJ=860kcal

  Japan : MJ/m2/y
- Classification according to air-conditioning method

  Central method

  Individual method
- Occupied area

  Occupied area=Gloss floor area –inside car park area – vacant room area

Activity of Building Committee of ECCJ

Energy Conservation Promotion Committee of Building

- **Team A**

  Hotels /Hospitals/Department sores :

  Measurement /Interview Investigation

- **Team B**

  Office Building Analysis

- **Team C**

  Development of New Program

Team B : Office Buildings

- Detailed Analysis ～150 buildings

  GFA: 15,000m2 or more

- Measurement of Effective of Improvement by Operation ～ 9 buildings/8 themes

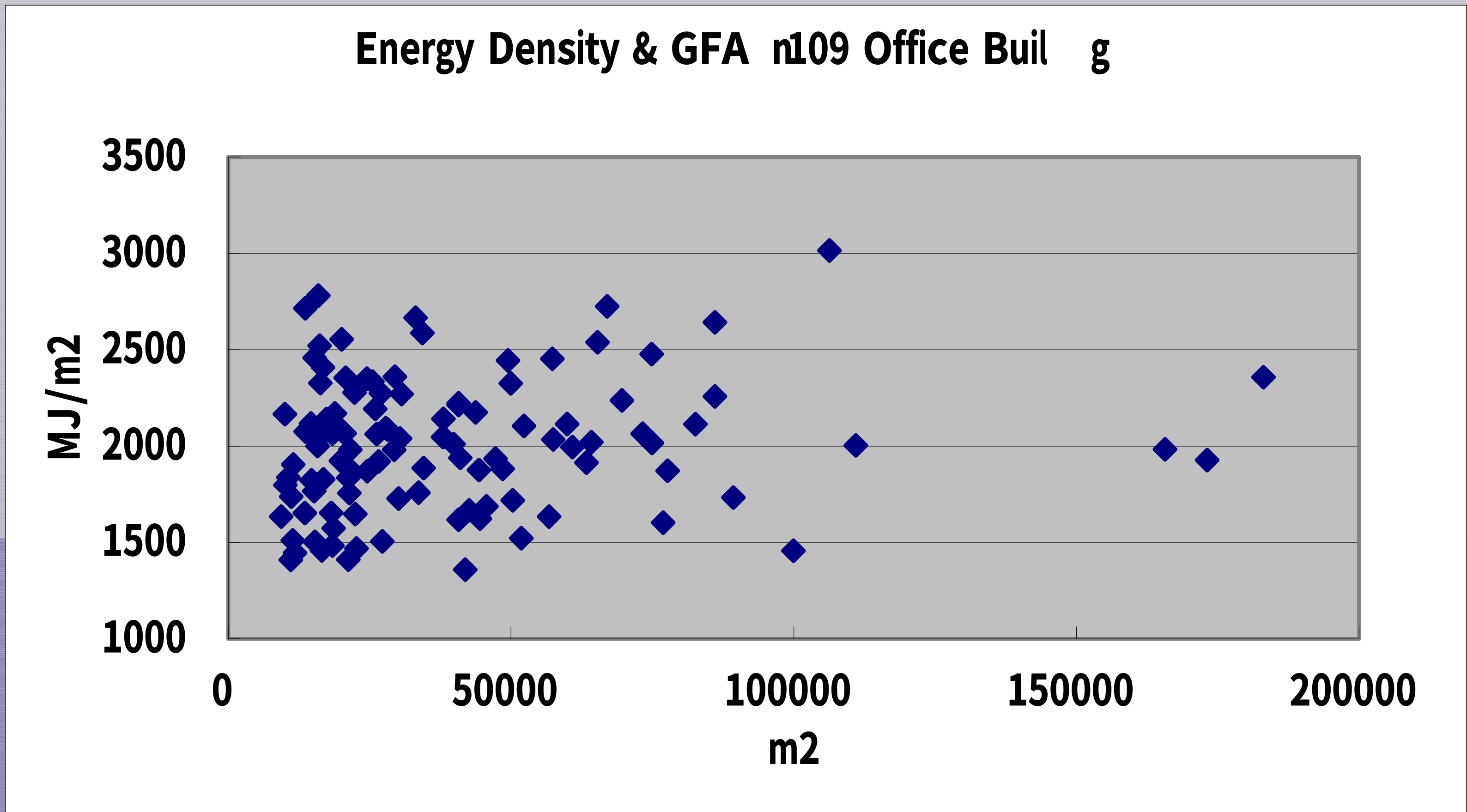
1 Proper temperature and humidity for rooms

2 Control of fresh air intake

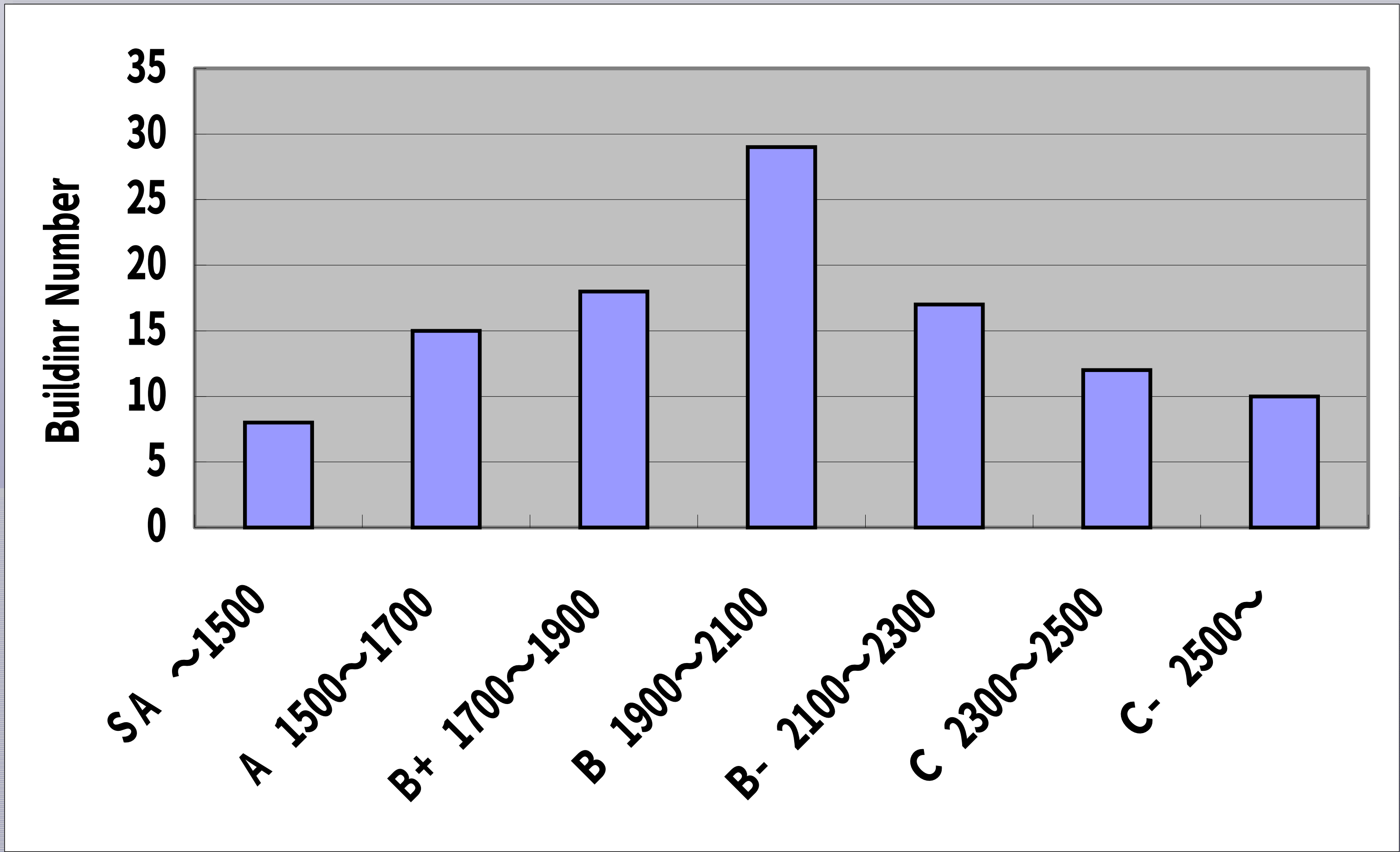
3 Change the Chilled Water Temperature

etc

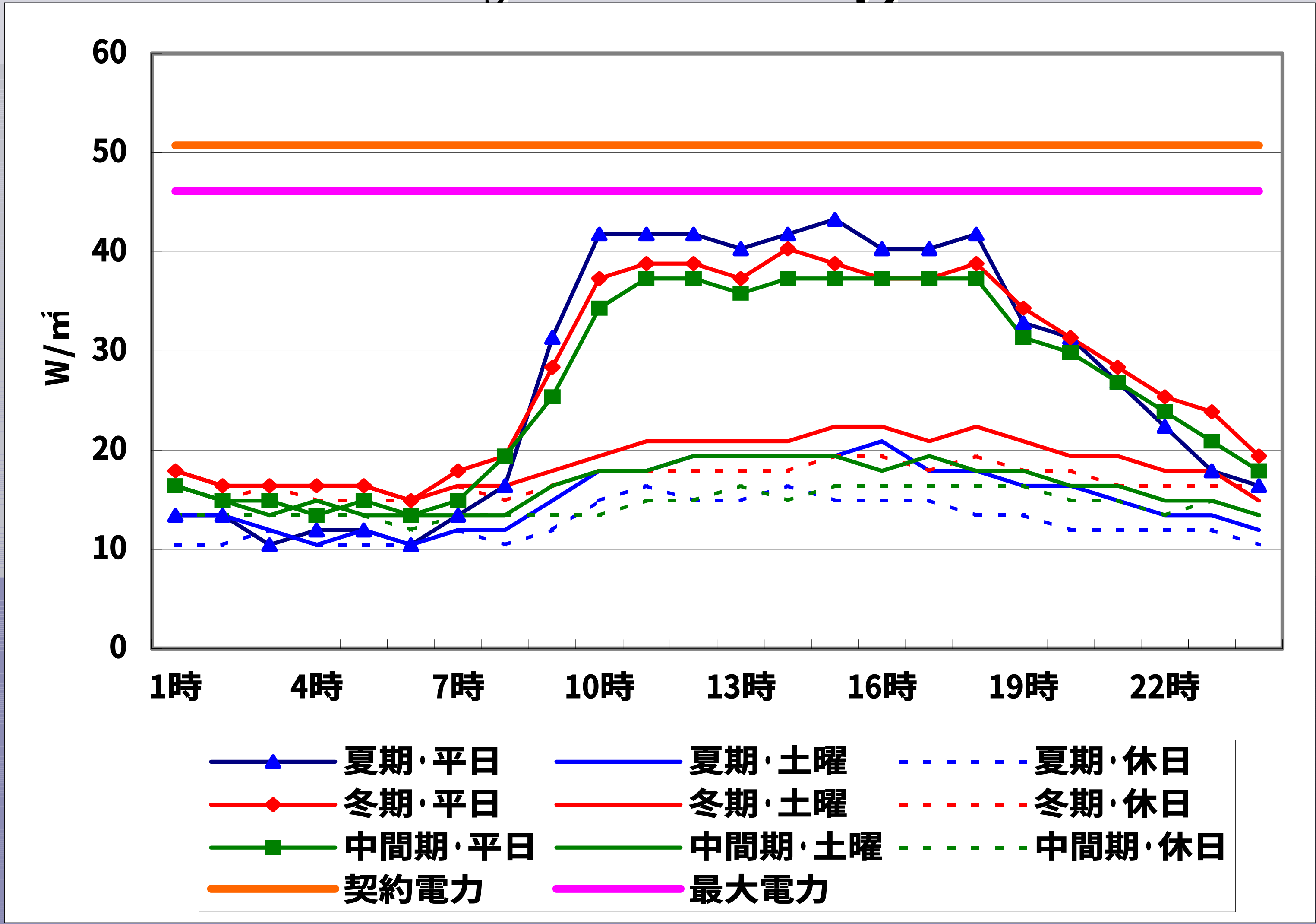
Energy Density & Gross Floor Area



Number of Classified Building (Total 109)



Electrical Power Consumption
Representative day according to season



Team A

Measurement /Interview Investigation

- Hotels : 60
- Hospitals:50
- Department sores :40
- Purpose～

  To Understand the Realities in Detail

  To make the management standards

Team C

- **Development of Energy Consumption Forecast Program**

  -Calculation of Air-conditioning Load

  -Calculation of Total Amount of Building Energy

The Future

- **Detail Data & New Program**

↓

- **Effective, New Benchmark**
- **New Guideline for Energy Reduction**

↓

Joint Development of ASEAN Countries & Japan

Thank you

The Energy Conservation Center, Japan

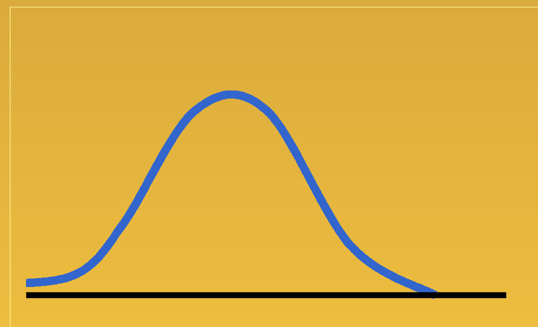
PROMEEC Benchmarking Workshop

Dr. Lee Siew Eang
Centre for Total Building Performance
School of Design and Environment, NUS

Benchmarking Methods:

- Single Benchmark Index.

- Multiple Benchmark Indices.



- Freely set individual Benchmark.

Development since the INCEPTION Workshop

- At the INCEPTION Workshop held in Yangon Feb 2003, Malaysia, the Philippines, Singapore, Thailand and Vietnam agreed to proceed with the first phase of the benchmarking project.

- It was targeted to have a first cut benchmarking website established by this coming 2004 Energy Ministers' meeting.

3. We are on schedule. Malaysia, Singapore, Thailand and Vietnam have all submitted substantial data for benchmarking.

- This presentation will report on progress, update the status of the project and put forth a future development plan.

Analyses of Malaysian Data

Analyses of Malaysian Data

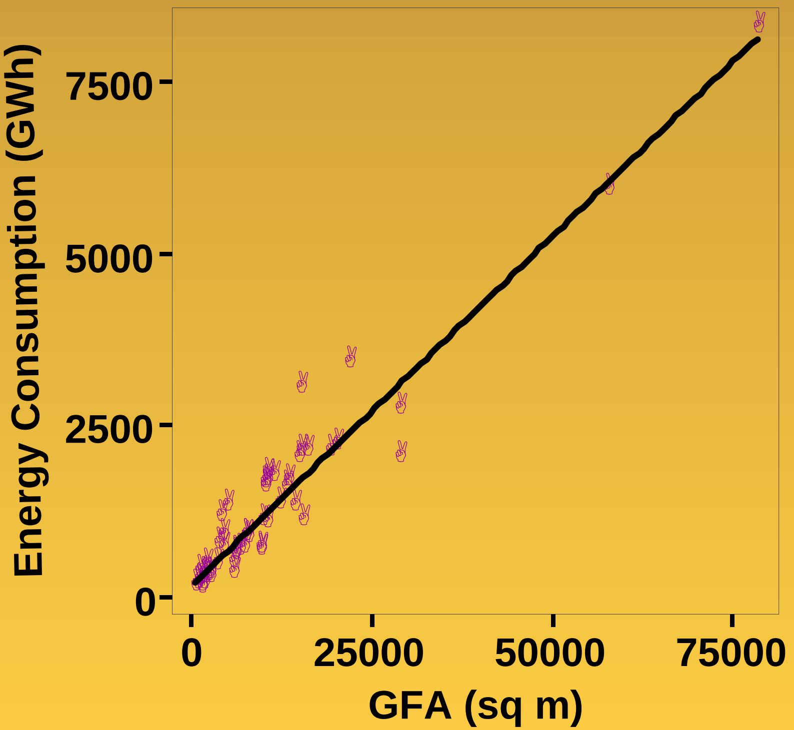
- 12 Audited Buildings
- 35 Surveyed Buildings
- 15 Other Buildings

Total 62 Buildings, with 4 no usable as they are multiple buildings site. All are mainly office building.

Data Properties: Malaysia - Office Buildings

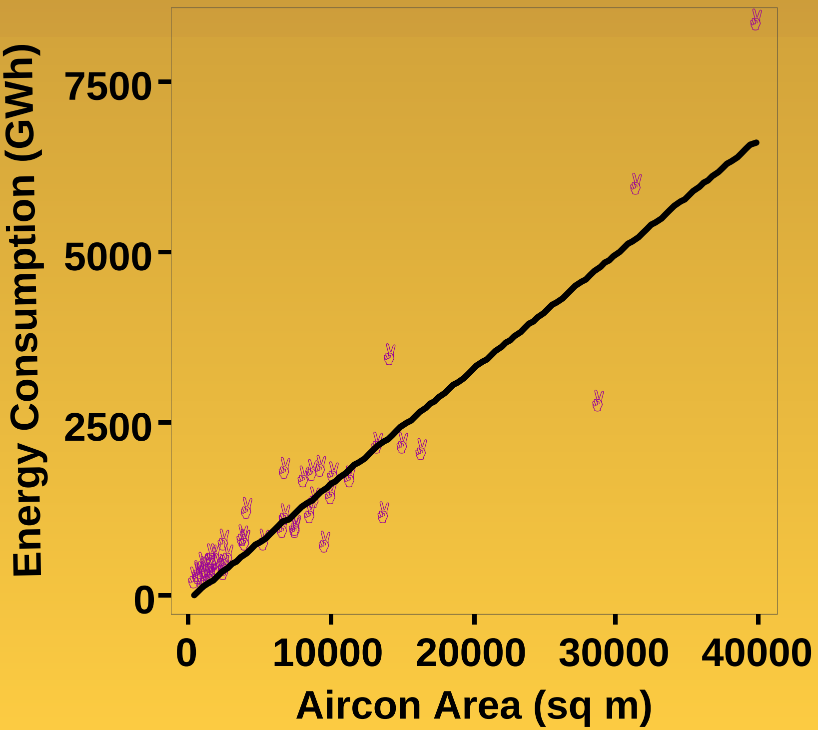
Energy Consumption vs. GFA

energyco = 161.29 + 0.10 * gfa
R-Square = 0.92



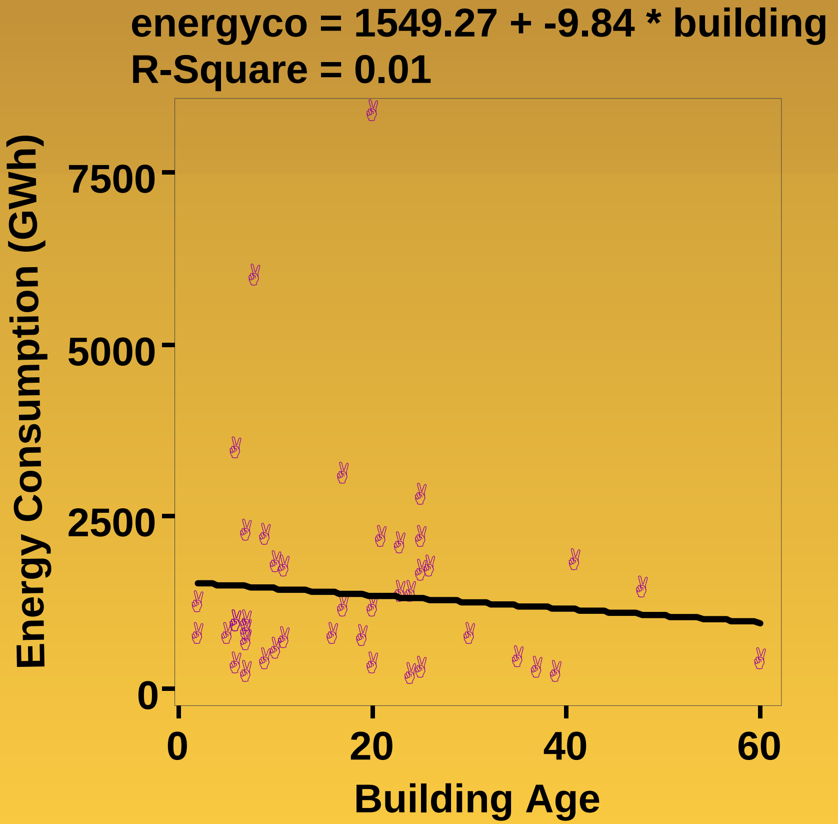
Energy Consumption vs. Aircon Area

energyco = -84.62 + 0.17 * airconar
R-Square = 0.87

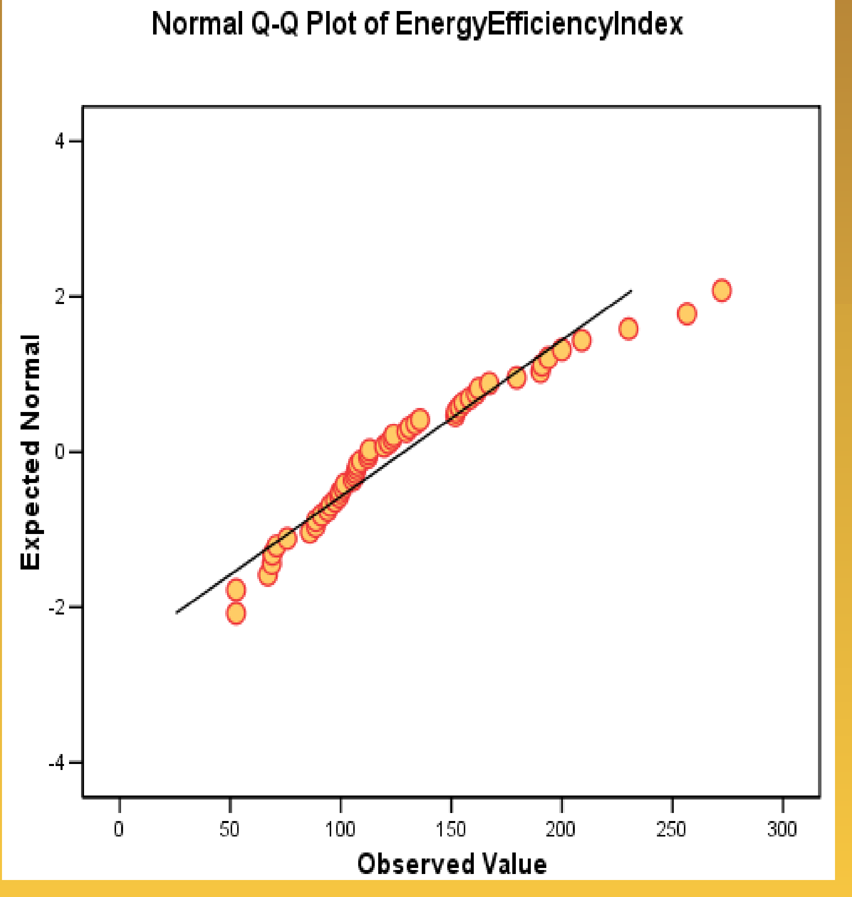


Data Properties: Malaysia - Office Buildings

Energy Consumption vs. Building Age



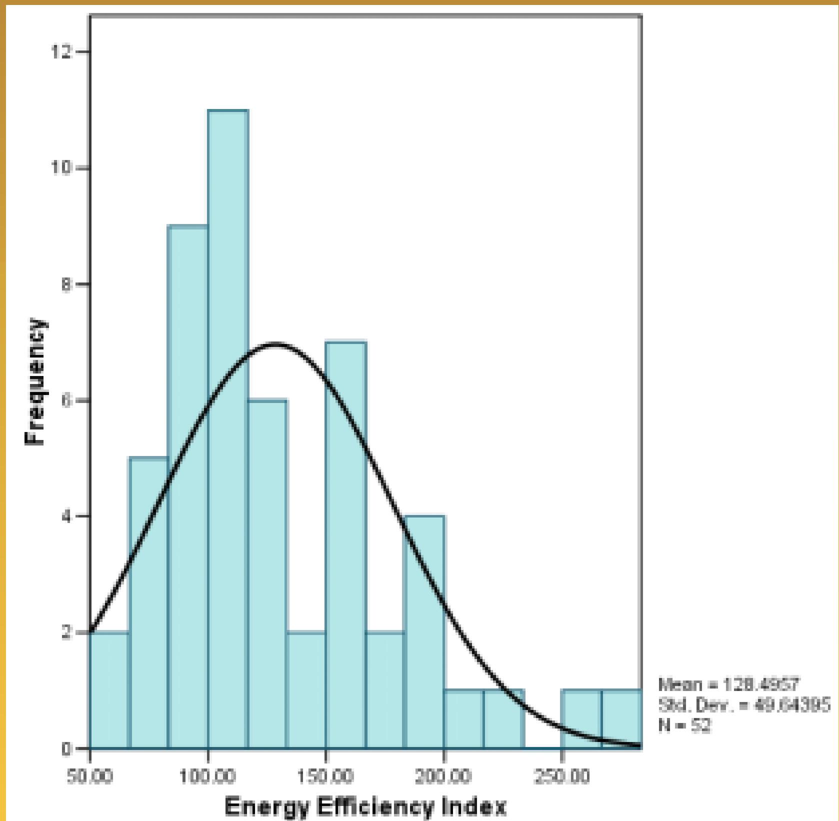
Data Properties: Malaysia - Office Buildings



Normal Probability Plot

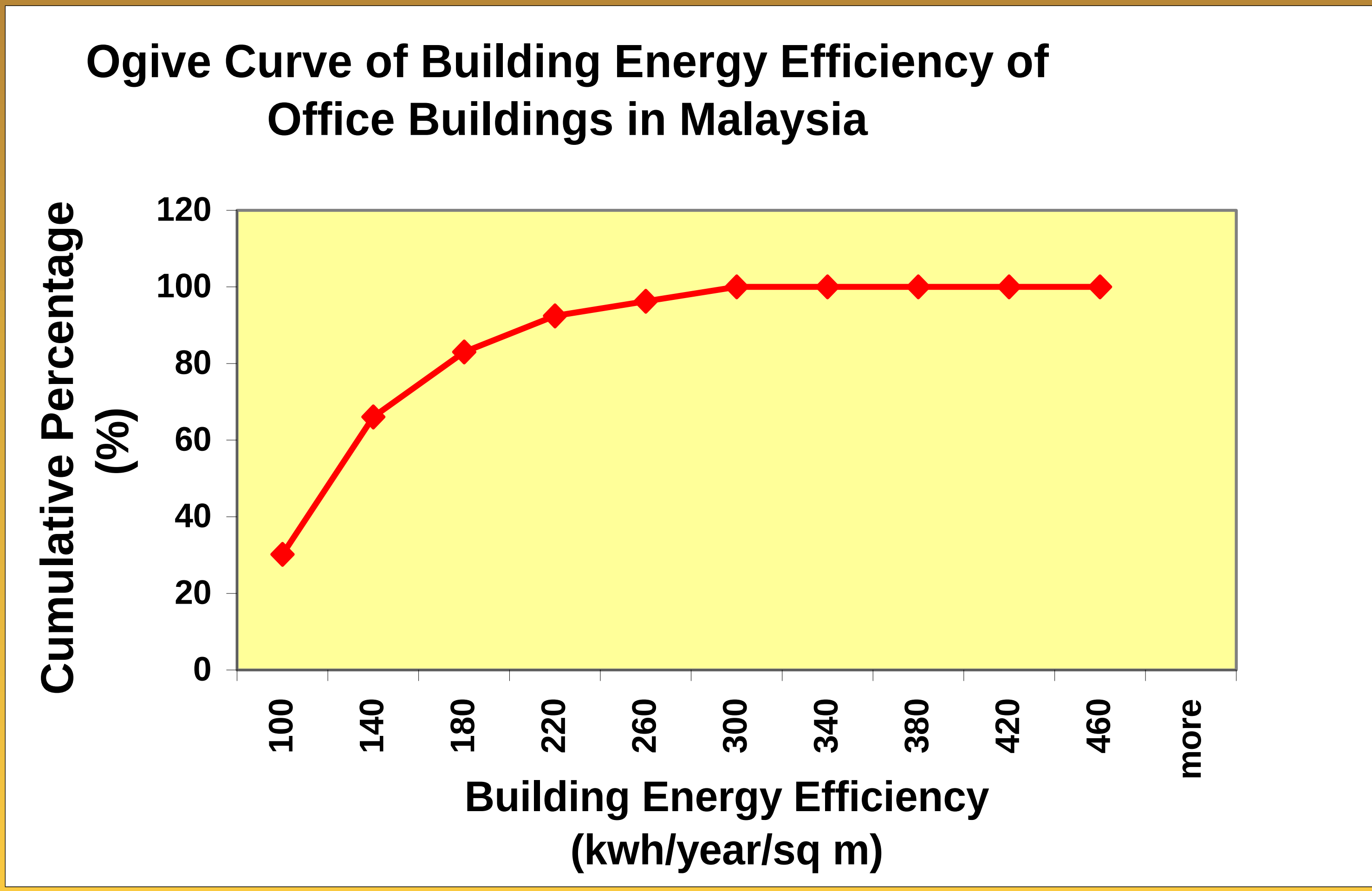
- If the data are from a normal distribution, the plotted values should fall roughly around the line.
- In this case, the plot suggests that the data are a normal distribution.

Data Properties: Malaysia - Office Buildings



- The distribution is only slightly skewed.
- Hence, it is assumed that the data are from a normal distribution.

Data Properties: Malaysia - Office Buildings



Centre for Total Building Performance, NUS

Analyses of Thailand's Data

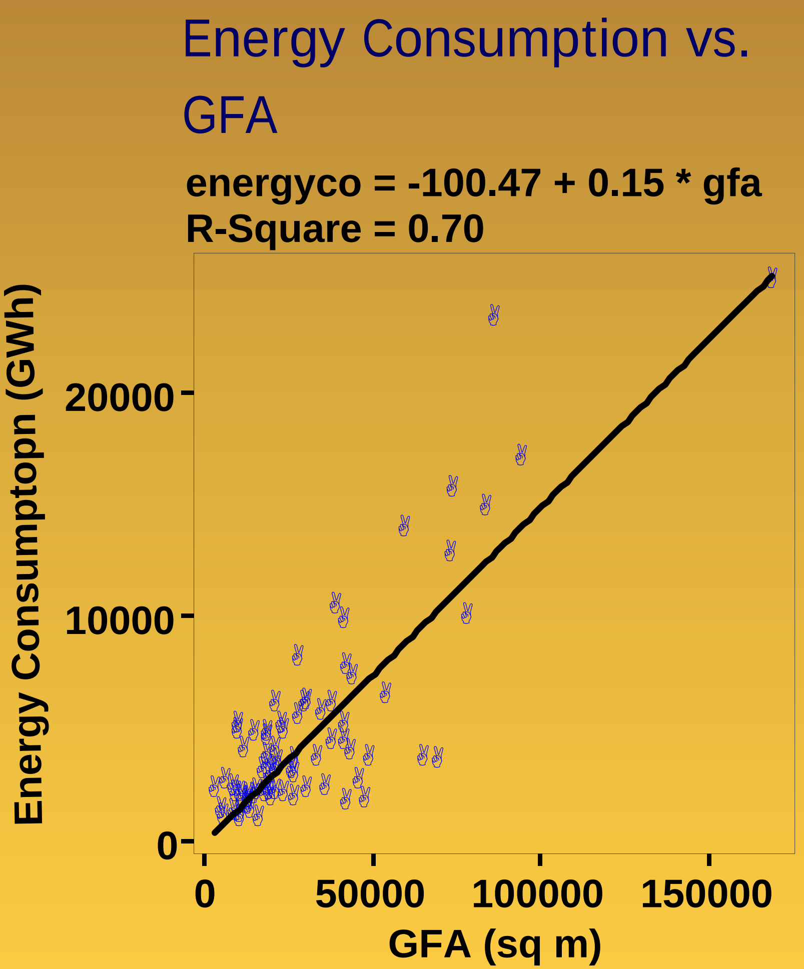
THAILAND OFFICE BUILDINGS

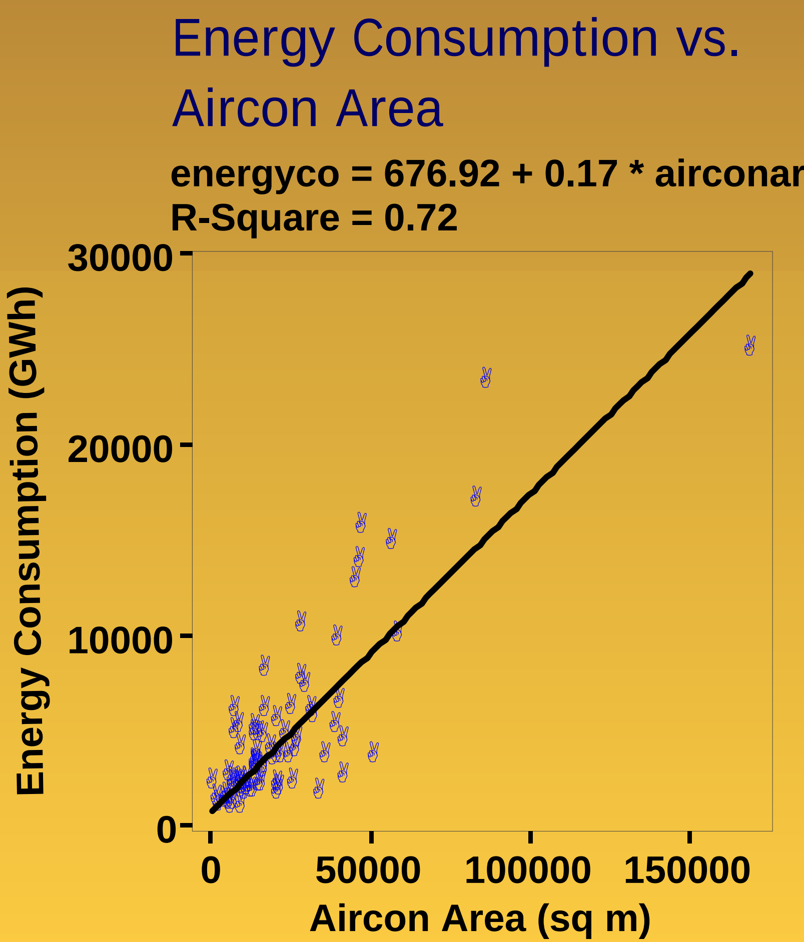
THAILAND OFFICE BUILDINGS

Analyses of Thailand's Data

Total 77 Office Buildings' data were procured for analyses and benchmarking.

Data Properties: Thailand - Office Buildings

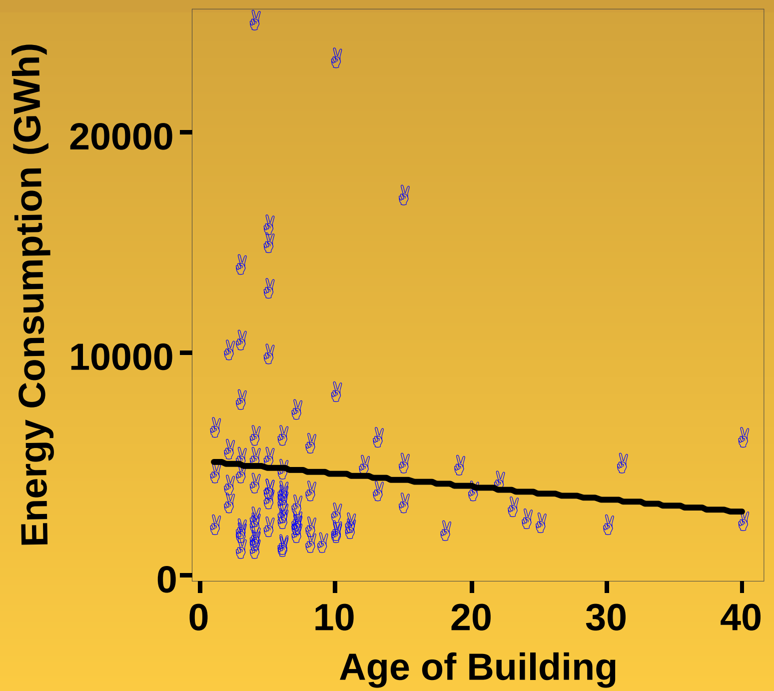




Data Properties: Thailand - Office Buildings

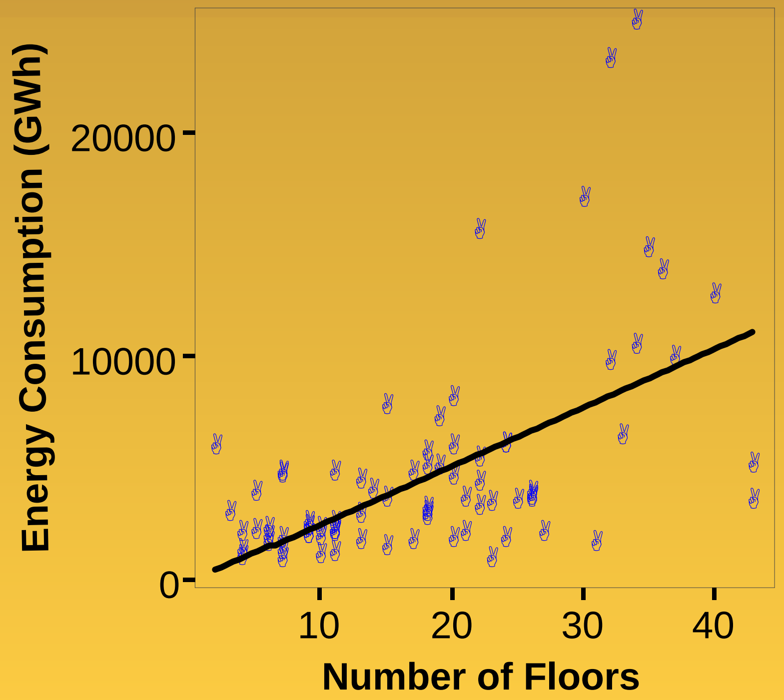
Energy Consumption vs. Building Age

energyco = 5143.39 + -58.30 * building
R-Square = 0.01



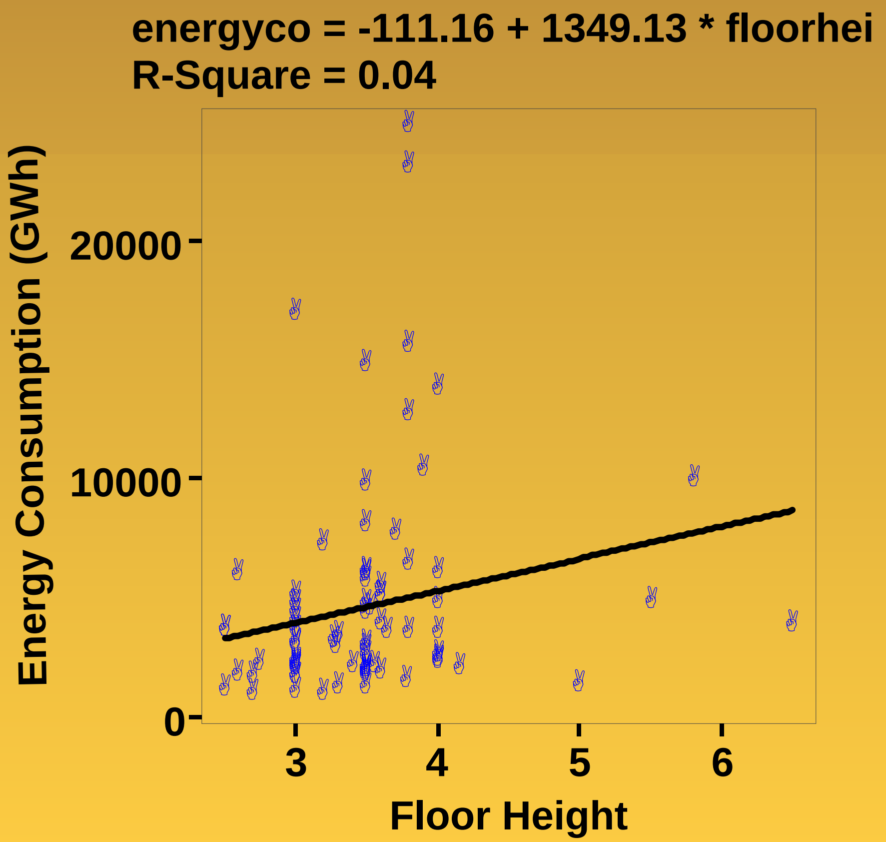
Energy Consumption vs. Number of Floors

energyco = -71.82 + 259.54 * numberof
R-Square = 0.32

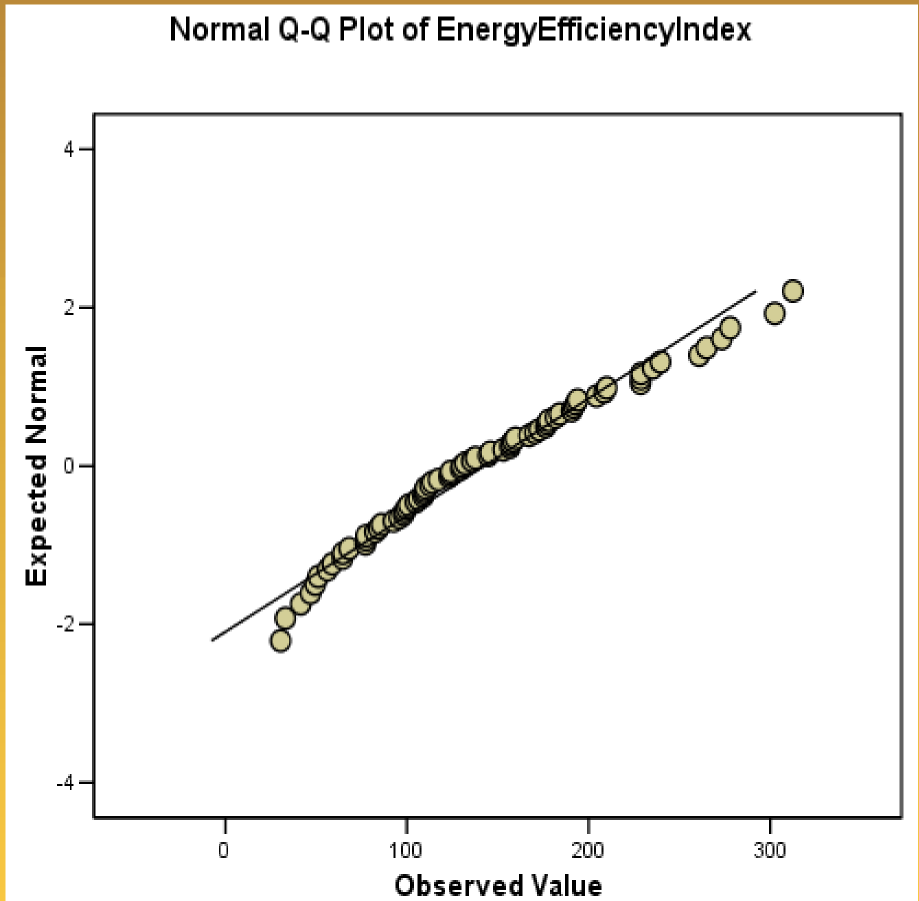


Data Properties: Thailand - Office Buildings

Energy Consumption vs. Floor Height



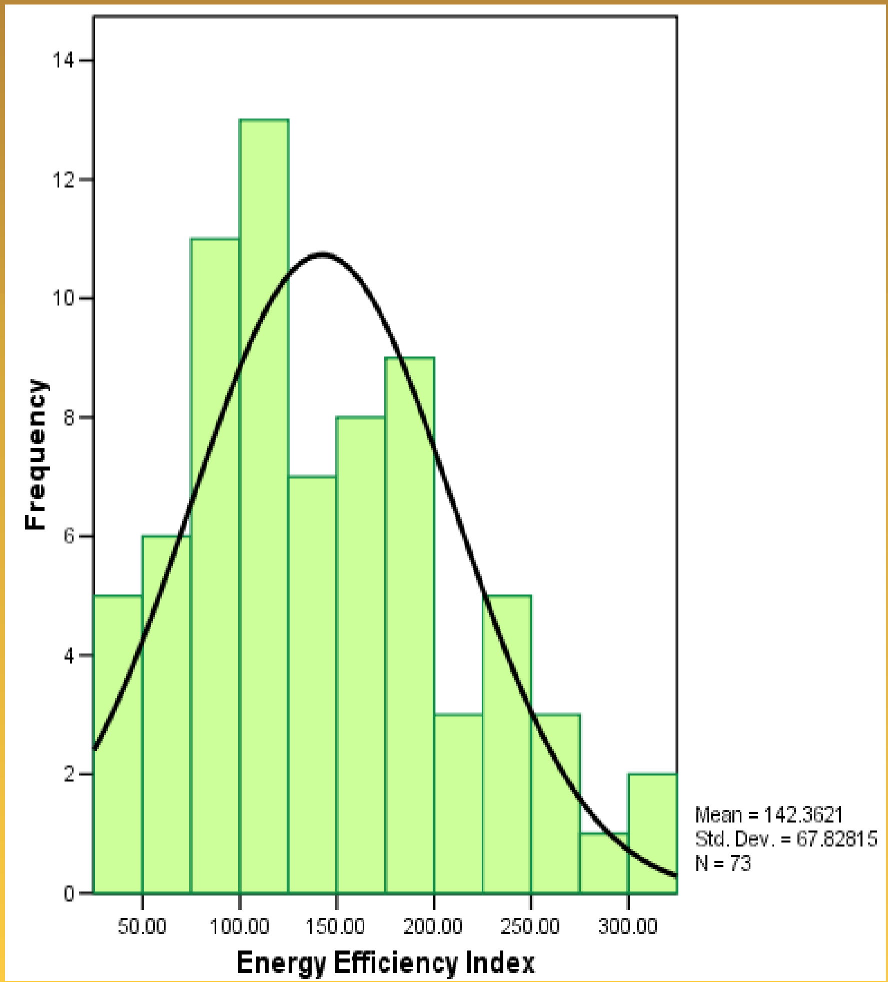
Data Properties: Thailand - Office Buildings



Normal Probability Plot

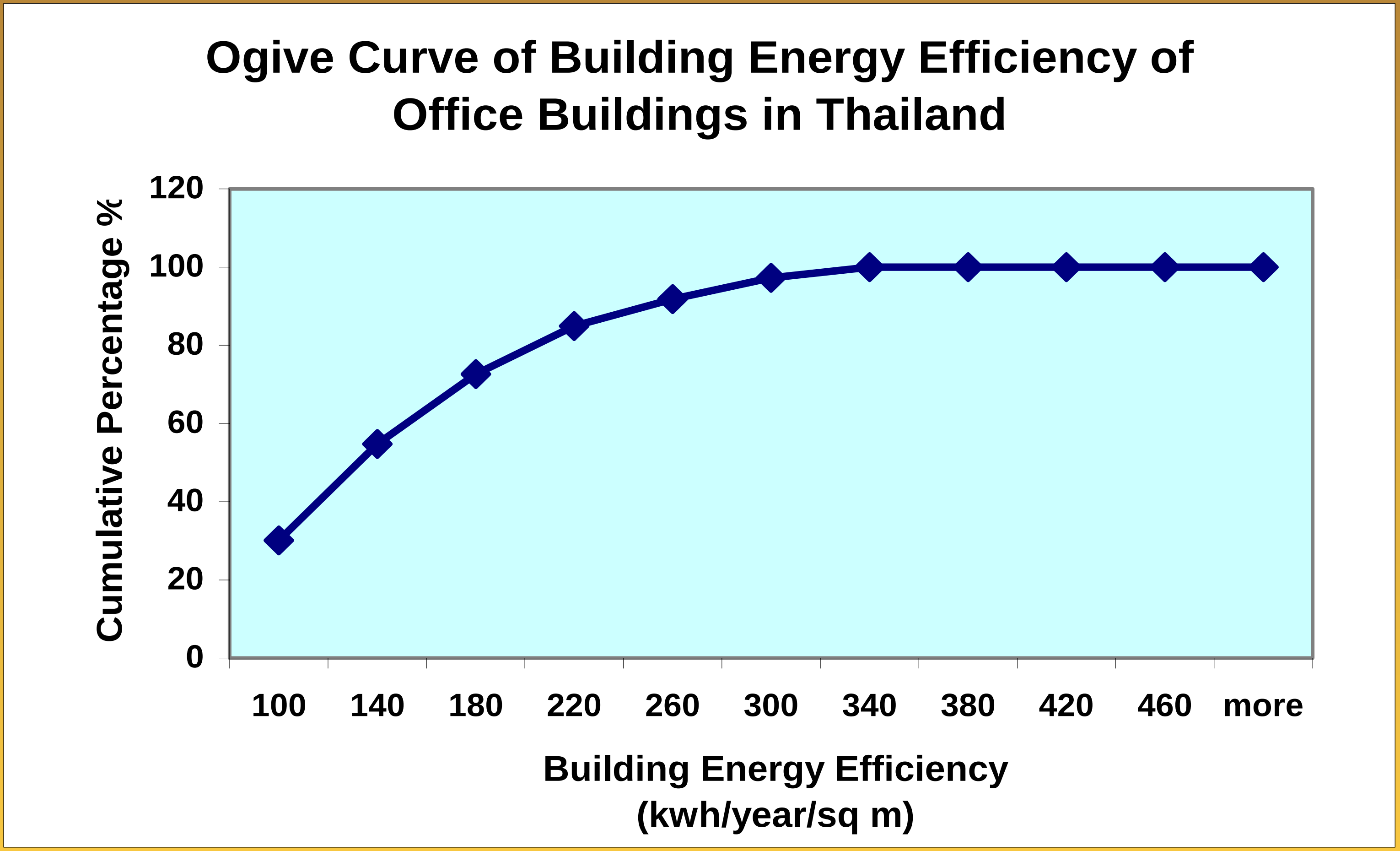
- If the data are from a normal distribution, the plotted values should fall roughly around the line.
- In this case, the plot suggests that the data are a normal distribution.

Data Properties: Thailand - Office Buildings



- ✓ The distribution is only slightly skewed.
- ✓ Hence, it is assumed that the data are from a normal distribution.

Data Properties: Thailand - Office Buildings



Analyses of Vietnam's Data

Analyses of Vietnam's Data

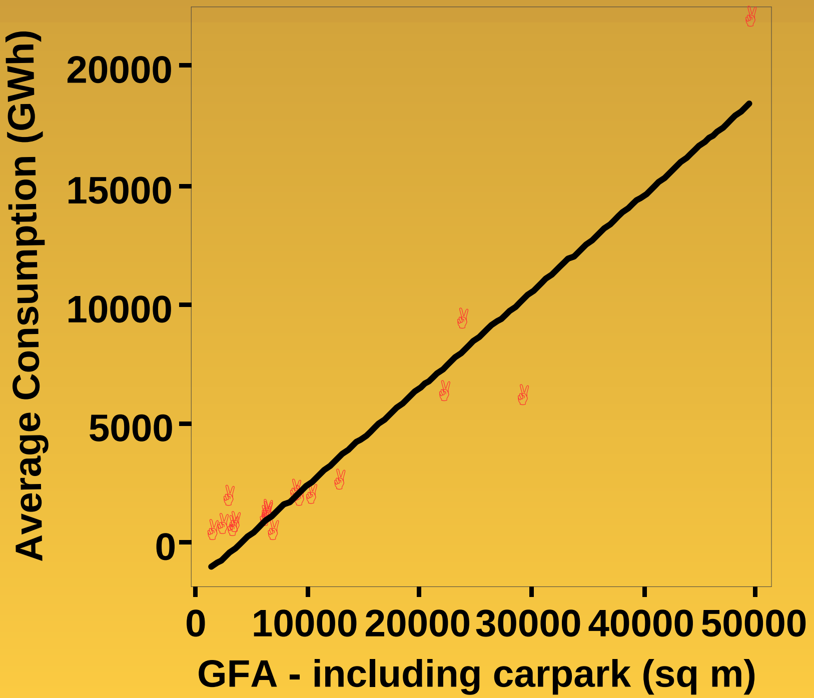
27 sets of building data have been submitted. This includes:

- **15 Hotels**
- **2 Entertainment Centres**
- **3 retails**
- **1 industrial**
- **6 office buildings**

Data Properties: Vietnam - Hotels

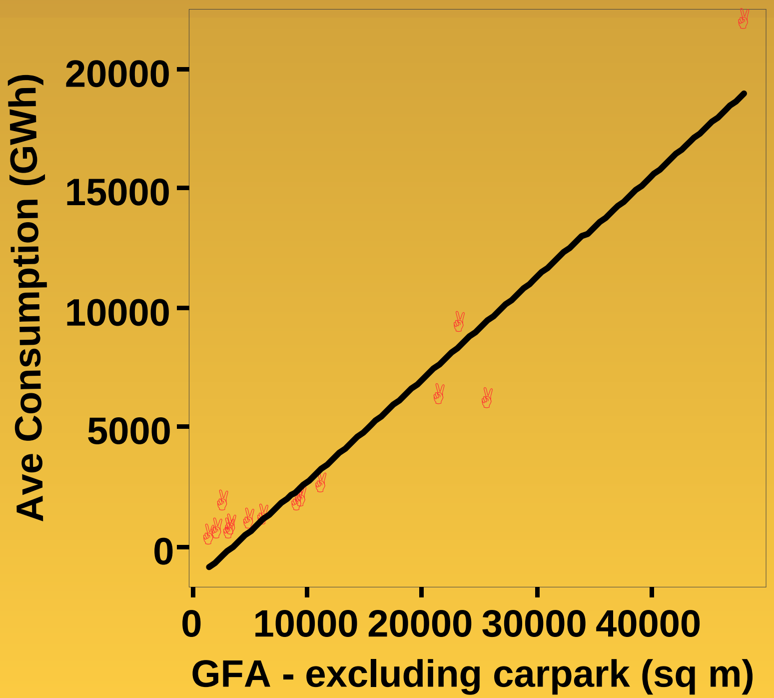
Energy Consumption vs. GFA *(including carpark)*

averagec = -1649.26 + 0.41 * gfaincp
R-Square = 0.90



Energy Consumption vs. GFA *(excluding carpark)*

averagec = -1523.11 + 0.43 * gfaexcp
R-Square = 0.93

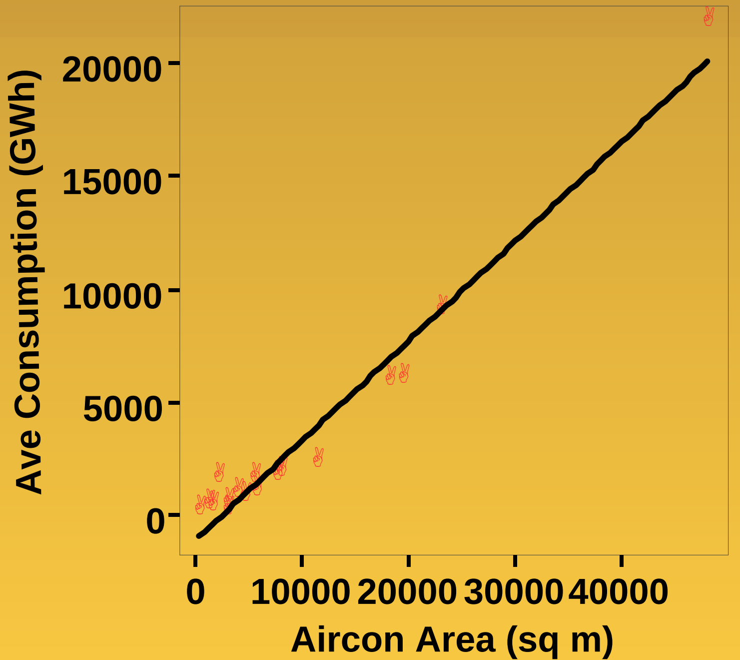


Centre for Total Building Performance, NUS

Data Properties: Vietnam - Hotels

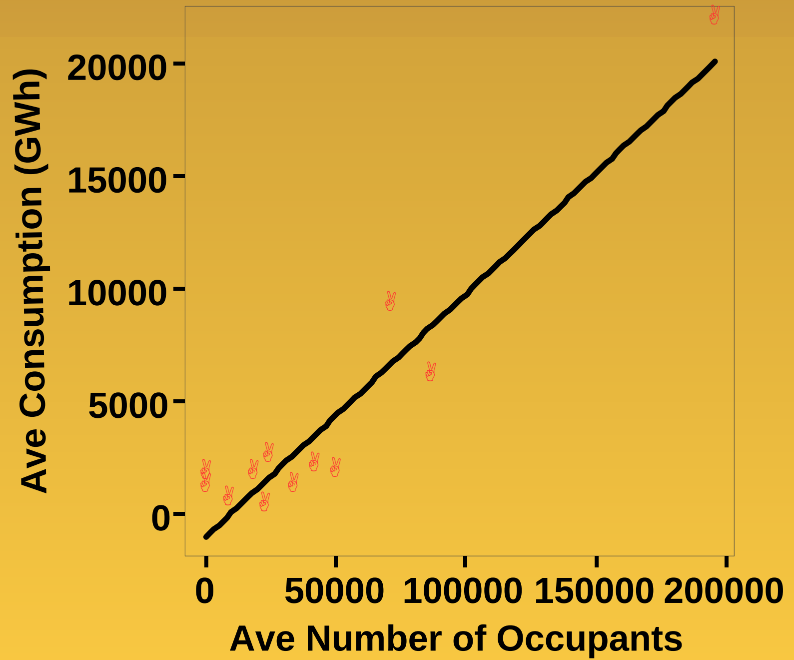
Energy Consumption vs. Aircon Area

averagec = -1087.62 + 0.44 * airconar
R-Square = 0.97

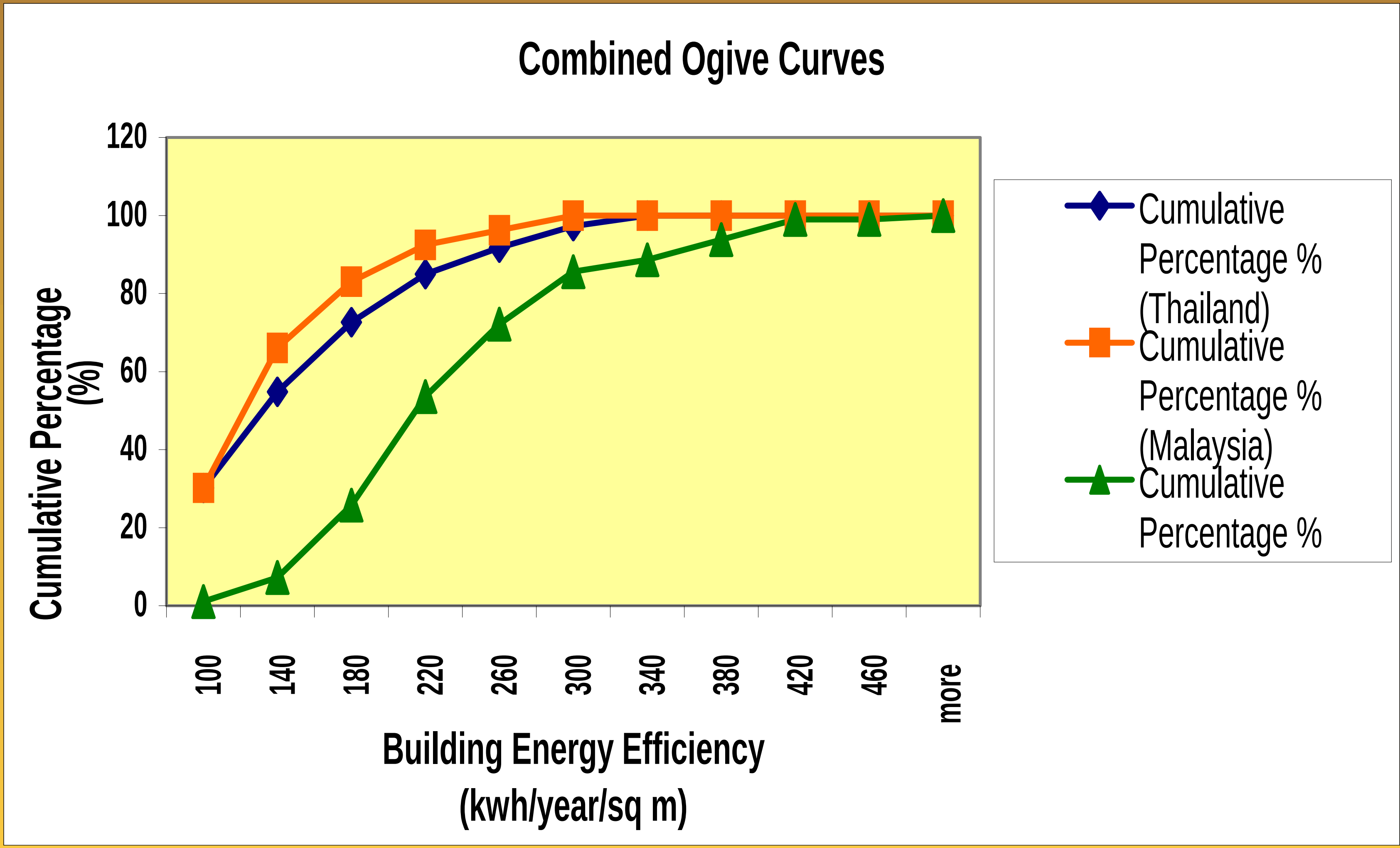


Energy Consumption vs. Number of Occupants

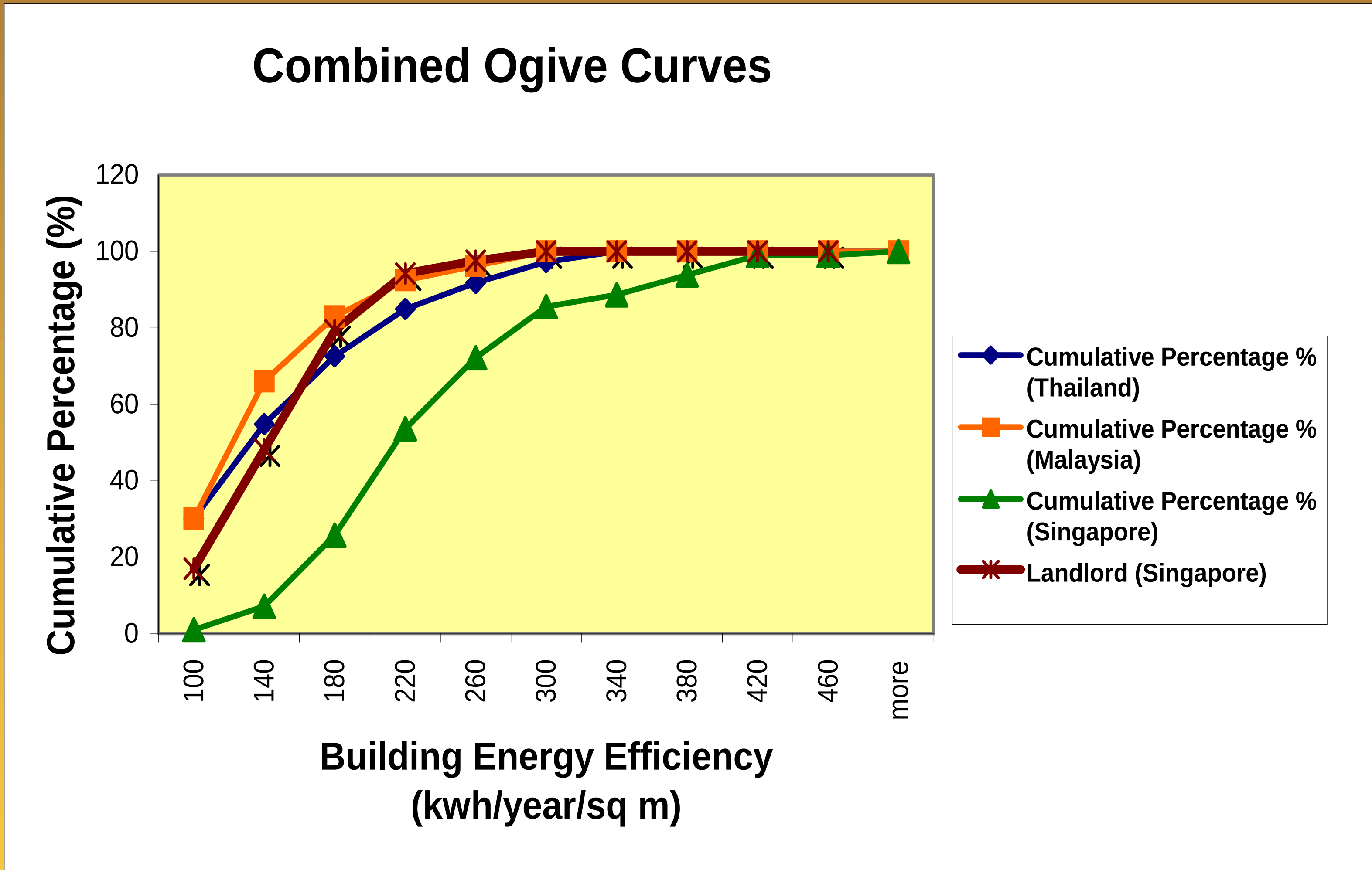
averagec = -1047.21 + 0.11 * aveoccu
R-Square = 0.90



Comparative Study



Comparative Study



Project Status and Achievements

- Phase 1 of the Energy Benchmarking project is about 70% complete.
- After data verification and check, a first benchmarking database can be launched at the Ministers' Meeting for industry use.
- It is interesting to note that the benchmarking curves are indeed very close. This paves the way for wider sharing of data and technologies.
- The project will be ready to launch its second phase, bringing all other potential members into the project.

Immediate Plan for Future Work

- Verify existing data selectively to ensure data integrity and accuracy. Expand data collection and standardise definition of terms, e.g. GFA etc.
- Prepare internet web-based benchmarking centre.
- Undertake selective detailed energy audits if resource permits. This serves to strengthen benchmarking applications.

4. Prepare for official launch of e-Benchmarking Centre and conduct workshop on the use of the benchmarking system.
5. Launch second part of project to bring all members on board. While existing members can strengthen the database and commence work on other building types. There is also need to procure additional resources to complete the project regionally.

An Internet Web-based Energy Benchmarking Centre for ASEAN

The Centre would serve the following objectives and meeting industry's needs:

What is Benchmarking? Tell me More!

To bring awareness to industry about benchmarking and its benefits.

What is the Standing of my Building?

To help set targets for the management of existing buildings, and set energy management plan.

An Internet Web-based Energy Benchmarking Centre for ASEAN

The Centre would serve the following objectives and meeting industry's needs:

I want to Build a Winner. Where to start?

To help set design targets for new buildings in the allocation of energy budgets.

My ESCO say I can save. Is it true?

To provide quick estimate on energy saving potential.

An Internet Web-based Energy Benchmarking Centre for ASEAN

The Centre would serve the following objectives and meeting industry's needs:

Can I set up an account to trend and monitor my EE?

SURE.

Can the Centre help develop building codes and R&D?

Most definitely! This paves the way to energy labeling and incentive systems.

Conclusion

In conclusion I would like to emphasise the importance of Energy Benchmarking. It is the foundation stone of a national energy efficiency drive. I hope all members here can participate in this activity.

Beyond whole building performance benchmarking, there are further scope for system and facility benchmarking which will be equally beneficial, and may be built upon current work.

Finally, I would like to thank Malaysia, Thailand and Vietnam for supporting this project and make the first phase of this project a great success.

I would also like to gratefully acknowledge the support and contribution of ECCJ and METI of Japan for making the project team's meetings and workshops possible.

Thank You

Phone 044 (520) 5190
Fax 044 (520) 5193