JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DEPARTMENT OF ELECTRICITY AND GAS SUPPLY, MALAYSIA (JBE&G)
MINISTRY OF ENERGY, COMMUNICATIONS AND MULTIMEDIA
MALAYSIA

STUDY
ON PROMOTION OF ENERGY EFFICIENCY
IN MALAYSIA

FINAL REPORT
(MAIN)

March 1999

TECHNO CONSULTANTS, INC.

MITSUBISHI CHEMICAL ENGINEERING CORPORATION

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PREFACE

In response to a request from the Government of Malaysia, the Government of Japan decided to conduct the Study on Promotion of Energy Efficiency in Malaysia and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent a study team led by Mr.Akinori Hashimoto of Techno Consultants, Inc. to Malaysia four times from February 1998 to February 1999.

The team held discussions with the officials concerned of the Government of Malaysia, and conducted related field surveys. After returning to Japan, the team conducted further studies and complied the final results in this report.

I hope this report will contribute to the promotion of the plan and to enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Malaysia for their close cooperation throughout the study.

March 1999

Kimio FUJITA
President
Japan International Cooperation Agency

March, 1999

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit to you the final report of "The Study on Promotion of Energy Efficiency in Malaysia". This report presents the results of the study that was carried out for a total period of 15 months from January 1998 to March 1999 by the Study Team composed of Techno Consultants, Inc., and Mitsubishi Chemical Engineering Corporation, in accordance with the contract concluded with your Agency.

The report consists of policy and technical studies. The former analyzes the legal and institutional structure for promotion of energy efficiency in Malaysia and presents recommendations and plans deemed effective in the commercial and industrial sectors. The latter presents energy audits for six selected entities in the commercial and industrial sectors, and makes recommendations for improving energy efficiency thereof.

On this occasion, we would like to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of International Trade and Industry, and Embassy of Japan in Malaysia. We also would like to express our sincere gratitude to all those who extended their kind assistance and cooperation to the Study Team, in particular the officials concerned from the Department of Electricity & Gas Supply, Malaysia (JBE&G), and the Ministry of Energy, Communications and Multimedia, Malaysia (MECM); and the concerned persons of the selected six entities, Mingcourt Vista Hotel, Bandar Utama City Corporation Sdn. Bhd., Hospital Seremban, Associated Pan Malaysia Cement Sdn. Bhd., Central Sugars Refinery Sdn. Bhd. and Amsteel Mills Sdn. Bhd.

We hope that the report will realistically contribute to the promotion of energy efficiency in Malaysia.

Sincerely yours,

Akinori Hashimoto

Akinori HASHIMOTO
Team Leader for the Study on Promotion
of Energy Efficiency in Malaysia

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List of Abbreviations

A	Ampere
ABF	ASEAN Bintulu Fertilizer
AC	Alternating Current
ACEE	AC Feedback Control System
AHU	Air Handling Unit
API	American Petroleum Institute
APMC	Associated Pan Malaysia Cement Sdn. Bhd.
AS	Air Slide
ASEAN	Association of Southeast Asian Nations
ASM	Amsteel Mills Sdn. Bhd.
B.F	Bag Filter
Bar	Bar Thermometer
BE	Bucket Elevator
BFW	Boiler Feed Water
BTU/hr	British Thermal Unit per Hour
C/S mill	Coal Shale Grinding Mill
CCM	Continuous Casting Machine
CEB	Central Electricity Board
CEC/EV	Coefficient of Energy Consumption of Elevator
CEC/HW	Coefficient of Energy Consumption of Hot Water
CEC/L	Coefficient of Energy Consumption of Lighting
CEL/AC	Coefficient of Energy Consumption for Air-conditioning
CEO	Chief Executive Officer
CFG	Control Flow Gate
CFM	Cubic Feet per Minute
CHN	Carbon, Hydrogen, Nitrogen
CO(%)	Carbon Oxide (percent)
CO_2(%)	Carbon Dioxide (percent)
CSR	Central Sugars Refinery Sdn. Bhd.
CW Pump	Chilled Water Pump
DB	Distribution Board
DB	Data Base
DC	Direct Current
DTA/TG	Differential Thermal Analysis / Thermal Gravimetric Analysis
EAF	Electric Arc Furnace
EBT	Eccentric Bottom Tapping
EP	Electrostatic Precipitator
EPU	Economic Planning Unit
ESCO	Energy Services Company
F	Frequency
F CaO, f cao	Free CaO
F.F	Flush Furnace
F.K pump	Fuller Kinyon pump
FCU	Fan Coil Unit
FIRROI	Financial Internal Rate of Return on Investment
G cal/h	Giga Calorie per Hour
GBF	Gravel Bed Filter

GCT	Gas Conditioning Tower
GDP	Gross Domestic Product
GPP	Gas Processing Plant
HM	Hydraulic Modulus
HP	High Pressure
HP	Horse Power
HRS	High Cycle Regenerative Combustion System
HSZ	Horizontal Single Zone
Humid.	Humidity
HV	High Voltage
Hz	Hertz
I	Electrical Current
IDF	Induced Draft Fan
IEA	International Energy Agency
IM	Iron Modulus
in w.g	Inch Water Column Gage
IPP	Independent Power Producer
IRR	Internal Rate of Return
JBE&G	Jabatan Bekalan Elektrik dan Gas Malaysia (Department of Electricity & Gas Supply, Malaysia)
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standard
JY	Japanese Yen
kl	kilo litter
kRM	Thousand Ringgit Malaysia
kTOE	kilo Ton Oil Equivalent
kTon	kilo Ton
kV	kilo Volt
kVA	kilo Volt Ampere
kW	kilo Watt
kWh	kilo Watt Hour
kWh/d	kilo Watt Hour per Day
kWh/h	kilo Watt Hour per Hour
kWh/t	kilo Watt Hour per Ton
L.O.I	Loss of Ignition
L/S mill	Limestone Grinding Mill
LF	Ladle Furnace
LFO	Light Fuel Oil
LHV	Low Heating Value
LNG	Liquefied Natural Gas
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LV	Low Voltage
Lx	Lux
m/s	Meter per Second
MECM	Ministry of Energy, Communications and Multimedia
MITI	Ministry of International Trade and Industry
MTBE	Methyl Tertiary Butyl Ether

MVA	Mega Volt Ampere
MW	Mega Watt
MWh/d	Mega Watt Hour per Day
N.A	Not Available
NEB	National Electricity Board
NSF	New Suspension Preheater with Flush Furnace
NSP	New Suspension Preheater
O_2(%)	Oxygen Content (percent)
OECD	Organization for Economic Cooperation and Development
OJT	On-the-job Training
P	Effective Power
PAL	Perimeter Annual Load
PCD	Pitch Circle Diameter
PDA	Petroleum Development Act
PE	Professional Engineer
PETRONAS	Petroleum Nasional Berhad
PF	Power Factor
PGU	Peninsular Gas Utilization
PH	Preheater
pH	Symbol of acidity and alkalinity
PS	Production Sharing
PSC	Production Sharing Contract
psi	Pound per Square Inch
PTM	Pusat Tenaga Malaysia (Malaysian Energy Center)
Q	Reactive Power
R&D	Reseatrch and Development
R.F	Rotary Feeder
RH	Relative Humidity
RM	Ringgit Malaysia
RMP	Rolling Mill Plant
RPM, rpm	Revolution Per Minute
S	Apparent Power
S/W	Scope of Work
SEB	Sabah Electricity Board
SESCO	Sarawak Electricity Supply Corporation
SF	Suspension Preheater with Flush Furnace
SIRIM	SIRIM Berhad
SM	Silica Modulus
SMP	Steel Making Plant
Sp. Gr., S.G.	Specific Gravity
STL	Stockage par Chaleur Latente (Storage of Latent Heat)
Surface T.	Surface Thermometer
T.G.	Temperature Gauge
Temp.	Temperature
TFC	Total Final Consumption of Energy
TNB	Tenaga Nasional Berhad
TOE	Ton Oil Equivalent
TPES	Total Primary Energy Supply
UK	United Kingdom of Great Britain and Northern Ireland

UNDP	United Nations Development Program
US GPM	United State Gallon per Minute
US$	United State Dollar
USA	United States of America
USRT	United State Refrigerating Ton
V	Voltage
VAV	Variable Air Volume
VSD	Variable Speed Design
VSZ	Vertical Single Zone
VVGD	Ward-Leonard System
VVVF	Variable Voltage Variable Frequency
VWV	Variable Water Volume
W	Watt
Wh	Watt Hour
WHO	World Health Organization
WTP	Water Treatment Plant
μ s/cm	Micro Second per Centimeter
ϕ	Phase

Chapter 1 Introduction

This is the main report of the Final Report for the Study on Promotion of Energy Efficiency in Malaysia. Consigned by the Japan International Cooperation Agency (JICA), this study was conducted by a consortium of Techno Consultants, Inc. (TCI) and Mitsubisi Chemical Engineering Corporation (MEC), an international consulting company and an international engineering company both based in Japan, who have prepared this Final Report for the Department of Electricity and Gas Supply (JBE&G), Ministry of Energy, Communications and Multimedia, Malaysia.

The study aims to present legal and administrative forms that would permit the government to promote effective use of energy in the commercial and industrial sectors; to diagnose selected institutions and factories; and to present recommendations for improving their energy use. Accordingly, the study may be broken down into two aspects: policy study and technical study; the former analyzes the administrative operation and legal structure of Malaysia and presents recommendations and plans deemed effective in the promotion of energy efficiency in commercial institutions and industrial factories. The latter presents energy audits of the three selected institutions and three factories, and makes recommendations for achieving more efficient use of energy.

The study took 15 months from January 1998 to March 1999, during which time three field surveys and one Draft Final Report presentation were conducted in Malaysia. Two seminars for the promotion of energy efficiency are included in the study, one of which was held successfully for the commercial sector during third field survey; the other for policy matters and the industrial sector was conducted during the period of the Draft Final Report presentation. The first, second, third field surveys, and presentation of the Draft Final Report and seminars have already been carried out according to the schedule shown below.

Survey	Schedule
1. The first field survey:	February to March 1998
2. The second field survey:	May to July 1998
3. The third field survey and seminar:	September to October 1998
4.The fourth field survey: (Draft Final Report presentation and seminar)	February 1999

Throughout the entire course of this study, the study team presented to JBE&G the following reports:

Report	Submission	Content of Report
Inception Report	February 1998	Plan for the study execution
Progress Report	May 1998	Results of the first field survey
Detailed Energy Audit Plan	June 1998	Plan for energy audit
Interim Report	September 1998	Interim results
Draft Final Report	January 1999	Explanation of the Draft Final Report
Final Report (Main and Summary Reports)	March 1999	Results of the entire study

This report contains outcomes of the investigation, which are the energy situation, policies and plans for the promotion of energy efficiency, as well as energy audits of the three selected institutions belonging to the commercial sector, which are a hotel, a shopping complex and a hospital, and three factories of the industrial sector, which are cement, food processing, and iron and steel factories.

The experts engaged in this study are shown below.

Name	Organization	Assignment
Akinori HASHIMOTO	Techno Consultants, Inc.	Team Leader, Energy Policy and Institution
Kazumitsu MITANI	Mitsubishi Chemical Engineering Corporation	Plan for Energy Efficiency Promotion
Hiroshi OMORI	Dia Research Martech Inc.	Energy Management (Heat)
Yasuo ISHIBASHI	Kokan Keisoku K.K.	Energy Management (Electricity)
Muneteru YOSHIZAWA	Techno Consultants, Inc.	Energy Audit (Heat)
Shunichi IIZUKA	Mitsubishi Chemical Engineering Corporation	Energy Audit (Electricity)
Kiyoshi KAMIYA	Mitsubishi Electric Building Techno-Service Co., Ltd.	Sector Technology (Commercial)
Yoshihiko UEDA	Onoda Engineering Co., Ltd.	Sector Technology (Industry)
Shinya KINOSITA	Kokan Keisoku K.K.	Process Technology (Iron & Steel)
Minoru NAGAI	Techno Consultants, Inc.	Economic and Financial Evaluation
Toshio SASAKI	Techno Consultants, Inc.	Coordinator

The counter parts engaged in this study are shown below.

Name	Position
Datuk Ir. Mohd. Annas Bin Haji Nohd. Nor	Director General, JBE&G
Ir. Chong Cheong Yin	Director of Electricity Regulation, JBE&G
Ir. Chah Ain Chuan	Principal Assistant Director, JBE&G
Ir. Francis Xavier Jacob	Principal Assistant Director, JBE&G
Ms Teratai @ Zainab Leman	Assistant Director, JBE&G
Mr. Mohd. Elmi Anas	Assistant Director, JBE&G
Mr. Mohd. Asri Sharani	Assistant Director, JBE&G

Chapter 2 Background and Objectives of Study

Background and objectives of the study are described in this chapter.

2-1 Background of Study

The average GDP growth rate in Malaysia was recorded at 8.7% p.a. from 1991 to 1995. In the scenario of "Vision 2020", the Malaysian Government assumes that the same level of growth will continue in future, though the growth has decreased recently. In line with the high economic growth rate, energy consumption in Malaysia has also shown rapid growth of 9 to 13% p.a. Although Malaysia is an oil and natural gas producing country, it is predicted that supply and demand will become unbalanced in future. As a national policy for energy supply, the preservation of oil resources is planned, and a diversification policy of four types of energy (oil, gas, coal, and electricity) is now being promoted. Energy consumption in Malaysia per unit GDP is two to four times higher than in industrialized countries. In addition, energy consumption per unit GDP accelerated during 1980 - 1990's. With the rapid growth of total energy, the decline of energy consumption efficiency is regarded as a problem.

Under these circumstances, in order to improve energy efficiency in the commercial and industrial sectors, the Malaysian Government issued a formal request to the Japanese Government regarding the execution of a study on the promotion of energy efficiency. This is to establish a "Master Plan" for the promotion of energy efficiency in the commercial and industrial sectors, that is consistent with energy-saving guidelines. Japan International Cooperation Agency signed the Scope of Work in February 1997, after confirmation of request details and discussion regarding the specifics of the study.

2-2 Objectives of Study

The objectives of the study are, as defined by the Scope of Work, to promote the energy efficiency in the country; specifically, the study aims at:

1. Recommending ways in which energy efficiency can be increased in the selected institutions and factories,
2. Outlining implementation plans including consolidation of the laws and regulations,

establishment of standard certifications and the engineer's training program, as well as of the institutions and organizations, and

3. Proposing necessary resources to be input into the Energy Efficiency Promotion Division of the Malaysian Energy Center (PTM).

The study includes:

1. Government policy, laws and regulations to help achieve the above objectives,
2. Organizations to promote energy efficiency,
3. Activities to promote the same,
4. Energy audits to promote energy efficiency in the selected industrial sub-sectors, which are cement, food processing and steel and iron, and commercial sub-sectors, which are hotel, hospital and shopping complex,
5. Measures to address the problems of inefficient energy use, and evaluation of the expected effects after implementation of the master plan, and
6. Preparation of reference materials to be used as guidelines for the promotion of energy efficiency.

Chapter 3 Procedure and Achievements of Study

This chapter describes procedure and achievements of the study.

3-1 Procedure of Study

Phase 1 (Preparatory Work in Japan) was the preparatory work performed in Japan, prior to the commencement of the First Field Survey in Malaysia. The work consisted of the preparation of this Inception Report; collection and analysis of data and information; grasping processes and equipment and facilities generally used in factories and institutions that might be selected for energy audits; and preparation of preliminary inspection forms and explanatory materials for energy audits as well as preparation of technology transfer and field survey plans.

Phase 2 (First Field Survey in Malaysia) was conducted for twenty days from February 16 to March 7, 1998. Works performed during this period were: presentation and discussion of the Inception Report; selection of model factories and institutions for the energy audits; preliminary inspection, and preparations for energy audits; and collection of data on financial status for the selected model factories and institutions. Basic data and information of Malaysia were also gathered and investigated during this period.

Phase 3 (First Home-office Work in Japan) covered mainly the review and analysis of results of the First Field Survey. In addition, the framework of the energy audit plan and the plan for the Second Field Survey were prepared during this period. A Progress Report was prepared as well.

Phase 4 (Second Field Survey in Malaysia) covered explanation of the Progress Report and the energy audits for the commercial sector. This survey was conducted from May 31 to July14, 1998.

Phases 5 (Second Home-office Work in Japan) covered the review and analysis of results of the Second Field Survey in Malaysia and preparation of the Interim Report.

Phase 6 (Third Field Survey in Malaysia) covered presentation and discussion of the Interim Report, and the first seminar; the energy audits for the industrial sector; and development of a work plan for the Energy Efficiency Division of the Malaysian Energy Center. This survey was

carried out from September 6 to October 21, 1998.

Phase 7 (Third Home-office Work in Japan) covered the following works: review and analysis of the results of the Third Field Survey in Malaysia; preparation of guidelines for the promotion of energy efficiency, policy for the promotion of energy efficiency and a master plan; preparation and submission of the Draft Final Report; and preparations for the second seminar.

Phase 8 (Fourth Field Survey in Malaysia) covered presentation and discussion of the Draft Final Report and presentation of the second seminar in Malaysia. This survey was carried out from February 1 to 7, 1999.

Phase 9 (Fourth Home-office Work in Japan) covered preparation of the Final Report.

3-2 Achievements of Study

The major achievements of this study are summarized as follows.

1. The study team clarified and analyzed the energy situation of Malaysia.
2. The study team investigated policies and institutions for the promotion of energy efficiency.
3. The study team formulated standards, guidelines and plans for the promotion of energy efficiency.
4. The study team conducted energy audits on the three selected institutions belonging to commercial sector and three factories of the industrial sector.
5. The study team identified problems with respect to energy consumption of the three institutions and three factories, and presented recommendations for modifications of operation and facilities to correct these problems.
6. The study team estimated the energy saving potential of the three institutions and three factories.
7. The study team prepared energy flowcharts of the three institutions and three factories.
8. The study team presented to JBE&G the Inception Report at the very beginning of the first field survey and established a thorough understanding between JBE&G and the study team.
9. The study team presented to JBE&G "Detailed Plans for Energy Audit" in June 1998 to explain audit methods.

10. The study team presented to JBE&G the Progress Report at the beginning stage of the second field survey held during June and July, and the Interim Report, respectively, to explain the activities of the study team and those of the other parties, as well as achievements, results of the fields surveys and understandings established between JBE&G and the study team.
11. The study team and JBE&G held a seminar for the promotion of energy efficiency in the commercial sector on October 5, 1998.
12. The study team presented to JBE&G the Draft Final Report before the fourth field survey held in February 1999. The study team and JBE&G discussed the Draft Final Report and basically agreed in the contents of the Final Report.
13. The study team and JBE&G held a seminar for the promotion of energy efficiency in the industrial sector and policy matters on February 4, 1999.
14. The study team and JBE&G prepared and signed minutes on completion of the first, second, third and fourth field surveys.

Chapter 4 Overall Conclusions and Recommendations of Study

This chapter summarizes conclusions and recommendations on policies, institutions and activities to be taken by the Government in order to promote energy efficiency. In addition, measures for improving energy efficiency are proposed for the six selected entities for which energy audits were carried out.

4-1 Recommendations of Policies and Institutions

4-1-1 Creation of Coordination Board for Promotion of Energy Efficiency

(1) Current State and Problems

There are many public organizations, universities and private entities participating in plans and activities for the promotion of energy efficiency. There should be effective coordination of the promotion of energy efficiency activities.

(2) Recommendations

It is recommended that an energy efficiency coordination board headed by organizations such as the Economic Planning Unit (EPU), and participated by the Ministry of Energy, Communications and Multimedia (MECM) as a key member be created to coordinate the energy efficiency activities of ministries, agencies and entities; to formulate plans; to undertake various studies; to create awareness; and to prepare reports. The board is advised to work on a basis with legal mandate.

4-1-2 Enactment and Enforcement of Regulations for Promotion of Energy Efficiency

(1) Current State and Problems

No laws or regulations for the promotion of energy efficiency have been enacted yet in Malaysia. To ensure that activities for energy efficiency can be carried out more effectively, the Department of Electricity and Gas Supply (JBE&G) formulated a draft of regulations for the promotion of energy efficiency and submitted it to MECM for approval in 1997.

(2) Recommendations

1) Early enforcement of laws and regulations

It is necessary for the government, governmental agencies, energy equipment manufacturers

and importers, and consumers to collaborate in promoting energy efficiency from their respective standpoints. In order to ensure that the activities for energy efficiency can be carried out more effectively, early enactment of the regulations is expected.

2) Expansion of scope of prepared regulations

The prepared regulations by JBE&G mainly concerns electricity. It is recommended that the scope of the regulations be expanded to cover not only electricity, but also fuel and other sectors such as residential and machinery when revision for the purpose of further energy saving is necessitated.

4-1-3 Preparation of Standards and Guidelines for Commercial and Industrial Sectors

(1) Current State and Problems

1) Standards:

There is no concrete form of energy standards that could serve as a basis for entities in the industrial and commercial sectors to judge the degree to which efficient energy use is promoted. The standards may help entity staff implement appropriate measures for efficient energy use and may help operators make positive efforts for streamlining energy use in their entities, by choosing better solutions suited to the given conditions.

2) Guidelines:

It is required that entities endeavor to improve the efficiency of their energy-consuming equipment. For this purpose, guidelines are necessary for each entity to apply standards.

(2) Recommendations

Standards for judgement are essential. MECM and JBE&G are strongly advised to take the initiative in preparing these standards in collaboration with the Malaysian Energy Center (PTM) and other organizations concerned with promotion of energy efficiency. The standards and guidelines of energy efficiency developed by the study team are described in Chapter 7 of the main report. For reference, the items of standards described in the main report are shown below:

1) Commercial Sector

Commercial sector (Preceding 4 years) :

-Lighting intensity

-Room environment

-Electricity standard

Commercial sector (Latter 6 years) :

-Prevention of heat loss through external walls, windows and others

-Effective utilization of energy in relation to air-conditioning equipment

-Effective utilization of energy in relation to lighting apparatuses

-Effective utilization of energy in relation to hot water supply systems

-Effective utilization of energy in relation to elevators

2) Industrial Sector

Industrial Sector (Preceding 4 years)

-Rationalization of fuel combustion system

-Rationalization of heating, cooling and heat transfer system

-Prevention of heat loss due to radiation and transmission

-Recovery and utilization of waste heat

-Rationalization of systems to convert heat into motive power

-Prevention of electric power loss due to resistance and other factors

-Rationalization of systems to convert electricity into motive power, heat, etc.

Industrial Sector (Latter 6 years)

-Combustion facility

-Rationalization of heating, cooling and heat transfer systems

-Recovery and utilization of waste heat

-Co-generation facilities

-Power-consuming facility

4-1-4 Energy-Managed Entities and Energy Manager System

(1) Current State and Problems

A system of energy-managed entities is one effective measure to promote rational use of energy, but is not yet established in Malaysia. Consequently, the energy manager system does not exist in Malaysia. According to the draft regulations prepared by JBE&G, entities that consume a large volume of electricity annually, for example consuming 360,000 kWh per month or more, are designated as energy-managed entities.

(2) Recommendations

1) Establishment of energy-managed entity system

For the promotion of energy efficiency, the early establishment of an energy-managed entity designation system is recommended. The designated entities are urged to effectively report and carry out energy efficiency programs, and furthermore are responsible for reporting their energy supply and consumption every year. This will help the designated entities to recognize their energy consumption; to analyze their energy consumption; and to understand

the causes of fluctuations in energy consumption.

2) Energy manager system

It is important to establish this system as soon as possible, and also important for the designated entity to have an energy manager and to enable these managers to play a key role in promoting energy efficiency.

4-1-5 Qualification System of Energy Manager

(1) Current State and Problems

An energy manager qualification system is not established in Malaysia. By the draft regulations prepared by JBE&G, the qualification criteria for energy managers are defined.

(2) Recommendations

Energy-managed entities will be obliged to appoint an energy manager when the systems for energy-managed entities and energy managers are introduced in Malaysia. The introduction of a state-approved qualification system and a system for certificate issuance to energy managers is needed. In order to maintain and improve the quality of energy managers, it is necessary to organize and register them; provide them with technical information on energy efficiency and conservation; and train them.

4-1-6 Award System for Promotion of Energy Efficiency

(1) Current State and Problems

To increase business interest in energy efficiency, awards should be given to individual engineers or groups of employees or factories, which have achieved excellent results in promoting energy efficiency.

(2) Recommendations

It is considered necessary for state organizations to publicly commend factories that have achieved excellent results in energy efficiency and that have made constant efforts in energy management, as well as manufacturers who have developed highly effective energy efficiency equipment during the year. This system will lead to the boosted morale of people engaged in energy efficiency.

4-1-7 Incentives

(1) Current State and Problems

The most popular legal incentives are tax credits and tax exemptions. Administrative incentives include soft loans, etc. Tax incentives and soft loans are not available for investment in facilities and equipment of the promotion of energy efficiency in Malaysia.

(2) Recommendations

The formulation of a tax and loan incentive system is recommended.

To increase the effectiveness of incentives for the promotion of energy efficiency, such as tax reduction and exemption, and loan incentives, it would be useful to formulate an incentive package that includes tax credits and exemption, and soft loans, etc.

4-2 Activities for Promotion of Energy Efficiency

4-2-1 Activities for Promotion of Energy Efficiency by JBE&G and PTM

(1) Current State and Problems

A number of activities were carried out by JBE&G recently. Many of them concern electricity and consist of holding seminars, workshops, and exhibitions; conducting energy audits; preparing materials for the promotion of energy efficiency; and approving co-generation projects.

PTM was newly established in 1998 as a technical arm of MECM and has just started its activities for the promotion for energy efficiency. According to PTM, the following organizational demarcation of activities regarding promotion of energy efficiency is clarified at present.

(a) Scope of Activities for PTM:

The scope of Activities for PTM are Campaign, seminars, research and energy audits for the promotion of energy efficiency

(b) Scope of Activities for Others (JBE&G, Universities and Others):

1. Education and training programs on energy efficiency
2. Energy manager's qualification
3. Energy management lessons for university students

The study team recognizes the following items still remain as important issues:

1. Decentralization of activities for energy efficiency will result in poor performance in

the future.

2. Though energy management should be on the basis of thermal and electrical energy, the current activity is too concentrated on electricity in Malaysia.

(2) Recommendations

In order to promote energy efficiency smoothly, it is necessary for JBE&G and PTM jointly or separately to carry out the following activities.

1. Energy Audits (JBE&G, PTM)
2. Seminars for Energy Efficiency (JBE&G, PTM)
3. Energy Data Base (PTM)
4. Research on Promotion of Energy Efficiency (PTM)
5. Promotion of Energy Efficiency Campaign (JBE&G, PTM)
6. Publication (PTM)
7. Education and Training on Energy Efficiency (JBE&G, PTM)

It is recommended that the Energy Efficiency Promotion Division of PTM be reinforced in order to centralize the activities mentioned above in the long-range plan.

4-2-2 Organization and Role of Energy Efficiency Promotion Division of PTM

(1) Current State and Problems

The Energy Efficiency Promotion Division of PTM is newly organized and does not have much experience in the promotion of energy efficiency activities. There is an insufficient number of staff for the promotion of energy efficiency. There are no plans for developing the capability of engineers of private entities by means of opening training courses.

(2) Recommendations

1) Decentralization of activities for energy efficiency among various organizations, universities and entities will be inefficient in the future. Centralization of activities to PTM is recommended.
2) It is hoped that the promotion of energy efficiency activities, namely education and consulting, can be further developed and enhanced using international collaboration schemes.
3) The activities of PTM should not be limited but diversified. As a centralized organization for the promotion of energy efficiency in Malaysia, it is recommended to expand and enhance PTM's organization in order to establish sections such for public relations and publication, research, technical and training.

4-2-3 Others

Recommendation:

It would be advisable for MECM to coordinate and arrange a study to enhance ESCOs, which are private entities. The further activation of ESCOs is one option to promote developments in the efficient use of energy. The function of an ESCO would be to carry out energy audits, assist arrangement of finance and modification of facilities and to operate for the benefit of various entities. These activities would be carried out through the allocation of profits obtained by the promotion of energy efficiency between entities and ESCOs.

4-3 Recommendations to Model Entities

Energy audits were conducted for three model entities in the commercial sector as well as for another three in the industrial sector. Based on the energy audits and subsequent studies for the six model entities, the following measures are recommended for improving their energy efficiency.

4-3-1 Hotel (Mingcourt Vista Hotel)

(1) VAV System in Air-conditioning

It is recommended that a Variable Air Volume (VAV) system be installed in the hotel's air-conditioning. It can be said that this measure is financially feasible from the results of the financial evaluation.

(2) VVVF System in Lifts

This measure is at a marginal level of financial feasibility, assuming an inverter system (VVVF) is installed together with lift replacement. Investigation of this measure is recommended at the time of lift replacement.

(3) Ice Storage System

Installation of an ice storage system in the hotel's chiller system has the potential for financial feasibility, provided that the price of electricity increases to the current level in Japan. It is recommended that this measure be investigated in the event that the electricity tariff increases in future.

(4) Increase in Room Temperature

It is recommended that the hotel investigate increasing the temperature of its building area. The expected benefit from increasing the temperature by 2℃ is an RM 140 thousand annual saving in the electricity bill.

(5) Other Recommendations

In addition to the above, several recommendations are made for hotel's energy facilities in terms of operation management as well as maintenance management and are summarized in Chapter 9.

4-3-2 Shopping Complex (Bandar Utama Shopping Center)

(1) Decreasing Illumination Intensity

The following are recommended: decrease the illumination intensity by installing an automatic on-off system activated by lighting intensity; replace incandescent bulbs with fluorescent lights; and extinguish unnecessary lights. This investment measure can be regarded as financially feasible based on the financial evaluation.

(2) Prevention of Heat Loss from Entrances

It is recommended that heat loss from entrances be prevented by installation of rotating doors and air curtains. The investment for this measure appears to be financially feasible.

(3) Utilization of Off-peak Electricity

It is recommend that off-peak electricity be utilized by expanding the ice storage system. The investment can be said to be financially feasible as well.

(4) Stoppage of Incoming Transformer

Stoppage of the incoming transformer, T-11-1, is recommended. This measure will enable an RM37,000 annual saving in the electricity bill without any investment.

(5) Increasing Temperature of Building Area

It is recommended that the temperature of building areas be increased by 2℃. By this measure, a RM 2.2 million annual saving in the electricity bill is expected.

(6) Other Recommendations

In addition to the above, several recommendations are made for the shopping center's energy facilities in terms of operation management as well as maintenance management and are

summarized in Chapter 10.

4-3-3 Hospital (Hospital Seremban)

(1) Introduction of Latent Heat Storage System

For space cooling, Hospital Seremban currently uses a combination of natural ventilation, mechanical ventilation and centralized air-conditioning and local air-conditioning systems. In the near future, expansion of air-conditioning will become inevitable instead of natural ventilation and mechanical ventilation. In the event of such air-conditioning system expansion, it is recommended that the introduction of latent heat storage be investigated. This technology will enable effective peak load saving and reduction in maximum demand by shifting peak demand into off-peak demand.

(2) Solution to Frequent Over-current Trip Problem

The chiller system often stops because of the over-current trip problem. According to the investigation by the study team during the energy audit, this system has two problems: extraordinarily low power factor and high current quite close to the trip set value of 300 amperes. The following measures should be investigated: "Clarifying the cause of low power factor"; "Increasing the fuse from 300 ampere to 350 ampere"; "Installation of capacitor"; and "Replacing distribution line cable with a larger size".

(3) Improvement of TNB Power Receiving System

Negative power factor values were observed at the power receiving system from Tenaga Nasional Berhad (TNB) during the energy audit by the study team. It is recommended that the automatic control system of the capacitor bank be adjusted.

(4) Improvement of Boiler Combustion Conditions

The air ratio of Boiler exhaust gas exceeds the Japanese guideline. Improvement is desired by reinforcement of operation management from an energy efficiency point of view, although the current air ratio may be affected by the on-off operation of boilers.

4-3-4 Cement (APMC Rawang Works)

(1) Waste Heat Boiler/Generation System

This measure enables the recovery of sensible heat of preheater exhaust gas and cooler exhaust gas. This system is composed of (1) a boiler to recover sensible heat of preheater exhaust gas,

(2) a boiler to recover sensible heat of cooler exhaust gas, and (3) a power generator system consisting of a turbine, a generator and a condenser. It could be said that this measure is at a marginal level of financial feasibility under the conditions set for the study. It is recommended that a detailed investigation be conducted for this measure.

(2) Construction of Coal Drying/Grinding Mill

Expensive fuel oil is used in the F.F furnace together with coal, owing to the limited capacity of the existing coal mill. The recommended measure is to construct a coal drying/grinding mill that is composed of (1) a vertical roller mill for drying and grinding the coal, (2) a bag filter, and (3) a set of pulverized coal weighers. By this measure, all the fuel oil used in the factory will be replaced with coal, resulting in fuel cost saving. In addition, combustion efficiency will be improved by combustion of fine coal powder. It could be said that this measure is financially feasible.

(3) Adoption of Lifter Brick

The energy audit revealed that a lot of unburned carbon is returned to the kiln because of poor fuel combustion in the preheater F.F furnace. It is recommended that the inner wall of the kiln be lined with lifter brick so that heat consumption can be reduced by maintaining efficient combustion of unburned carbon from the preheater F.F furnace. This measure is especially recommended, as it is excellent in terms of financial feasibility.

(4) Prevention of Air-leakage

During the energy audit, air-leakage was observed from various locations in the plant. Total air-leakage volume is estimated at around 39.5% of the total exhaust gas volume. A 3.8 kWh per ton-clinker power saving is anticipated by reducing this air-leakage. It is recommended that this measure be investigated.

(5) Rationalization of Transportation System

Currently, coal shale and cement are transported by pneumatic transportation facilities such as an FK pump and compressor. By modifying this transportation system into a mechanical bucket elevator and air slide system, about a 5.3 kWh per ton-clinker power saving is expected. Further investigation is recommended for this measure.

(6) Change of Feeding Point and Feeding System of Coal Shale

From the results of differential thermal analysis (DTA) and thermogravimetric analysis (TG) of coal shale, it is deemed necessary to investigate changing the feeding point from direct feeding

into the F.F furnace to the C4 cyclone inlet, in consideration of coal shale burning conditions. In addition to this, it is recommended that the feeding system of coal shale be changed from a pneumatic to a mechanical system. A 1,258 ton-coal per year heat saving is expected by this measure.

(7) Improvement of C5 Cyclone Collecting Efficiency

It was observed that the collecting efficiency of the C5 (bottom) cyclone was poor. Consequently, exhaust gas temperature of the C1 (top) cyclone increased. By improving the collecting efficiency, an 8,510 ton-coal per year heat saving is expected through exhaust gas temperature reduction. This measure is recommended.

(8) Replacement of Cooler GBF

It is suggested that investigation be made into the replacement of the existing Gravel Bed Filter (GBF) with an Electrostatic Precipitator (EP) for cooler exhaust gas. By this measure, the following benefits are expected: "heat saving by stable combustion in the kiln and F.F. furnace", " electricity saving by preventing air-leakage from the cooler exhaust line and kiln hood", and "clinker recovery by improving collecting efficiency". It is recommended that this measure be investigated further.

(9) Grinding Aids

It is recommended that investigation be made into the use of grinding aids, although the economics of the measure depends on its price in Malaysia. A 7,500,000 kWh per year power saving is expected at the grinding mill, assuming a 0.02% addition of grinding aids.

4-3-5 Food Processing (Central Sugars Refinery (CSR))

(1) Improvement of Heat Energy Conservation in Steam and Steam Condensate System

The energy audit revealed a rather high temperature of boiler flue gas and a low recovery rate of steam condensate. It is recommended that the heat of boiler flue gas be recovered to increase the boiler feed water (BFW) temperature. As for a measure to increase the recovery rate of steam condensate, the installation is recommended of a steam condensate recovery system, consisting of a condensate tank, a condensate recovery pump, and related piping. This measure is considered financially feasible.

(2) Improvement of Steam Trap System

It was observed that thirty-one steam traps among the sixty-four installed in the steam-utilizing facilities were malfunctional due to blowing, leaking or blocking. It is recommended that

blowing or leaking steam traps be replaced with new steam traps. As for the blocked or low-temperature steam traps, scheduled maintenance is recommended. This measure is considered financially feasible.

(3) Decreasing Heat Loss by Thermal Insulation

During the energy audit, it was observed that some portions of straight lines, valves and flanges were not insulated. It is recommended that these parts be insulated to prevent heat loss.

(4) Power Generation to Recover Energy Loss from Steam Control Valve

Of the 50 ton per hour of steam generated by boilers, 20 ton per hour was depressurized by the steam control valve to low-pressure steam at 0.5 bar for heating purposes. According to a rough estimation by the study team, 750 kW of power could be generated by recovering the energy loss due to this depressurization. It is recommended that a supplementary turbine be installed to recover this energy loss, provided that the present tariff system is amended to allow CSR to supply excess electricity to outside users through TNB.

4-3-6 Iron and Steel (Amsteel Mills (ASM))

(1) Reduction in Air/Fuel Ratio of Reheating Furnace in Rod Rolling Mill

During the energy audit, an air/fuel ratio of 1.25 was observed for the reheating furnace. It is recommended that the ratio be reduced to 1.15 of the optimum attainable value. Reduction in air/fuel ratio results in a decrease in exhaust gas volume, which contributes toward saving energy for the reheating furnace. For this measure, an investment is required for installation of an oxygen content meter at the reheating furnace tail, replacing the broken one. This investment is financially feasible under the conditions of the study.

(2) Reduction of Heat Loss from Reheating Furnace Wall in Rod Rolling Mill

A reheating furnace wall temperature of over 130℃ was observed during the energy audit, although it is generally around 100℃ for ordinary furnaces. It is recommended that insulation be improved for reducing heat loss from the wall. The most convenient way of improving insulation is a veneering method, which involves overlaying a ceramic fiber blanket on the inside of the pre-build wall. This measure is regarded as financially feasible.

(3) Reduction in Temperature Variation of Extracted Material in Rod Rolling Mill

It was observed that the extracted billet temperature varied from 1,030℃ to 1,097℃, and the rolling procedure was performed successfully, even at the lowest temperature in the variation. It

is recommended that the range of extracted billet temperature be reduced by half and the mean temperature be reduced to 1,045℃ by improved estimation of heating pattern changes. About a RM 57,000 annual fuel oil cost saving is expected by this measure.

(4) Introduction of Hot Billet Charging in Rod Rolling Mill

Hot billet charging to the reheating furnace is a popular energy-saving measure adopted by many steel mills. ASM has very favorable conditions to introduce hot billet charging in terms of facilities and their layout. It is recommended that hot billet charging be introduced into ASM. It is expected that 342 ton of medium fuel oil or RM 111,000 of the fuel bill be saved annually by this measure, depending on the operation, especially the cooperation of the steel making shop and the rod rolling mill.

(5) Reduction in Electricity Consumption for New Shredder Plant

It was observed during the energy audit that electricity was consumed at a rate of around 35 kWh per hour in the new shredder plant even when the plant stopped. It is recommended that the cause of this loss be investigated and that the heat loss be prevented.

(6) Reduction in Electricity Consumption for Electric Arc Furnace (EAF)

The electricity consumption of ASM's EAF is somewhat higher than Japanese steel shops. ASM's data suggests that heat transfer in the EAF is rather poor. This problem would be solved by an active boiling reaction in the EAF, which would require additional carbon and would therefore increase heat generation. It is recommended that the oxygen lance position be well into the molten phase and also influence the metal phase, so that the boiling reaction is not localized only in the slag phase. About a 15 kWh per ton electricity saving in the EAF is anticipated by this measure.