

2004 Achievement Report

International Project for Increasing  
the Efficient Use of Energy  
International Project for Improving Infrastructure  
for the Efficient Use of Energy  
(Programs for Promotion of Energy Conservation  
in Major Industries in ASEAN Countries)

Report on the Results

March, 2005

The Energy Conservation Center, Japan

## 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 overcoming 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 with as little burden on the environment as possible and the development of energy having little impact on the environment, etc.

In order to contribute to the balanced development of economy and 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 their energy use and environmental measures and on the results of in-depth surveys on the progress in development of infrastructure, living habits, etc.

Under the mentioned circumstances, we advanced to and worked on a new stage in this project this year that aimed to strengthen the infrastructure for implementing and promoting energy audits and improvement plans, on the strength of the achievements of the energy audits and energy audit skills transfer programs that we implemented in 10 ASEAN countries regarding one selected industry per country during the past 4 years.

For an effective tool to help achieve such an aim, we set out to create the Technical Directory and Database/Benchmarks/Guidelines by business category.

In the meanwhile, as the activities to strengthen the infrastructure for the mentioned implementation and promotion, we conducted follow-up surveys on the factories that were subject to energy audit in the past to check the progress in the practice of the recommended improvement plans and also simplified energy audits in other factories to ensure the transfer of energy audit skills. In 2004, the factories that received our follow-up survey and short energy audit included that of the ceramic industry in Vietnam, a hydraulic power station in Laos, a textile factory in Malaysia and refineries in Myanmar. Furthermore, we held seminar and workshop in each country, inviting people from factories of different categories of industries in countries other than the host country to make a report on their successful energy conservation cases so that information could be shared in the ASEAN region and the foundation of promotion activities could be provided. In the seminars and workshops, the concept and development policy regarding the creation of the Technical Directory and particularly database by category of industry were discussed.

We believe it is very meaningful that as the result of the activities for the first year of the new stage in the project, we could achieve the above objectives and give direction to promotion of energy conservation in the new stage.

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

March, 2005  
The Energy Conservation Center, Japan

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## Summary

ASEAN countries are continuing to achieve dramatic economic development and their energy consumption is anticipated to increase rapidly from now on. It will become vital to use energy more efficiently and to give sufficient consideration to prevention of global warming.

This project has entered its 5<sup>th</sup> year. ASEAN Center for Energy (ACE), our ASEAN counterpart and people concerned of the respective ASEAN countries are engaged in more and more enhanced and substantial energy conservation activities, thereby contributing to gradually spread change in the consciousness of the people in ASEAN countries toward the reduction of energy consumption, particularly with the increases in energy price resulting from the recent soaring crude oil prices and the Kyoto Protocol put into force in the background.

The current year was positioned as the first year of the 2<sup>nd</sup> stage for making serious efforts to put into practice and disseminate the results we have made to date by combining all the achievements we made in the projects of the past 4 years and making further self-supporting efforts. In other words, the 2<sup>nd</sup> stage aims to establish the infrastructure for implementing and promoting practical improvements centered on improvement plans discussed and proposed in the respective countries in the past, based on the achievements and results of energy audits conducted on factories of 10 different types of businesses in all ASEAN countries over the past 4 years.

Specifically, the following activities were developed in 4 countries; Vietnam (ceramic industry), Laos (hydraulic power generation), Malaysia (Textile) and Myanmar (oil refinery).

- Follow-up survey on the factories that underwent an energy audit in the past and short energy audits on newly chosen factories  
Intended for understanding of the problems lying in carrying out and promoting improvement plans and the development of improvement measures
- Creation of Technical Directory  
Intended to introduce effective technologies usable in ceramic/hydraulic power/textile/oil refining industries in ASEAN countries and also successful cases of the utilization of the respective technologies for the purpose of information-sharing and enhancing the possibility of implementation and dissemination of these technologies
- Development of databases/benchmarks/guidelines  
Intended to establish a scheme for setting numerical targets to advance energy conservation activities and providing guide lines to achieve such goals  
As an immediate task, the development of databases in 4 categories of businesses; Ceramic/hydraulic power generation/textile/oil refining, is essential.

In the above mentioned countries, surveys including energy audits and seminars/workshops were conducted. In the survey conducted in each country, guidance was given to the local people concerned on the site again while the progress in their acquisition of energy audit skills transferred from Japanese specialists in the past was confirmed so that technology transfer could be further ensured. In addition, as it was found in the survey that some factories had not practiced improvements as instructed, factors seemingly constituting impediments to the

implementation as well as solutions were discussed, which lead to create the clue for the implementation and progress in the future.

In the seminar/workshop held in each country, in addition to the aforesaid discussions, people from the governments and the factories including those of different categories of industry in other ASEAN countries (including people of the factories undergoing energy audit in the past) were invited to join with the people of the factories of the countries concerned to report on their respective activities and the cases of practicing improvement plans. The seminar and workshop held in each country had a large number of participants each, playing an important role in terms of information sharing and dissemination.

On-site activities of the project of the current FY year were commenced with Inception Workshop held in late August 2004 (Same as the one for both Building and Energy Management Infrastructure Development Projects) and topped off by Summary /Post Workshops conducted in early February 2005 (common with Building and Energy Management Infrastructure Development Projects).

In the Inception Workshop, for the purpose of smooth launching of the project, the action plan was explained and finalized, and preparations for the activities at site were confirmed among the participants. Following that, surveys and workshops in 4 countries were smoothly completed by December 2004. In Summary Workshop/Post Workshop where delegates from ASEAN countries (Focal Points) were present, reports on the activities and the results in the 4 countries, including those on the ASEAN Benchmarking activities and the results, were made with the view to knowledge- and information-sharing, and discussions regarding the creation of Technical Directory and the development of database/benchmark/guideline for each country were held. Finally, the policy for action plans for the project next year and in the future was discussed.

Specific details of activities of the project for this year are as follows;

August 25-26, 2004 (Trip: August 24-27)

Participated in "Inception Workshop on Promotion of Energy Efficiency and Conservation (PROMEEC) (Major Industry, Building and Energy Management), SOME - METI Work Program 2004 - 2005" (Venue: Denpasar of Indonesia, Same as the one for Building/Energy Management Infrastructure Development projects)

Although delegates from Laos and Brunei were absent, about 20 people including delegates of ASEAN countries, members of ASEAN Center for Energy (ACE) and Energy Conservation Center, Japan (ECCJ), participated and had sessions as follows.

Opening address (Delegates of the countries subject to survey and the organizations concerned)

Session 1: Explanation and discussion on action policy for Phase-1 and Phase-2

Session 2: Presentation on "Japan's cooperation in energy management in foreign countries" (ECCJ)

Session 3: Lessons learned from Phase-1 and expectations for Phase- 2 (ASEAN delegates)

Session 4: Program for energy management (ASEAN delegates)

Session 5: Explanation on and finalization by discussion of 2004-2005 action plan (ECCJ)

October 25-29, 2004 (Trip: October 24-30);

On-site activities in Vietnam (Primary survey)

1. Follow-up survey on a ceramic factory surveyed in the past and short energy audit of a newly selected glass factory  
Surveys were conducted and reporting of the results and discussions were made in each factory.
2. Seminar-workshop in Vietnam  
More than 120 people participated and were engaged in vigorous discussions and active information exchange. The policy for creation of Technical Directory and the action policy regarding the development of database/benchmark/guideline proposed by Japan were approved in principle from the participants. The seminar-workshop was concluded successfully.
  - (1) Energy conservation policy and program (Vietnam and Japan)
  - (2) Report on energy conservation cases by people concerned in major industries in Vietnam and other ASEAN countries
  - (3) Discussions on the policy regarding the creation of Technical Directory
  - (4) Discussions on the action policy regarding the development of database in Vietnam

November 15-26 2004 (Trip: November 13-27);

On-site activities in Laos and Malaysia (Secondary survey)

1. Follow-up surveys on a hydraulic power station (Laos) and a textile factory (Malaysia) surveyed in the past and a short energy audit of a newly selected factory (garment/Laos)  
Surveys on the factories were conducted and reporting of the results and discussions were made in each factory.
2. Seminar-workshop in each country  
50-90 people participated in each country and were engaged in active information exchange through vigorous discussions. The policy for creation of Technical Directory and the action policy regarding the development of database/benchmark/guideline proposed by Japan were approved in principle from the participants. The seminar-workshop was concluded successfully.
  - (1) Energy conservation policy and program (each country and Japan)
  - (2) Report on energy conservation cases by people related to building in each host country and other ASEAN countries
  - (3) Discussions on the policy regarding the creation of Technical Directory
  - (4) Discussions on the action policy regarding the development of database in each host country

December 8-15, 2004 (Trip: December 7-16);

On-site activities in Myanmar (Thirdly survey)

1. A follow-up survey and a short energy audit on an oil refinery surveyed in the past and a newly selected factory were conducted respectively and reporting of the results and

discussions were made in the respective factories.

## 2. Seminar workshop in Myanmar

More than 50 people participated and were engaged in active information exchange through vigorous discussions. The policy for creation of Technical Directory and the action policy regarding the development of database/benchmark/guideline proposed by Japan were approved in principle from the participants. The seminar-workshop was concluded successfully.

- (1) Energy conservation policy and program (Myanmar and Japan)
- (2) Report on energy conservation cases by people concerned in major industries in Myanmar and other ASEAN countries
- (3) Discussions on the policy regarding the creation of Technical Directory
- (4) Discussions on the action policy regarding the development of database in Myanmar

February 7-9, 2005 ( Trip: February 6 - 10)

Summary Workshop /Post Workshop

Participated in “Summary Workshop and Post Workshop on Promotion of Energy Efficiency and Conservation (PROMEEC) (Major Industry, Building and Energy management), SOME-METT Work Program 2004-2005” (Venue: Singapore, same as the one for building and energy management infrastructure development)

Although delegates from Brunei and Vietnam were absent, about 21 people including delegates of ASEAN countries and members of ASEAN Center for Energy (ACE) and Energy Conservation Center, Japan (ECCJ) participated and had comprehensive discussions on the items given below. After reports on Technical Directory prepared by the 4 countries we visited this time and on the policy regarding and the progress in the development of Database/Benchmark/Guideline in each country were made, lively and active discussions were held. Although we confirmed that it remained our future challenge to make more efforts to improve mutual understanding of the specific ways of advancing these practical works, we could earn high evaluations from ASEAN countries on the results of our activities for this year and also gain agreement in principle on the policy for advancing the project in the years to come.

Opening address (Delegates of the countries surveyed and the organizations concerned)

Summary Workshop

Session 1: Major industries

- Activity report of this year/Results and evaluations
- Planning of creating Technical Directory and Database/Benchmark/Guideline in each country
- Achievements in “ASEAN Benchmarking” and “Board of Judges” relating to the recognition system
- Policy for approaches to be taken after next year.

Session 2: Buildings

Session 3: Energy management

### Post Workshop

Session 1: Summary of discussions held in Summary Workshop for each project

Session 2: Basic implementation plan for years after next

In the current fiscal year, with an aim to support ASEAN countries in the establishment of a firm foundation for developing continuous energy conservation activities, we improved the level of our activities, requesting them to further make self-help efforts. As we could gain cooperation in our activities from all the participating countries, we successfully made significant results. On the other hand, we recognized the necessity to gain further understanding of our improved activities and build a system in each country so that they could fully respond to us. Thus, our future task was clarified. At the same time, we appreciate such identification of our future issue as a step forward in our activities, because it looked emerging when our project made substantial advance and results.

Finally, we hereby would like to thank all those at ACE along with the organizations and companies concerned in each country for their all-out cooperation.

## **. Purpose and Background of the Project**

This project generally aims to contribute to the promotion of energy conservation and environmental protection in Southeast Asian countries by helping promote energy conservation measures in the major industries in the countries concerned through providing support for activities on the ASEAN with the view to promote and disseminate technologies for the efficient use of energy in the major industrial fields.

This project was set up in 2000 with ASEAN Center for Energy as the core organization, with the aim of reducing ever-increasing energy consumption in the industrial sectors in the ASEAN region. ASEAN call this project PROMEEC (Major Industries). PROMEEC is an abbreviation of “Promotion of Energy Efficiency and Conservation” and a cooperative project with Ministry of Economy, Trade and Industry certified by the conference of ministers of energy-related ministries of 10 ASEAN countries. We are providing support for the promotion of energy conservation in the industrial sectors of ASEAN countries in the aspects of technology and management through the activities of the project.

The project has the following objectives;

1. To deepen and strengthen the cooperative relation between ASEAN countries and Japan in the energy field
2. To promote energy efficiency and energy conservation in the major industries in ASEAN countries.
3. To promote transfer of energy-related technologies of Japan and the introduction of good practice cases of energy conservation.
4. To raise the quality level of ASEAN countries through energy audits and OJT for energy audit
5. To create Database/Benchmark/Guideline for energy audit in ASEAN countries.

The current year is positioned as a very important year to determine the direction of the activities to be developed in the second stage, with the understanding that this cooperative project are advanced in the 3 stages based on the discussions held to date with ASEAN countries including ACE. Through the activities we developed in all ASEAN countries by March 2004 in the first stage, we could build a foundation for developing energy conservation activities on an equal footing with ASEAN countries.

1st stage: Transfer of technologies and experiences from Japan to ASEAN countries (Completed in 2004)

2nd stage: Japan-ASEAN joint implementation of improvement plans in each country and promotion in other countries

3rd stage: Promotion of energy conservation with independent efforts by ASEAN countries

Starting in this year, we began to create a basis for advancing implementation and

dissemination of energy conservation based on the prepared foundation. In short, our activities are centered at follow-up surveys on the factories that underwent energy audit in the past, the creation of Technical Directory and the development of Database/Benchmark/Guideline for each category of industry. In the current fiscal year, we developed such activities mentioned above targeting the ceramic industry in Vietnam, the hydraulic power generation in Laos, the textile industry in Malaysia and the oil refining in Myanmar.

In the respective countries, we conducted follow-up surveys on the factories that underwent an energy audit in the past to grasp the progress and the issues lying in the implementation of improvement plans and also OJT-based simple energy audits of newly selected factories jointly with local people involved. In addition, we held seminar- workshop in which we invited instructors from factories of several categories of business in Japan and other countries to introduce successful cases of implemented improvement plans and cases of cutting-edge energy conservation technology to further raise the awareness of energy conservation among ASEAN countries. The concept for promoting the creation of Technical Directory and Database/Benchmark/Guideline for the use of each country and practical preparation activities were discussed and the future direction was determined. These activities are intended to serve as the core work for establishing the foundation for promoting energy conservation in the respective countries subject to the survey and to establish networks to promote it to other countries.

In the end, we held Summary Workshop bringing together delegates of the respective countries to share the results and achievements of the activities made in the respective countries and to discuss the basic plan for future activities.

## II. Vietnam (Ceramic Industry)

### 1. Outline of Activities

We conducted a follow-up survey on a company that underwent an energy audit in the previous round (January 27 - February 1, 2002) and gave Seminar-Workshop in Vietnam (Hanoi) that included reporting on examples of energy conservation in various industries.

#### 1.1 Period

October 25 - 29, 2004

#### 1.2 Venue

Follow-up survey: Hai Duong City (60km northeast of Hanoi)

Walkthrough energy audit on a newly selected factory: Hanoi City

Seminar-Workshop: Hanoi City

#### 1.3 Schedule

October 25 (Mon.): Seminar-Workshop  
26 (Tue.): Follow-up survey (Hai Duong Porcelain Company)  
27 (Wed.): Walkthrough energy audit (Rang Dong Light Source And Vacuum Flask Joint Stock Co.)  
28 (Thu.): Meeting of Japanese staff and summary  
29 (Fri.): Meeting about Technical Directory and Database/Benchmark/ Guideline in MOI (Ministry of Industry)

#### 1.4 People Involved

ACE (ASEAN Center for Energy):

Mr. Christopher G. Zamora: Manager

Vietnam Focal Point: Ministry of Industry (MOI)

Mr. Le Tuan Phong: Official on Energy and Environment, Science and Technology Dept. (STD) Ministry of Industry

Technical experts from Japan:

Messrs. Hideyuki Tanaka, Fumio Ogawa, Motomu Ishikawa

Technical experts of International Engineering Dept.,  
ECCJ

## 2. Latest Situation of Energy Conditions and Industries in Vietnam

Vietnam is endowed with diverse energy resources such as oil, gas, coal and hydro. Coal proven reserve is about 3.88 billion tons, 95% of which is accounted for by anthracite or good quality coal. Brown coal or lignite is estimated at 37 billion tons, of which about 3-5 billion tons are located in less than 500 meters underground. Oil resource is estimated at about 2.3 billion tons but proven oil reserve is estimated between 615 to 957 million tons. The proven gas reserve is about 600 billion cubic meters, which is about 50% of the total gas potential. Oil and gas are concentrated in the southern continental shelf. Hydropower resources can generate about 300 billion kWh but only 50 to 70 billion kWh are feasible.

### 2.1 Energy Situation in Vietnam

#### (1) Energy Production and Consumption

Crude oil production increased from 7.6 million tons from 1995 to 16.6 million tons in 2002. The production of washed coal almost doubled, from 8.35 million tons by 1995 to roughly 16 million tons by 2002. Electricity recorded the highest growth rate. Electricity generation increased from 15.6 TWh in 1995 to 46.84 TWh in 2004, posting an average annual growth rate of 13.7%.

As of December 2004, the total installed capacity of power plants was 11,360 MW. The total electricity sold was about 39.70 TWh out of the total 46.84 TWh of electricity generated.

In 2002, Vietnam exported 16.8 million tons of crude oil, nearly 6 million tons of coal and imported about 10 million tons of petroleum products.

#### (2) Vietnam Energy Plan (VEP) 2020

The country's long-term energy plan has firmed up programmes onto to 2020, which are expected to develop and maximise the country's energy resources. The main objective is to diversify energy sources and to ensure energy security.

Under the VEP 2020, the projected annual supply of indigenous energy will come from the following energy resources:

- 1) 25 to 30 million metric tons of anthracite coal per annum, of which 6-8 million tons will be allocated for power generation;
- 2) 25 to 30 million metric tons of crude oil per annum;
- 3) 15 to 30 billion cubic meter of natural gas per annum, of which 12 billion cubic meter will be for power generation; and
- 4) 50-60 billion kWh of hydropower per annum.

The country has other energy sources, such as nuclear and new and renewable sources of energy, which could provide long-term security of energy supply. Nuclear fuel is available. The reserve of uranium deposits is about 300,000 MT of U308, of which nearly 50% is

economically viable for utilisation. New and renewable sources of energy are also available such as geothermal, biomass, wood and agricultural by products, wind, solar and mini-hydro.

### (3) Energy Efficiency and Conservation Programme

Over the planning period, energy efficiency and conservation will be given an important role in the energy economy. The Prime Minister of Vietnam signed the Energy Efficiency Decree in September 2003. Current regulations and circulars to promote energy efficiency include:

- 1) Conduct of energy audit in designated factories;
- 2) Preparation of financial incentives/mechanism for energy efficiency programme; and
- 3) Classification of designated building to be undertaken by the Ministry of Construction.

Some programmes on E&C that have been implemented were:

- Demand-side management phase I completed in 2003;
- Capability building on DSM for EVN personnel;
- Load research and load management;
- Lighting pilot programme;
- Standard and labeling programme which have set up two MEP standards on lighting and motor and submitted to government for approval;
- Formulation of Building Code;
- Design of energy efficient street lighting and formulation of EE programme for small and medium enterprises;
- Survey of 60 buildings for ASEAN energy benchmarking project; and
- Participation in SOME-METI Work Programme on PROMEEC – Projects.

The on-going EE&C programmes are as follows:

- Formulation of detailed plan of action to smoothly implement the Energy Efficiency Decree of Vietnam;
- Implementation of DSM Phase II from 2003 to 2007 funded by World Bank/Global Environment Fund;
- Commercial pilot EE programmes starting from 2004 to 2007 also with funding support from WB/GEF;
- EE for SME which will be implemented from 2004 to 2008 (2009) funded by WB/GEF;
- Promotion of energy efficient public lighting programme; and continued participation and
- Support to the PROMEEC projects of SOME-METI.

## 2.2 Energy Outlook in Vietnam

### (1) Energy Demand- Supply Forecast 2010-2020

Vietnam is expected to achieve an annual average economic growth rate of between 7.0 -

7.5% onto 2010 and about 7.0% from 2011 to 2020. The agricultural sector's share will gradually shrink in the national economic mix, from 23% to 11 % by 2020, whereas the industrial and service sectors will increase from 38.5% to 44%.

In 2010, the total commercial energy consumption of the country will reach about 28-32 million tons of oil equivalent (TOE). Coal will account for 18%, oil and gas 57% and electricity 25%. The annual average growth rate of energy will be between 8.8%-10.4%.

By 2020, Vietnam's total commercial energy demand will reach about 53 to 63.6 Mtoe. Coal, oil and gas, and electricity will have a share of 15%, 56%, and 29%, respectively. During the 2010-2020 periods, the annual average growth rate of energy demand is projected at 6.6% - 7.1 %.

In the consumption mix, industry will remain the largest energy consumer. Its share will increase from 38% in 2001 to 42% and 47% in 2010 and 2020, respectively. The transportation sector will account for about 35% by 2010 and then decrease slightly to 33% by 2020. The energy demand for household activities will gradually decrease from 23% in 2001 to about 19.4% and 17.6% in 2010 and 2020, respectively. Although energy resources in Vietnam are relatively abundant and diverse, the country is likely to experience a shortage in domestic energy supply after 2015. Therefore, Vietnam has to develop new energy resources and import energy.

## (2) Energy Development Thrusts in 2010-2020

During the 2010-2020 planning period, the Government of Vietnam shall pursue the following policy directions for the energy sector:

- 1) Develop various resources of energy; satisfy energy demand for socio-economic development, and security and defense in the whole country and territories;
- 2) Diversify supply of energy, give priority to development of domestic energy resources, try to ensure energy independency, and at the same time, pay due attention to regional cooperation on energy;
- 3) Control and mitigate environmental pollution in view of ensuring the stability and sustainability in socio-economic development;
- 4) Formulate policies for a competitive energy tariff geared towards the establishment of an energy market;
- 5) Formulate investment policies and incentives for energy development. Diversify investments in the forms of BOT, BTO, BT JV, and IPP and so on, in order to mobilise various capital sources at home and abroad;
- 6) Formulate policies for rural and mountainous areas;
- 7) Formulate energy, science and technology policies.

## (3) Policies and Measures for Energy Security

During the 2015-2020 planning period, crude oil exploitation in Vietnam is projected to reach 25-30 million tons. In 2020, the demand for oil products is projected at about 27-30 million tons. Coal demand is projected to reach 35-40 million tons by 2020, of which 5-10

million tons will be imported to satisfy burgeoning domestic coal demand supply.

A total of 31,616 MW in installed generating capacity will be implemented during the 2001-2020 planning period, broken down as follows (Table II -2-1):

To reduce dependence on imported energy and to ensure energy security, the policies of Vietnam are as follows:

- 1) Further search for substitute energy resources. Intensively explore gas fields to meet the exploitation capacity of 20 billion m<sup>3</sup>, promote joint exploration and development of brown coal mining technology in the Red River Delta;
- 2) Import electricity, petroleum, gas and coal of different sources;
- 3) Develop nuclear power, new and renewable energy.

Table II -2-1 Power Generating Capacity by Year

Year	Capacity
2001 – 2005	6,432MW
2006 – 2010	6,432MW
2011 – 2015	8,152MW
2016 – 2020	10,600MW
2001 – 2020	31,616MW

#### (4) Power Sector Policies up to 2010

- 1) To accelerate the pacing of implementing projects, to allow EVN to skip the step of elaborating pre-feasibility study reports of power source and grid projects;
- 2) To allow EVN to appoint domestic consultancy agencies to act as main consultants for power source and grid projects. In case of complicated issues, EVN may sign contracts to hire foreign consultancy agencies;
- 3) The Ministry of Industry shall coordinate with the Ministry of Finance in studying and submitting to the Prime Minister mechanisms providing partial budget capital support for investment in power sources and grids in service of economic and social development in remote and rural areas; allocating capital for renewable energy sources in areas where national power grids do not exist; and separating EVN's public utility activities from its production and business activities;
- 4) Commercial banks shall be allowed to provide EVN with a loan exceeding 15% of their own capital for investment in electricity projects deemed efficient and whose feasibility study reports have been approved by competent authorities;
- 5) The provincial/municipal People's Committees must closely coordinate with the Ministry of Industry, EVN and others investors in settling the compensation for ground clearance and population resettlement related to power source and grid projects in accordance with schedules approved by competent authorities.

The Government encourages domestic and foreign investors to participate in the construction of power source and power grid projects in various forms, such as independent power producers (IPP), build-transfer (BT) contracts, build-operate-transfer (BOT) contracts and joint venture or joint-stock companies.

## 2.3 Situation in Vietnam

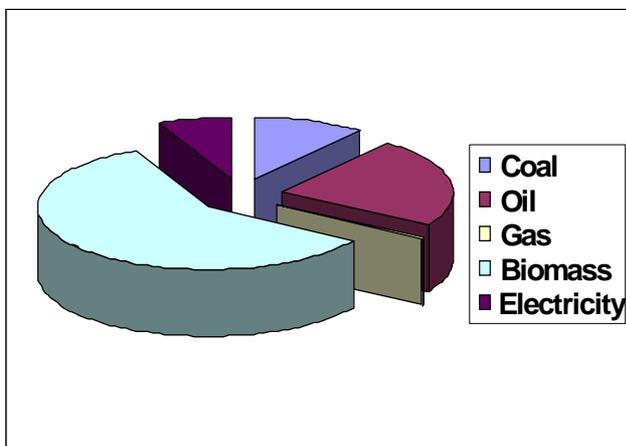
### (1) General condition

- Area: 329,241km<sup>2</sup>
- Population: About 82,060,000 (as of October 2004)  
Population growth rate: 1.18% (2003)
- Religion: Buddhism (80%), Catholic, Cao Dai, etc.
- System of government: Socialist Republic
- Economy: Major industries: Agriculture, Forestry and Fishery and Mining  
Per capita GDP: US\$ 483 (2004 IMF data)  
Economic growth rate: 7.6% (provisional figure for 2004)  
Currency: Dong, US\$1 = 15,740 Dong (December 2004)
- Economic overview: Although the nation's economy has continued to grow at a rate of around 7% since 2000, there are factors for concern such as chronic trade deficit, immature investment environment, etc.

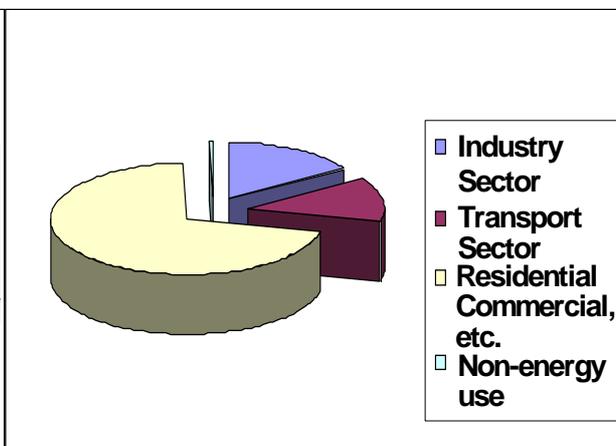
### (2) Energy situation in Vietnam

Energy supply and consumption in Vietnam are shown in Figure II-2-1. Renewal energy (RE, mainly biomass energy) consists of a large portion of the total primary energy supply, followed by oil and coal. Vietnam produces oil and coal and exports 97% and about 40% of oil and coal productions respectively. For petroleum products, 60% of the oil export is reverse-imported (2002). Residential and commercial consumption consists of the largest portion of the energy use, followed by industry and transportation sectors. As the nation is expected to be industrialized at a rapid pace, approaches based on energy conservation should be taken from the outset.

**Total Primary Energy Supply**  
(Excluding of use for Power plant, Oil refinery, etc.)



**Total Final Consumption**



Primary Energy Supply	(ktoe)	%
Coal	4017	10.6
Oil	8756	23.1
Gas	19	0
Biomass	22484	59.4
Electricity	2586	6.9
<b>Total</b>	<b>37862</b>	<b>100</b>

Total Final Consumption	(ktoe)	%
Industry Sector	6001	15.8
Transport Sector	4969	13.2
Residential, Commercial, etc.	26716	70.6
Non-energy use	176	0.5
<b>Total</b>	<b>37862</b>	<b>100</b>

Figure II-2-1 Vietnam - Energy Balance in 2002  
(Source: IEA Energy Balance - Edition 2004 -)

### 3. Follow-up Survey on Hai Duong Porcelain Company Factory

#### 3.1 Outline of Hai Duong Porcelain Company Factory

##### (1) Company profile

Address:	Pham Ngu Lao Str, Hair Duong City, Vietnam
Company form:	State-Owned Company
Capital:	Government 10 billion VND, Bank 3 million VND
Production item:	Pottery and porcelain
Production output:	24 million pcs/y
Sales amount:	US\$ 4 million
No. of employees:	950
Average salary (direct worker):	960,000 VND (US\$ 90)
Working hour:	7:00 – 17:00

##### (2) Production process of pottery and porcelain

Law material → Crushing → Blending → Fine grinding (wet process) → Dehydration → Kneading → Forming → Drying → Rough finish → Glazing → Glost firing (1350°C) → Decoration → In-glaze Firing (915°C) → Inspection → Packing → Shipping

##### (3) Major equipment and capacity

Major equipment and their capacities are shown in Table II -3-1.

Table II -3-1 Major Equipment and Capacity

Equipment	Energy	Rating
Electric installation	Electricity	90,755 kW
Boiler	Coal	3.2 t/h
Kiln for firing	Coal	–
Kiln for china painting (periodic kiln, single-crucible kiln)	Electricity	496 pieces/firing
Kiln for china painting (Roller hearth kiln: RHK)	LPG	1,230 pieces/ firing
10 m <sup>3</sup> Shuttle kiln	LPG	3,500 pieces/firing
4.7 m <sup>3</sup> Shuttle kiln	LPG	1,800 pieces/firing

##### (4) Status of energy use

Energy use condition is shown in Table II -3-2.

Table II-3-1 Status of Energy Use

Energy	Quantity consumed		Use
	2000	2001	
Diesel oil	25.2t	25.5t	Power generator
LPG	251.8t	799.1t	Porcelain firing kiln
Natural gas	647,623m <sup>3</sup>	594,160m <sup>3</sup>	Glass firing kiln
Coal	4,407t	4,736t	Porcelain firing kin

### 3.2 Brief Review of the Results of the Previous Energy Audit

The purpose of the previous energy audit was to accurately know heat balance of the heat equipment, in other words, what quantity of heat comes in from where and how much of it is used for what purpose. The next purpose was to know based on the results of the audit which equipment to focus on to get significant effects in energy consumption.

For these purposes, we obtained heat balances of the heat equipment such as the tunnel kiln for firing of pottery and porcelain (glost firing), the shuttle kilns and the roller hearth kiln (RHK) for firing again of the decorated products, and proposed energy conservation plans based on the results of such calculations.

In addition, we gave guidance in the points of improvement in the current firing control and firing technology, which will lead to energy conservation.

The results of the survey and points of improvement are given below.

#### (1) Heat balance

The results of the tunnel kiln and the RHK for firing, and those of the shuttle kilns are shown in Table II-3-3 and II-3-4 respectively.

Table II-3-3 Heat Balance of Tunnel Kiln and Roller Hearth Kiln

(Unit: kcal/t)

Kiln type		Chinese-made Tunnel Kiln		Roller Hearth Kiln	
		Heat quantity	%	Heat quantity	%
Heat Input	Combustion heat of fuel	$7,387.2 \times 10^3$	99.8	$836.0 \times 10^3$	99.6
	Heat gained from unfired objects and saggars	0	0	3.4	0.4
	Heat gained from unfired objects	0	0	2.1	0.2
	Heat gained from saggars	0	0	1.3	0.2
	Heat gained from kiln carts	13.1	0.2	—	—
	Heat gained from refractory part	12.3	0.1	—	—
	Heat gained from iron part	0.8	0.1	—	—
	Total	$7,400.3 \times 10^3$	100	$839.4 \times 10^3$	100
Heat Output	Heat carried away with fired objects and saggars	8.0	0.2	23.8	2.8
	Heat carried away with fired objects	3.1	0.1	6.2	1.9
	Heat carried away with saggars	4.9	0.1	7.6	0.9
	Heat carried away with kiln cars	144.4	2.0	—	—
	Heat carried away with refractory part	141.1	1.9	—	—
	Heat carried away with iron part	3.3	0.1	—	—
	Heat carried away with cooling air	1,732.6	23.3	295.0	35.1
	Heat carried away with combustion exhausts gas	1,772.8	24.0	442.0	52.7
	Heat losses due to radiation/conduction and others	3,742.5	50.5	78.6	9.4
	Total	$7,400.3 \times 10^3$	100	$839.4 \times 10^3$	100
Effective heat	Effective heat per 1 ton of fired products	$457.5 \times 10^3$		$308.2 \times 10^3$	
	Heat consumed for firing of unfired objects	457.5		308.2	
	Effective heat per 1 ton of fired products including saggars	1,188.5		395.9	
	Heat consumed to heat saggars	731.0		87.7	
Heat efficiency for fired products only		6.2%		36.9%	
Heat efficiency for fired products including saggars		16.1%		47.4%	

Table II -3-3 Heat Balance of Shuttle Kilns

(Unit: kcal/t)

Heat type		Kiln type	Shuttle Kiln (10m <sup>3</sup> )	Shuttle Kiln (4.7m <sup>3</sup> )
Effective heat	Effective heat per 1 batch of fired products		321.9 × 10 <sup>3</sup> kcal/batch	165.6 × 10 <sup>3</sup> kcal/batch
	Heat consumed for firing of unfired objects		321.9	165.6
	Effective heat per 1 batch of fired objects including slabs		748.6	384.2
	Heat consumed to heat slabs		426.7	218.6
Heat efficiency for fired products only			5.3%	5.8%
Heat efficiency for fired products including slabs			12.2%	13.4%

(2) Suggestions for improvement in energy conservation

1) Chinese-made tunnel kiln

a. Reduce the amount of radiation heat from the kiln surface.

In the heat balance shown above, “heat loss from radiation/conduction and others” makes up the largest portion of the total heat loss, accounting for 50.5%. This means that most of the heat is lost through diffusion from the surface of the kiln.

Accordingly, it is recommendable to lay insulating material on the surface of the kiln as reducing such heat loss will bring about significant effect of energy conservation (Figure II -3-1).

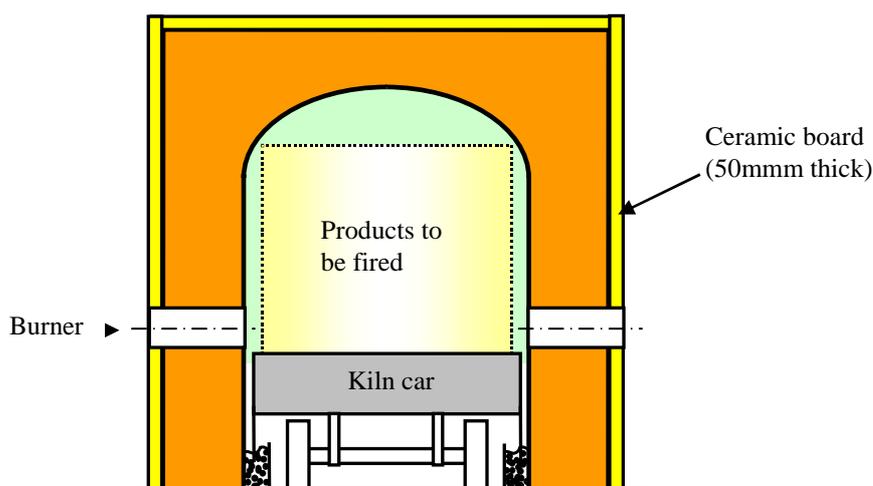


Figure II -3-1 Cross-section View of Tunnel Kiln

- b. Reduce the amount of heat going out with combustion exhaust gas.  
Reducing the “amount of heat escaping from stacks”, which makes up the second largest portion of the total heat loss, leads to energy conservation. In order to achieve it, it is necessary to keep an appropriate quantity of sand in the sand channel mentioned in item d. below and the in-kiln pressure at the area of the first burner entering the reducing flame at a level of  $\pm 0\text{mmH}_2\text{O}$ .
- c. Introduce the process of biscuit firing  
As the firing temperature of Roller Hearth Kiln (RHK) for over-glazed decoration ( $915^\circ\text{C}$ ) is about at the same level as the temperature of biscuit firing of the normal process of producing pottery and porcelain and RHK has sufficient installation capacity, biscuit firing using this RHK before the step of glazing will improve the condition of the glazed surface and the whiteness of the fired objects, thereby upgrading their grade and quality.
- d. Renew the sand for sand sealing and maintain an appropriate quantity of sand  
In the firing of pottery and porcelain under the reduction condition, one of the key points for improving production yield is to stabilize the atmosphere in the kiln. One of the conditions disturbing this stabilized atmosphere is the air invading into the kiln from the bottom of the kiln cars due to the insufficient sand sealing caused by shortage of sand. Under the present condition, as the amount of the sand is not enough and the size of particles is too small, all sand in the kiln should be replaced with rougher-grained sand (3~5 mm in diameter) (Figure II-3-2).

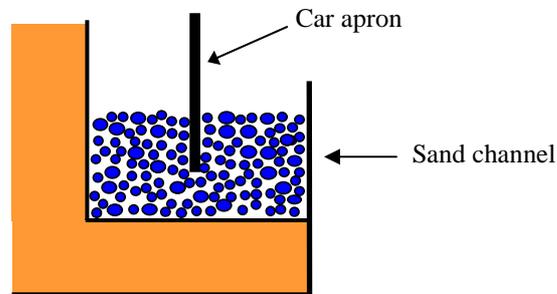


Figure II-3-2 Sand Channel

- e. Put bricks (60~100mm height) on the bricked top of the kiln car to make clearance between the top of the car and saggars so that combustion gas can come in easily.  
By doing so, the temperature of the bottom stage of saggars on the kiln car will rise, narrowing the gap in temperature between the upper and lower levels and thereby improving the condition of firing dramatically (Figure II-3-3).

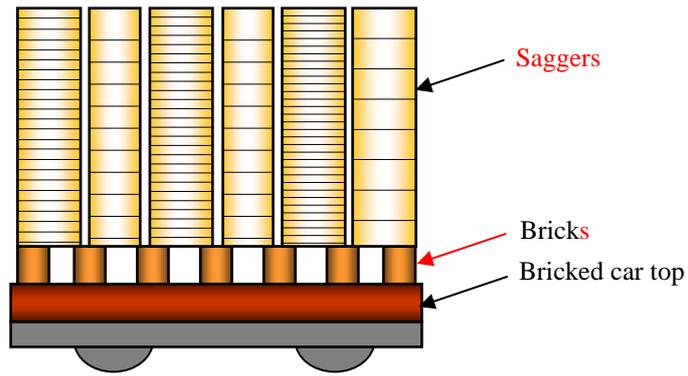


Figure II -3-3 Kiln Car

- f. Keep a regular height of the saggars of each kiln car  
 The uniformed sagger height will stabilize gas flow in the kiln and thus stabilize the atmosphere and temperature. In short, it will improve production yield (Figure II -3-4).

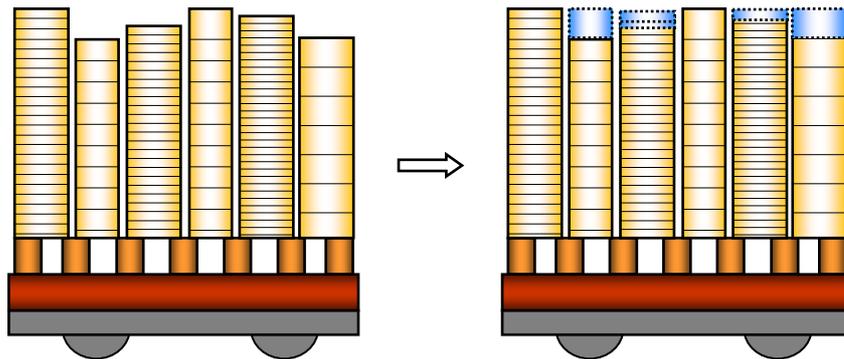


Figure II -3-4 Height of Saggars

- g. Set up an exit door of the kiln  
 If the kiln has no door, cold air will come into the kiln and disturb the atmosphere of the firing zone. Particularly, the maximum temperature will fluctuate and may cause change in color (yellow color) of the lower products at the center of the kiln. Setting up of a door is highly recommendable.

h. Too short firing time from the entrance to reducing flames (14 hours up until 1050°C)

This short firing time will bring about a big gap between the highest and lowest temperatures later and cause change in color (yellow color) of products as in term g. above.

In addition, as such uneven firing will result in bad quality of products; it is recommendable to extend this pre-reduction time from 14 hours to 19 hours. By introducing this method, although the time from 1,050°C to the maximum temperature will be shortened by 5 hours compared the present method; this improvement is highly recommendable because it will cause no defect in products and difference in the highest and lowest temperatures.

However, the firing time should be changed gradually over 3 months or so while the state of products are carefully checked each time (Figure II-3-5).

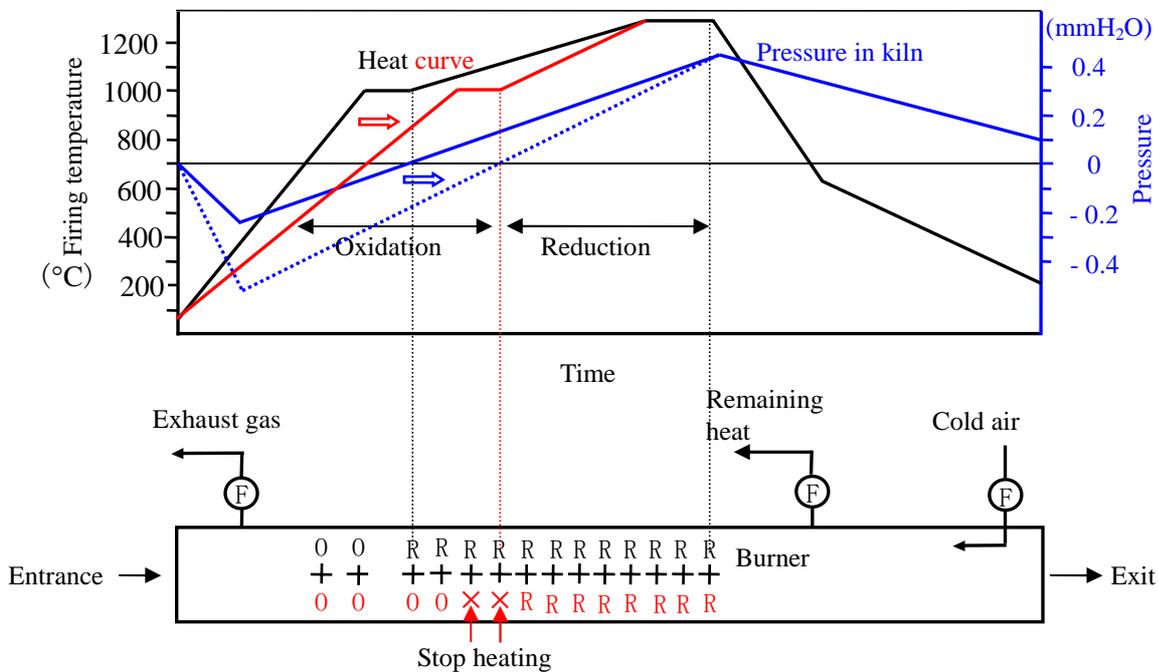


Figure II-3-5 Heat Curve and Pressure in Kiln

## 2) Roller Hearth Kiln

a. Keep the pressure value in kiln positive

As the pressure in the kiln is currently minus in general, the damper for combustion exhausts (exhaust damper of stack) should be narrow down the opening so that the pressure in the kiln can be  $\pm 0\text{mmH}_2\text{O}$  at around the first burner. By keeping the kiln pressure slightly positive, the amount of incoming air from the outside will decrease, reducing the amounts of combustion exhaust and heat loss accordingly. This will also help to lessen the maximum-minimum temperature difference and lead to the reduction

in fuels.

- b. Introduce biscuit fire if the installation capacity can afford.

As mentioned in (2) 1) c above, biscuit firing is recommendable because it improves the condition of the glazed surface and the whiteness of the fired objects, thereby enhancing the grade and quality of the objects.

3) 10m<sup>3</sup>, 4.7m<sup>3</sup> shuttle kiln

- a. Install high-speed burner

The shuttle kiln in current use has ceramic fiber inner walls. This is advantageous in energy conservation because they reduce heat radiation from the surface of the kiln. However, the burner used is of a natural suction type and not the burner agitating atmosphere in the kiln.

Accordingly, if the burner is replaced with a high-speed burner agitating atmosphere in the kiln on the occasion of remodeling or repair of the kiln in the future, it will help lessen the maximum-minimum temperature difference and the firing time, thus contributing to energy conservation (Figure II-3-6).

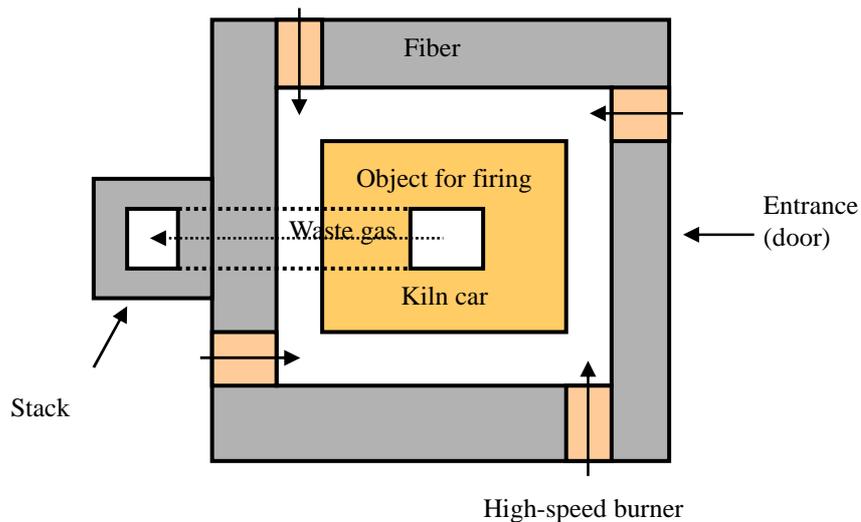


Figure II-3-6 The Shuttle Kiln Section

### 3.3 Results of the Follow-up Survey on the Improvements Proposed in the Previous Energy Audit

We conducted a follow-up survey on the progress in the improvement plans suggested in the previous audit and on the points for possible additional guidance, and confirmed with the persons concerned on the factory side as follows. We did not conduct an energy audit this time and only explained in detail improvements yet to be implemented.

(1) Date of survey: October 26 (Tue.), 2004

(2) Examiners: Messrs. Hideyuki Tanaka, Fumio Ogawa and Motomu Ishikawa,  
Technical experts, International Engineering Dept., ECCJ

Participants: MOI: Mr. Le Tuan Phong (ACE Focal Point)

ACE: Mr. Christopher Zamora

PTM, Malaysia: Mr. Phubalan Karunakaran

(3) Interviewee: Mr. Hoang Quoc Thanh (Vice Technical Director) and 8 other people of Hai Duong Porcelain Company

(4) Check on the progress in the improvement plans proposed in the previous audit

As no answers were prepared for the questionnaires we had requested in advance, we toured the factory, after we had interviews regarding the implementation of our proposals.

Although several of our proposed improvements had already been implemented, the overall progress was not very good.

Here is a summary of the condition of each proposal.

1) Chinese tunnel kiln

a. The measure for reducing heat diffused from the surface of the kiln had not been taken and it was set as a subject for future study.

b. The measure for reducing the quantity of heat escaping with combustion exhausts had not been taken and its immediate implementation was decided.

c. The introduction of the process of biscuit fire was set as a subject for future study.

d. Sand for sand sealing was not replaced and its appropriate quantity was not determined. The immediate implementation of the plans was decided.

e. The improvement plan of putting bricks (60–100 mm height) on the bricked top of the kiln car for making clearance between the car top and saggars to help combustion gas easily flow in was not implemented and its immediate implementation was decided.

f. A regular height of piled saggars on each kiln car had already been maintained and the resulting stable temperature and atmosphere created effects.

g. The proposed door at the exit of kiln had not been set up and the plan was to be implemented immediately.

h. The elongation of a short firing time from the entrance to the reducing flame (14 hours

up until 1,050°C) was not implemented and the plan was decided to implement at the furnace halt time (turn off the heat).

## 2) Roller Hearth Kiln

a. The suggested plan of keeping the pressure in the kiln slightly positive had already been implemented and the temperature difference was a little lessened but no significant numerical effect in reduction of fuels was recognized.

### b. Biscuit fire

It was set as a subject for future study in the same way as 1) c.

## 3) 10m<sup>3</sup>, 4.7m<sup>3</sup> shuttle kiln

### a. Installation of high-speed burner

It is to be studied when the currently used kiln is repaired or replaced in the future.

As summarized above, out of the 11 improvements proposed in the previous energy audit, only 2 plans were implemented. It is regrettable that they were not fully aware of energy conservation, improvement in quality and yield, cost reduction, etc. In the post-survey session on the results, staff members concerned of the factory joined in discussions in a serious manner. We would like to expect that the remaining plans will be implemented as early as possible (Photo II-3-1).



Photo II-3-1 Discussions and Explanations on the Results of the Follow-up Survey

### 3.4 Barriers to the Promotion of Energy Conservation and Countermeasures

It was too bad that few of the proposed energy conservation plans were actually put into practice.

This shows that the Focal Point (country) and top managers of the company in question are not paying attention to energy conservation.

Accordingly, Japan, Focal Point and the company concerned should seriously think about how they can be more interested in and aware of energy conservation. Focal point, for example, should make the company report on the progress in the implementation of the plans on a regular basis and establish a system in which they can inquire of Japan for whatever they want to know more.

It may be a good plan that Focal Point will legislate for the program in which companies that have achieved energy conservation to a certain extent will enjoy such benefits as subsidies and taxation incentives (Figure II-3-7).

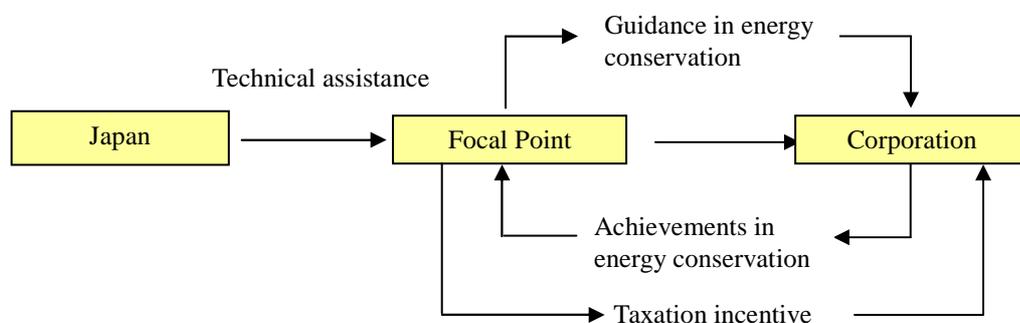


Figure II-3-7 Energy Conservation Promotion System

#### 4. Walk-through Energy Audit on the Factory of Rang Dong Light Source & Vacuum Flask Company

We visited Rang Dong Company, a report on whose energy conservation had been made in Seminar-Workshop. This company is manufacturing lighting fixtures such as electric bulbs and fluorescent lamps and vacuum flasks. The company's major energy-consuming equipment was melting furnaces of glasses.

The survey was conducted as follows;

- Date of survey: October 26 (Tue.), 2004
- Examiners: Messrs. Hideyuki Tanaka, Fumio Ogawa and Motomu Ishikawa, Technical experts, International Engineering Dept., ECCJ
- Other participants: Mr. Ngo Huy Toan (MOI, Vietnam)  
Mr. Phubalan Karunakaran (PTM (Malaysia Energy Center), Malaysia)
- Interviewees: Hai Duong Porcelain Company  
Mr. Vuong Bich Son: Deputy Director General (Leader of Energy Team of MOI) and 2 other persons from Energy Team

#### 4.1 Outline of Rang Dong Light Source & Vacuum Flask Company Factory

##### (1) Company profile

Address:	Ha Dinh Str., Thanh Xuan District, Hanoi, Vietnam
Company form:	State Owned Company
Capital:	80 billion VND (Government 51%, Individual investors 49%)
Production items:	Glass tubes for lighting and vacuum flasks
Production output:	Lighting fixtures 73 million pcs/y, Vacuum flask, 7 million pcs/y
Sales amount (2003):	350 billion (2.45 billion yen = US\$23.8 million)
No. of employees:	1,600
No. of factories:	6
Working schedule:	2 shifts/day for 5 factories and 3 shifts/day for one factory

##### (2) Major equipment

###### 1) Tank furnace for melting glass

Fuel used:

Burner for melting purpose:	Heavy oil (quantity consumed 3,700 t/2002)
Burner for maintaining the maximum temperature:	Light oil
Maximum temperature:	1,500°C

Quantity for melting processing:	22t/day
Melting time:	8 hours
Temperature of exhaust gas after heat exchange:	350°C

2) Processing of glass

Fuel used:	LPG
Fuel consumption:	1,400t/2002

(3) Energy consumption (2003)

Heavy oil:	3,900t
Light oil:	380,000kL
LPG:	1,750t
Electricity:	$8.50 \times 10^6$ kWh

#### 4.2 Walk-through Energy Audit and Proposed Improvements

We conducted a simple energy audit focusing on the tank furnace for melting glass, which consumes the largest quantity of energy.

This type of furnace is characterized with its high maximum temperature at 1500°C and a large amount of heat loss from its surface. Although we did not measure the surface temperature of the furnace, because it was not hot as we anticipated due to the open environment in which the furnace was set up, the surface temperature of the furnace was apparently about 150°C (normally 200–300°C).

The temperature of the exhaust gas after heat exchange was 350°C. Although this temperature is normal for this type of furnace, this sensible heat should be utilized effectively.

As a result of having checked various glass processing machines, any particular energy conservation measures were not recognized. .

## 5. Results on Seminar-Workshop

### 5.1 Summary

Seminar-Workshop was conducted on October 25, 2004.

The Seminar, where many practical examples of energy conservation were reported, was concluded with great success. However, as the Workshop was short of time for discussions on Technical Directory, Database/Benchmark/Guideline, a meeting with MOI was held on a later date (29<sup>th</sup>) in Ministry of Industry.

#### (1) Place

Press Club, Hanoi, Vietnam

#### (2) Reports made in Seminar-Workshop

Shown in “Program” in Attachment

#### (3) Participants

The list of participants from Vietnam is included in Attachment.

ACE: Mr. Christopher G. Zamora, Manager

Foreign presenters:

Mr. Djoko Wiryano (PT Kertas Leces, Indonesia)

Mr. Vanthong Khamloonvylayvong (Nam Ngum Hydropower Plant, Lao PDR)

Mr. Phubalan Karunakaran, (PTM: Malaysia Energy Center, Malaysia)

ECCJ: Technical experts, International Engineering Dep.

Messrs. Hideyuki Tanaka, Fumio Ogawa and Motomu Ishikawa

As can be seen in the lists, the total number of participants was 122, including 112 participants from Vietnam, translators and participants from other countries.

### 5.2 Results of Seminar-Workshop

#### (1) Opening ceremony (Congratulatory speech and opening address)

- 1) Mr. Nguyen Dinh Hiep: Deputy Director Dept of Science Technology, Ministry of Industry (MOI)
- 2) Mr. Hideyuki Tanaka: Technical expert from ECCJ
- 3) Mr. Christopher G. Zamora: Program Manager of ACE

## (2) Energy conservation plans and activities

### 1) Current status and activities on EE&C in Vietnam • • • Mr. Phong: MOI

He introduced the country's planned future energy conservation measures and legislations, barriers recognized to the promotion of energy conservation and the efforts of the country.

### 2) Energy conservation plans in Japan • • • Mr. Hideyuki Tanaka ECCJ

He explained energy situation and energy management and laws, subsidy systems and private sector activities on energy in Japan.

### 3) Energy conservation best practices for major industries in Vietnam.

#### a. Promoting EE&C in industry of Vietnam (Dr. Pham Hoang Luong, Hanoi University of Technology)

He explained the necessity to reduce carbon dioxide to prevent global warming issue and reported on logical energy conservation methods and barriers to them, the effects of the introduction of state-of-the-art shuttle kilns in a brick factory and a tableware factory, and on energy conservation efforts through improvement of efficiency of blower fans in a cement company. It was easy for participants to understand and his presentation was very informative.

#### b. Example of energy conservation in paper and pulp factory (Bai Bang Paper Co, Ltd.)

Material had been created in Vietnamese language and the translator's technical knowledge was not enough and regrettably we could not understand the material.

Later we obtained the material translated into Japanese. The report on the case example, in which energy conservation effects were achieved through prevention of steam leakage of the boilers, thermal insulation of the steam piping, improvement of the combustion method, recovery of the exhaust heat, etc., was very meaningful.

#### c. Example of energy conservation in lighting apparatus manufacturing factory (Rang Dong Light Source & Vacuum Flask Co, Ltd.)

There was a report on the case in which significant energy conservation effects were achieved through the development of energy-saving products in conformity to the energy conservation law, the implementation of thermal insulation of walls of gas furnaces in the factory, the optimization of air ratio for combustion, etc.

However, as reported in 4. above, judging from the company's explanation and attitude we faced on the occasion of our simple energy audit, we thought this report on energy conservation was a little questionable.

### 4) Promotion of energy conservation and practical examples in other ASEAN countries

#### a. Experience and application of EE&C in PT KERTAS LECES (Paper and Pulp Company, Kertas Leces, Indonesia)

A report was made on the guidance and energy audit provided by ECCJ in 2001 and its effects

b. Experience and application of EE&C in Num Ngum hydropower plant (Lao PDR)

In the same way as Indonesia, a report was made on the energy audit conducted by ECCJ in 2002 and its effects.

c. Experience and application of EE&C in textile factory (AMDB, Malaysia)

A report was made on the energy audit at AMDB Company conducted by ECCJ in 2001 and the energy conservation effects gained from the change of boiler fuel from heavy oil to gas.

With the above reports on many successful examples of energy conservation creating effects, the Seminar was very meaningful. (Photo: II -5-1)

Agenda and the list of participants of the Seminar-Workshop are contained in the Attachment.

This Seminar-Workshop was, as a result, short of time due to active and vigorous discussions among the participants including 112 attendees from Vietnam. Accordingly, after the Seminar part was completed, we visited MOI on the last day to hold Workshop there. The Workshop held is described below.



Photo II -5-1 Participants in the Seminar (October 25, 2004)

### 5.3 Workshop (Discussions on the Policy of Establishing Database/Benchmark/Guideline)

We visited MOI and had a meeting with the persons concerned to discuss Technical Directory (TD), Database (DB), Benchmark (BM) and Guideline (GL). (Photo II -5-2)

Vietnam side: Mr. Le Tuan Phong, Mr. Dang Hai Dung, Mr. Ngo Huy Toan

PTM (Malaysia Energy Center): Mr. Phubalan Karunakaran

ECCJ: Messrs. Hideyuki Tanaka, Fumio Ogawa and Motomu Ishikawa



Photo II -5-2 Meeting with MOI

(1) Current situation in Vietnam

Although there were problems about the collection of data on energy consumptions from the respective companies for the purpose of developing DT/BM/GL, the following decree of “Energy Conservation & Energy Efficiency” was issued in 2003 and 2004.

Designated companies:	Over 1,000t of annual fuel consumption Over 500kW of capacity of electric installation or over 3 million kWh of annual power use
Other companies:	Energy consumption below those of designated companies

All companies falling under either of the above categories shall submit to MOI a report on their annual energy consumptions and the implementation of energy conservation efforts. They shall receive an energy audit every 3 to 5 years and report on the results. If any problems are identified, they shall submit improvement plans.

(2) Condition of other ASEAN countries.

There is an association in Malaysia, which collects information and data on companies of steel, cement, etc. Singapore also has a similar association.

(3) Development of Technical Directory and Database/Benchmark/Guideline

As the manufacturing process, the manufacturing scale and the type of product are different depending on the industry, comparisons on the same basis may be difficult. In addition, in terms of disclosure of information, the respective industries are not very positive. There are several obstacles to get over in the way of creation of these Technical Directory and Database/Benchmark/ Guideline.

#### (4) Future plan

Although there are obstacles and difficulties as mentioned above, in Vietnam, we decided to give assistance in collection of data on energy consumptions from companies and promotion of energy conservation efforts to companies for the final goal of establishing Technical Directory, Database/Benchmark/Guideline.

In the current on-site activities, the time of Seminar-Workshop ran out and a workshop had to be held on a separate date and Seminar-Workshop itself should have been scheduled after the follow-up examination. These remained our future issues to be studied.

## . Lao PDR (Hydropower Generation Industry)

### 1. Outline of Activities

We conducted a follow-up survey on a plant that underwent an energy audit in the previous round (January 29 - February 1, 2002) and an energy audit on a newly selected plant. We gave Seminar/Workshop in Vientiane in Lao PDR. The seminar included reporting on practical examples of energy conservation in various industries as well as reports on the results of these surveys. In the workshop, Technical Directory and Database/Benchmark/Guideline, etc. was studied.

#### 1.1 Period

#### 1.2

November 15-19, 2004

#### 1.3 Venue

#### 1.4

Follow-up survey:	Nam Ngum Hydropower Plant (Approx. 90km north of Vientiane city)
Walkthrough energy audit on a newly selected factory:	Vientiane city
Seminar/Workshop:	Vientiane city

#### 1.3 Schedule

November 15 (Mon.):	Follow-up survey (Nam Ngum Hydropower Plant)
16 (Tue.):	Walkthrough energy audit (Factory of Textile 55 Co. Ltd.)
17 (Wed.):	Meeting of Japanese staff and summary
18 (Thu.):	Seminar/Workshop
19 (Fri.):	Meeting about Technical Directory and Database/Benchmark/ Guideline in Ministry of Industry and Handicrafts (MIH)

#### 1.4 People Involved

ACE (ASEAN Center for Energy):

Mr. Christopher G. Zamora: Manager

Lao PDR Focal Point: Ministry of Industry and Handicrafts (MIH), Dept. of Electricity

Mr. Sisoukan Sayarath: Chief of Electricity Management Division (EMD)

Mr. Khamso Kouphokham: Deputy Chief of EMD

Technical experts from Japan:

Messrs. Hideyuki Tanaka, Fumio Ogawa, Keiichi Yoneda and Yoichi Kita:

Technical experts of International Engineering Dept.,  
ECCJ

## 2. Latest Situation of Energy Conditions and Industries in Lao PDR

### 2.1 Energy Situation in Lao PDR

#### (1) Overview

Lao PDR has a total population of 5.6 million people. The country's GDP is mainly made of agricultural activities. In 2003, agricultural product accounts for 48 percent of total GDP, while industrial sector contributes only 26 percent. In the industrial sector, electricity sector is playing an important role in gaining revenues for the sector development. In pursuing the government's policy in eradicating the nationwide poverty and getting rid of in the least-developed-country list, electricity sector development is considered as the basic infrastructure. By 2020, the country has a target of increasing electrification ratio up to 90 percent of the country's total households. In 2004, the ratio has reached 44 percent.

Energy sector in Lao PDR is under the responsibility of different organizations. There is no single organization that is responsible for the whole energy sector like. But those organizations are in charge of each energy type. For example, Ministry of Industry and Handicrafts is responsible for the electricity sector and Ministry of Commerce is for gas and oil. In terms of energy planning and management, it is carried individually by sector. With regards to energy efficiency and conservation, the Ministry of Industry and Handicrafts is proposed to be leading in developing policy and legislations of the energy efficiency and conservation. After joining ASEAN in 2003, Lao PDR has been participating the Energy Efficiency and Conservation program with other ASEAN member countries. Through this participation, many concerned governmental and private officials got trainings of energy efficiency and conservation in buildings and industries.

In Lao PDR, just like in other Southeast Asian countries, energy is fundamental to socio-economic development. The demand for energy of the country is expected to increase rapidly due to high rising economic and population growth rates. And large proportion of this demand will be met by imported energy to meet domestic requirements. In 2003, the country's energy consumption was 3,852 KTOE and about 49 % is met by imported energy.

#### (2) Energy Situation in Industry

It is expected that the industrial sector will become a major sector in the economy as the Lao government has a goal to industrialise and modernise the country. Even though in 2003 energy consumption in the industrial sector was only around 6 percent of total, this figure will rise and be more than those of other sectors. Energy consumption of the industry in 2003 has accounted for 249 KTOE, while it was 3,332 KTOE for residential sector. At the moment, Sepong gold mining is the biggest electricity consumer in the country, which has power demand of 30 MW. In the near future, such energy intensive plant will be developed in many sites, especially for industrial mining.

In Lao PDR, the legislations and guidelines on energy efficiency and consumption are not established yet, as up to now most of the government's efforts are made on an increase of electrification ratio and provide electricity to industrial development sites. However, there are some evidences showing that many industrial sites have their own energy management system, in particular in reducing and conserving energy in their factories. Since 2002, the country is introducing the current electricity tariff system, which increases monthly by 2.3 percent. This system of tariff makes most consumers, especially industrial and business ones taking care of their electricity consumption. Until June 2004 the monthly increase of electricity tariff has been cancelled, and now Electricity tariff for industry is about 6.17 US cents per kWh. Some factories have developed energy saving activities including energy auditing which are undertaken by their own personnel. In addition, the Ministry of Industry and Handicrafts, ASEAN Centre for Energy and Energy Conservation Centre of Japan co-organized a number of in-country workshops and seminars for the industrial staff on energy auditing and management.

### (3) Energy Situation in Hydropower Generation Industry

In Lao PDR, more than 96 percent of electricity supplied is from hydropower plants. The hydropower scheme is being developed for two purposes, domestic and export supplies. In terms of export, at the moment, Lao PDR has two plants namely; Theun Hinboun Hydropower plant with installed capacity of 220 MW and another, Houay Ho Hydropower Plant with installed capacity of 150 MW. These two plants are under concession agreement with the joint ventures of overseas private and Lao companies. The power generated by these 2 plants is exported to Thailand. In addition, Lao PDR plans to develop additional hydropower sites for electricity export to neighbouring countries. This development is also considered as an important aspect of the government in enrichment of the economy in particular of gaining income to the country.

If compared with other industrial plants, hydropower generation industry does use less energy. The energy used in this industry is mostly in the form of electricity and mainly for lighting and pumping water. In the past, there were little efforts on energy savings in hydropower plants in Lao PDR. Most efforts are made only to keep the hydropower plants in a good working condition and often not paying attention to energy usage in the plants. In 2002, Lao government has requested Energy Conservation Centre of Japan (ECCJ) via ASEAN Energy Efficiency and Conservation Sub-Sector Network to assist Lao PDR to conduct energy audit in Nam Ngum Hydropower Plant. This plant began its operation from 1971 the efficiency of the production have been decreased and energy consumption in the plant was also high. Now, because of the well implemented measures and recommendations by the Japanese technical experts in that energy auditing, the amount of energy used for the plant has been reduced and more importantly efficiency of production has been also improved.

## 2.2 Situation of Industry in Lao PDR

### (1) Overview

For the past ten years, there are some big investments in industrial sector, especially in hydropower development sites and mining sites. For hydropower development in the same period, there were four hydropower plants built with a total installed capacity of 460 MW. In 2003, the gold and copper mining is being developed in Sepong district of Savannakhet province. Apart from hydropower and mining plants, Lao PDR has got other industries such as cement, garment, metal, timber, brewery and soft drinks.

### (2) Situation of Hydropower Generation Industry including Promotion in EE&C

Lao PDR can produce power energy annually of around 3,500 GWh. The below Table -2-1 shows major hydropower plants and their annual production of energy in MWh. In this table, two plants namely; Theun Hinboun and Houay Ho are under private ownership or Independent Power Producer Scheme. The two plants are developed for exporting energy to Thailand. The remaining plants belong to Electricite du Lao PDR (State-owned enterprise).

Table -2-1 Annual Hydropower Generation

(Unit: MWh)

No	Name of hydropower plant	2000	2001	2002	2003	2004
1	Nam Ngum	1,117,005.00	1,138,574.72	1,153,049.64	919,852.30	961,399.00
2	Theun Hinboun	1,483,788.15	1,507,498.70	1,454,594.94	1,432,080.00	1,527,713.75
3	Houay Ho	617,550.42	592,512.58	579,313.27	429,219.44	402,069.81
4	Xeset	168,016.35	147,574.63	155,707.57	157,352.34	112,264.00
5	Nam Leuk	263,486.30	237,177.10	226,787.10	211,677.50	219,879.00
6	Xelabam	24,263.16	25,403.29	23,732.94	17,770.60	15,799.00
7	Nam Ko	-	-	5,000.41	5,306.80	4,509.00
8	Nam Dong	5,735.97	4,762.29	5,827.52	4,881.23	4,936.00
	Total	3,679,845.35	3,653,503.31	3,604,013.39	3,178,140.20	3,248,569.55

In the near future, the Lao government plans to develop a number of hydropower plants both for domestic and export purposes. For domestic supply, 7 new projects are proposed to be built in order to meet the energy demand of the country by 2020. These plants are Xeset 2, Nam Sim, Nam Bieng, Nam Ngiep 1, Nam Chia, Houay Lam Phan Gnai, and Nam Theun 2 (for domestic). For export scheme, the government has signed some agreements of power deal with Thailand and Vietnam. The planned projects for export are Nam Theun 2, Xekaman 3, Nam Mo, and Nam Ngum 3.

The information relating to promotion of Energy Efficiency and Conservation in the hydropower is generally limited, except those of Nam Ngum hydropower plant. In the near future, it will be very useful to introduce promotion of Energy Efficiency and Conservation for other plants by taking Nam Ngum hydropower plant as an example. The Nam Ngum plant demonstrated excellent practices in saving energy that is good for the economy and people of Lao PDR.

## 2.3 Situation in Lao PDR

### (1) General condition

- Area: 240,000km<sup>2</sup>
- Population: 5.526 million (2002)
- Religion: Buddhism.
- System of government: People's Democratic Republic
- Economy: Major industries: Agriculture, forestry/ wood processing and hydropower generation
- Per capita GDP: US\$ 365 (2002)
- Economic growth rate: 5.9% (2002)
- Currency: Kip, US\$1 = 10,800 Kip (As of November, 2004)
- Economic overview: The introduction of market economy and the policy of open economy have been promoted. Currently the nation's economy is slowly recovering through promotion of foreign investments, etc.

### (2) Energy situation in Lao PDR

Energy sources and fuel/electricity consumptions in Lao PDR are shown in Figure -2-1. As energy source, fuel oil makes up the largest share, followed by electric power and renewal energy (RE, mainly biomass energy). About a half of fuel and electricity go for residential use. Industrial sector is the third largest user of fuels after transport sector and the second largest user of electricity following residential sector. It would be very important to raise energy conservation activities in the industries from now.

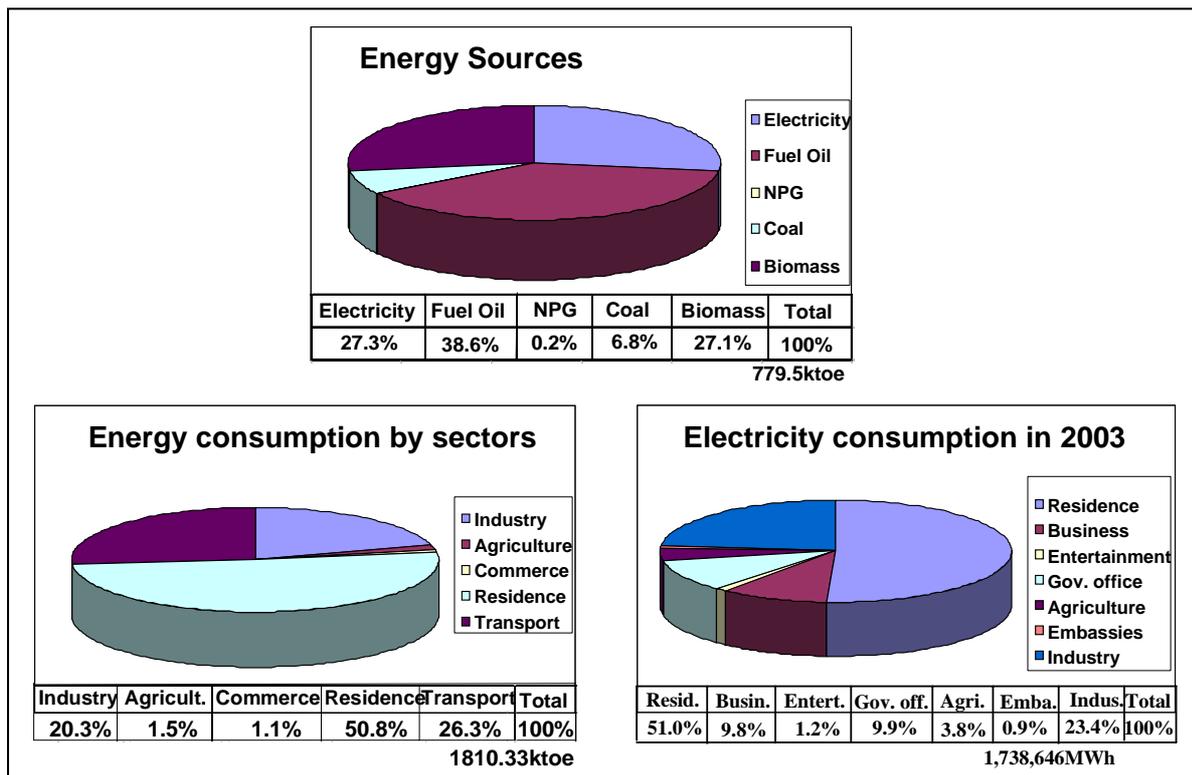


Figure -2-1 Energy Consumption Share in Lao PDR  
 (Source: EE&C Programs of Lao PDR (MIH, Lao PDR))

### 3. Follow-up Survey on Nam Ngum Hydropower Plant

#### 3.1 Outline of Num Ngum Hydropower Plant

This is a concrete dam-type power station located 90km north of Vientiane. Num Ngum hydropower plant was constructed in 3 phases with the financial cooperation of various foreign countries.



Photo -3-1 Exterior View of Nam Ngum Hydropower Plant

In Phase I of the plant construction, which began in 1968, 2 power units with installed capacity of 15MW (No. 1 and No. 2) and a 115kV-70MVA substation with one high-voltage line were constructed and connected to the grid network in Nong Khai in Thailand owned by EGAT (Electricity Generating Authority of Thailand) via substation in Vientiane. Power transmission was started in 1971.

In 1976, Phase II started and 2 more power units with installed capacity of 40MW (No. 3 and No. 4) and an 115kV substation with 2 high-voltage lines were constructed and connected to the Thanaleng substation in Udon in Thailand. The operation was started in 1978.

Phase began in 1983 and one power unit with the generation capacity of 40MW (No 5) was constructed and the operation was started in 1984.

The equipment subject to the previous energy audit and the current follow-up survey is the lastly constructed No. 5 unit.

The reason why No. 5 unit was chosen for the survey was that this equipment had not been

overhauled once since its operation was commenced in 1984 and it was anticipated that the deterioration in efficiency of its hydraulic turbine would be most significant of all. (No. 1 & 2 and No. 3 & 4 were overhauled in 1981 and 1990 respectively and No. 1 and No. 2 were subjects of the Rehabilitation and Modernization Project implemented in 2002 with the aid from Japan.)

### 3.2 Summary of the Results of the Previous Energy Audit

The results of the previous survey are briefed below.

(1) Date of survey: January 28 (Mon.) - February 1 (Fri.), 2002

(2) Examiners:

Mr. Yasunori Serizawa: GM of International Engineering Dept., ECCJ and

Mr. Nobunari Kawamoto: technical specialist, ECCJ

(3) Outline of equipment surveyed

Outline of power plant having equipment concerned,

Name of power plant: Nam Ngum Hydropower Plant

Generation capacity: Sum total 150,000 kW (155,000 kW from 2004)

Total of units: No. 1 & No. 2: 30,000kW

(35,000kW from 2004)

Total of units: No. 3 & No. 4: 80,000kW

Unit No. 5: 40,000kW

Reservoir:

Catchments area : 8,460 km<sup>2</sup>

Reservoir capacity (at EL. 212m) : 7,030 x 10<sup>6</sup> m<sup>3</sup>

Submerged area (at EL. 212m) : 370 km<sup>2</sup>

Full water level : 212.0 m

Low water level : 196.0 m

Water depth in use : 16.0 m

Dam:

Type : Concrete gravity type

Length of top of dam : 468 m

Height : 75 m

Intake gate:

Type : Roller gate

Pipeline:

	Unit 1&2	Unit 3&4	Unit 5
No. of pipelines :	2	2	1
Diameter :	3.4m	6.0m	6.0m
Length :	50m	55m	55m

Power plant:

Type :	Semi-basement
Size :	H20 m × W16 m × L107 m

Hydraulic turbine:

	Unit 1&2	Unit 3&4	Unit 5
Type :	Francis	Francis	Francis
Power output :	15,500kW	53,000kW	53,000kW
Maximum head :	45.5m	45.5m	45.5m
Standard head :	32.0m	32.0m	32.0m
Rotating speed :	176.5rpm	136.4rpm	136.4rpm
Manufacturer :	Hitachi, Ltd	Hitachi, Ltd	Hitachi, Ltd
Commencement of operation :	1971	1978	1984

Power generator:

	Unit 1&2	Unit 3&4	Unit 5
Rated output :	17,500kVA	50,000kVA	50,000kVA
Rated voltage :	11kV	11kV	11kV
Power factor :	0.86	0.8	0.8
Rated frequency :	50	50	50
Rotating speed :	176.5rpm	136rpm	136rpm
Manufacturer :	Hitachi, Ltd	AEG	Hitachi, Ltd
Commencement of operation :	1971	1978	1984

The structure of Nam Ngum Hydraulic Power Plant is shown in Figure -3-1.

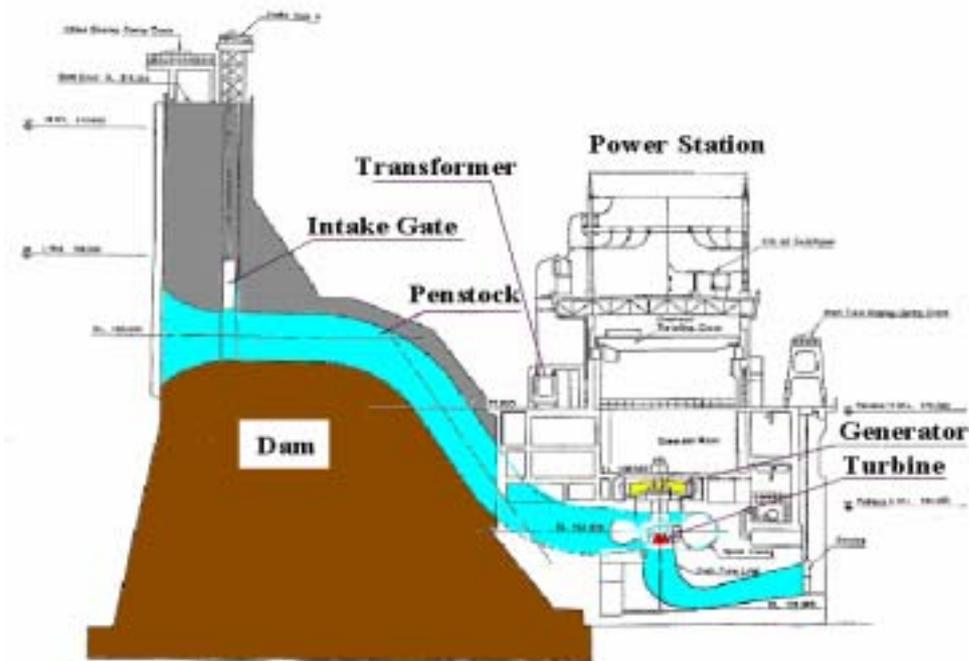


Figure -3-1 The Structure of Nam Ngum Hydraulic Power Plant

(4) Summary of the results of energy audit

As regards the operation of reservoir, although the water level of dam appears to drop due to drought, there were no increase in the frequency of ineffective discharges due to operation errors and no effective discharge at the time of the outage of hydraulic turbines/power generators, and thus, the inflowing water was utilized without waste. In addition, as the result of actual measurement, it was found that the maximum output of the hydraulic turbine had dropped by about 1,224kW (2.61%) compared to the time when the operation was started. (See Figure -3-2, 3)

Based on these results, the following improvement plans were proposed.

1) Retaining or increasing power generation (improvement of efficiency)

- a. Improve efficiency of hydraulic turbine
- b. Improve efficiency of power generator/transformer
- c. Improve management of reservoir (Install robot rain gauge)

2) Saving electricity used in the plant

- a. Turn off outdoor lighting
- b. Adopt inverter fluorescent lamps
- c. Employ intermittent operation of pressure oil pump



Figure II-3-3 Points Causing Losses

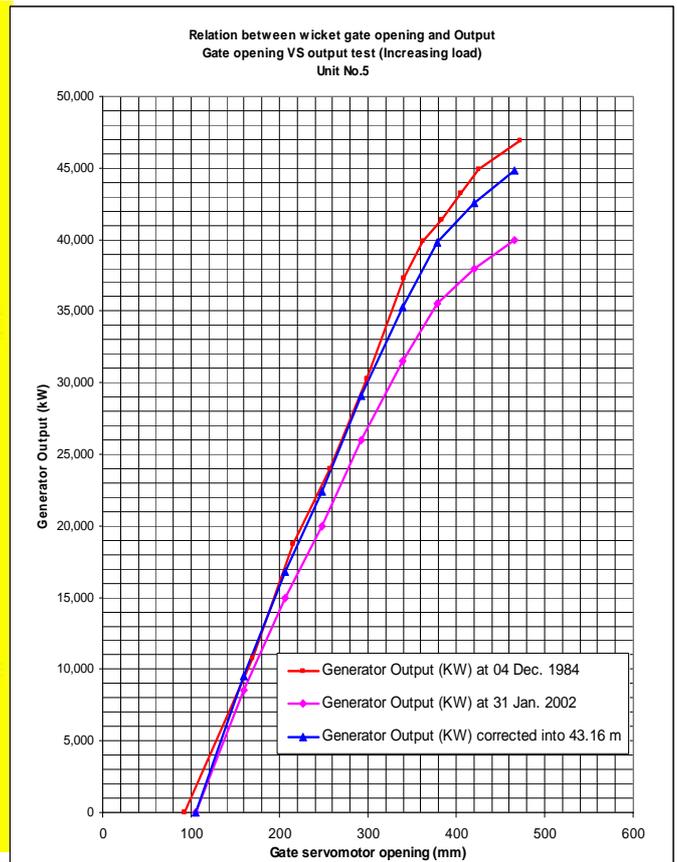


Figure -3-3 Deterioration in Generating Efficiency

### 3.3 Results of the Follow-up Survey on the Improvements Proposed in the Previous Energy Audit

(1) Date of survey: November 15 (Mon.), 2004

(2) Examiners: Messrs. Hideyuki Tanaka, Fumio Ogawa, Keiichi Yoneda and Yoichi Kita:  
Technical experts of International Engineering Dept., ECCJ

Participants: MIH Mr. Sisoukan Sayarath  
ACE Mr. Christopher Zamora

(3) Interviewees: Nam Ngum Hydro Power Plant

Mr. Vanthong Khamloonylayvong (Deputy Manager of the plant)  
Mr. Phet Sychaleune (Manager of Electrical Dept.)

(4) Check on the progress in the improvement plans proposed in the previous audit

We had a Q and A time based on the answers to the questionnaire we had requested in advance. It happened that our report on the previous audit had not been delivered to the

plant side and they received it only one month before our current visit with them. However, they were thankful for the report and said that it provided very useful material.

The implementation status is described below. Except for very costly proposals, almost all of our suggested plans had already been implemented.

1) Retaining or increasing power generation (improvement of efficiency)

a. Improvement in efficiency of hydraulic turbine

It was implemented.

They tried to recover the efficiency by comprehensively repairing the water paths including coating of pipeline with the overall focus on the repair of the runner damaged from cavitations.

They said that they carefully carried out the process obtaining advice from the manufacturer because this improvement involved the repair of the core part of the equipment and therefore was technically difficult.

As can be seen from the chart, the efficiency improved from 97.39% to 98.7%. (Up of 1.3%)

As a result, the maximum output increased by about 520kW.



Photo -3-2 Runner Damage from Cavitations

b. Improvement in efficiency of power generator/transformer

It was under study.

As it involves a significant amount of money, it is likely that it will be realized when the funded program such as Rehabilitation and Modernization program that was applied to No. 1 and No 2 units becomes available.

c. Improvement in management of reservoir (Install robot rain gauge)

It was not implemented.

According to Mr. Vanthong, as the data of Meteorological Center is available, the installation of a new rain gauge is not necessary.

According to a JICA specialist stationed in Lao PDR for a long time assignment

(specialized in hydraulic power generation) who Mr. Vanthong consults with regarding the dam operation plan, it is very difficult to forecast water level of dam, particularly to make accurate forecasts as it is done not only based on the rainfall of the year concerned but also from the data on inflowing water quantity and water stage collected over the past 10 or more years. (Figure -3-4 Changes in water level)

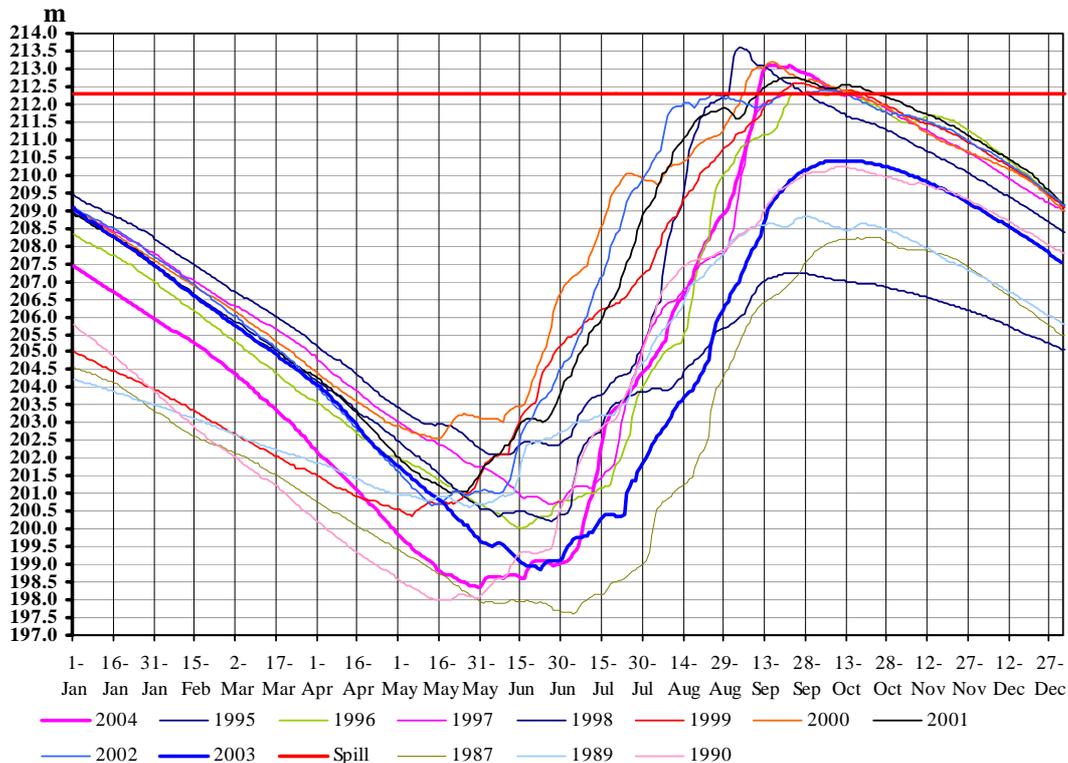


Figure -3-4 Changes in Water Level

## 2) Saving electricity used in the plant

### a. Turn off outdoor lighting

It is practiced.

Outdoor illumination equipment was changed from 400W × 30 lamps (Total: 12kW) to 250W × 30 lamps (Total: 7.5kW) and saving electricity of 4.5kW has been achieved. Saving energy is totals 19,710kWh on an annual basis (8,760/2h).

As a next step, they plan to change to the illumination equipment of 40W × 55 lamps (Total 2.2kW) in 2005.

### b. Adopt inverter fluorescent lamps

It has not been practiced.

The reason is that inverter lighting apparatus is extremely expensive.

According to Mr. Vanthong, inverter lighting fixture made in New Zealand cost US\$ 6,000 (including installation cost).

As such lighting fixture costs several tens of thousand yen at a list price in Japan (excluding installation cost), we decided to send reference material from Japan when we are back.

c. Employ intermittent operation of pressure oil pump

Although the pressure oil pump had initially been controlled by automatic operating system, it looked to be running continuously because of too much oil leakage.

Through the improvement of the sealing part including the replacement of packing, oil leakage was avoided and load operation hour of pressure pump was shortened.

In the same way, compressed air leakage also was eliminated through the improvement of the sealing part and load operation hour of compressor was shortened. For both cases there was no reporting on specific energy reduction amount.

### 3.4 Results of the Current Survey

As an important operation assessment criterion for hydraulic power plant, annual total output is used. In other words, it measures how efficiently electricity was generated against the obtained water resource.

Generally speaking, with the highest average water stage with the fewest ineffective discharges, the maximum annual total output will be achieved.

(1) Changes in annual output (No. 5 power unit) (Figure -3-5 annual total output)

This figure shows that in 2003, despite the low average water level due to the scarce of water resource, annual total output did not drop profoundly.

Compared to other years under the similar condition (1991, 1992, 1998), the operation efficiency is obvious.

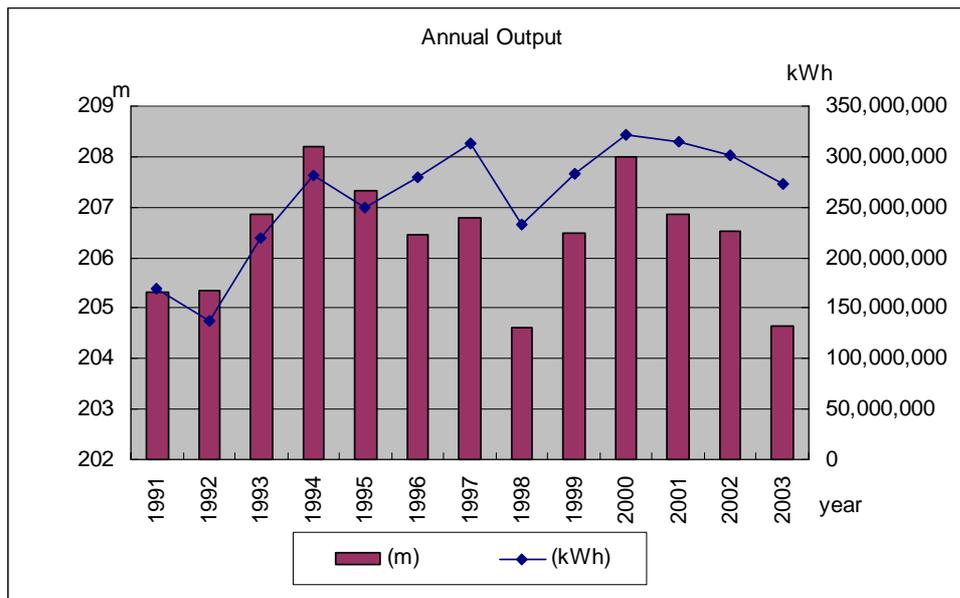


Figure -3-5 Annual Total Output (No.5 Power Unit)

(2) Changes in annual operating hours (No. 5 Power unit) (Fig. -3-6 annual total operating hours)

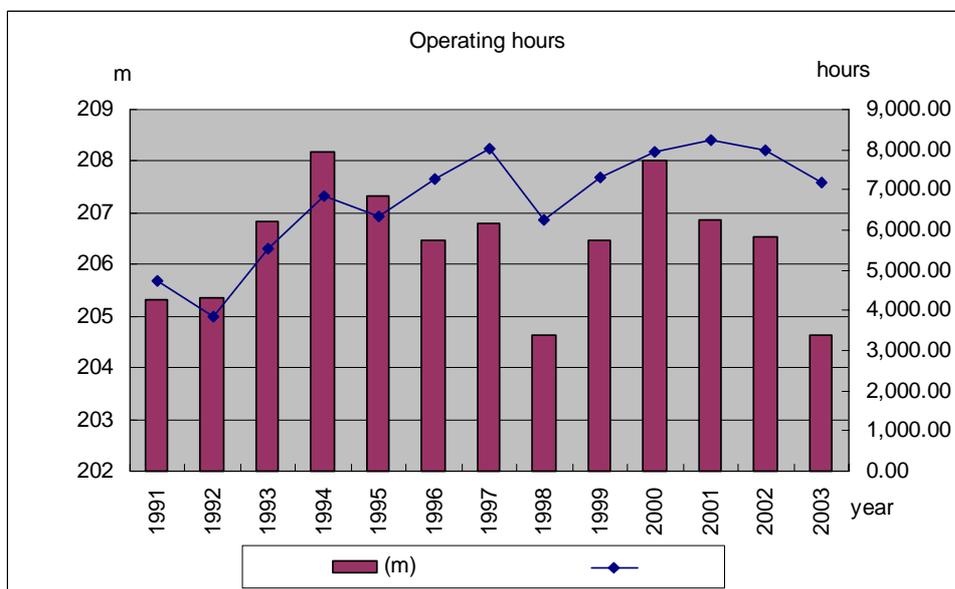


Figure -3-6 Annual Operating Hours (No.5 Power Unit)

This figure shows that in 2003, despite the low average water level due to the scarce water resource, total annual operating hours did not decrease significantly.

Compared to other years under the similar trend (1991, 1992, 1998), the annual operation

time is lengthened.

(3) Changes in average power output (No. 5 unit)

Figure -3-7 shows that in 2003 despite the scarce water resource and low average water level, average generated output did not decrease significantly.

Compared to other years under the similar condition (1991, 1992, 1998), the operation efficiency is obvious.

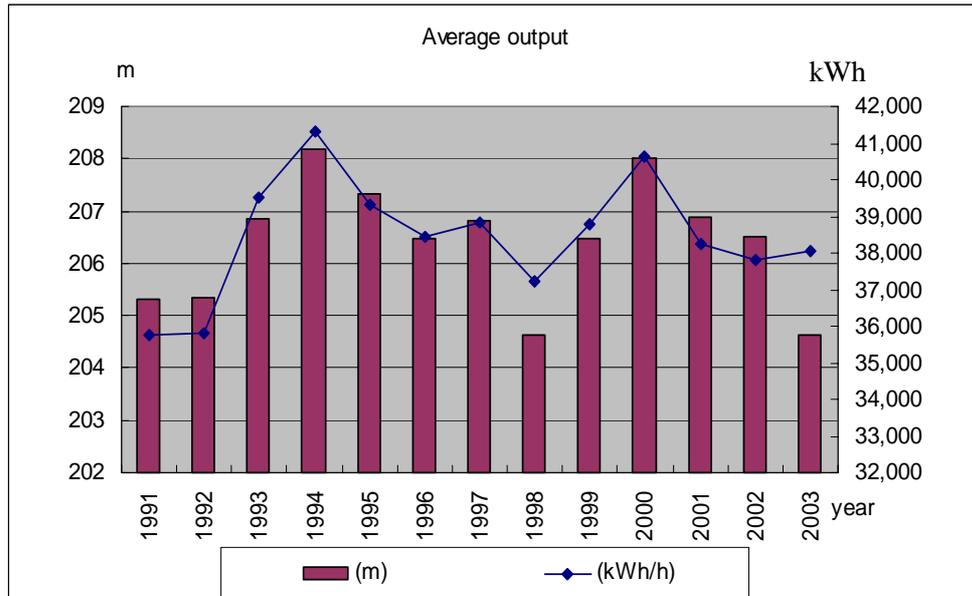


Figure -3-7 Annual Average Output (No.5 Power Unit)

#### 4. Energy Audit on Factory of Textile 55 Co. Ltd.

We visited a garment factory located in Vientiane city and conducted a survey on their energy conservation activities. In Lao PDR, the garment industry is the second largest industry after the power generation industry and an important industry in terms of acquisition of foreign currency.

The survey was conducted with the following date and members.

Date of survey:	Morning, Tuesday November 16, 2004
Examiners:	Messrs. Hideyuki Tanaka, Fumio Ogawa, Keiichi Yoneda and Yoichi Kita: Technical experts of International Engineering Dept., ECCJ
Participants:	Mr. Sisoukan SAYARATH (MIH, Lao PDR) Mr. Christopher Zamora (ACE)
Interviewees:	Textile 55 Co. Ltd. Mr. PAPIN (Factory Manager) Mr. WATT (Stuff)

##### 4.1 Outline of Factory of Textile 55 Co. Ltd.

This is a small-to-medium-sized garment factory where casual pants and jackets are manufactured for export.

The head quarters are in Thailand and this garment factory in Vientiane was constructed about 6 years ago.

After purchasing closing fabric, sewing/labeling/packing are done in this factory. Most of the products are apparently exported to European Union (EU).

The general manager of the factory, who is a French person living in Asia for many years, has been associated with the Thai owner over 20 years and is entrusted with the management of the factory from the opening of the factory. He said that he and Thai owner could take heart-to-heart communication with each other although they spoke only their own languages.

The brand's characteristics are low prices and good quality and the scale of the management staff is minimized (about 15 people).

Recently the second factory has been constructed and products for selling in supermarkets are manufactured there. 10 experienced workers are transferred from this factory each time to help upgrade the manufacturing level of the new factory.

The scene of workers in workplace of Textile 55 Co. Ltd Factory is shown in Photo -4-12.

- (1) Product: Casual wear (Pants 90%, Jacket 10%),  
Importing of materials and exporting of all products
- (2) Production volume: 60,000 pieces/month

(3) No. of employees: 568

(4) Working hours: 8:00~17:00 from Monday through Saturday  
Sometimes overtime working until 19:00  
No shifts



Photo -4-1 Workers at Work in Textile 55 Co. Ltd Factory

#### 4.2 Analysis of the Current Condition and Results

##### (1) Equipment in the factory

Under Mr. PAPAN's guidance, we conducted a site survey of the factory. We toured from the upstream to downstream of the manufacturing process and then, to utilities to check the current condition of the equipment.

##### Auditing flow

Pattern making place → Yard of materials → Cutting of clothing fabric → Numbering and sorting → Sewing by sewing machine in 5 lines → Checking and adjustment → Production of sample products → Compressor and boiler

There was no air conditioner in the factory except in the office, and only natural draft, ceiling fans and local fans were used.

Equipment of each spot in manufacturing process is as follows;

- 1) Warehouse for clothing fabric: Fluorescent lamps
- 2) Paper pattern cutting: Fluorescent lamps
- 3) Clothing fabric cutting: 5 or so small-size electric cutting machines, fluorescent lamps
- 4) Numbering of cut fabric (Stamping): Fluorescent lamps, ceiling fans
- 5) Machine-sewing: 230 sewing machines, fluorescent lamps, ceiling fans
- 6) Adjustment/finishing: Fluorescent lamps, ceiling fans
- 7) Packing/picking broken thread/ironing/hole-checking/putting price tags and labels: Small sized air compressor, air blower and electric heating boiler

## (2) Specification of major equipment

- 1) Sewing machine: 1.3 HP = 0.975KW × 230 units
- 2) Ceiling and floor fan: 0.5 HP × many
- 3) Electric heating boiler: 380V, Max 5.5 kg/cm<sup>2</sup> Specification not known
- 4) Air compressor: 3 HP, 5kg/cm<sup>2</sup>
- 5) Air conditioning: Several units are in use in the office
- 6) Lighting fixture: Many pair-type fluorescent lamps
- 7) Iron: 5 units
- 8) Emergency generator: Not installed

## (3) Manufacturing cost

Monthly manufacturing cost: US\$ 60,000 – 65,000/M

Personnel expense accounts for 80% (approx. US\$85/month/person on a factory-wide average) and energy cost (electricity charge) accounts for 3.2 – 3.4%.

## (4) Annual energy consumption

Electricity: Average for January to December 2003: 27,333kWh/M  
(= US\$1,552/M)

Average for January to September 2004: 29,290kWh/M (= US\$2,066/M)

Increase in electricity unit charge: January 2003 = 545Kip/kWh (¥1 = 100Kip)

September 2004= 826Kip/kWh (1.52 as much of that of Jan. 2003)

Electricity unit charge is extremely high compared to commodity prices.

Electric consumption by individual equipment is not measured and only the total monthly electricity consumption for the entire factory is obtained from receipts. No energy other than electricity is used. There is little water consumption and municipal water service is sufficient for the use of the factory.

(5) Energy conservation activities practiced

We toured the factory following the casual wear manufacturing process (in the order of numbers in (1) above). Although the electricity is used in many places, as the consumed amounts are small in all places and energy conservation will be hardly effective. Energy conservation efforts that have been made to date include completely turning off individual lights where it is light enough and individual switches where fluorescent lamps are removed.

The air conditioning equipment has not been used for about 5 years and air conditioning of the factory was shifted to ventilation by opening windows and ceiling fans.

They say this is preferable for the working environment.

Only 2 persons, Mr. Papin, Plant Manager and Mr. Watt, a young engineer, are in charge of management and they look quite busy. Although the parent company urges cost reduction, only small-scale energy conservation is practical and no measure has been taken. However, they were concerned about the ever-increasing electricity charge.

#### 4.3 Proposed Improvements and Expected Effects

All the ceiling fans were in operation. The number of fans to be put in operation should be controlled depending on the rain season or dry season.

The size of the steam piping is small. Although thermal insulation was installed around the pipes, it had dropped in some parts. Thermal insulation should be enhanced.

## 5. Results on Seminar-Workshop

### 5.1 Summary

Mr. Houmphone, Director General of Department of Energy of MIH, expressed his strong support for the promotion of the theme of the current program in his speech that he made representing Lao PDR ahead of other speakers in the opening remarks. Mr. Houmphone, who had been responsible for the engineering management of Nam Ngum Hydraulic Power Plant until 1985, has a profound knowledge of energy. Mr. Tanaka of ECCJ told Japan's way of contributing to this project, the meaning of the theme of the current program, etc. Seminar-Workshop was well organized and proceeded smoothly and was concluded with great success. The following positive factors contributed to this result.

We could have a discussion time with ACE and Lao PDR on the previous day and could prepare and distribute the updated agenda and handouts for Seminar-Workshop. Accordingly, the audience could understand the overall structure of the session and the content of each subject.

MC (Mr. Zamora of ACE)'s time management was very appropriate.

Partial use of English/Lao PDR interpreter for only key points of the session underlined the points of the session and thus made it easy to understand. It also helped save time. In addition, as Mr. Khamso of MIH served as an interpreter, his translation of technical terms and technical matters was accurate and proper.

Each presentation had enriched content and most participants listened to the end ardently. There was also a Q and A time with the audience of the conference.

MC did a good job. Responding to the request for approval on the promotion of Technical Directory and DB/BM/GL proposed in the end of the session, the majority of the participants raised their hands. The session was concluded with great success.

This Seminar-Workshop received Lao PDR state television coverage, and the conference was videotaped (Aired on evening news on 7:00 P.M.) It was a very meaningful event in the light of promotion of energy conservation to general public.

(1) Venue: Lane Xang Hotel, Vientiane, Lao PDR

(2) Content of reports/presentations made in Seminar-Workshop  
Shown in Attachment Program

(3) Participants

List of participants from Lao PDR is contained in attached material. Foreign participants included:

ACE: Mr. Christopher G. Zamora, Manager

Foreign presenter:

Mr. Hishamudin Ibrahim

Pusat Tenaga Malaysia (PTM), Malaysia Energy Center  
Messrs. Hideyuki Tanaka, Fumio Ogawa, Keiichi Yoneda and Yoichi Kita,  
Technical experts of International Engineering Dept., ECCJ

As the list of participants shows, total number of attendees was 48 including foreign participants in addition to 42 from Lao PDR.

## 5.2 Discussions on the Results of the Survey (Barriers in Implementation / Promotion of Energy Conservation Plans and Countermeasures)

The energy situation in the nation of Lao PDR, problems lying in the way of promoting energy conservation etc. are, as Mr. Khamso of MIH explained in the Seminar, that per capita annual consumption of primary energy in Lao PDR is as little as 0.16 toe and about half of it is used in households, that laws concerning energy conservation are yet to be laid down, that the nation's population is small and scattered in local areas and the resulting difficulty in energy supply makes a big obstacle, etc.

The importance of the hydraulic power generation in Lao PDR was easily recognized through the current follow-up survey, in which we knew that high-level energy conservation measures were implemented in Nam Ngum Hydropower Plant and that Mr. Sisoukan Sayarath, the chief of MIH Electricity Management Division (EMD), took part in a joint project with JICA to work on the improvement of hydraulic power generation.

On the other hand, as Table -5-1 below shows, domestic power needs are growing and domestic sale surpassed export and the environmental assessment of large-scale hydraulic power generation such as Nam Then 2 has been tightened. Thus, the circumstances that affect hydraulic power generation are changing and it is anticipated to be a future challenge to advance the development of hydraulic power while coordinating with such changes in circumstance.

## 5.3 Discussions on the Policy of Creation of Technical Directory for Hydraulic Power Industry

It was agreed that out of the energy conservation measures implemented in Nam Ngum Hydropower Plant, the repair of cavitations of the hydraulic turbine that produced the maximum results was appropriate because of its wide range of impact.

## 5.4 Discussions on the Policy of Development of Database/Benchmark/Guideline for Hydraulic Power Industry

As it was the first time we gave explanations on Database/Benchmark/Guideline in Lao PDR this time, we explained them in detail in the Seminar. We reconfirmed their awareness of its importance and their consent to the promotion of development of DB/BM/GL. Specific framework and work-sharing need to be further discussed in the future.

Table -5-1 Highlights of the year

Descriptions	Unit	Year	Year	Percentage (%)
		2003	2002	Increase/Decrease
Installed Capacity	MW	271.5	271.5	0.00
Generation of Energy	GWh	1,319	1,570	16.17
Import of Energy	GWh	229	200	14.50
Energy Sales	GWh	1,319	1,538	14.23
Domestic sales	GWh	884	766	15.40
Export	GWh	435	771	43.57
Revenue from Domestic Sales	Million kip	343,785	242,438	41.80
Revenue from Export	Million kip	133,732	228,173	41.39
Finance				
Total revenue	Million kip	682,527	619,560	10.16
Total Expense	Million kip	509,902	500,015	1.98
Profit (losses) before tax	Million kip	172,627	119,545	44.40
Corporate tax	Million kip	21,909	13,495	61.76
Net Profit	Million kip	150,716	106,050	42.12
Number of Employees	persons	2,930	2,826	3.68
Transmission / Distribution Line				
115 kV Transmission line	km-circuit	1,013.23	761	33.11
35 kV Transmission line	km-circuit	167	167	0.00
22 kV Transmission line	km-circuit	7,969	5,916	34.70
0.4 kV Transmission line	km-circuit	6,261	5,993	4.47
115/22 kV (Substation)	No.	16	12	33.33
Installed Capacity	KVA	322	281	14.60
Number of Transformer	Unit	5,569	4,654	19.66
Installed Capacity	KVA	1,001,730	876,905	14.23
Provincial Agencies	No.	13	12	8.33
Number of Consumer (meters)	No.	355,651	308,024	15.46

## . **Malaysia (Textile industry)**

### 1. Outline of Activities

We conducted a follow-up survey on a company that underwent an energy audit in the previous round (January 15-19, 2001) and gave Seminar-Workshop that included reports on the practical examples of energy conservation in various industries in Malaysia.

#### 1.1 Period

November 22-26, 2004

#### 1.2 Venue

Follow-up survey: Taiping City (about 250km North-northwest of Kuala Lumpur)  
Seminar-Workshop: Putrajaya City (Suburb of Kuala Lumpur)

#### 1.3 Schedule

November 22 (Mon.)	Had a meeting and coordinated the schedule in PTM in Kuala Lumpur (Pusat Tenaga Malaysia, Malaysia Energy Center) and later moved to Taiping City.
23 (Tue.)	Visited Arab-Malaysia Development Berhad (AMDB) Co. and conducted a follow-up survey. Moved back to Kuala Lumpur in the evening.
24 (Wed.)	Had a meeting and prepared materials for Seminar-Workshop in PTM
25 (Thu.)	Held Seminar-Workshop in Marriott Putrajaya Hotel
26 (Fri.)	Reviewed Seminar-Workshop in PTM

#### 1.4 People involved

ACE (ASEAN Center for Energy):

Mr. Weerawat Chantanakome: Executive Director  
Mr. Christopher G. Zamora: Manager

Malaysia Focal Point: PTM

Mr. Asfaazam Kasbani: Program  
Ms. Azah Ahmad: Research Officer, EISD

Technical experts from Japan:

Messrs. Hideyuki Tanaka, Fumio Ogawa and Keiichi Yoneda  
Technical experts of International Engineering Dept., ECCJ

## 2. Latest Situation of Energy Conditions and Industries in Malaysia

### 2.1 Energy Situation in Malaysia

#### (1) Overview

Malaysia's economy has exceeded its forecast GDP growth after achieving real GDP growth of 5.3% as compared to 4.1% in 2002. Higher volumes of export and lower interest rate have been able to offset global economic uncertainties due to an outbreak of Severe Acute Respiratory Syndrome (SARS) during the first half of the year. Apart from strong economic fundamentals coupled with supportive monetary and financial policies, the stable government leadership lends extra weight towards the continuity of positive growth for Malaysia.

In the energy sector, the final energy demand for 2003 recorded a positive growth of 3.9%, lower than the previous year's figure which was 5.6%. On the other hand, final energy supply marked a 13.4 % growth in 2003 as compared to 0.6 % in 2002.

Overall, growth in the energy sector was driven by both supply and demand factors. The supply growth was driven by three major factors. First, energy supply grew due to the successful commissioning of four new power plants, which resulted an increase of total installed capacity in the power sector. Secondly, higher import levels of coal for existing coal power plants and the completion of PETRONAS's third LNG plant (MLNG3) in Bintulu to support higher demand of LNG here in Malaysia. .

On the demand side, almost all sectors exhibited growth in their consumption of energy for the year 2003 with industrial and transport making their mark due to growth of manufacturing and construction sectors. These developments contribute towards expansion of the Malaysian energy sector

#### (2) Energy Situation in Industry

In 2003, total final energy demand was recorded at 34,586ktoe, an increase of 3.9 percent compared to 5.6 percent in 2002. This was mainly due to increased spending by consumers in the industrial and transport sectors. Transport sector remained as the leading consumer of final energy demand accounting for 41.3 percent after registering an increased of 6.2 percent of growth. The share of industrial sector also increased to 39.0 percent after recording 4.8 percent growth from previous year. The growth was largely contributed by the manufacturing sector, which was supported by increases in exports and strong domestic demand. The share of both residential and commercial sectors remained about 13 percent during the same period.

Analysis on the demand of fuel type showed petroleum products decreased marginally from 62.0 percent in 2002 to 61.2 percent in 2003. Of this share, motor petrol and diesel were the major contributors at around 34.9 percent and 40.3 percent respectively. The share of natural gas stabilized at 17.0 percent and electricity at 18.3 percent in year 2003.

### (3) Energy Situation in Textile Industry

In general, energy in the textile industry is mostly used in the forms of: electricity, as a common power source for machinery, cooling and temperature control systems, lighting, office equipment, etc.; oil as a fuel for boilers which generate steam; Liquefied Petroleum Gas (LPG); coal; and natural gas

## 2.2 Situation of Industry in Malaysia

### (1) Overview

Malaysia, a middle-income country, transformed itself from 1971 through the late 1990s from a producer of raw materials into an emerging multi-sector economy. Growth was almost exclusively driven by exports - particularly of electronics. As a result Malaysia was hard hit by the global economic downturn and the slump in the information technology (IT) sector in 2001 and 2002. GDP in 2001 grew only 0.5% due to an estimated 11% contraction in exports, but a substantial fiscal stimulus package equal to US \$1.9 billion mitigated the worst of the recession and the economy rebounded in 2002 with a 4.1% increase. The economy grew 4.9% in 2003, notwithstanding a difficult first half, when external pressures from SARS and the Iraq War led to caution in the business community. Healthy foreign exchange reserves and a relatively small external debt make it unlikely that Malaysia will experience a crisis similar to the one in 1997, but the economy remains vulnerable to a more protracted slowdown in Japan and the US, top export destinations and key sources of foreign investment. The Malaysian Ringgit is pegged to the dollar, and the Japanese central bank continues to intervene and prop up the yen against the dollar

During the last decade, Malaysia's trade expanded by 2.3 times to reach RM716.6 billion, with exports increasing by 2.6 times to RM398.9 billion and imports doubling to RM317.7 billion. Today, Malaysia is the world's 18th leading exporter and 20th leading importer.

The manufacturing sector now accounts for 30.8% of Malaysia's GDP while exports of manufactured goods make up 82% of the country's total exports. From being the world's largest producer of rubber and tin, Malaysia is today one of the world's leading exporters of semiconductor devices, computer hard disks, audio and video products and room air-conditioners.

Malaysia's rapid industrialization was the result of the country opening itself relatively early in the 1960s to foreign direct investments (FDI). Today, its market-oriented economy, combined with an educated multilingual workforce and a well-developed infrastructure, has made Malaysia one of the largest recipients of FDI among developing countries. The Institute for Management Development (IMD) in its 2004 World Competitiveness Yearbook ranked Malaysia as the fifth most competitive country in the world (for countries with a population of greater than 20 million), ahead of countries such as Germany, United Kingdom, Japan and Mainland China. In addition, according to the latest Offshore Location Attractiveness Index compiled by the global management consulting firm A.T. Kearney, Malaysia is among the top three contenders for off-shoring

business in the world. In its report, A.T. Kearney considers Malaysia a “natural choice” for offshore services in view of its low costs, particularly for infrastructure, the most attractive business environment among emerging markets, and high levels of global integration. For more details on Malaysia’s expected projected economic growth, please refer to Table -2-1 below.

Table -2-1 Malaysia’s Key Economic Indicators

<b>Malaysia Key Economic Indicators</b>		
	<b>2003<sup>e</sup></b>	<b>2004<sup>f</sup></b>
<b>Population</b>	25.0 million	25.6 million
<b>GDP</b>	RM229.3 billion (US\$60.3 billion)	RM241.8 billion (US\$63.6 billion)
<b>GDP Growth</b>	4.5%*	5.5%-6.0%
<b>Per capita income</b>	RM14,343 (US\$3,774)	RM14,954 (US\$3,935)
<b>Inflation rate</b>	1.5%	1.5 - 1.9%
<b>Labour force</b>	10.5 million	10.8 million
<b>Unemployment</b>	3.5%	3.4%
<b>Total export (f.o.b.)</b>	RM368.9 billion (US\$97.1 billion)	RM392.5 billion (US\$103.3 billion)
<b>Total import (f.o.b.)</b>	RM306.0 billion (US\$80.5 billion)	RM325.2 billion (US\$85.6 billion)
<b>Major exports</b>	Manufactured goods (electronic products, chemicals and plastic products, wood products, iron and steel products, metal products, and petroleum products).	
<b>Major imports</b>	Intermediate goods (thermionic valves and tubes, primary and processed industrial supplies, parts and accessories of capital goods, primary and processed fuel lubricants, and parts and accessories for transport equipment).	

e – estimated, f - forecast

(Source: " Economic Report 2003/2004" published by the Ministry of Finance, Malaysia)

\* Actual GDP growth in 2003 was 5.2% (Bank Negara Malaysia 2003 Annual Report)

(2) Situation of Textile Industry including Promotion in EE&C

The textile industry in Malaysia was a cottage industry until recent times.

When Singapore began to implement increases of over 200% in the minimum wage for textile workers over the course of 15 years, textile companies from Singapore began to relocate across the border. The textile and apparel industry of Malaysia was ranked as the country's fourth largest export earner in 2001, bringing in just under \$2.7 billion. The workforce of 150,000 employees ranks it as the second largest source of employment in the country.

The textile industry in Malaysia is divided into two major segments: fiber-weaving, yarn-spinning, clothing manufacturing and dye and print industry; and the manufactured garment products and other fabric accessories-- such as gloves, bags, hats, carpets-- plus textile machinery and equipment.

The apparel sector is facing rising costs of production due to a tight labor market and increasing wages for workers. The government has approved 218 textile-manufacturing projects. In addition, a large number of textile mills are known to be operating without any manufacturing license.

Among the major export markets for Malaysia's apparel industry, the U.S., Europe and Canada currently impose annual quotas on the volume of apparel that can be imported from Malaysia. Malaysia's Ministry of International Trade, in turn, sets quotas for individual exporters. However, those quota restrictions are expected to be lifted in 2005, as part of the Asean Free Trade Agreement and a general opening of world trade.

Since quotas have driven Malaysia's textile business, the bulk of exports have consisted of "low-end commodity apparel" or items that are manufactured under contract. In order to compete with countries with lower labor costs (such as China, Indonesia, Vietnam and Thailand), Malaysia's industry are now intending to move into higher-value commodity apparel and specialty markets. Technical experts agree that the country must also deal with the high cost of labor, a tight labor market and a lack of research and development.

Malaysia mainly concentrates on being a contract textile manufacturer. Among the major world brand names Malaysian manufacturers produce include: Adidas, Arnold Palmer, Active Wear, BUM Equipment, Calvin Klein, Christian Dior, Gucci, Guess, Donna Karan, YSL, Levi's, Nike, Padini, Polo, Ralph Lauren, Reebok, Slazenger, Pierre Cardin, Camel, Mizuno and Montagut. Due to the situation above, Malaysia's dyeing, accessories, printing and finishing sub-sectors are lacking and limited to selected products.

Recently, the effect of the SARS epidemic has also hurt the Malaysian industry. As a result, the Malaysian Garment Manufacturers Association (MGMA) asked the Ministry of International Trade and Industry to further lower duties on fabric imports from 15% to a 0-5% range. (Tariffs had already been cut from 20% to 15% in 1999.)

Still, the industry's internal efficiencies must be improved if the country is to compete when the WTO agreement to eliminate tariffs and quotas comes into

effect in 2005. For these reasons mentioned above, Malaysian textile manufacturers realize that energy efficiency is one way of maintaining their competitive edge in the world market.

Promotion of energy efficiency and conservation measures has been carried out in two ways for the Malaysian textile industry. The first of which is indirectly through the promotion of Cleaner Technology efforts in Malaysia through the Standards and Industrial Research Institute of Malaysia (SIRIM) as the implementing agency. The second is through the Ministry of Energy, Water and Communications via Pusat Tenaga Malaysia. Pusat Tenaga Malaysia as the implementing agency carried out many energy promotion efforts either on its own or through collaboration with international agencies such as the Energy Conservation Center of Japan and UNIDO.

#### 1) Cleaner Technology in Malaysian textile industry

As a promotion measures by the Malaysian government for End Of Pipe technology treatment, there have been specific measures introduced as investment incentives. To be specific, for companies involved in the storage, treatment, and disposal of toxic and hazardous wastes, income tax will be charged on only 30% of the statutory income for 5 years, or a 60% investment tax allowance will be given for capital expenditures for 5 years. Furthermore, import taxes and sales taxes will be exempted for such machinery, equipment, raw materials, and components.

Aside from toxic and hazardous waste-related matters, environmental protection equipment is given an initial tax credit of 40% and an annual credit of 20% for 5 years. In addition to such tax credits, a commendation is awarded to companies, which contribute to environmental protection. It was named the Hibiscus Award and was elevated in 1999 as the Prime Minister's Hibiscus Award.

Also, efforts are under way to promote CT. For example, from 1996 to 1998 a program called The Promotion of Cleaner Technology in Malaysian Industry was conducted by Standards and Industrial Research Institute of Malaysia (SIRIM), in cooperation with Danish cooperation for Environment and Development (DANCED). This program involved consultation with small and medium size enterprises (SMEs), demonstration projects, workshops, etc., aimed at the dissemination of CT. The target industries were food, textiles and electroplating. The results of those actions have been summarized in the table -2-2 2.

Table -2-2 Results of the Promotion of Cleaner Technology  
in Malaysian Industry: examples

Industry	Reduction	Pay back time
Food	150,000kWh of electricity 4,200m <sup>3</sup> of water	0.5 - 1.5 years
Textiles	136m <sup>3</sup> of light fuel oil 8,000m <sup>3</sup> of water	1 - 1.5 years
Electroplating	Subsidiary chemical 75% of water	< 3 months

(Source: SIRIM)

The Food Industry, for example, reduced its consumption of electricity and water following the introduction of CT. The initial investment required for the introduction of CT was recovered within 0.5 - 1.5 years. The Textile Industry reduced its consumption of light fuel oil and water, recovering its investment within 1 - 1.5 years. The Electroplating Industry reduced its consumption of additive chemicals and water, recovering its investment within 3 months. It is apparent that CT reduces production costs; and economically speaking it is technology worth the investment.

## 2) Energy efficiency in Malaysian textile industry

The second method, by which energy efficiency efforts have been executed, is through collaborations with the Ministry of Energy, Water and Communications as well as its implementing agency, Pusat Tenaga Malaysia. Long ago in 1992, UNIDO, with the financial support of the Japanese Government, carried out a regional programme on the promotion and application of energy saving technologies in selected Asian developing countries. This programme was aimed at adopting innovative energy conservation technologies, developed in Japan, to the conditions of developing countries. For this reason, a Handy Manual on Textile Industry was prepared by UNIDO, with the cooperation of technical experts from the Energy Conservation Center (ECC) of Japan, on energy saving technologies in the framework of the above mentioned UNIDO project. It is based on the results of the surveys carried out, the plant observations and the recommendations and suggestions emanating from the Seminars on Energy Conservation in the Steel and Textile Industries, held under the same project in January 1992 in Jakarta, Indonesia, and Kuala Lumpur, Malaysia.

Nearly nine years later, ECCJ then proceeded to conduct an energy audit in one textile factory as requested by the Malaysian government in 2001. The factory selected, Arab Malaysian Development Berhad Textile Plant was

audited as part of the Promotion of Energy Efficiency and Energy Conservation activities organized by ECCJ in collaboration with the ASEAN Centre for Energy (ACE). The factory is a small factory with an annual turnover of RM 60 million. It mainly produces 100% cotton products along with polyester, cotton and viscose blends of the woven type in either dyed or finished forms. The products are exported to both the local market as well overseas markets such as Australia, New Zealand and the European Union (EU).

The following recommendations made together with the assistance of the Pusat Tenaga Malaysia team members were divided into three main energy-consuming areas as follows:

- Pre-treatment range (Perble range)
- Stenter (Artos Stenter No. 3)
- Boiler and steam distribution system

Altogether, the implementation of these measures would provide potential annual cost savings of up to USD 63,142. Subsequently, having been impressed with the potential cost saving measures, the factory management decided to implement some of the measures recommended and execute measures that were proposed by the in house technical team. Over the course of the next three years, the following measures were actually implemented by Arab Malaysian textile plant: -

- Replacement of old boilers
- Reduction of boiler daily operation time
- Improved weekly maintenance of existing steam traps
- Auto Temperature Control for steam supply for Washing Basins.
- Convert to Natural Gas burning for our Steam Boiler

By carrying out the combined measures, the factory has achieved annual savings of USD228,000 that is nearly four times higher than recommended! This is clearly a key example of how a little promotion by the ECCJ, ACE and PTM can actually go a long way in motivating this factory to achieve major cost and energy savings. It is hoped that in the future that these energy audits can be extended by the technical experts from the respective agencies above to the rest of the Malaysian textile sector.

## 2.3 Situation in Malaysia

### (1) General condition

Supplemental data for Table -2-1.

- Area: About 330,000 km<sup>2</sup> (approx. 0.9 times as large as Japan)
- Religion: Muslim (Federal religion), Buddhism, Confucianism, Hindu, Christian, Aboriginal religion
- System of government: Constitutional monarchy (Parliamentary democracy)
- Economy:
  - Major industries: Manufacturing industry (electric equipment), Agriculture and Forestry (natural rubber, palm oil, timber) and mining (tin, crude oil, LNG)
  - Economic growth rate: 7.1% (2004)
  - Currency: Ringgit
  - Fixed exchange rate since September 2, 1998:  
US\$1 = 3.8Ringgit
- General economic condition: Although minus growth was recorded in 1998, Malaysia's economy is on a recovery track centered at the manufacturing industry. Since 2002, positive growth has been maintained.

### (2) Energy situation in Malaysia

The states of energy supply and energy consumption in Malaysia are shown in Figure -2-1. Malaysia produces ample oil and gas and about half of the production is exported. Accordingly, oil and gas hold large shares in energy supply and the share of RE is extremely small among the 4 countries.

In energy consumption, the transport sector is the second, following the industry sector and over 80% of the total energy is consumed by these two sectors.

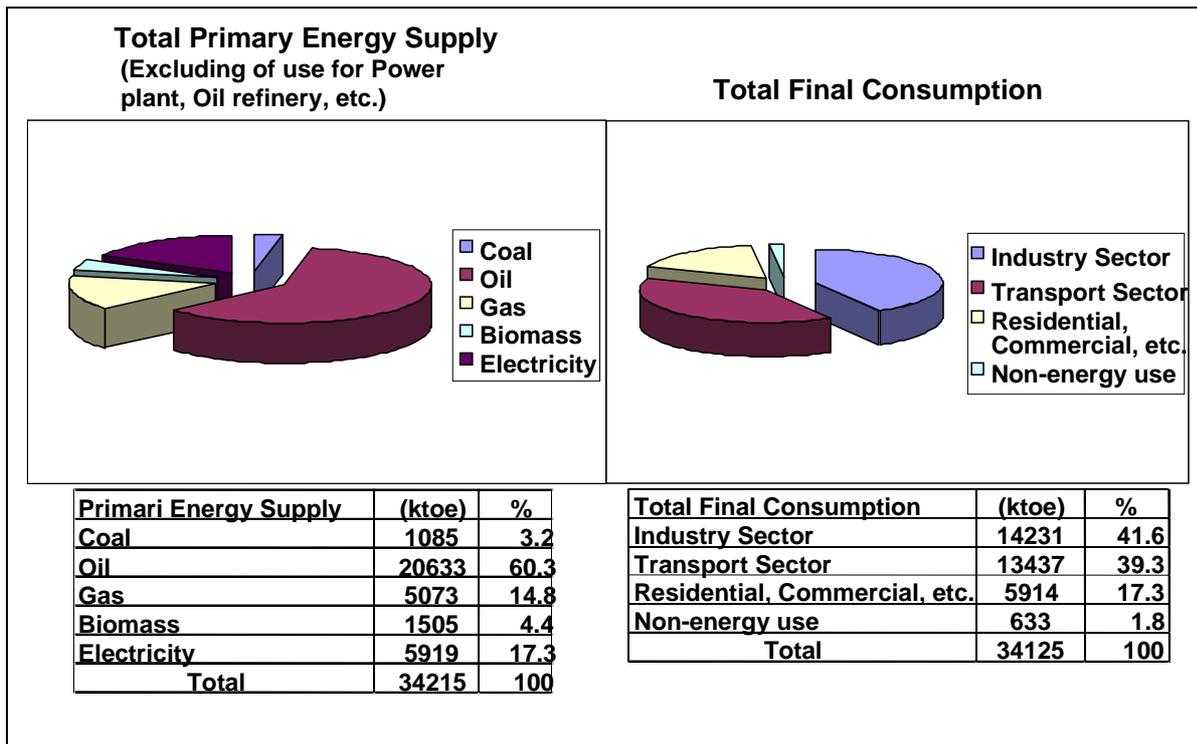


Figure -2-1 Malaysia -Energy Balance in 2002  
(Source: IEA Energy Balance - Edition 2004 -)

### 3. Follow-up Survey on AMDB Factory in Taiping

#### 3.1 Outline of AMDB Taiping Factory

##### (1) Company profile

- Co. name: Arab-Malaysian Development Berhad (AMDB Co.)
- Location: Kamunting Industrial Estate, 34600 Kamunting, Taiping, Perak,  
P.O. Box 9834008 Taiping, Perak, Malaysia  
Tel: +605-891-4000 Fax+605-891-2900
- Capital: RM 291 million (approx. US\$ 11.1 million @26.2RM/US\$1)
- Product: 100% cotton fabric, Polyester-cotton blended fabric,  
Polyester-viscose blended fabric, 100% polyester fabric  
(Production of this type of fabric was started 2 years ago. Dyeing is  
outsourced and finishing processing only is carried out in this  
factory.)
- Production volume: 9,895,600m (2000)  
5,825,747m (2003: 59% of 2000)  
4,312,907m (Jan.–Sept. 2004)
- Market: Australia, New Zealand, EU, and within the country
- No. of Employees: 243 (2000, Dyeing division)  
200 (2004, Dyeing division)  
Due to the market condition, production volume dramatically  
dropped compared to the time of the previous audit (January 15-19,  
2001) and the workforce was downscaled accordingly.
- Operation system: 24 hours/day, 3 shifts

##### (2) Dyeing and finish processing flow

Raw cloth → Inspection → Sewing → Gas-singeing → Desizing/Scouring/Bleaching →  
Mercerizing → Dyeing → Resin treatment → Sanforizing → Inspection → Packaging →  
Shipping

##### (3) Equipment installed in factory

###### 1) Bleaching equipment

- Benninger Bleaching Machine (Singeing machine, Bleaching machine, 40-cylinder  
drying machine) - Benninger/Switzerland: One unit
- Continuous Bleaching Range (Singeing machine, Perble Range, 40pce-cylinder drying  
machine) - Santo Tekko/Japan: One unit
- Mercerizing machine -Santo Tekko/Japan: One unit

2) Dyeing equipment

- Continuous Dyeing Range - Santo Denko/Japan: One unit
- Continuous Dyeing Range - Babcock/Germany: One unit
- 30pce-cylinder dryer - Luen Fung/Hong Kong: One unit
- Jigger - Luen Fung/Hong Kong: One unit
- Cold Batch Dyeing Machine - Babcock/Germany: One unit

3) Finishing equipment

- Stenter - Babcock/Germany: 3 units
- Curing machine - Bruckner/Germany: One unit
- 5 Bowl Friction Calender Machine - Kyoto Machinery/Japan: One unit
- Sanforizing Machine - Morrison/USA: 2 units
- Emerizing Machine - Sucker/Germany: 1 unit

4) Utility

- Steam boilers: 16t/h: One unit, 11t/h: 3 units
- Screw-type air compressor: 8kg/cm<sup>2</sup>: One unit
- Water system: Municipal water service = 1,000m<sup>3</sup>/d,  
Pond and underground water = 2,500m<sup>3</sup>/d
- Effluent treatment equipment: Lagoon treatment

(4) Energy consumption status

Energy consumption of AMDB Company is shown in Table -3-1

Table -3-1 Energy Consumption of AMDB Co.

Energy		2000		2003	
		Consumption	Unit price	Consumption	Unit price
Heavy oil	kL	5,016	RM0.705/L	3,452	RM0.754/L
Diesel oil	kL	827	RM0.643/L	231	RM0.851/L
LPG	t	362	RM1.613/kg	283	RM1.818/kg
Electricity	MWh	2,469	RM0.168/kWh	1,846	RM0.286/kWh
Total cost	RM	5,067,331		3,841,046 (76% of total energy cost of 2000)	

(5) Operation status

- 1) As the operation at full capacity was no longer possible due to decreases in the number of orders received, only Benninger Bleaching Machine was running at full capacity in the bleaching process and the capacity operating rate of Continuous Bleaching Range, which was the central equipment for the

previous audit, was low and its operation was halted at the time of our visit.

- 2) Although there were 2 continuous dyeing machines, they apparently were placed in operation alternately depending on the material.
- 3) Out of the 3 stenters installed for the finishing process, one was completely brought down and No. 3 machine, which received an energy audit in the previous time, was in operation all the time with the other one in supplemental operation.
- 4) Out of the 4 boilers, the newly installed boiler (capacity: 16t/h) was in operation all the time with the other 3 as standby facilities.

### 3.2 Summary of the Results of the Previous Energy Audit

#### (1) Selection of equipment for energy audit

This factory has a woven cloth division and a dyeing finish division. Energy used in the woven material division is only electricity, while the dyeing finish division consumes a variety of energy, such as electricity, heavy/light oil and LPG and also consumes a large quantity of water. Accordingly, the focus of the previous energy audit was placed on energy conservation in fuel used in the dyeing finish division.

The whole process of dyeing finish consists of wet process such as scouring/bleaching and dyeing and dry process such as finishing process

The main equipment used in the wet process includes 2 continuous scouring/bleaching machines, one mercerizing machine and 2 continuous dyeing machines. All of these machines have a similar structure consisting of multi-tab washer having cylinder dryer in its rear end. The main equipment used in the dry process is three stenters

In the previous audit, due to the number of days available, the equipment surveyed was an old-type Perble Range continuous bleaching machine (hereinafter Perble Range) in the former process, which was installed in 1971 and apparently caused significant heat loss, and No. 3 stenter of the latter process. These machines were chosen by request from the factory.

Steam boilers used in this factory, though they were not the equipment for dyeing processing, had a low efficiency of 78% and were considered to be one of the problems to be improved. It was necessary to promptly start studying modernization of the overall boiler system (in terms of boiler efficiency, etc.) including change of boiler fuels.

#### (2) Suggestions for energy conservation

Recovery of cooling water of gas-singeing machine

Lower temperature setting of Perble Range washers (85–90°C → 80°C)

Reduction in water and energy consumption by adoption of counter-flow to Perble Range washers

Recovery of drainage and waste heat of Perble Range washers

Automatic stopping of water supply at the time of shutdown of machines of Perble Range

Energy conservation by replacing temperature controller of Perble Range steaming box  
Replacement of steam trap of Perble Range cylinder dryer  
Control of residual moisture of cloth in Perble Range cylinder dryer  
Control of exhaust air humidity of No. 3 stenter  
Modernization of boiler system (including improvement of boiler efficiency)

The energy conservation effect expected from the above improvement plans was estimated at RM 241,000/y (- US\$63,142/y) in total.

### 3.3 Results of the Follow-up Survey on the Improvements Proposed in the Previous Energy Audit

Results of the follow-up survey on the progress in the suggestions made in the previous energy audit are summarized below.

- (1) Date of survey: November 23 (Tue.), 2004
- (2) Examiners: Messrs. Hideyuki Tanaka, Fumio Ogawa and Keiichi Yoneda  
Technical experts of International Engineering Dept., ECCJ
- PTM Participants: Mr. Phubalan Karunakaran, Energy Audit Engineer  
Mr. MUhamad Muhtazam Noor Din, Technical Assistant  
Ms. Norazean Mohd. Nor, Technical Assistant
- (3) Interviewees of AMDB Co.:
- Mr. Leong Tuck Thoon (Mill Manager)
  - Mr. Mohd Nayan Mohd Isa (Production Manager)
  - Mr. Ong Chin San (Operation Manager)
  - Mr. Zail (Electrical Engineer)

#### (4) Follow-up survey

In the follow-up survey, we made an inspection tour of the factory and had a Q & A time with top managers of the factory. Although we had obtained the response to the questionnaire we requested in advance, it was only data on production volume and energy consumption. AMDB Co. had prepared material on its recent energy conservation activities.

- 1) Recovery of hot water from gas-singeing machine was practiced.
- 2) Repair and replacement of steam trap of cylinder dryer was 50% completed
- 3) Adoption of counter-flow, temperature control, etc. for water supply in Perble Range will continually be included in the agenda because these improvements require investment in facilities
- 4) Exhaust of No. 3 stenter was under control.
- 5) The following improvements were practiced after the previous energy audit with significant effects

a. Installation of a 16t/h boiler

Improved boiler efficiency: 78% → 85%  
Effect in money: RM720,000/y (= US\$189,500/y)

b. Automatic operation of boilers

Shortened boiler running time: 45min/d  
Effect in money: RM144,000/y (=US\$38,100/y)

c. Shifting fuel from oil to natural gas (to be completed in 2005)

Effect in money: RM 1,600,000/y (=US\$421,100/y)

During the current follow-up survey, we confirmed that gas piping was in progress outside the premises of the factory.

Out of the 10 improvement points suggested in the previous energy audit, 4 plans are already implemented or are being practiced, resulting in a 40 % achievement ratio. In terms of money, however, compared to the initially expected monetary effect of RM 241,000/y (= US\$63,142/y), the saving amount actually attained through these improvements is as much as RM864,000/y (=US\$227,000/y), at this point in time, which is about 3.6 times as much as that of the initial plan.

If fuel conversion is implemented, the cost reduction benefit will total RM 2,464,000/y (=US\$648,700/y), which is over 10 times as much as that expected initially.

What are completed or being practiced are suggestions , , and . Now that production volume has dramatically dropped, the capacity operating ratio of machines is low and accordingly they have apparently not been making significant effects in energy conservation. (On the contrary, due to the frequent machine shutdowns, energy consumption per unit quantity of production (energy intensity) may be higher than before). Energy conservation effects attained are shown in Table -3-2.

Table -3-2 Energy Conservation Effects Attained

Item			Energy conservation effect (RM/y)			
			Initial forecast	Actual result		
Perble Range			241,000 (US\$63,142/y)	Completed		
Gas-singeing machine		Recovery of cooling water			1 section completed	
Washer		Lower temperature setting ( 85 – 90°C → 80°C )				
		Adoption of counter-flow				
		Recovery of waste heat				
		Automatic stop of water supply following machine shutdown				
Cylinder dryer		Replacement of temperature controller of steaming box				Under study 50% completed
		Replacement of steam trap				Completed
		Control of remaining moisture of cloth				
No. 3 stenter		Control of emission volume				
Modernization of boiler system		Replacement of boiler	720,000			
		Shorter boiler running time	144,000			
		Boiler fuel conversion (heavy oil → natural gas)	[1,600,000]			
Total			241,000	864,000		

As shown in the above table, compared to the amount of cost reduction projected at the time of the previous audit, that is, RM241,000/y (= about US\$63,142/y), the actual result obtained is RM864,000/y (= about US\$227,600), which is about 3.6 as much. As the operation efficiency was as low as 78% when checked in the previous survey, we proposed comprehensive modernization of the boiler system that included boiler fuel conversion, which the top management accepted and implemented after studying. This is a significant result of this project.

### 3.4 Results of the Current Survey

The company's top officials and employees seem to be concerned with energy conservation in their respective capacities under the current circumstances of the company in which its production volume has been decreasing. Regrettably, however, energy conservation measures for the processing equipment proposed in the initial survey have not been advanced sufficiently. Therefore, as an immediate step, we recommended the following less costly energy conservation measures during the Q and A time.

- (1) What has the largest share in energy conservation in a dyeing factory is saving water, in

principle. At least a flow meter should be installed for each continuous bleaching machine, continuous dyeing machine, continuous washer, etc.

- (2) It is easier to control flow volume by cock than by valve, and cock is easier for operators to use. It is recommendable to change to cock-based control when valves are replaced.
- (3) As the easiest and cheapest water control method, it is recommendable to insert orifice in water supply pipe of washing tank.
- (4) Currently, warm waste water is discharged by caustic soda recovery equipment. Waste heat should be recovered by installation of heat exchanger.

### 3.5 Barriers to the Promotion of Energy Conservation and Countermeasures

#### (1) Good points

##### 1) Improvements concerning utilities

Out of the 10 improvement plans proposed in the previous energy audit in January 2001, 3 plans were put in practice and the remaining 7 were not yet implemented.

Because the effects from increased boiler efficiency after replacement of the boiler and its shortened running time after shifting to automatic operation were significant, with these improvements alone, approximately 3.6 times as much energy cut as that initially expected was realized. In addition, if boiler fuel is converted in 2005, the effect will further increase up to over 10 times of the initial plan, realizing significant cost cut.

In 2003, the energy cost for the year was RM3,841,046/y owing to the saved amount of RM864,000/y. This energy cost saving was equivalent to about 18.4% of that original amount without energy saving.

The effects achieved from such replacement of boiler and fuel conversion to natural gas scheduled for near future can be said the outcome of the awareness of energy conservation and cost reduction that successfully penetrated among top management of AMDB Company and managers of the factory as the result of the previous guidance of ECCJ and PTM, which gave them a momentum. In this sense, the previous energy audit and guidance were meaningful activities.

Fuel conversion, increase in boiler efficiency, etc. are technically not so difficult know-how. We strongly wish to press ahead with this example case to other companies and/or factories and raise energy conservation performance.

##### 2) Improvements concerning production

The factory of AMDB Company is, as a dyeing processing factory, well managed and almost no water leakage and steam leakage, which is often seen in small- and medium-size factories, was recognized. There were no strips of cloth or pieces of trash on the floor. In dyeing factories, water leakage and steam leakage often occur unless they are well maintained. In factories where steam piping has good thermal insulation and no water

leak and no steam leak occur, quality control of products and delivery management are often in good shape. In this context, in the case of AMDB Company, the management of the equipment affecting energy conservation is fairly good, though not sufficient.

(2) Points need to be further improved and worked on in the future

1) Energy efficient equipment

Although some measures for energy conservation are taken regarding the dyeing and finishing processing in the factory, as the production volume sharply decreased by almost half from the previous guidance and the capacity utilization rate of the major equipment dropped accordingly, not much energy conservation effects have been achieved.

The factory apparently hesitates over improvement of equipment that requires a large amount of investment.

Although the top management of the company and general manager and other managerial class of the factory are concerned with energy conservation, they should be more so. At least, as mentioned above, they should continue energy conservation activities in a step-by-step manner starting with improvement plans that do not require a large amount of investment and continue to work on the improvements suggested in the previous audit to realize them in stages, if possible.

Dyeing and finishing industry consumes a large quantity of water. In this industry, saving water eventually lead to energy conservation. Effective use of water is essential. In order to do so, as mentioned previously, the installation of a flow meter to the main equipment is critical. Meters capable of measuring integrated value and instantaneous value are preferable. Measuring equipment for basic management is necessary also from the viewpoint of developing/introducing/implementing Database/Benchmark/ Guideline, etc. It is worth considering.

In the meanwhile, the most important production equipment is aging and need to be renewed. In Japan and Indonesia, the machining speed of continuous bleaching machine is 100–150m/min, while it was 45–50m/min in AMDB Company.

The important thing in promoting energy conservation is to avoid impairing quality of product.

Energy conservation and water saving are premised on ensuring stable and good quality. Even though labor cost is low, manufacturers cannot win international competition without improved productivity, stable quality and reliable delivery. If they fail to meet quality and delivery demanded by the time, the market will turn away. How to recover order volume that decreased by half from 3 years ago will be a big challenge for the time being.

2) Promotion of energy conservation

For factories of a certain scale, it is desirable to assign person such as “Energy Conservation Officer”, who has knowledge of energy conservation, to each job place. It would be one way to regularly convene “Energy Conservation Committee” to discuss specific measures for implementing energy conservation, while enhancing the morale of

the entire workforce for energy conservation.

In the meanwhile, as the number of technical experts who actually carry out energy conservation is apparently small in the textile department, the education and training of technical staff are also critical.

As one of the measures to help promote the awareness of energy conservation among corporate management, administrative measures, such as incentives and preferential tax treatment for companies that have made significant effects and subsidies for investments in energy-efficient equipment, may be necessary.

## 4. Results of Seminar-Workshop

### 4.1 Summary

Seminar-Workshop was given as described below.

(1) Date and time

November 25 (Thu.) 2004 8:30-16:40

(2) Place

Marriott Putrajaya Hotel

(3) Reports and Presentations made in Seminar-Workshop

The program is contained in the attachment.

(4) Participants

A list of attendees is contained in the attachment.

Attendees included the following persons from foreign countries

ACE: Dr. Weerawat Chantanakome, Executive Director  
Mr. Christopher G. Zamora, Manager

Foreign presenter

Mr. Djoko Wiryono, Manager, PT KERTAS LECES (PERSERO),  
Indonesia

Technical experts from Japan

Messrs. Hideyuki Tanaka, Fumio Ogawa and Keiichi Yoneda  
Technical experts of International Engineering Department, ECCJ

In this Seminar-Workshop, 90 persons participated. They consisted of 26 persons from Malaysia governmental organizations, 58 persons directly related to companies and 6 persons from foreign countries.

The participants were engaged in enthusiastic discussions to the end. This Seminar-Workshop, on the whole, was concluded with great success. The following factors contributed to this success.

The ECCJ side could have a preliminary meeting with ACE and PTM on the previous day and time for preparing the updated Agenda and handouts. Participants could understand the overall structure of the Seminar-Workshop and individual subjects. Particularly, PTM prepared a nice file and distributed to all participants.

As all the proceedings went in English and no interpreter was required, time was used efficiently. MC did a good job and the entire course of the session went smoothly almost as scheduled

Each presentation had substantial content and all participants were enthusiastically

involved in the session to the end. There were lively questions and answers with participants.



Photo -4-1 Seminar-Workshop Presenters and Malaysia VIP

#### 4.2 Discussions on the Results of the Survey (Barriers to Implementation/ Promotion of Energy Conservation Improvement Plans and Countermeasures)

##### (1) Opening ceremony

- 1) The opening address by Mr. Weerawat (ACE) covered a wide range of topics, from rapid increases in oil price and the meaning of the PROMMEC project to the introduction of the ASEAN Energy Competition Award system and the outline of the program of the day.
- 2) Mr. Tanaka (ECCJ) gave an address of thanks on behalf of METI and ECCJ and mentioned Japan's contributions to this project and the meaning of the theme of the current project.
- 3) Representing Malaysia government, Mr. Roy (substituting Dr. Halim, Vice Minister of Energy) gave an address. He reported that with the intention to cope with the recent skyrocketing crude oil prices, a committee was set up in the cabinet, which would aim at development of alternative energy sources, particularly practical use of renewable energy (Vision). In his comprehensive speech, he said "The government also is an energy consuming body and must exemplify itself as a good model. Our office in Putrajaya is a low energy consuming office and energy consumed in this building is about half of that in a conventional building."

(2) EE&C activities in the glass product manufacturing industry (Mr. Ashok Rao, Malaysia)  
Receiving energy audits by PTM, they are involved in energy conservation improvement activities.

- 1) Although the glass-making industry is an energy-intensive industry, it produced results in energy conservation owing to energy audits by PTM.
- 2) For improvement of glass melting furnace, technologies of Asahi Glass, Co., Ltd. were utilized.
- 3) While electric consumption accounts for 13% of the total energy consumed, electric charge has a 37% share in the total energy cost and more measures should be taken for efficient use of energy.
- 4) For an ultimate goal set at 4.8GJ/t-Glass, efforts are being made.

(3) Food product industry (Mr. Hishamudin Ibrahim, PTM, Malaysia)

- 1) This is a case in which an energy audit was given as part of PTM operation and under the government reinforcement program. Audit fee was not charged to the company accordingly.
- 2) They achieved cost reduction by RM1,761,000/y through recovery of waste heat of manufacturing process, enhancement of thermal insulation of piping, maintenance management of steam trap, improvement of cooling system, etc.

(4) Textile industry (Mr. Phubalan Karunakaran, PTM, Malaysia)

He made a report on energy conservation efforts in a textile factory of AMDB Company given in the foregoing item.

- 1) An energy audit was conducted with the focus on energy intensive processes; Perble Range continuous bleaching machine and No. 3 stenter and boiler system.
- 2) Cost reduction by RM864,000/y was realized due to shortened operating hours of boiler because of replacement of the old-type boiler and upgraded boiler efficiency. This amount corresponds to about 3.6 times as much as that forecasted in the audit.
- 3) If boiler fuel conversion (oil → natural gas) scheduled for 2005 is completed, an additional cost reduction by RM1,600,000 will be possible.

(5) Barriers/Measures (Mr. Ogawa, technical expert of ECCJ)

He listed the following 7 items as barriers to energy conservation and proposed countermeasures for each item.

PROMEEC project is one of effective measures to get over these barriers

- Policy
- Human Resources
- Technology

- Finance
- Information
- Inadequate Local Manufacturing Capability
- Society/Culture

#### 4.3 Discussions on Policy of Developing Technical Directory for Textile Industry Use

ECCJ explained basic points on Technical Directors. In responding to the questions made in advance from the audience, such as “Where can we obtain the latest information on energy conservation?” ECCJ introduced ECCJ homepage for information source. Concern about energy conservation and interest in activities of ECCJ are apparently high in Malaysia.

#### 4.4 Discussions on Development of Database/Benchmark/Guideline

ECCJ explained using the material for each item. In Malaysia, DB/BM is already put in practice and Mr. Asfaazam made a supplementary explanation on this point.

## . Myanmar (Oil Refining Industry)

### 1. Outline of Activities

As regards Myanmar, in 2001, which is the first year of Phase 1 of this project for promotion of energy conservation in ASEAN countries, Mann Thanbayakan Oil Refinery operated by Myanmar Petrochemical Enterprise (MPE) under Ministry of Energy was selected for the subject of survey and an energy audit was conducted from December 18 to 22 in 2001.

In 2004, which is the first year of Phase 2, we revisited the refinery and checked the progress status of the recommendations for energy conservation made in the previous energy audit. In addition, we selected another oil refinery as an additional subject of our survey and conducted an energy audit.

#### 1.1 Period

December 8-15, 2004

#### 1.2 Venue

Follow-up survey: Mann Thanbayakan Oil Refinery (about 500km north of Yangon city)

Walk through energy audit of a newly selected factory:  
Thanlyin Oil Refinery (suburb of Yangon city)

Seminar-Workshop: Yangon city

#### 1.3 Schedule

December 8 (Wed.)	Moved by a land route to visit Mann Thanbayakan Oil Refinery (about 14 hours)
9 (Thu.)	Conducted a follow-up survey of the refinery
10 (Fri.)	Moved back by road to Yangon city (about 12 hours)
11 (Sat.)	Prepared/compiled material and studied
12 (Sun.)	Same as on Saturday
13 (Mon.)	Visited and conducted an energy audit of Thanlyin Oil Refinery.
14 (Tue.)	Gave Seminar-Workshop
15 (Wed.)	Compiled material

#### 1.4 People Involved

ACE (ASEAN Center for Energy):

Mr. Christopher G. Zamora: Manager

Myanmar: Myanma Industrial Construction Services (MICS), MOI No.2

U Aung Kyi: Director, MICS, MOI No.2 [Focal Point for Myanmar]

U Tin Oo: Head of Division, MICS [Assist of U Aung Kyi]

Technical experts from Japan: Technical experts, International Engineering Dept., ECCJ

Messrs. Hideyuki Tanaka and Fumio Ogawa

## 2. Latest Situation of Energy Conditions and Industries in Myanmar

### 2.1 Energy Situation in Myanmar

#### (1) Overview

Myanmar is richly endowed with natural resources of commercial Energy and Biomass. Economic growth in Myanmar has been in the upward trend and would continue to be so in the years to come. According to this reason, Energy consumption in nation also has been increased proportionately. Yearly increasing of Primary Energy Consumption by type is as follows:

Table -2-1 Primary Energy Consumption by Type

Type	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003
Commercial Energy					
- Crude Oil	1583	1820	1983	1991	1924
- Natural Gas	1386	1311	1205	1033	1264
- Hydro	365	399	728	701	858
- Coal	44	55	85	72	77
Biomass	7386	7769	7825	8036	8249
Total	10764	11354	11826	11833	12372

Exploration and production of crude oil and natural gas in Myanmar onshore and offshore areas, Multi-national companies are in cooperation with Myanma Oil & Gas Enterprise (MOGE) under the Ministry of Energy on a production sharing basis. In 2003-2004 financial year, total production of onshore crude oil and natural gas are 4327804mmbbls and 50,069.83mmcf each.

65 % of natural gas produced by MOGE is used for electricity generation by gas turbines, 14% by Petrochemical plants and remaining 21% by Industries.

Energy Related Organizations in Myanmar are as follows:-

- |                                    |                                      |
|------------------------------------|--------------------------------------|
| - Ministry of Energy               | = Oil & Gas                          |
| - Ministry of Electric Power       | = Electricity (Including Hydropower) |
| - Ministry of Mines                | = Coal                               |
| - Ministry of Forestry             | = Biomass & Fuel Wood                |
| - Ministry of Science & Technology | = Renewable Energy                   |

(2) Energy Situation in Industry

The total amount of sectorial energy consumption for 2002-03 financial year was 10699.78KTOE: Transport 10.82 %, Industry 5.76%, Services 1.0%, Residential 80.78%, Agriculture 1.15% and others 0.49%.

The growth rate of energy consumption by industry sectors for financial years from 1994-95 to 2002-03 are 4.39 % , 3.94 % , 4.67 % , 5.87 % , 5.29 % , 5.46 % , 6.05 % , 5.55 % and 5.76 % respectively.

(3) Energy Situation in Oil Refinery Industry

There are three refineries in Myanmar and operated by Myanma Petrochemical Enterprise (MPE) under the Ministry of Energy. These are No.1, Oil Refinery in Thanlyin, No.2, Oil Refinery in Chauk and Petrochemical Complex in Thanbayakan. However, as these refineries have been in operation for many years, the present refining capacity is about one third of manufactures' name plate capacity.

In order to fulfill the requirement of the petroleum products of the country, the MPE had refined 138456 million gallons local crude oil and 110108 million gallons Yetagun condensate during 2003-2004 financial year.

In order to meet the growing demand of petroleum products in Myanmar, these refineries are required to be revamped and renovated, to refine more petroleum products.

## 2.2 Situation of Industry in Myanmar

(1) Overview

In Myanmar, present condition of the industrial activities belongs to the three sectors, State 3 %, Cooperative 1 % and Private 96 %.

The main industrial policy of the governments had been import substitution, export promotion and utilization of local resources. The economic development objectives always stressed on agricultural development and then the promotion of industries based on agriculture. Within these polices and objectives, the private small and medium enterprises (SMEs) had survived and grown contributing substantially to the national gross domestic product. The existing large enterprises are not large and powerful enough as in the developed countries to influence the small and medium-sized enterprises operation and growth.

The industrial enterprises in Myanmar had been classified into three groups in the Private Industrial Enterprises Law promulgated in November 1990 as shown below.

1) Large Industrial Enterprises

Capital Outlay	-	More than 5	Million Kyats
Annual Production Value	-	More than 10	Million Kyats

Electrical Power used	-	More than 50H.P
Labour	-	Above 100 Numbers
2) Medium Industrial Enterprises		
Capital Outlay	-	More than 1 Million Kyats
Annual Production Value	-	More than 2.5<10 Million Kyats
Electrical Power used	-	More than 2.5<50H.P
Labour	-	51 to 100 Numbers
3). Small Industrial Enterprises		
Capital Outlay	-	Up to 1 Million Kyats
Annual Production Value	-	Up to 2.5 Million Kyats
Electrical Power used	-	3 to 25H.P
Labour	-	10 to 50 Numbers

SMEs in Myanmar can be found not only in the private sector but also in the State sector. The largest number of SMEs depends upon the agricultural production which accounts for 38 percent of gross domestic product. Rice milling, wheat flour mills, oil mills, small scale sugar mills, production of palm sugar, cleaning and size separation of beans and pulses etc., are all agriculture based industries scattered all over the country.

There are private small and medium enterprises in other sector of the economy such as tourism, transportation, mining and services. Although no definite figures are at present available, a rough estimation indicates the number of SMEs in the country as about 2 million.

In Myanmar, after the adoption of market economy in 1998, the private sector had grown appreciably in all sectors of national economy. In 1996-97, the state-owned industries contributed 28.7 % of Gross Domestic Product while the cooperative and private sectors contributed 0.9 % and 70.4 % respectively. The State-owned industries are much larger and more capital intensive than the private ones.

These small and Medium industries are scattered all over country but the majority are situated in Yangon and Mandalay. The government is now making arrangements to relocate these SMEs previously operating in residential areas, in industrial zones close to the cities and towns. Already 6 industrial zones in Yangon and 2 in Mandalay have been constructed with all necessary facilities. The development of these industrial estates was a great step forward in the industrialization process.

Myanma industrial policy emphasizes on the following points: -

The industrial activities belong to the three sectors, namely, State, Cooperative and Private.

The cooperative and private sectors can be permitted to undertake those industries which were classified under the State sector by the government notification.

The manufacture of defence equipment and materials is reserved as belonging to the defence industries.

Encouragement will be given to those industries which are based on local natural resources.

The development of industries will be in accordance with the economic policy "The initiative to shape the national economy must be kept in the hands of the State and the national peoples".

In order to accelerate the present of industrialization, Myanma Industrial Development Committee (MIDC) was formed on 18 July 1995.

The objectives of Myanma Industrial Development Committee are as follows: -

Development of Industries with agriculture as the base.

Enhancement of quantity and quality of industrial products.

Increased production of new types of machinery and equipment.

Production of machinery and equipment for industrial use.

Creation of suitable conditions for changing over to unindustrialized state.

## (2) Situation of Oil Refinery Industry including Promotion in EE&C

### 1) The refining capacity and process plants of each of these refineries are as follows:-

#### a. No. 1 Oil Refinery (Thanlyin)

Location	-	Thanlyin Township, Yangon Division
Year Built	-	COD (A) 1957 (6,000 BPSD) COD (B) 1963 (14,000 BPSD) COD (C) 1980 (6,000 BPSD)
Capacity	-	26,000 BPSD of Crude oil
Contractor	-	COD (A) - Foster Wheeler Co. (England) COD (B) - Foster Wheeler Co. (England) COD (C) - Mitsubishi Heavy Industries Ltd. (Japan)
Process Plants	-	Crude Oil Distillation Units A, B & C, SBP Plant, Delayed Coker Plant, Lube Blending Plant LPG Terminal, Candle Factory, Drum Manufacturing Plant, 6 MW Power Plant

#### b. No.2 Oil Refinery (Chauk)

Location	-	Chauk Township, Magway Division
Year Built	-	1954
Capacity	-	6,000 BPSD of Crude oil

- Contractor - Foster Wheeler Co. (England)
- Process Plants - Wax Extraction Plant, Candle Factory

c. Petrochemical Complex (Thanbayakan)

- Location - Min Hla Township, Magway Division
- Year Built - 1982
- Capacity - 25,000 BPSD of Crude oil
- Contractor - Mitsubishi Heavy Industries Ltd. (Japan)
- Process Plants - Topper, Reformer, Delayed Coker, Naphtha HDS, Kerosene Smoke Point Improving & LPG Recovery Units

2) Application of Energy Conservation in Mann Thanbayakan Oil Refinery

For energy saving purposes, the following measures are being carried out.

- Fuel consumption for heaters & boilers are monitored and maintained at optimum condition.
- Burning efficiencies of burners are improved, the excess air content of flue gases are measured once a week.
- Air registers from burners and dampers of furnaces are adjusted to minimum open position.

a. Measures on Energy Audit's Recommendations

Energy Audits form ECCJ visited Mann Refinery in December, 2001 and advised for energy conservation matter. Some recommendations had been undertaken and some could not implement as yet due to lack of spare parts and technical condition.

- Air leakages from furnaces are repaired as necessary.
- Steam leakages, steam traps and insulation are replaced and repaired.
- According to design, low pressure off gas from Topper overhead drum was vent out to flare. To conserve the energy, this off gas had been recovered and burned at pilot burners of Topper furnace since 1990 saving some 72,000 cu-ft of Associated Gas daily.

b. Recommendations for energy conservation

- To decrease the excess air in boilers Actions had been taken and excess air contents in flue gases measured on 3-12-04 were as follows:

Boiler	Excess air %
B (Oil-fired)	31.72
C (gas-fired)	20.8

- To reduce the excess air of Topper heater (from 62.5% to 20%)  
The heater is combined fuel (gas & oil) fired. Excess air flue gas was 48% (measured on 1-12-04). Further improvement is to be carried out during next shut-down period.
- To repair part of the boiler wall to prevent heat loss.  
Additional fillings of glass wool and repairing of castable (insulation cement) were carried out. Improvements are thus observed.

- To maintain steam traps in good conditions.  
Some were replaced and some were repaired as necessary. But some damaged traps are still out of service due to lack of spare parts.
- Reduction of steam leakages from flanges, stem of valves.  
Repaired as necessary. Further steam leakages will be eliminated at boiler shut-down periods.
- To charge Topper bottom product (TC) directly to Coker unit.  
Charging of TC directly to Coker will decrease the gas absorbing efficiency of Coker gas oil used in absorber. This will cause escape of some LPG to fuel gas system reducing LPG yield. At present, Coker unit is producing maximum LPG to meet the domestic demand that this item is only under consideration. The plant is normally operated low load with longer operation time for the following reasons:-
  - The Crude oil received is insufficient for high load operation.
  - To prevent additional energy consumption for frequent shut downs and start-ups.
  - Some coolers are heavily corroded, thus many tubes are plugged.
  - To prevent from thermal stress occurrences during intermittent plant operations.
- To reconsider production planning.
  - Full load operation for short time and longer idle time (or)
  - Longer operation time and longer circulation time to minimize shut down.
- Recover the heat of Heavy Gas oil (HGO) Installation of an additional exchanger between Kerosene heat exchanger and Light Gas Oil heat exchanger is planned.

### 3) Modification of Thanlyin Refinery

Thanlyin Refinery is currently processing the Condensate from Yetagun Offshore field in place of Crude Oil with two Crude Oil Distillation Units of "B" and "C", while Unit "A" is shut down due to old age with undesirable heavy consumption of utilities. The processing capacity of the existing units are limited to about 40 to 50 % of its design capacity 20,000 BOPD due to bottle neck of fire heaters and tower overheads as well as low efficiencies of Heat Exchanging System, hence suppressing the refined products at a low level even though the import of transport fuel is gradually increasing. Therefore there is an imperative requirement for the existing distillation units and accessories of Thanlyin Refinery to be upgraded for efficient energy utilization to enhance production to fulfill the ever increasing demand of petroleum products in the country.

The following items were nominated for efficient energy use:-

- a. Modification of Distillation Unit (B)
- b. Modification of Distillation Unit (C)
- c. Modification of Cooling Water System
- d. Addition of Equipments & Spare Parts for MHI Power Plant
- e. Addition of Equipments & Spare Parts for Coker Plant
- f. Addition of Equipments & Spare Parts for Tank Loading/Tank Inventory
- g. Replacing/ Renewing Parts of Some Utilities/Facilities

## 2.3 Situation in Myanmar

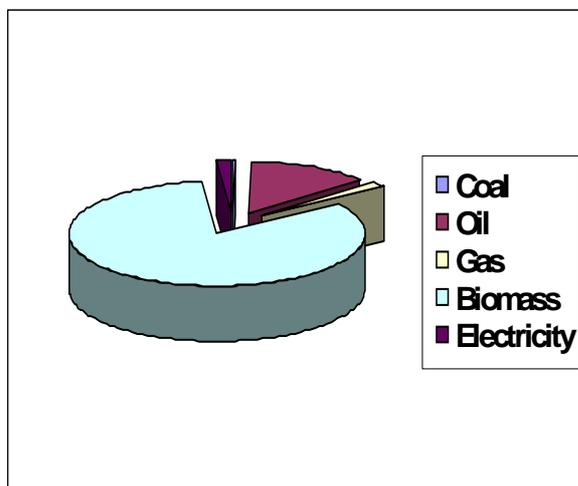
### (1) General condition

- Area: 680,000 km<sup>2</sup> (approx. 1.8 times as large as Japan)
- Population: 52,170,000 (Myanmar Government Statistical Year Book 2002)
- Religion: Buddhism (90%), Christian, Muslim, etc
- System of government: Military government (interim government)
- Economy:
  - Major industry: Agriculture
  - Per capita GDP: US\$180 (2003 IMF World Economic Outlook 2003)
  - Economic growth rate: over 10% (2002 by the government's announcement)
  - Currency: Kyat, US\$1 = 5.86 Kyat (official parity rate) (as of August 2004)

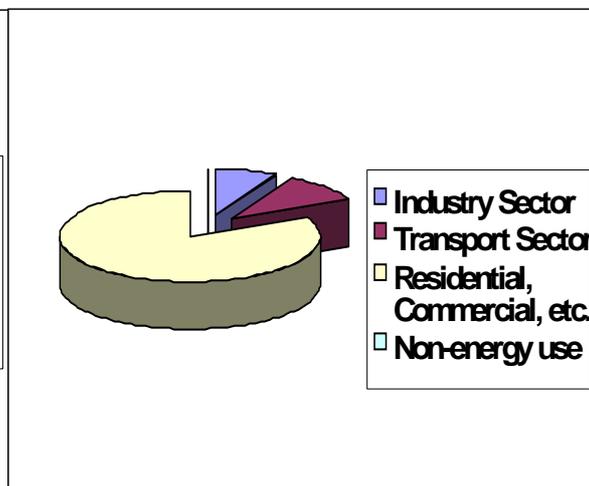
### (2) Energy situation in Myanmar

The states of energy supply and energy consumption in Myanmar are shown in Figure -2-1. Although the country produces oil and gas, their quantities are hardly sufficient and the quantity of oil production is a little over 40% of the domestic oil consumption. As the domestic gas consumption level is still low, more than 80% of the gas production is exported. RE has an 80% share in energy supply and it is extremely high among the 4 ASEAN countries surveyed. In consumption, the civil sector accounts for 80% of the total and the industrial sector's share is less than 10%. It would be important to raise energy conservation activities in the industry from now.

**Total Primary Energy Supply**  
(Excluding of use for Power plant, Oil refinery, etc.)



**Total Final Consumption**



Primary Energy Supply	(ktoe)	%
Coal	44	0.4
Oil	1487	12.8
Gas	230	2.0
Biomass	9408	80.9
Electricity	192	3.9
<b>Total</b>	<b>11622</b>	<b>100</b>

Total Final Consumption	(ktoe)	%
Industry Sector	920	8.0
Transport Sector	1155	10.0
Residential, Commercial, etc.	9539	82.0
Non-energy use	9	0.0
<b>Total</b>	<b>11623</b>	<b>100</b>

Figure -2-1 Myanmar -Energy Balance in 2002

(Source: IEA Energy Balance - Edition 2004 -)

### 3. Follow-up Survey of Mann Thanbayakan Oil Refinery

#### 3.1 Outline of Mann Thanbayakan Oil Refinery

This oil refinery is located far upward from Yangon in the upstream of the Irrawaddy River. As most of typical oil refineries in Japan are so, normally oil refineries are constructed near the sea in the light of convenience for receiving crude oil and shipping oil products. The location of Thanbayakan oil refinery was apparently decided for a strategic reason (including development of the region) in addition to its nearness to the producing district of domestic oil.

This oil refinery was constructed by Mitsubishi Heavy Industries, Ltd. under the economic aid from Japan's former OECF (Overseas Economic Cooperation Fund) in 1982 and its operation was started in 1984. (Since around the time when the construction was completed, production volumes of the oil field began to decrease and the scheduled commissioning was delayed due to the shortage of crude oil.)

In December 2001, an energy audit on this oil refinery was conducted by Mr. Kise and Mr. Noka of ECCJ and reported in detail in the 2001 report.

#### 3.2 Summary of the Previous Energy Audit

As can be seen in the attachment and the relevant report (2001), the following recommendations were made in the energy audit in 2001.

##### (1) Reducing percentage of excess air in boilers (B and C)

The following numerical targets were set based on the Japanese standard values and measurements on the site.

<u>Boiler</u>	<u>Actual percentage of excess air</u>	<u>Target percentage of excess air</u>
B (Heavy oil combustion)	35.7%	30%
C (Gas combustion)	33.6%	20%

##### (2) Reducing percentage of excess air in heating furnace of atmospheric distillation unit

There are comments in pages I-23 and I-28 of the previous energy audit report as follows respectively; "In cases where there is only a limited amount of crude oil and frequent shuts and starts of equipment take place, as in the case of this oil refinery, production planning is considerably important in terms of energy conservation." "The excess air can be reduced by changing the production plan to increase the current low rate of operation during operating periods and extending the non-operational period. The average (62.5%) of measured values was used as the current amount of excess air. Assuming that this excess air could be reduced to 20%, savings in heating value were calculated."

##### (3) Direct feed of bottom oil of atmospheric distillation column (topped crude) to coker

Bottom oil of the atmospheric column (or topped crude) remaining at comparatively high

temperatures (design value 159°C, measured value 150°C) is cooled with water to drop into the tank, while in the coker unit, material fed from the tank is heated before it is used. Therefore, possible significant energy conservation from direct feeding of material to the coker was proposed.

(4) Effective use of heat of HGO

As HGO that is still at high temperatures (design value 180°C measured value 160°C) is cooled with water, effective use of heat should be sought through the installation of heat exchanger with crude oil (The utilization of the heat exchanger of the reformer, which is currently out of operation, was also studied).

(5) Maintenance and replacement of steam traps

In the previous audit, the actions of steam traps randomly chosen were checked. Based on the results of this checkup, maintenance and replacement were proposed.

### 3.3 Results of the Follow-up Survey on the Recommendations Made in the Previous Audit

This refinery is located about 500 km northward from Yangon. Although we could flown to Mandalay and move from there by car, we moved all the way by car because there were not many flights available and we were afraid that we might be tied to the schedule. As it took more than 12 hours one way including lunch time and breaks, it took 3 days to complete the trip. There was no choice for accommodations other than the guest house of the refinery. The current follow-up survey is summarized below.

(1) Date of survey:

December 9 (Thu.) 2004, 8:30 - 17:30

(2) Venue:

Petro-chemical Complex (Mann-Tan Payar Kan) Minhla, Magwe Division, Myanmar

(3) Visitors

Auditors: Messrs. Hideyuki Tanaka and Fumio Ogawa,

Technical experts, International Engineering Dept., ECCJ

Participants (from the government and the company, accompanying from Yangon):

U Aung Kyi: Director, MICS, MOI No.2 (Focal Point for Myanmar)

U Tin Oo: Head of Division, MICS, MOI No.2

U Than Htoon Deputy Director (Planning), MPE, MOE

(4) Interviewee:

On the Company's part: Mann Oil Refinery (MOR), Myanmar Petrochemical Enterprise (MPE), Ministry of Energy (MOE)

U Tun Myint: General Manager

U Zaw Win: Deputy General Manager (Production)  
U Zaw Win: Deputy General Manager (Planning)  
U Aung Dwe: Assistant General Manager (Planning)  
U Myo Chit: Deputy Assistant General Manager (Planning)  
U Than Tun: Deputy Assistant General Manager (Production)  
U Myo Maung Maung: Deputy Assistant General Manager  
(Prod.-Coker)  
U Tun Win: 2<sup>nd</sup> Eng. (Maint. & Oper.), Boiler & Utility Dept.

#### (5) Current status of Mann Oil Refinery

The overall condition of the refinery has not changed since the audit of 3 years ago. However, they have continued strenuous efforts to secure crude oil since then and as a result, they made a little improvement from 35% capacity utilization rate of 3 years ago to 40% of today, compared to Mann's designed crude oil processing capacity of 25,000 barrels /day based on 100% Mann crude oil.

They also tried to streamline their operation and reduced its work force from 1053 to 980 employees. Profit also is currently improved up to 2 million kyat per month.

All participants in the survey (Mr. U Aung Kyi of Myanmar FP, Mr. U Than Htoon of MPE, etc.) and people concerned of Thanbayakan Refinery including Mr. Tun Myint, General Manager and other staff members were serious, cooperative and friendly. They had prepared answers to the questionnaire we had requested them in advance.

However, the management of the refinery itself is confronted with such fundamental problems as aging equipment, chronic shortage of raw material, shortfall of fund, etc. and they apparently could not pay attention to efficient use and conservation of energy. They seemed to be working hard on improvements under many constrained conditions.

On the day of the survey, we toured the site following discussions on the answers to our questions. In the afternoon, we made commends for improvement regarding the material for Seminar-Workshop on December 14 (\* Attachment) prepared by them.

\*Power Point material to be presented by MPE on December 14. "Experiences and Application of Energy Conservation in Mann Thanbayakan Oil Refinery"

The current conditions of product production, facilities operation, and energy consumption are given below.

#### 1) Product production status

First, we confirmed the way they took statistical figures. Their fiscal year starts in April and ends in March of the ensuing year. Accordingly, the latest data at the time of audit of 3 years ago is that for the period from April 2000 to March 2001 and this will be used as the basis for comparison. The latest figures obtained this time are those for the period from April 2003 to March 2004. (Hereinafter the former is called FY 2000 and the latter FY 2003 for convenience's sake).



Photo -3-1 Refinery Tower of Thanbayakan Oil Refinery  
(Atmospheric Distillation Plant, etc.)

As regards the quantity of crude oil processing, this refinery had suffered chronic shortage of row material. The designed crude processing capacity at the time of construction was 25,000 barrel/day based on 100% of Mann crude oil. However when the construction was completed and commissioning was started, declines in the quantity of crude oil production were obvious and therefore the schedule for launch was postponed so that the time for storing crude oil could be gained. Owing to the efforts made by people involved afterward (a and b below), the quantity of crude oil processing increased as follows;

- a. Receiving crude oil not only from Mann but also oil fields in neighboring areas by pipeline (about 60%)
- b. Changing the initial plan and converting 2 piers for shipping of products (one is for common uses for products/crude) to receiving crude oil by barge (about 40%)

	<u>FY 2000</u>	<u>FY 2003</u>	(Unit: kL/y)
Crude oil processing volume	410,800	498,000	



Photo -3-2 Discussions Held in Thanbayakan Oil Refinery

In other words, while crude oil processing volume per calendar day in FY 2000 was 7,080BCD, it was 8,580BCD in FY 2003, which is an increase by about 21%. Behind this successful increase, many strenuous efforts were made. Raw material is in a wide range of conditions from condensate to heavy crude oil (of specific gravity even exceeding 0.9). It would have been extremely hard to adjust the operation of process units depending on the property of raw material (while making efforts to save energy). (BCD: Barrel per Calendar Day)

The kinds of product and production shares have not changed dramatically from 3 years ago. Production volumes of major products are shown below.

<u>Major product</u>	<u>FY2000</u>	<u>FY2003</u>	(Unit: kL/year)
Motor gasoline	98,000	110,000	
Diesel oil	190,000	240,000	
Heavy fuel oil	50,000	32,000	

LPG is produced in two kinds, propane and butane and they are filled into cylinders to be shipped out. As gasoline is, as Whole Range Naphtha, treated with Merox processing (Merox Extraction or Merox Sweetening) and just blended with COG (without going through reforming processing), its octane number is roughly between 65 and 70. Kerosene is produced as ATF (jet fuel). Diesel oil (HSD) is produced from light gas oil and heavy gas oil, and COG is mainly used for home fuel use. Because this refinery is a hydro-skimming type refinery that does not have a cracking units (in addition, the operation of the secondary treatment units is minimized), the production pattern is almost

definitely determined depending on the combination of raw materials available.

## 2) Facilities operation status

As detailed in the 2001 report, the major facilities include the following;

Processing facilities:	Atmospheric distillation unit, coker
Offsite facilities:	Crude oil tanks, product tanks, shipping facilities
Utilities:	Boiler, Electricity receiving equipment

For the reasons mentioned in the preceding item, the operation status of the facilities (standing idle of splitter, for example) has not much changed from 3 years ago. However, the way of operation of atmospheric distillation unit (CDU or Topper) changed a little compared to that in 3 years ago. This will be related to our later discussions on energy conservation.

At the time of the previous audit:

According to P. I-22 of the report prepared in March 2002 (NEDO-IC-01ED05), “Operation is performed at the rate of 35% of the equipment capacity. For the standard operation pattern, the operation is continued for 20 days, and is thereafter stopped for 10 days.”

At the time of the current survey:

“The operation is continued as much as possible and when it is inevitable due to the shortage of raw material, the operation is suspended in a status of Hot Circulation.”

As a result, the number of operated days including days in Hot Circulation increased to 305 in FY 2002 and 315 in FY 2003. This way goes against energy conservation and does not follow the recommendation proposed by technical experts of ECCJ in the previous audit. This will be examined in the item 3.3 “Results of the follow-up survey on the recommendations made in the previous audit” below.

## 3) Energy consumption status

In this refinery, the following 3 kinds of fuels are used.

- a. AG (Associated Gas)
- b. HFG (Off Gas from CDU and Coker)
- c. HFO (Coker Gas Oil)

The consumptions of these fuels are shown in a unified unit of GJ in Table -3-1.

(As the quantity of AG is subject to the condition of production in oil field, the balance is made up for with HFO.)

Table -3-1 Actual Fuel Consumptions

(Unit: 10<sup>3</sup>GJ/y)

Fuel consuming equipment	FY 2000	FY 2003
<u>Boiler</u>		
AG	386	258
HFO	56	253
<u>Atmospheric distillation apparatus</u>		
AG + HFG	36	22
HFO	126	238
<u>Coker</u>		
HFG	272	312
Total	876	1,083

All electricity used is bought from external suppliers and actual electric consumptions are shown in Table -3-2.

Compared to 3 years ago, fuel consumption dramatically increased (due to increases in quantity of crude oil processing) and electric consumption slightly increased.

Table -3-2 Actual Electric Consumptions

(Unit MWh/year)

Electricity consuming facilities	FY 2000	FY 2003
Atmospheric distillation unit/Coker	4,890	5,309
Utilities	12,451	12,308
Shipping facilities /Water treatment facilities, etc.	5,252	5,175
Total	22,593	22,792

(6) Implementation status of recommendations made in the previous audit.

Implementation status of recommendations made in the audit of 3 years ago is described in the attachment.

1) Reducing percentage of excess air in boilers (B and C)

Measures mentioned below were taken and targets were almost achieved.

<u>Boiler</u>	<u>Target percentage of excess air</u>	<u>Achieved percentage</u>
B (Heavy fuel oil combustion)	30%	31.7%
C (Gas combustion)	20%	20.8%

In order to achieve targets, once-a-week measurement of oxygen level of flue gas, repair

of air-leaking places, adjustment of air register of burners, adjustment of stack damper, etc. were implemented.

2) Reducing percentage of excess air in heating furnace of atmospheric distillation unit

This heating furnace is a mixed combustion type using gas and heavy fuel oil. Although its high-load running as recommended in the previous audit was not realized, with other efforts, the percentage of excess air of 48% (measured on December 1, 2004) was realized

In the previous audit, concluding that under the current low-load operation, it is impossible to reduce excess air rate, a plan to reduce excess air rate during the operation by changing the operation plan (to high-load operation for a short period of time to get longer plant shut down time) was recommended. However, actually, on the contrary, they tried to retain the equipment in operation including a state of hot circulation so as to minimize the suspended operation period. Although various reasons for this measure are given in Attachment ( - 1.4 - (2), Document 3 – (g)), their real reason might be that as the equipment is aging and maintenance is not sufficient, they want to minimize opportunities of thermal shock accompanying the starting and shutdown of the operation of the equipment.

3) Direct feed of bottom oil of atmospheric distillation column (topped crude) to coker

Piping for direct feed is already laid down as the piping for emergency operation. The problem is that if it is implemented immediately, the temperature balance in the current heat exchange system changes and the temperature of CGO entering TW 503 (absorber) goes up, thereby aggravating the recovery of LPG fraction from Coker Off Gas (LPG escapes to the home fuel gas system). This problem may be solved by rearrangement of the heat exchange system or installation of additional heat exchanger. This remains to be studied in the future.

4) Effective use of heat of HGO

They are in the process of further studying.

5) Maintenance and replacement of steam traps

They said that although they were doing but no as much as they wanted because of cost (budget).

### 3.4 Results of the Current Survey

(1) General comment

Persons concerned of the refinery responded to us honestly and had already prepared answers to our questionnaire. Our impression is that they apparently pour all their efforts into continuation of the operation under such a serious condition as insufficient supply of raw material and have no bandwidth to care about other points.

(2) Energy conservation efforts

Energy cost is generally maintained at a low level (probably for a policy reason) as the unit price of electricity, for example, is set at 0.5 Kyat/kWh. In this sense, the price structure is

not designed for encouraging energy conservation. However, in this refinery, owing to the energy audit given in the past, the awareness of the efficient use and conservation among workers is apparently high. (While the exchange rate between Kyat and foreign currencies is officially set at US\$1 = 6 Kyat, the real rate is US\$1= 900 to 930 Kyat.) For the energy management, Energy Management Committee is convened once a week (Tuesday). The general manager of the refinery hosts a meeting and about 20 Committee members including from managerial class to process engineers attend the meeting. They discuss various agenda items. This approach is very effective.

As the result of these efforts, they successfully reduced electric power consumption rate. Although this unit electricity consumption is normally expressed in numerical value against the “quantity processed by atmospheric distillation unit”, it is also meaningful to express it in numerical value against the total of ”quantities processed by atmospheric distillation unit and coker” because coker consumes large quantities of fuel. Both numbers went down as shown in Figure -3-1.

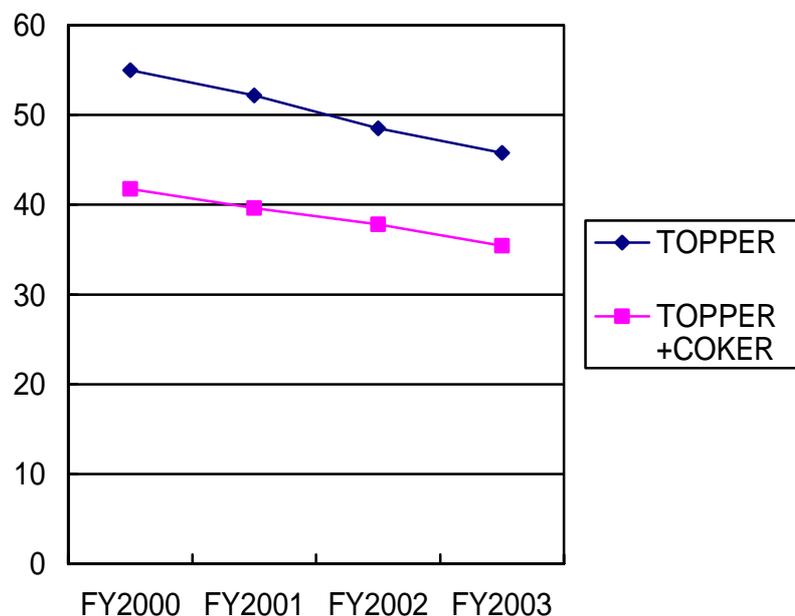


Figure -3-1 Changes in Unit Electricity Consumption (Reprinted from Attachment)  
(Unit: kWh/KL - Quantity Processed)

(3) Progress in recommendations made in the previous audit

The results of the follow-up survey on the previously proposed recommendations are as mentioned above. Recommendations comparatively easy to implement such as improvement of excess air rate of heating furnace are carried out, while suggestions entailing more or less budgetary steps are not been advanced. (They say it is difficult even to find heat exchanger convertible from idle units.) As regards the suggestion that the production schedule be reviewed so that the level of processing during the operation can be

raised while the suspension period is extended, it seems to be unavoidable for them to postpone its implementation for the reasons such as the timing of obtaining raw material is uncertain and they want to avoid changes in thermal history of the equipment as much as possible.

(4) Impression of the site

Our overall impression was that despite the generally old equipment and the poor budget for maintenance, the refinery was well organized and in good housekeeping condition. Concrete foundations in the plant had some cracks and cave-ins. (Although we are reported that the condition of the ground is comparatively good.) Slogans for safety and energy conservation were shown in Burmese.

Judging from our standards, thermal insulation of part of the piping is insufficient and leakage of steam is recognized in some places. However, they may not be able to improve them due to the shortage of budget, even though they want to.

### 3.5 Barriers to Promotion of Energy Conservation and Countermeasures

In this oil refinery, as mentioned previously, the top management has developed a policy for efficient use and conservation of energy and employees have the awareness and knowledge of energy conservation, thus creating a certain level of results. However, due to the strong budgetary constraints, not to mention the installation of additional heat exchangers, even the repair or replacement of steam traps is difficult to do. Behind that, there are problems regarding operation and profitability resulting from the lack of raw material. Countermeasures to cope with these problems are not easy and technical or financial assistance from the outside may be necessary.

#### 4. Energy Audit on Thanlyin Oil Refinery

As a refinery other than Mann Thanbayakan refinery, Thanlyin refinery located in the suburb of Yangon city was introduced. (There is one more refinery, Chauk Refinery, in Myanmar, making a total of 3 across the country.)

The energy audit was conducted as described below.

Date of survey: December 13 (Mon.) 2004, 9:00 – 12:30  
Venue: Thanlyin Refinery (Suburb of Yongon, about 30 minutes by car from Downtown), Auditorium of the main building of the refinery  
Examiners: Messrs. Hideyuki Tanaka and Fumio Ogawa  
Technical experts, International Engineering Dept., ECCJ  
Participants (party who accompanied): (Government, company and ACE)  
U Tint Lwin: Head of Department (Planning), MPE  
U Aung Kyi: Director, MICS, MOI No. (2) {Focal Point for Myanmar}  
Mr. Christopher G. Zamora: Manager, ACE  
Attendees on the part of MPE, Myanma Petrochemical Enterprise, Ministry of Energy  
Mr. Khin Maung Shwe: General Manager, No.1 Refinery, Thanlyin  
In addition, 5 top officials of the refinery were present

Unlike the case of Thanbayakan, in Thanlyin refinery, not much advance preparation had been made. (There were no answers prepared for the questionnaire we had delivered in advance.) We guess that we made a request to visit on too short notice.

In the refinery, the entire quantity of raw material in a form of condensate has been processed with 2 units of atmospheric distillation since November 2002. This is a very abnormal operation form. This refinery also is confronted with fundamental problems such as the old equipment, varying quantities of processing along with fluctuating amounts of supply of raw materials, lack of funds, etc. and they were apparently too busy to pay attention to energy efficiency and conservation.

We had an impression that they also were making strenuous efforts under many constraint conditions.

On the day of audit, we first explained the purpose of our visit and necessary data and then, were provided with an explanation on the general outline of the refinery before the inspection tour of the site. Later when we were back to the main building, we made some remarks.

The audit is summarized below.

##### 4.1 Outline of Thanlyin Refinery

The refinery is located in Thanlyin district across the bridge over the Bago River, a tributary to the Yangon River, running east of Yangon. The premises of the refinery face the Bago River in the west and the Yangon River in the south and stretch over 4km east to west.

The history of the refinery is given below.

- 1925 Established (As Burma Oil Co. , a UK company)
- 1943-45 Processed crude oil delivered from Chaulk by pipeline
- 1945-47 Used only as an oil depot for receiving and shipping oil products
- 1957 Commissioning of CDU (Atmospheric distillation unit) - A (Capacity: 6,000BSD)
- 1963 Commissioning of CDU-B (Constructed by Foster Wheeler, Capacity: 14,000BSD)
- 1963 Taken over to be nationalized
- 1980 Commissioning of CDU-C
- 1980 Commissioning of private electric power generating facilities (Constructed by MHI, Capacity:6MW)
- 1986 Commissioning of delayed coker (Constructed by MHI, UOP process, Capacity: 5,200BSD)
- 1998 Rebuilding of CDU-B (Cosmo Engineering, Tapis crude oil processing 12,000BSD)
- 2001 Shut-down of CDU-A
- 2002 Processing of condensate of Yetagun gas filed started from November (Crude oil processing stopped)



Photo -4-1 Diagrammatic Illustration of the Thanlyin Refinery and People Involved

(1) Product production status

The state of the raw material is explained below.

Material is of low specific gravity and mainly for naphtha fraction mixed with a small fraction of heavy distillate.

At the point about 110 km off shore, crude oil is transshipped from 100,000DWT tanker to 6,500 DWT tanker to be carried.

Specific gravity	60/60°F	0.75
API Gravity		57
Sulfur content, weight %		0.005

According to the report on the past results (April 2003 - March 2004), raw material processed was about 114 million IG/year and monthly average processing quantity was about 43,460kl (9,100BCD). This amount was processed by two atmospheric distillation units as follows:

CDU-B	approx. 6,000BCD (50% Load)
CDU-C	approx. 3,000BCD (50% Load)
Total	approx. 9,000BCD

Major products and quantities of production (share %) are as follows;

LPG (mixture of propane and butane)	
Motor gasoline	68%
ATF (jet fuel)	13%
HSD (diesel oil)	12%

Solvent and lubricant (only mixture) also are produced.

(2) Equipment operation status

As mentioned above, CDU-B was remodelled for processing of crude oil from Tapis, Malaysia. However, as the situation changed, it was switched to processing of condensate alone. For that purpose, a circulation pipeline for residue was installed within each of the 2 CDUs (Residual oil flowing out from the bottom of the main distillation column is returned to the point before entering the pre-flash column on the feed pipeline after the exit of the heat exchanger with raw material.) At the start of the operation of the unit, residue brought in from the outside is fed to the equipment and made circulate to maintain. If the level gets down, it is replenished. Enhancements of cooling capacity at the top of the distillation column, etc. have not been implemented.

The secondary equipment (including coker) is out of service.

(3) Energy consumption status

In this refinery, only off gas (called Natural Gas) is used for fuel. As electricity is generated by privately-owned power generator, energy consumption does amount to consumption of this NG.

Consumptions of NG, steam and electricity are as follows;

NG	1,600 million SCF/year
Steam	360,000 t/year
Electricity	19 million kWh/year

#### 4.2 Results of Analysis of the Current Situation

The current operation condition of the equipment is, as mentioned above, abnormal because the equipment initially designed for processing of crude oil is used for processing of condensate, which is extremely different in property.

It is questionable how much technological study was made before the operation was shifted to the current form. Even if they had determined on remodelling of the distillation units as the result of their technological study, they could not have implemented it due to lack of fund. It is our impression that keeping the operation of the equipment is all what they can do now. Accordingly we suspect that they have no bandwidth to think about energy efficiency and conservation.

To our request for data on energy consumption, they could not immediately present it. We could not determine whether they had no established system of collecting, analyzing and managing data or our visit was on too short notice for their current situation.

After touring the site, we had an impression that with the generally old equipment, their budget could not afford sufficient maintenance. The condition of housekeeping looked a little worse than that of Thanbayakan refinery. In this refinery, too, thermal insulation of the piping, etc. was not enough in some points and leakage of steam was recognized here and there.

#### 4.3 Recommendations for Improvement and Expected Effects

##### (1) Technological study of atmospheric distillation unit

It is desirable as a preliminary step toward discussions on energy efficiency and conservation to improve the operational condition of the equipment to as much sound a status as possible. In this context, technological study on and some modifications to atmospheric distillation unit itself may be necessary. (For example, enhancing cooling capacity of the upper part of the distillation column, ensuring appropriate pressure for operation, etc.)

##### (2) Possible energy conservation measures

We had an impression that not much energy conservation effort was made in this refinery, compared to Thanbayakan Refinery. For example, excess air rates of the heating furnace were not analyzed.

We gave advice that the analysis of excess air rates should first be attended using portable Orsat apparatus.

We also explained repair and replacement of steam traps, thermal insulation of piping, reviewing of performance of the equipment at low load operation, etc.

#### 4.4 Improvements Completed

They installed circulation pipeline for residue in the still columns to enable the plant to process all amount of raw material in a form of condensate only. We give credit to them for these voluntary efforts, although it is not an energy conservation measure.

## 5. Results of Seminar-Workshop

Seminar-Workshop was held on December 14 (Tue.). Minister of Energy of Myanmar attended and made a speech, showing their great enthusiasm for this project.

### 5.1 Summary

(1) Date

December 14 (Tue.), 2004 8:30 – 17:00

(2) Place

Myanmar Ballroom, Traders Hotel Yangon, Yangon, Myanmar

(3) Contents of presentations of Seminar-Workshop

Shown in Program of Attachment-1

(4) Attendees:

Myanmar' (host country)

H.E. Brig.Gen. Lun Thi : Minister, Ministry of Energy

U Aung Kyi: Director, Myanma Industries Construction Services, MOI II  
(Focal Point for Myanmar)

U Tin Oo: Myanma Industries Construction Services, MOI II

Presenters from Myanmar

U Tun Myint: General Manager, Petrochemical Complex (Man Tan Payar  
Kan), Myanma Petrochemical Enterprise (MPE)

Daw Hla Hla Kyi: Assistant Director, MPE (Kyawzwa Fertilizer Plant)

Presenters from other countries

Mr. Abdul Karim Abdul Bari: Project Manager, MIEEIP, Pusat Tenaga  
Malaysia

Mr. Subagyo, Supervisor: Rencana Dan Evaluasi Produksi, PT Kertas Leces

ASEAN

Dr. Weerawat Chantanakome: Executive Director, ACE

Mr. Christopher G. Zamora: Manager, Administration & Finance Dept. and  
Manager for Renewable Energy & Energy Efficiency and  
Conversion Programmes, ACE

Japan'

Messrs. Hideyuki Tanaka and Fumio Ogawa,  
Technical experts, International Engineering Dept., ECCJ

In addition, there was general-interest audience of Myanmar. The total number of attendees was 54 including persons concerned given above.



Photo -5-1 Minister of Energy Making an Address in Seminar-Workshop

#### (5) Contents

##### 1) Overall impression/contents

The session proceeded smoothly almost as scheduled.

The audience was attentive to presentations and there was sufficient time for questions and answers. Seminar-Workshop was successfully concluded on the whole. The following positive factors contributed to this result.

We could have a discussion time with ACE and Myanmar on the previous day and could prepare and distribute the updated agenda and handouts for Seminar-Workshop. (Part of the material was copied and distributed on the day of session.) Accordingly, the audience could understand the overall structure of the session and the content of each subject.

Mr. Lun Thi, Minister of Energy of Myanmar, attended and addressed the meeting.

Strong enthusiasm on Myanmar's part for this project was felt.

Seminar-Workshop was given in English and as no interpreter was necessary, the session proceeded efficiently time wise.

Each presentation had enriched content and most participants listened to the end ardently. Lastly, Mr. Zamora of ACE asked the pros and cons of "Promotion of the Technical Directory Plan" and approval was enthusiastically expressed from the floor with applause.

## 2) Welcoming Remarks/Opening Statements

First, Minister of Energy of Myanmar delivered an opening address. Honorable Minister mentioned the energy policy of the Myanmar government, the meaning of this project and the nation's expectations for this project. Mr. Tanaka, technical expert, on behalf of METI and ECCJ, made an address of thanks to all people involved including the attendance of Honorable Minister, and mentioned Japan's contributions to this project, the meaning of the theme of this project (necessity of cooperation from countries concerned), etc. Lastly, Dr. Weerawat, Executive Director of Ace made a speech. His speech covered a wide range of subjects from rapid increases in the price of crude oil to the meaning of the PROMEEC project, the introduction of the ASEAN Energy Competition Award and the outline of the program of that day.

## 3) Particulars of each presentation

### a. Situation of energy efficiency and conservation in Japan (Tanaka)

Mr. Tanaka explained the energy situation in Japan, the history of legal systems, support and promotion measures of the Japanese government (low interest loan, tax benefits, etc.) and efforts by the private sector.

### b. Oil refining industry in Myanmar (U Tun Myint)

Mr. Tun Myint, General Manager of Mann Refinery that we visited on December 9, made a report. We had already had an interview with him on this report at the time of our visit and given advice.

### c. Fertilizer manufacturing industry in Myanmar (Daw Hla Hla Kyi)

She made a report on the results of energy conservation regarding the ammonia- and urea- producing facilities in the Kyawzwa factory out of the 4 fertilizer manufacturing factories. This factory was remodelled with NEDO's FY 2000 aid budget. Energy consumption of the ammonia-manufacturing facilities that include a hydrogen manufacturing unit (Reformer) and the urea-manufacturing facilities were reduced by about 20% through the implementation of 11 improvement measures and 6 improvement measures respectively.

### d. Additional comments on case examples of oil refining industry in Myanmar (Ogawa)

He made comments on Thanbayakan Oil Refinery, on which a presentation was made in this Seminar-Workshop, and Thanlyin Refinery that we visited on the 13th. Thanbayakan Refinery is suffering absolute shortage of raw material and Thanlyin Refinery is compelled to treat condensate from gas field, which is decisively different from crude oil that the equipment was initially designed for. Their efforts to solve their respective problems were appreciated. The introduction of various energy conservation measures practiced in Japan was omitted due to the lack of time.

### e. Textile industry in Malaysia (Mr. Abdul Karim)

Although the presentation was basically of the same content as the report made in Malaysia, the material had been slightly revised. They developed their own energy conservation plans and made results exceeding energy conservation effects estimated

from the implementation of our recommendations.

f. Paper and pulp industry in Indonesia (Mr. Subagyo)

They also achieved similar achievements as reported in the preceding presentation. As the result of a short term plan, they succeeded in energy conservation by changing boiler fuel from heavy fuel oil to gas. They have a long-term plan to further change it to coal in the future.

g. Food product industry in Singapore (Ogawa)

Mr. Ogawa of ECCJ made a report, substituting the planned presenter from Singapore who was absent.

h. Iron and Steel Industry in Philippine (Tanaka)

Mr. Tanaka of ECCJ made a report, substituting the planned presenter from Philippine who was absent.

#### 4) Workshop

a. Barriers and Measures (Ogawa)

Minor changes were made to the presentation material in Malaysia. As barriers hampering energy conservation, 7 factors were listed and improvement measures for the respective item were proposed. The PROMEEC project is one of effective measures to remove these obstacles.

b. Technical Directory (Mr. Christopher Zamora)

He explained that the creation of technical directory would be a natural course of development of the past PROMEEC activities (70 factories have already been subject to an energy audit).

c. Database, Benchmarking and Guideline (Mr. Christopher Zamora)

He explained it by making several revisions to existing materials.

d. Questions and Answers

There was a sufficient time for active questions and answers. Topics of the discussions included the background of the legislation of energy-related laws in JAPAN, energy managers (heat/electricity), problems associated with coal combustion, promotion of energy conservation under the condition of poor fund, etc.

#### 5) Closing Remarks

Lastly, Dr. Weerawat concluded the session touching upon skyrocketing crude oil prices, the success of Seminar-Workshop of the day, the prospect of the ASEAN PROMEEC activities in the future, etc.

#### 5.2 Discussions on Results of Survey (Barriers to and Measures for Implementation and Promotion of Energy Conservation Measures)

As mentioned above, the current Workshop could afford plenty of time for questions and answers and there were lively discussions in the conference room. For example, there was a request from Myanmar government circles; "We would like to be provided with detailed

information on the background of the legislation of energy conservation-related laws in Japan that brought about great success.” There was also a question from Dr. Weerawat as follows; “There are possibly two ways of implementing/promoting energy conservation measures, government’s so-called top-to-bottom control by making laws, and grass-roots activities aiming to gradually spread it among the general public until the time is mature, which is better?”

Concerns and problems of the countries that must strongly promote energy conservation in the future were reflected in their questions and requests.

### 5.3 Discussions on Policy for Creation of Technical Directory for Oil Refining Industry

The meaning of, the policy for creation of and examples of Technical Directory were explained. Good understanding was gained from the floor. As mentioned previously, approval on the promotion of the program in the future was confirmed with the floor through their enthusiastic clapping of hands.

### 5.4 Discussions on Policy for Developing Database/Benchmark/Guideline for Oil Refining Industry

The response from the floor to this plan also was favorable. However, as the creation of database and benchmarking involve the problem of protecting confidentiality, it should be advanced with care.

## . Activities and Efforts as ASEAN

### 1. Outline of Summary -Post Workshop

Summary Workshop and Post Workshop common to the 3 projects in ASEAN Countries; Programs for Promotion of Energy Conservation in Major Industries and Buildings, and for Improving Infrastructure for Energy Management, were held in Singapore.

In the Workshops, delegates of 10 ASEAN countries and representatives of ACE and ECCJ gathered to evaluate the achievements and results of these 3 projects for the current fiscal year and to confirm the direction of activities for the next and ensuing fiscal years. In the Summary-Post Workshop on each project, 2004 activity reports on the 3 projects regarding Major Industries/Buildings/Energy Management were made from Japan's part and all participants in the Workshop joined in evaluations of the activities and discussions on the achievements and issues (Photo -6-1).

#### 1.1 Period

February 7 (Mon.) – 9 (Wed.), 2005

#### 1.2 Venue

Allson Hotel, 101 Victoria Street, Singapore

#### 1.3 Participants

Contained in Attachment



Photo -6-1 Summary-Post Workshop Participants (February 7, 2005 at Singapore)

## 1.4 Outline of Activity Reports

The session proceeded according to Workshop Agenda (contained in Attachment), with Dr. Prasert as MC.

### (1) Summary on activities

In Phase-1, ACE-ECCJ conducted energy audits in major industries of 10 ASEAN countries. In 2004, as the first year of Phase-2, we conducted follow-up surveys and energy audits of newly selected factories with the purpose of surveying the penetration status of guidance and suggestions made in energy audits of Phase-1 in major industries of the 4 countries listed below. Then, we gave Seminar-Workshop in the respective countries.

In the wrap-up Summary-Post Workshop, we made a summary report on our activities in these 4 countries.

First year of Phase 2 - Countries and schedule for our visit

Vietnam	October 25 - 29, 2004
Lao PDR	November 15 - 19, 2004
Malaysia	November 22 - 26, 2004
Myanmar	December 8 - 15, 2004

Our activities in the respective countries are shown in Table -6-1.

Table -6-1 Overview of Phase-2 Activities in 2004

Country Time		Vietnam	Lao PDR	Malaysia	Myanmar
		Oct. 25 ~ 29	Nov. 15 ~ 19	Nov. 22 ~ 26	Dec. 8 ~ 14
1. Follow-up of Energy Audit	Porcelain Factory		Hydropower Plant	Textile Factory	Oil Refinery Factory-1
	Lighting Fixture Factory		Garment Factory		Oil Refinery Factory-2
2. S-W	1) EE&C Policy	Vietnam-MOI	Lao PDR-MIH		
2) EE&C Activities	Cement (Brunei)		ECCJ		
	Ceramics (Vietnam)			ECCJ	
	Caustic Soda (Thailand)				
	Garment (Cambodia)		ECCJ		
	Food (Singapore)		ECCJ		ECCJ
	Iron/Steel (Philippines)			ECCJ	ECCJ
	Oil Refinery (Myanmar)				Myanmar
	Power (Lao PDR)	Lao PDR-MIH	Lao PDR-MIH		
	Pulp/Paper (Indonesia)	Indonesia	ACE	Indonesia	Indonesia
	Textile (Malaysia)	Malaysia	Malaysia	Malaysia	Malaysia
	Other Presentations	PROMECC in VN Industry			EE&C in Glass Factory
EE&C in Paper Factory				EE&C in Food Factory	
EE&C in Lighting Fixture Factory					

In each Seminar-Workshop, reports on the energy conservation policy of the host country and energy conservation efforts on the part of industries were made. There were guest presenters from several other ASEAN countries who made reports on energy conservation activities in major industries of their countries. For absent foreign presenters who had planned to make a presentation on the theme requested by the host country, ECCJ and ACE made a report on their major industries on behalf of them. However, a report by ECCJ was not an activity report and only reviewed the outline of the survey made in Phase-1 and recommendations for energy efficiency and conservation. Reports from foreign countries were on the following 3 industries; hydraulic power generation in Lao PDR, Pulp/Paper industry in Indonesia and Textile industry in Malaysia. There was no request for reporting on the caustic soda industry in Thailand.

(2) Activities in Vietnam

In Vietnam, Seminar-Workshop was given on the first day of our visit. Then, a follow-up survey on the ceramics factory having undergone an energy audit in January 2002 and an energy audit of a lighting fixture manufacturing factory (mainly glass melting furnace units) reported in the preceding Workshop were conducted. Despite insufficient preparations for the Seminar-Workshop, including handouts, etc. due to its being scheduled for the first day, there were more than 100 attendants, the largest number in the 4 countries. Activities in Vietnam are described in Table -6-2.

Table -6-2 Activities in Vietnam

<b>1. Schedule:</b>	<b>October 25 – 29, 2004</b>
<b>2. Seminar-Workshop:</b>	<b>October 25 at Press Club, Hanoi</b>
<b>Participants:</b>	<b>122 (MOI, etc.: 51, University: 6, Institute: 23, Company: 32, Interpreters: 3, Foreigners: 7)</b>
<b>Presentations:</b>	
<b>1) Current Status and Activities on EE&amp;C in Vietnam (MOI, VN)</b>	
<b>2) EC Program in Japan (ECCJ)</b>	
<b>3) Promoting EE&amp;C in Industry of Vietnam (Hanoi University, VN)</b>	
<b>4) Experience and Application of Energy Efficiency in:</b>	
<b>- Paper Factory (Vietnam)</b>	
<b>- Lighting Fixture Plant (Vietnam)</b>	
<b>- Pulp/Paper Factory (Indonesia)</b>	
<b>- Hydropower Plant (Lao PDR)</b>	
<b>- Textile Factory (Malaysia)</b>	
<b>5) Barriers/Measures (ECCJ)</b>	
<b>3. Factory visits for follow-up energy audit</b>	
<b>1) Hai Duong Porcelain Company (HAPOCO), (Oct. 26)</b>	
<b>2) Rang Dong Light Source &amp; Vacuum Flask Co., (Oct. 27)</b>	
<b>4. Discussion of Technical Directory and D/B, B/M and G/L at MOI, (Oct. 28)</b>	

In Seminar-Workshop, a governmental organization of Vietnam made a report on its energy conservation initiatives and energy conservation efforts concerning the reduction of GHG on the part of industries. This was followed by reports from a pulp/paper factory and a lighting fixtures factory (possessing glass melting furnaces). There were also reports on the pulp/paper factory in Indonesia, the hydropower plant in Lao PDR and the Textile factory in Malaysia that had undergone an energy audit by ECCJ in Phase 1 and it was clarified that significant energy reduction effects were achieved. There was no reporting on the energy conservation activities in the ceramics factory and there was no time for making a report on the results of our follow-up survey.

Barriers/Measures were reported by ECCJ.

As discussions of TD (Technical Directory), DB (Data Base), etc. were not held for lack of time, they were separately conducted in MOI with the participation of ECCJ and PTM (Malaysia).

### (3) Activities in Lao PDR

Activities in Lao PDR are described in Table -6-3

Table -6-3 Activities in Lao PDR

<b>1. Schedule:</b>	<b>November 15 – 19, 2004</b>
<b>2. Factory visits for energy audit</b>	
1) Num Ngum Hydropower Plant (Follow up), (Nov. 15)	
2) Textile 55 Co., (Nov. 16)	
<b>3. Seminar-Workshop:</b>	<b>November 18 at Lane Xang Hotel, Vientiane</b>
Participants:	<b>48 (MIH, etc.: 7, University: 1, Company &amp; Hotel: 34, Foreigners: 6)</b>
<b>Presentations:</b>	
1) EE&C Programs of Lao PDR (MIH, Lao PDR)	
2) EC Program in Japan (ECCJ)	
3) Experience and Application of EE&C in:	
- Cement Factory (ECCJ for Brunei)	
- Textile Plant (Malaysia)	
- Garment Factories (ECCJ for Cambodia and Lao PDR)	
- Pulp/Paper Factory (Indonesia)	
- Food Processing Factories (ECCJ for Singapore)	
- Num Ngum Hydropower Plant (Lao PDR and ECCJ)	
4) Barriers/Measures, Technical Directory, D/B, B/M, G/L (ECCJ)	

In Laos, we conducted a follow-up survey of the hydropower plant on the first day and an energy audit of a garment factory on the second day.

The hydropower plant, the subject of our follow-up survey, is located about 90km north of Vientiane. It underwent an ECCJ energy audit in January, 2002.

The garment factory we visited is located in the city of Vientiane. The results of our surveys were reported in Seminar-Workshop.

In the Seminar-Workshop, 42 persons on Laos's part were present.

From Laos, a governmental organization made a presentation on their energy conservation

initiatives and a report on energy efficiency and conservation activities of the hydropower plant was made.

From ASEAN, ACE and ECCJ, reports on energy efficiency and conservation activities in cement, textile, garment, pulp/paper, and food factories as well as the above-mentioned hydropower plant were made. These subjects were selected by Laos's request and enthusiastic discussions were developed regarding each subject.

This Seminar-Workshop was televised.

#### (4) Activities in Malaysia

Activities in Malaysia are described in Table -6-4.

In Malaysia, a follow-up survey of the textile factory, on which ECCJ conducted an energy audit in January, 2001, was made. As the location of the factory is about 250km north-northwest far from Kuala Lumpur, capital of Malaysia, we visited only one factory site.

Participants in Seminar-Workshop on the part of Malaysia were 84 persons.

In Seminar-Workshop, from Malaysia, reports on energy efficiency and conservation efforts in a glass factory, a palm oil factory and a textile dyeing factory were made. From ASEAN, a report on a pulp/paper factory in Indonesia was made. ECCJ, on behalf of Vietnam and Philippines, made a report on energy conservation in ceramics and iron & steel factories.

Table -6-4 Activities in Malaysia

<b>1. Schedule:</b>	<b>November 22 – 26, 2004</b>
<b>2. Factory visits for energy audit</b>	<b>1) Arab Malaysian Development Bhd (AMDB) Textile Plant, (Nov. 23)</b>
<b>3. Seminar-Workshop:</b>	<b>November 25 at Marriott Putrajaya Hotel</b>
<b>Participants:</b>	<b>90 (PTM, etc.: 26, Company : 58, Foreigners: 6)</b>
<b>Presentations:</b>	
<b>1) Experience and Application of Energy Efficiency in:</b>	
	<b>- Glass Factory (Malaysia)</b>
	<b>- Food Factory (Malaysia)</b>
	<b>- Textile Plant (Malaysia and ECCJ)</b>
	<b>- Pulp/Paper Factory (Indonesia)</b>
	<b>- Ceramics (Porcelain) Factory (ECCJ for Vietnam)</b>
	<b>- Iron &amp; Steel Factories (ECCJ for Philippine)</b>
<b>2) Barriers/Measures,</b>	
<b>3) EC Program in Japan and Technical Directory (ECCJ)</b>	
<b>4) D/B, B/M, G/L (ECCJ)</b>	

#### (5) Activities in Myanmar

Activities in Myanmar are described in Table -6-5.

In Myanmar, energy audits of two oil refineries were conducted. The refinery for a follow-up survey was the one on which ECCJ carried out an energy audit in December 2001 and because of its location about 500 km north from Yangon, it took us the whole 2



in “Finishes” and “Under study”, approaches of some sort were taken and some of them have already created results. We concluded that the remaining one fourth (1/4) of the plans would be implemented in near future. It can be said that generally active energy conservation efforts have been made except in some facilities.

Table -6-6 Summary of EE&C Activities (Follow-up Energy Audit)

Country	Company Name	Number of Recommended Items by ECCJ	Finished	Under Study	Non-activity
Vietnam	Hai Duong Porcelain Company	11	2 18%	0	9 82%
Lao PDR	Num Ngum Hydropower Plant	4	3+ 1 No need 100%	0	0
Malaysia	Arab-Malaysia Development Berhad: - Textile	9	4 44% Other 2+ (1) items	5 56%	0
Myanmar	Mann Thanbayakan Oil Refinery	4	2 50%	2 50%	0
Indonesia (By Presentation)	PT KERTAS LECES: - Pulp/Paper Industry	34	28 82% Short & long term plans	0	6 18%

2) Result of energy audits of newly selected factories and activity status in reporting factories

Energy efficiency and conservation activities developed by another (3) factories that we visited in FY 2004 and 4 factories on which reports were made in Seminar are summarized in Table -6-7.

According to presentations made in Seminar, all these factories have successfully reduced their unit energy consumption. They apparently advanced their activities following the basic flow from understanding of issues by energy audit to understanding of the current level of their own factory, target setting based on such understanding and the implementation of energy management. It shows that management and employees worked together to make these results.

Among added factories for subjects of our energy audit, only Rang Dong Co. made a presentation in Seminar. Although there are still items yet to be improved, they made good attainment of goals and created results. In the garment factory in Lao PDR, the share of energy cost to the total cost was very low and thus, the motivation for promotion of energy conservation was not strong enough.

In the oil refinery in Myanmar, the stabilization of the plant operation was an issue of great importance and here, too, it did not create impetus and motivation for promotion of

energy conservation.

Table -6-7 EE&C Activities at 4 Countries on PROMEEC Phase 2 (2004)

Country	Company Name	EE&C Activities
Vietnam	Bai Bang Paper Company *1	By Internal energy audit and training, Coal reduction = 27,200t/y Electricity reduction = 1,435MWh/y (0.7-1.0%)
	Rang Dong Light Source and Vacuum Flask Co. - Glass Industry *2	By internal energy audit, EC Committee, EC target = -10% Fuel reduction: Oil = 561t/y (-12.6%), Diesel oil = 64.3kL (-14.5%), LPG = 64.0t/y (-3.5%) Electricity = 312MWh/y (-3.5%)
Lao PDR	Textile 55 Co., Ltd. - Garment Industry *2	No activities for EE&C Energy cost =2.5-3.0% of total cost Non-use air conditioning in factory
Malaysia	JG Containers (M) Sdn. Bhd - Glass Industry *1	Energy management team, Energy audit by PTM Target: 5.0GJ/t-Glass melting Energy cost = >20% of Turnover 13% Energy intensity = 8.0GJ/t-Glass 5.1GJ/t-Glass Electricity intensity = 1.4GJ/t-Glass 0.87GJ/t-G
	Cargill Palm Products Sdn Bhd - Food Industry *1	Energy audit by PTM EC target = 10% vs. 2000/2001 Results in 2002: Energy = -2.7%, Cost = - 13.3%
Myanmar	MPE - Fertilizer Industry *1	Equipment modification 2000, as model JI between MPE and METI-NEDO Modified items: 17 Energy consumption = -20.9% (=26,300toe/y)
	MPE Thanlyin Oil Refinery *2	Countermeasures in equipment and operation - CDU (Crude Distillation Unit) modified to have residue circulation lines - Operation adjusted for low load factor

\*1: Presentation only, \*2: Energy audited by ECCJ Experts in 2004

(7) Summary of energy conservation activities

Table -6-8 shows a summary of FY 2004 PROMEEC activities in ASEAN countries. Through our activities for this time, we had a strong impression that energy efficiency and conservation activities had recently been more and more actively developed in ASEAN countries.

In order to advance energy conservation activities, the awareness and leadership on the part of top management of companies and the driving force that fits each factory are necessary. If it is clearly understood that energy efficiency and conservation lead to cost reduction and contribute to profits of companies and eventually to interests of society, these activities will become even more invigorated.

Table -6-8 Summary of METI-ASEAN PROMEEEC Activities in 2004

**PROMEEEC Activities in ASEAN Countries:**

**Promotion of EE&C is becoming actively year by year at factories in ASEAN countries, and many companies challenging EE&C issues can get the profits!**

**1. Start of PROMEEEC in Factories:**

**By the stimulus of**

- **Government policy (New policy or revision)**
- **Cost down**
- **EE&C training by outer organization, etc.**
- **Efficiency up, production increase**
- **Exterior help**
- **Others, etc.**

**2. Effects of PROMEEEC**

- **Profit increase**
- **Bringing up of EE&C awareness**
- **Good Image as a Green company**

**The “Management’s supports and all in activities together” are important to get the good results in EE&C.**

1.5 2005 Action Plans

In FY 2005, METI-ASEAN PROMEEEC activities will be continued in the same way as in FY 2004 with ACE, ECCJ and FPs (Focal Point) of ASEAN countries as the main bodies. In FY 2005, surveys and Seminar-Workshops will be given in Brunei and Indonesia in August and Cambodia and Philippines in November. The detailed schedule is shown in Figure -6-1.

The implementation period will be one week for each country. During the period, energy follow-up surveys on 2 to 3 factories will be carried out and then Seminar-Workshop will be given. In Seminar, reports on energy efficiency and conservation activities by the host country, presentations from requested ASEAN countries, etc. are planned. In Workshop, discussions on the creation and the current status of technical Directory (TD) and Database (DB)/Benchmark (BM) / Guideline (GL) are planned.

As a closing session, FY2005 Summary and Post Workshop will be held.

		Year												
		2005										2006		
Activities	Month	4	5	6	7	8	9	10	11	12	1	2	3	
(1)	Preparation: Detailed Plan/ Arrangement for 1st Site Activity													
(2)	1st Site Activity (Follow-up Survey (1) / Workshop (1))													
(3)	Analyses of 1st Site Activity Results / Preparation for 2nd Site Activity													
(4)	2nd Site Activity (Follow-up Survey (2) / Workshop (2))													
(5)	Analyses of 2nd Site Activity Results / Preparation for 3rd Site Activity													
(6)	3rd Site Activity (Workshop (3))													
(7)	Preparation of Report													

Figure -6-1 Implementation Schedule, PROMEEC (Industry) for 2005 - 2006,

In Summary Workshop, the results of activities in the current fiscal year as reported herein were highly evaluated and in Post Workshop, the direction of approaches to make in the next year and basic contents of the plan were confirmed by all the staff and participants. Eventually, a draft basic plan proposed by Japan was agreed upon by all delegates of the respective countries, Focal Points, (including ACE members) and consensus was achieved.

## 2. Discussions on Barriers and Countermeasures to Promotion of Energy Conservation in Industries

Table -6-9 shows barriers actually constituting obstacles to promotion of energy conservation activities in ASEAN countries and countermeasures against them.

While information collection, education, etc. are what they must continue to work on, it is important for the administration of each country to establish and enforce laws and for top managements of factories to fully understand the necessity of energy efficiency and conservation and promote it.

Table -6-9 Barriers and Possible Measures

<b>Barriers</b>	<b>Possible Measures</b>
<b>1) Policy</b>	- <b>Laws &amp; Regulations</b> - <b>Awareness of Top Management</b> - <b>Commitment of Top Management</b>
<b>2) Human Resources</b>	- <b>Top-level Decision</b> - <b>Education &amp; Training</b>
<b>3) Technology</b>	- <b>Seminar / Workshops</b> - <b>Study Tour</b> - <b>Technical Directory</b>
<b>4) Finance</b>	- <b>Feasibility Studies and Economic Justification</b> - <b>Economic Instruments (Incentives, Subsidies, Soft Loans, etc.)</b> - <b>Availability of Funding Facility</b>
<b>5) Information</b>	- <b>Seminar / Workshops</b> - <b>Technical Directory</b>
<b>6) Inadequate Local Manufacturing Capability</b>	- <b>Seminar / Workshops</b> - <b>Capability Building</b> - <b>Investment Promotion &amp; Facilitation</b> - <b>Technical Directory</b>
<b>7) Society &amp; Culture</b>	- <b>Education</b> - <b>Awareness Campaign</b> - <b>Reward System</b>

This was explained in Workshop in the 4 countries subject to survey, though there was not enough time for thorough discussions on it.

In discussions held in Summary Workshop, most of the opinions presented were about the importance of capacity building.

### 2.1 Education in Energy Conservation

The lack of the awareness of energy conservation was pointed out as the number one problem. While concerns on the part of the government are important, so are interests by owners of companies, managers, engineers and general employees. Therefore, what should be immediately done may be development of human resources and improvement of the awareness of energy conservation in the industrial sector, while legislation and low prices of energy also are critical issues that must be addressed for promotion of energy conservation.

We proposed the use of the Training Center in Thailand as the facilities for energy conservation capacity building.

## 2.2 Promotion of Energy Conservation

Most Asian companies are operated and managed by their owners in a top-down style. Therefore, top management's capacity building is particularly important. If the companies clearly show employees their policies, corporate goals and incentives, energy conservation activities in the companies will advance.

There are 3 types of energy conservation activities involving no cost, a small amount of cost and a large amount of investment. As a first step, it is recommendable to set out improvements that cost none and then study the next measure with the gains earned from the implementation of the first improvements. Most energy conservation measures involve no cost or a small amount of investment and still 10% to 15% energy reduction may be possible.

## 2.3 Energy Conservation Dissemination Activities

ACE is involved in EE&C-SSN (Sub-section Network), RE (Renewable Energy)-SSN, EP (Energy Policy)-SSN activities. ACE is also doing coordination work for AEMAS and has a lot of information. We believe that they should make a nice-looking pamphlet or something to communicate the results of their activities.

How about issuing "PROMEEC News Letter" carrying reports on PROMEEC activities?

We expect much from activities by ACE.

### 3. Discussion on Creation of Technical Directory for Each Industry and Policy of Dissemination

In the first place, ECCJ presented 4 kinds of sample TDs. Although these samples were presented and explained in Workshop given in each country to help participants' understanding, in this Workshop, more specific TD examples based on the follow-up surveys were presented. For example, they are the method of checking air ratio of burner of tunnel kiln in the ceramic industry, the method of repairing cavitations of turbine runner, countercurrent washing machine, the method of hydrogen membrane separation in oil refining, etc.

#### 3.1 Presentations on Technical Directory from 3 ASEAN countries

From 3 ASEAN countries, presentations on Technical Directory (TD) and Status & Plan of Database (DB) were made as described below.

##### (1) Presentation by delegate of Malaysia

- 1) Introduction of TD on Adjustable Speed Drive (ASD)
- 2) Calculations of value in money of assumed energy conservation effects attained through implementation of recommendations made for "Cargill Palm Products Sdn. Bhd." that were presented in Seminar-Workshop given in Malaysia, e.g. measures for leakage of compressed air and steam, thermal insulation and heat recovery, maintenance pitch of steam traps, etc.

##### (2) Presentation by delegate of Lao PDR

Explanation by "TD and Plan of Database Preparation in Lao PDR" was done, although TD had not been prepared. Lao PRD's Understanding of TD was explained. Lao PDR needs advice and assistance from ASEAN and ECCJ.

##### (3) Presentation by Myanmar

Specific examples of energy conservation technologies employed in Mann Thanbayakan Oil Refinery were demonstrated. They were not specific TD, however. Collection of these reference case examples of actual activities may help creation of an effective TD.

#### 3.2 Discussion on TD

##### (1) Contents of TD

Consensus was achieved on the understanding that TD should contain all technical information that is usable and useful in each ASEAN country concerned.

##### (2) Creation method of TD

Many opinions were presented and most were questions about what cases would be taken

up in TD and who would be in charge of creation.

In response to this, the ASEAN part mentioned that ECCJ should take the leadership in the creation, while ECCJ expressed its opinion that ASEAN countries should take the initiative in establishment of a system and ECCJ's responsibility would be to support and give advice to such activities of them. There was also a suggestion that outsourcing of the work and offering some incentives be considered if companies and businesses in ASEAN declined to get involved in the creation.

ECCJ suggested that TD be created based on examples of specific results in the past.

It was agreed that it would be necessary to establish a network and a system for creation of TD so that sustainability of this activity could be maintained.

ACE indicated that ACE would have to get involved in creation of TD in some way.

Ultimately, the specific results of activities that have been made since 2000 will be incorporated into TD so that it can be utilized in implementation and dissemination of energy conservation.

#### 4. Discussions on Development of Database/Benchmark/Guideline for Each Industry

##### 4.1 Method of Database Construction in Industries

###### (1) Characteristics of data collection in industries

Opinions presented are as follows;

While large-size companies have already established DB/BM/GL, medium-and small-size companies have not yet developed a sufficient energy management system and most of them do not even have data. In the industrial sector, data collection itself is difficult and it is costly. In addition, they don't provide data easily for confidentiality reasons, etc. It is impossible to obtain data enough to achieve objectives of this activity only by relying on energy audits of factories under PROMEEC.

To seek cooperation from Associations in industrial circles may be one way.

###### (2) Construction of Database with the use of Internet

Out of ASEAN countries, in Singapore, Thailand and Malaysia, surveys and database construction via Internet are advancing. In Thailand, collected data is compiled and provided to User.

Proposals made are as follows;

Shouldn't the utilization of this method be considered for construction of even more enriched database in this project? Data will be collected via Internet from ASEAN countries under this project so as to be compiled and distributed. Based on the understanding of the data construction program gained from each country, first of all, an easy-to-see and enriched PROMEEC website will be opened within the homepage of ACE. It should be made accessible with entry of password. How about enlisting cooperation from the above 3 counties where data collection is advanced in accumulating data?

We explained and gained full understanding of the basic stance that these will serve as preliminary, important activities before eventually the specific results of activities that have been made since 2000 are incorporated into TD so as to be utilized in implementation and dissemination of energy conservation. We confirmed that we would continue to advance the plan by our original method of approach.

## . **Technical Directory Created**

Presentations titled “Technical Directory (TD)” were made by 3 ASEAN countries.

### a. Presentation by delegate of Malaysia

- Introduction of TD on Adjustable Speed Drive (ASD)
- Energy conservation plans recommended for “Cargill Palm Products Sdn. Bhd.” that were presented in Seminar-Workshop given in Malaysia,

### b. Presentation by delegate of Lao PDR

- Explanation on understanding of TD on the part of Lao PDR by “TD and Plan of Database Preparation in Lao PDR”. Lao PDR needs advice and assistance from ASEAN and ECCJ.

### c. Presentation by Myanmar

- Specific examples of energy conservation technologies employed in Mann Thanbayakan Oil Refinery were demonstrated. They were not specific TD, however. Collection of these reference case examples of actual activities may help creation of an effective TD.

ECCJ showed the following 4 kinds of sample TDs.

- Method of checking air ratio of burner of tunnel kiln in the ceramic industry
- Method of repairing cavitations of turbine runner
- Countercurrent washing machine
- Method of hydrogen membrane separation in oil refining

These samples are attached hereunder.

## . **Reference Material**

### 1. Material for Seminar-Workshop in each country - Results of energy audits, ASEAN achievement presentation materials

Results of energy audits reported in Seminar-Workshop given in each country and ASEAN achievement presentation materials are listed below.

In addition, the Activity Schedule, Seminar-Workshop Program and Participant List in each country are listed together.

#### 1.1 Presentation materials of Vietnam

(1) Activity Schedule in Vietnam, Seminar-Workshop Program and Participant List

(2) Current Status and Activities on Energy Conservation and Energy Efficiency in Vietnam (by Mr. Le Tuan Phong)

(3) Promoting Energy Efficiency and Conservation in Industry of Vietnam (by Dr. PHAM Hoang Luong)

Another two materials from Vietnam, “Energy reduction and energy conservation (by Ms. Tham Luen, Bai Bang Paper Co., Ltd.)” and “Energy conservation activities in the lighting fixture manufacturing factory (by Mr. Le Quoc Khanh, Rang Dong Light Source & Vacuum Flask Co, Ltd.)” were written in Vietnamese, so no attached here.

#### 1.2 Presentations materials of Lao PDR

(1) Activity Schedule in Lao PDR, Seminar-Workshop Program and Participant List

(2) Energy Efficiency and Conservation in Lao PDR (by Mr. Khamso Kouphokham)

(3) NAM NGUM 1 HYDRO POWER PLANT (by Mr. Vanthong Khamloonvilayvong)

#### 1.3 Presentation materials of Malaysia

(1) Activity Schedule in Malaysia, Seminar-Workshop Program and Participant List

(2) Experience and Application of EE&C in JG Containers (M) Sdn. Bhd - Glass Industry (by Mr. Ashok Rao)

(3) Experience and Application of EE&C in Cargill Palm Products Sdn. Bhd. - Food Industry - (by Mr. Hishamudin Iblahim)

- (4) Experience and Application of EE&C in Arab Malaysia Development Berhad Textile Plant  
(by Mr. Phubalan Karunakaran)

#### 1.4 Presentation material of Myanmar

- (1) Activity Schedule in Myanmar, Seminar-Workshop Program and Participant List
- (2) Experiences and Application of Energy Conservation in Mann Thanbayakan Oil Refinery  
(by U Tun Myint)

Myanmar's presentations included also an EE&C activity report on a fertilizer plant, but material was not obtained.

#### 1.5 Presentation materials of Indonesia

- (1) Experience and Application of EE&C in PT KERTAS LECES (by Mr. Djoko Wiryono & Subagyo)
- (2) Technical Report of Experience and Application of EE&C in PT KERTAS LECES (by Mr. Djoko Wiryono & Subagyo)

#### 1.6 Presentation materials of Japan

- (1) Energy conservation activities in Japan

- 1) Energy Conservation Program in Japan
- 2) Barriers and Measures on Implementing EE&C in Industry

- (2) Follow-up energy audit

- 1) Energy Conservation Promotion, Ceramics (Vietnam)
- 2) NAM NGUM I HYDRO POWER PLANT (Lao PDR)
- 3) AMDB, Textile Industry (Malaysia)
- 4) Energy Audit Findings at Oil Refinery (Myanmar)

- (3) Energy Conservation Promotion of Phase 1 presented by ECCJ

- 1) Cement (Brunei)
- 2) Food Processing (Singapore)
- 3) Garment (Cambodia)
- 4) Iron/Steel (Philippines)

(4) Materials of Seminar-Workshop in each country - regarding TD, DB, BM, GL

1) Development of Technical Directory

2) Development of Local Database/Benchmark/Guideline

2. Summary-Post Workshop Material

(1) Summary/Post-Workshop Program and Participant List

(2) Summary of Local Seminar-Workshops and Follow-up Surveys in Major Industries

(3) Major Industry, Proposed Plan in 2005-2006

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