

**5. ENERGY CONSERVATION ACTIVITIES IN
THAILAND INCLUDING TRAINING AND
EDUCATION OF STAFF**

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5.1 Energy Policy

(1) Policy framework

Thailand has set out its energy policy framework in the 7th NESDP which started in October 1991, as follows:

- ① To promote petroleum and coal development, increase oil refining and power generation capacities, and promote the development of alternative energy sources to secure sustainable energy supply at stable prices.
- ② To reform energy-related regulations, promote the use of energy saving machinery and equipment, and encourage cooperative efforts among concerned organizations, conducive to efficient and economical use of energy.
- ③ To encourage private investment in oil business and electric utilities, and strengthen the financial position of national enterprises through privatization.
- ④ To reduce environmental release of lead, carbon monoxide, and sulfur dioxide in the process of energy consumption from a viewpoint of environmental protection.
- ⑤ To develop energy resources in rural regions for the benefit of fostering local industries.

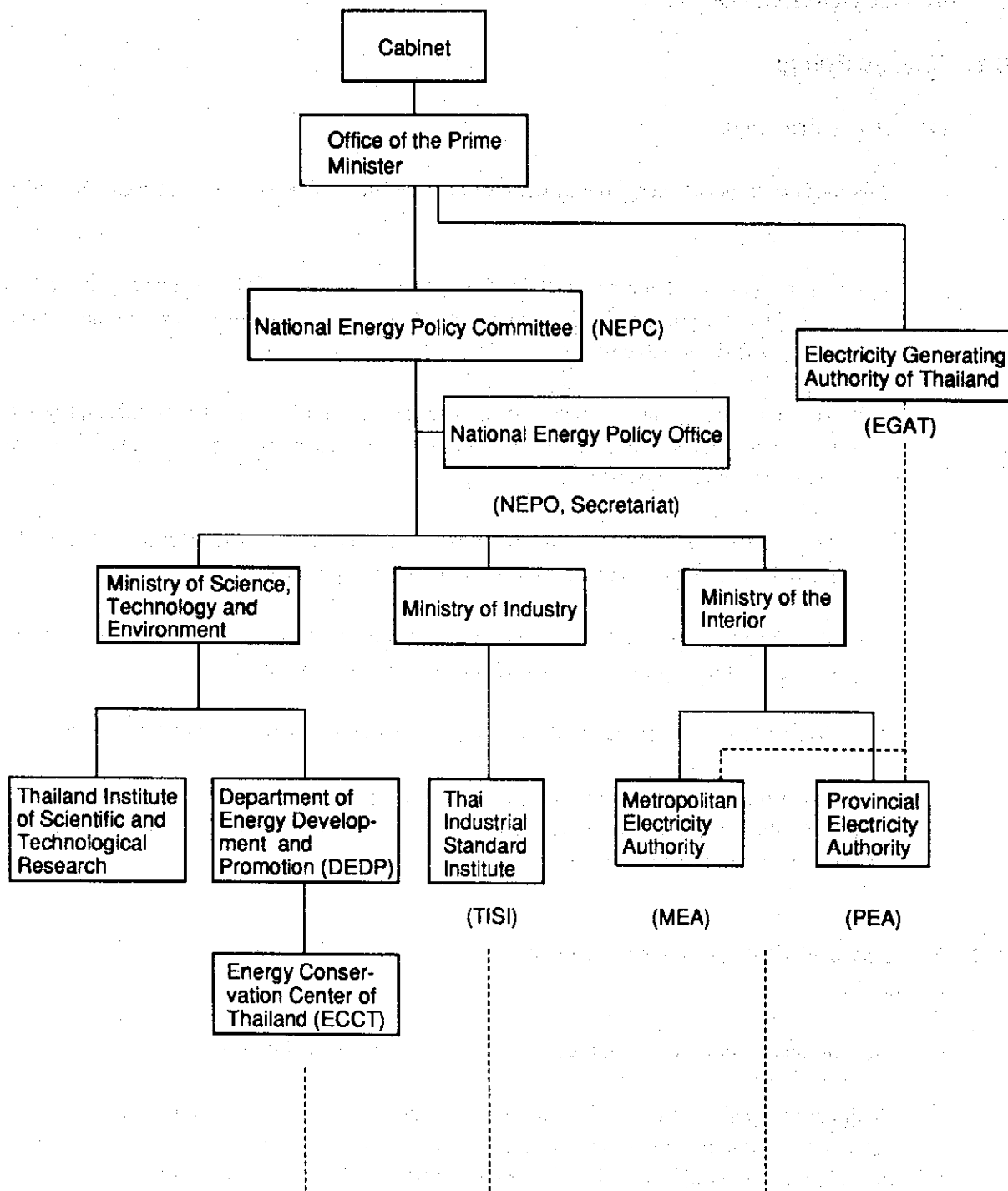
The plan also aims to maintain annual growth of energy supply below 8% and demand growth below 10% during the planning period between 1992 and 1996, while keeping import dependence ratio of energy sources under 60%.

5.2 Institutional Framework for the Implementation of Energy Conservation Measures

(1) Institutional Framework for Energy Policy Implementation and Coordination

Major energy policy matters are decided by the National Energy Policy Committee (NEPC, which is chaired by the prime minister and consists of ministers and vice-ministers of all ministries involved in energy policy). The committee's secretariat is the National Energy Policy Office (NEPO) and agencies concerned include the Ministry of Science, Technology and Environment, the National Economic and Social Development Board, and the Ministry of Industry. Fig. 5.1 shows the relationship of these ministries and agencies.

Figure 5.1 Relationship of Energy-related Ministries and Organizations



It is planned that DEDP will supervise designated factories and buildings.

The Ministry of Industry supervises factories.

The Ministry of Interior supervises building construction.

(2) Institutional Framework for Energy Conservation Promotion

Thailand started its efforts to promote energy conservation in 1981 when the Energy Conservation Center (ECC) was established as an organ in National Energy Administration of the Ministry of Science, Technology and Energy.

In 1985, with support from the Federation of Thai Industries and other organizations, the Energy Conservation Center of Thailand (ECCT) was established as a core organization for energy conservation promotion.

In April 1992, based on the 7th 5-year plan, the "Energy Conservation Promotion Act" was promulgated. At the same time, 1.5 billion bahts (about 6 billion yen) as the starting amount were transferred from the Oil fund to "Energy Conservation Promotion Fund", which is to be used as a financial source of low-interest loans and subsidies.

(3) Organization and Duties of Department of Energy Development and Promotion (DEDP)

a. Organization, Staff and Budget

The DEDP consists of 11 divisions. The Energy Conservation Division and Energy Economics Division deal with matters related to energy conservation with total staff of 115 (as of August 1993). The organizational charts of the Ministry of Science, Technology and Environment and DEDP are shown in Figures 5.2 and 5.3.

b. Energy Conservation Related Activities

The Energy Conservation Division is composed of 4 sections and works on planning of energy conservation programs, examining of energy conservation in factories and buildings, etc. Usually the teams of 6 staff members each conduct energy use audit service for 30 factories and 30 buildings a year. This program is intended to be implemented at 10,000 factories and 600 buildings in total.

The Energy Economics Division manages data which is collected from EGAT and other institutions and energy standards. The division also has the Energy Training Center.

Energy conservation evaluation and training activities are also conducted by the Energy Conservation Center of Thailand (ECCT) (with staff of 40) which was established as an auxiliary organ in 1985 with assistance of the Federation of Thai Industries.

c. Provincial Organs

There is no provincial organs established so far.

Figure 5.2 Organization of Ministry of Science, Technology and Environment

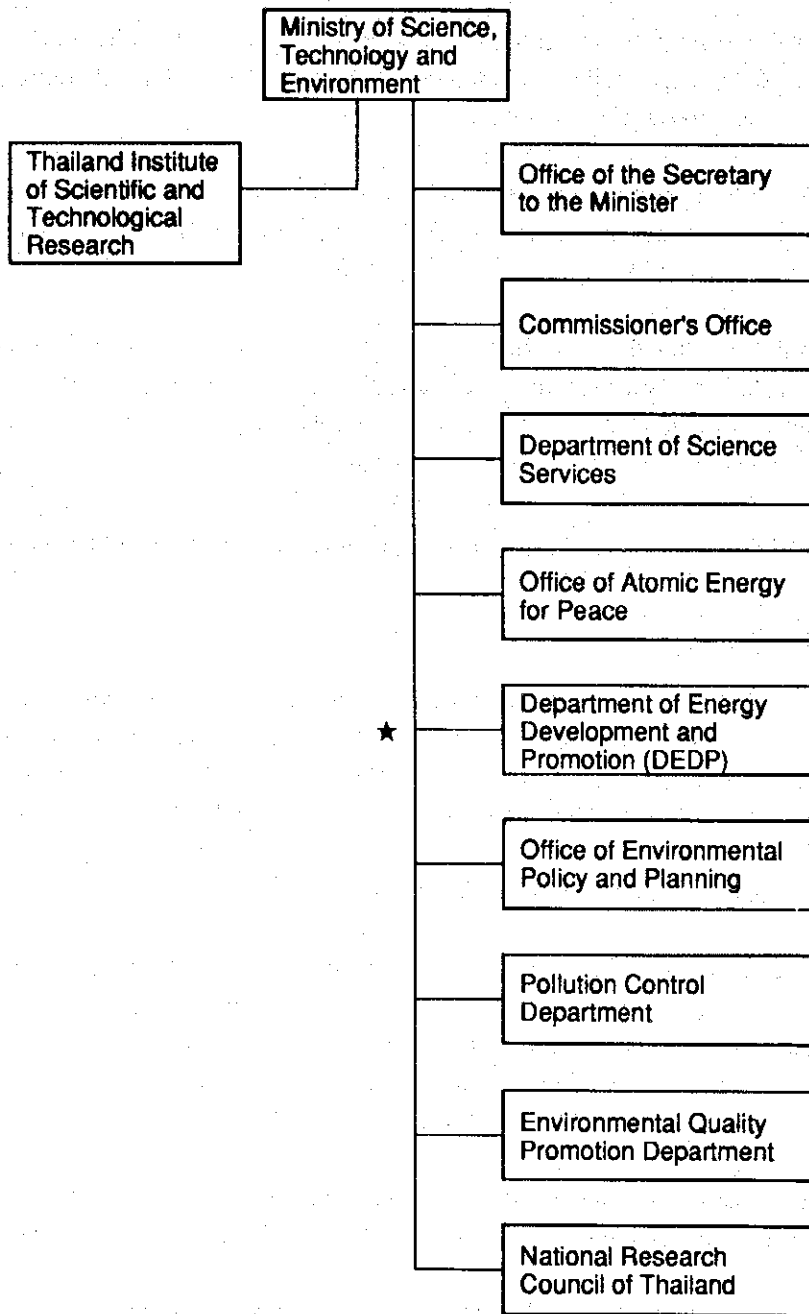
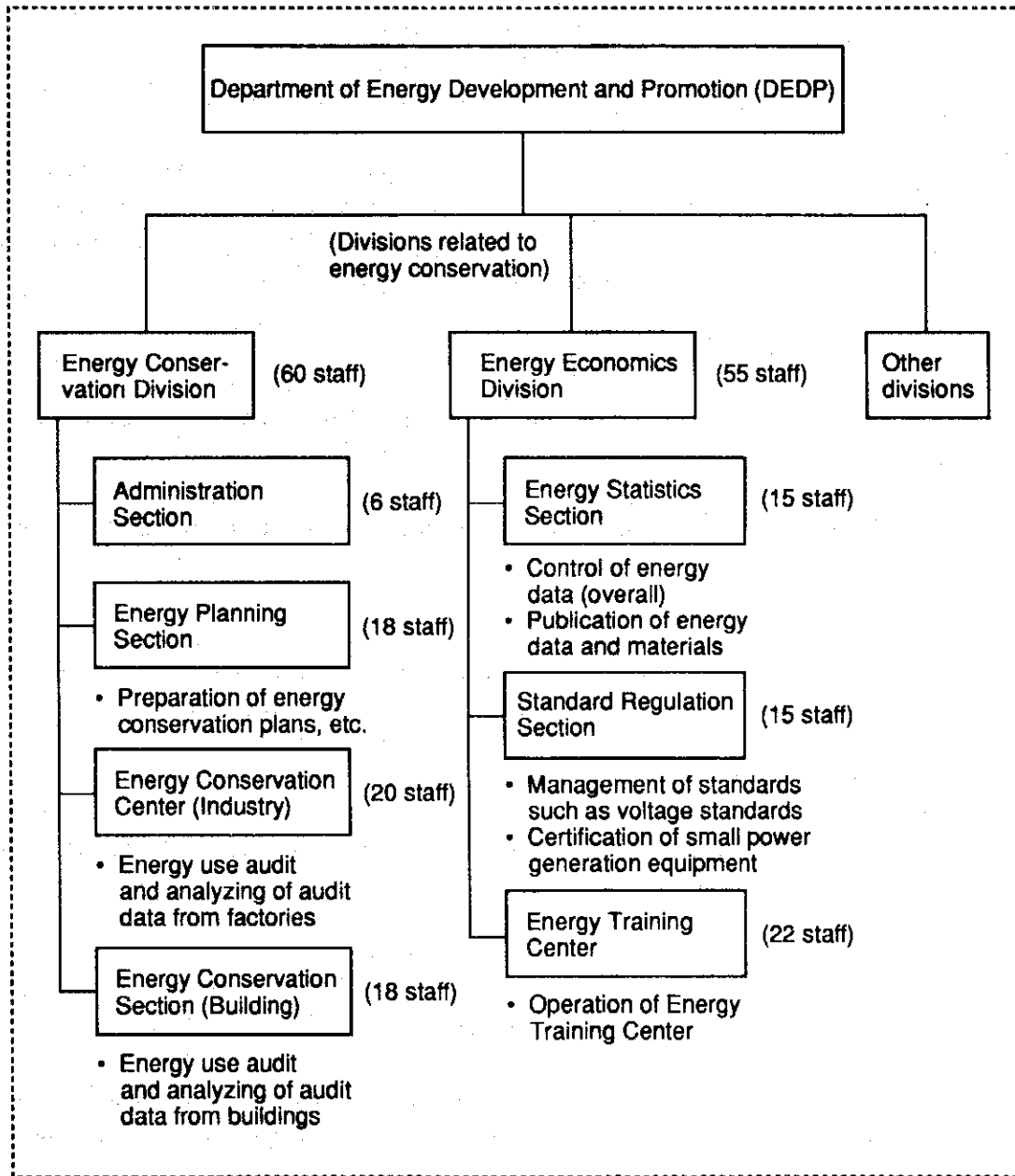


Figure 5.3 Departments and Divisions Related to Energy Conservation



↑ ↓

Energy Conservation Center of Thailand (ECCT)

- Energy use audit (on commission)
- Training for energy conservation (on commission)
- Advertisement of energy conservation

5.3 Laws and Regulations Related to Energy Conservation

(1) Enactment of the Energy Conservation Promotion Act

The Energy Conservation Promotion Act was enacted in April 1992.

The Act so operates to designate factories and building of a certain size to promote energy conservation, strengthening regulations such as requiring submission of energy consumption data and improvement plans, while providing financial aid to accelerate energy conservation through grants and subsidies with the Energy Conservation Promotion Fund.

(2) Outline of the Act

The following are an outline of the Energy Conservation Promotion Act which is also summarized in Fig. 5.4:

(a) Energy conservation should be encouraged for the following facilities with guidance:

① Factories

Efficient fuel combustion, prevention of energy loss, recovery of waste heat, improvement of energy conversion efficiency, efficient electricity use, etc.

② Buildings

Improvement of air conditioning, use of construction materials leading to energy conservation.

③ Energy-consuming machines and appliances

Standards for energy utilization and energy efficiency regulations

(b) Factories and buildings which consume more energy than a certain standard are designated and required to report their actual status of energy consumption and energy conservation plans.

Notes:

- Electricity supply contracts of 1,000 kW or more and 20 million MJ/year or more are considered in the ministerial regulation.
- 3,600 establishments (3,000 factories and 600 buildings) are planned to be designated. The 3,000 factories consume 60% of the total amount of energy in the whole industry.

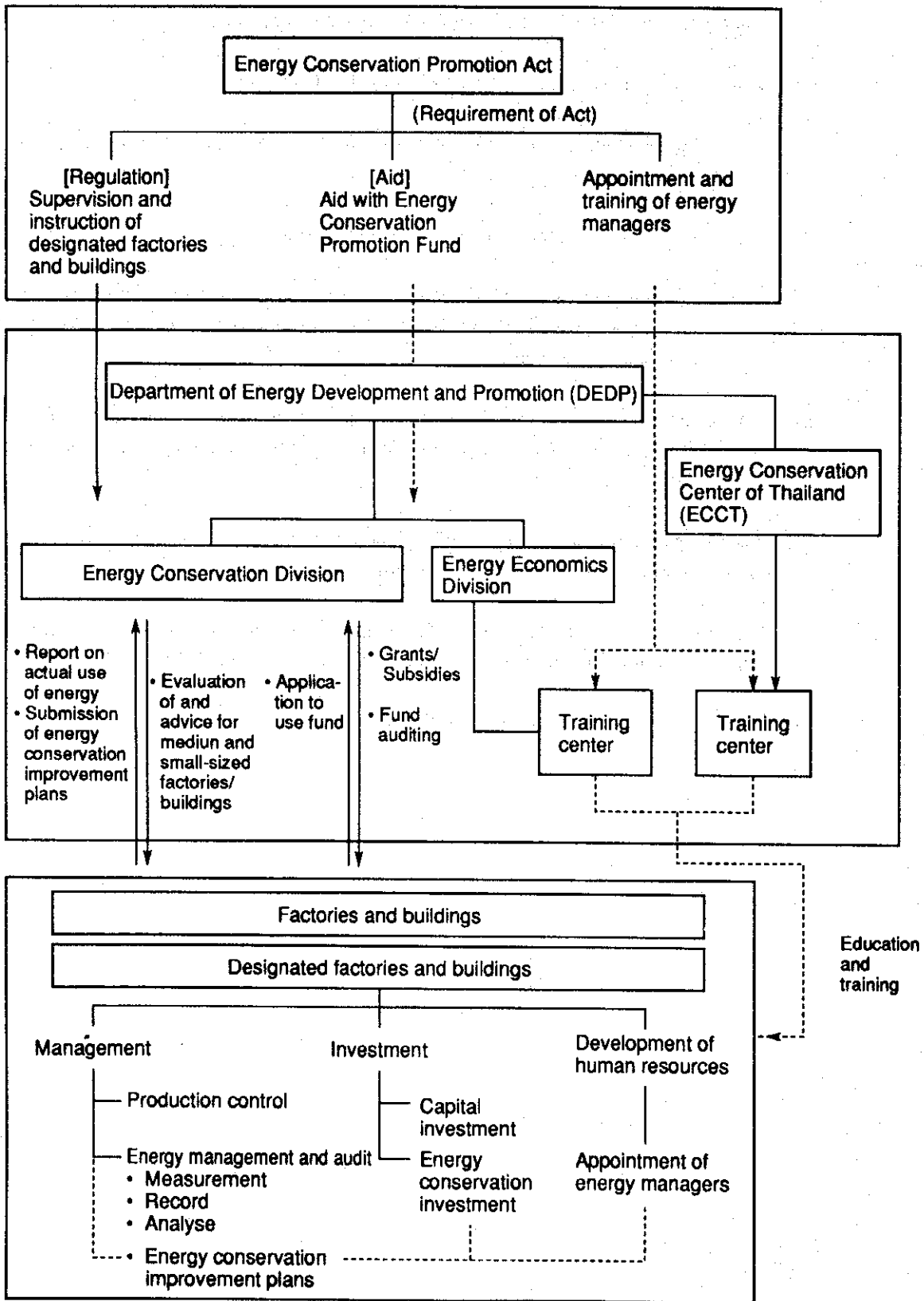
- (c) Energy managers should be appointed at designated factories and buildings.

Energy managers should be educated in training courses, etc.

Note: Energy managers must have one of the following qualifications:

- ① having a Higher Vocational Certificate and at least 3 years' experience in the factory;
 - ② having a degree in Science or Engineering; or
 - ③ completing a training course in energy conservation or training course with similar objectives organized or approved by the Ministry of Science, Technology and Environment.
- (d) The designated factories and buildings must record and report their actual use of energy every 6 months as well as prepare and submit an energy conservation improvement plan once a year.
- (e) The Energy Conservation Promotion Fund should be established to support plans to promote energy conservation with grants and subsidies.
- (f) Those who violate the above rules will be imposed electricity surcharges which will be collected by three electric power companies (EGAT, MEA and PEA).
- (g) Those who violate the above rules will be punished.

Figure 5.4 Requirements of Act and Current System



5.4 Implementation Status of Energy Conservation Activities

The Government and the related organs have so far conducted the following energy conservation activities to promote energy conservation in Thailand.

(1) **Department of Energy Development and Promotion (DEDP)**

- a. Working out energy conservation policies and plans
- b. Deciding on feasibilities for energy conservation
- c. Working out guidelines and regulations for energy conservation
- d. Supply of information on energy conservation technology
- e. Energy audit
- f. Implementation of training for the education of energy managers
- g. Dissemination of energy conservation

(2) **Energy Conservation Center of Thailand (ECCT)**

ECCT conducts the following activities based on the project by the Department of Energy Development and Promotion (DEDP)

- a. Energy audit (entrusted by DEDP)
- b. Training for energy management (entrusted by DEDP)
- c. Energy audit services entrusted by enterprises
- d. Consultancy on energy conservation
- e. P.R for energy conservation
- f. Seminars for dissemination of energy conservation
- g. Supply of information related to energy conservation

(3) **Technological Promotion Association (TPA)**

- a. Training for energy conservation
- b. Workshop, seminars and study tours related to energy conservation

(4) Industrial Finance Corporation of Thailand (IFCT)

Financing of energy conservation plans at a special rate (11.5%)

(Reference: Open market rate 14 ~ 16%)

(5) Ministry of Finance (MOF)

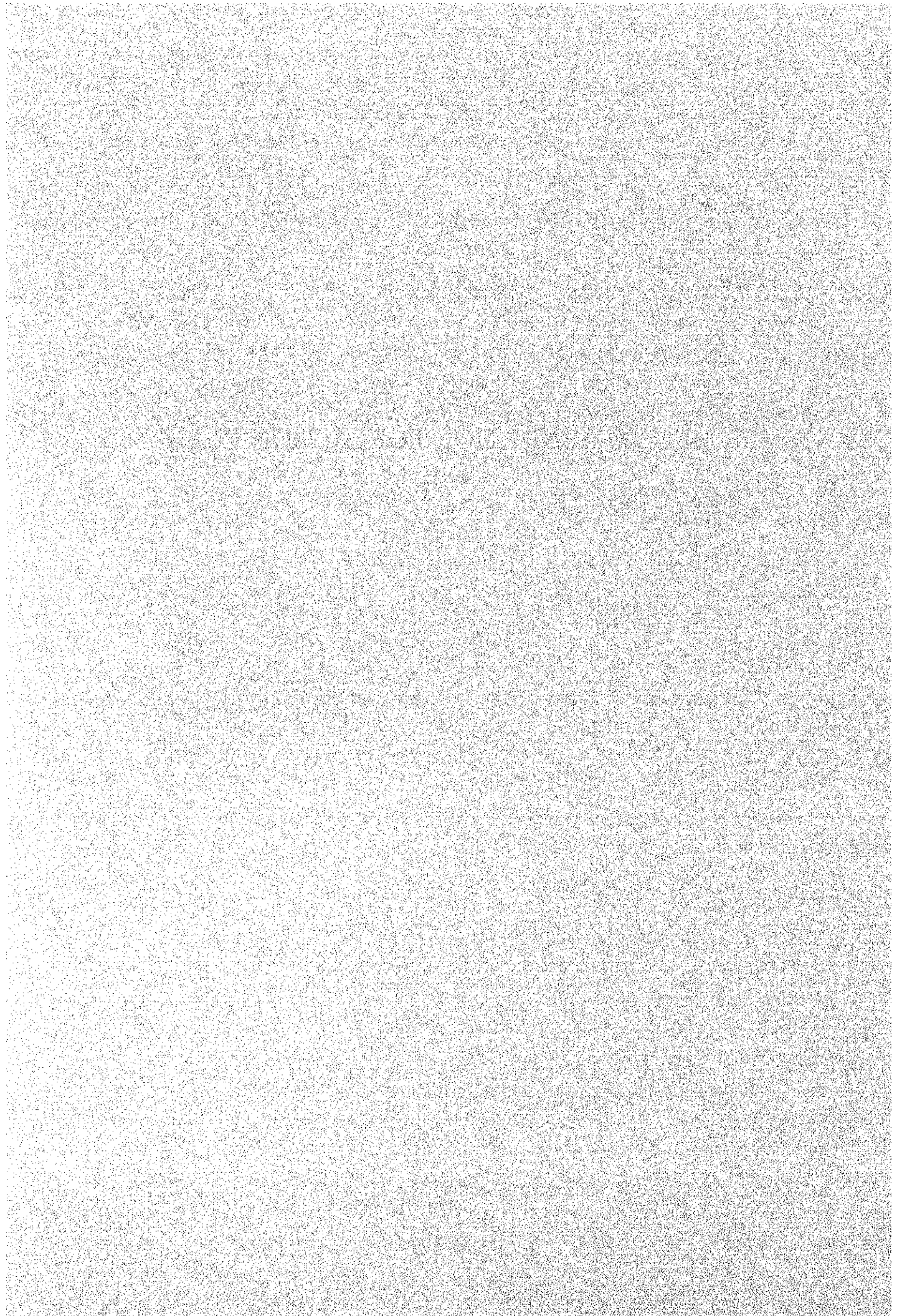
Lowering of customs duties on machines and tools for energy conservation and environmental protection

(6) Universities (Chulalongkorn University, King Mongkut's Institute of Technology, Chiang Mai University, Prince of Song Khla University)

a. Research on energy conservation technology

b. Training for energy management

6. RECOMMENDATION FOR ACTION PLAN



6. RECOMMENDATION FOR ACTION PLAN

6.1 Recommendation for Organizational Reform Including Arrangement of DEDP Staff Enforcing the Energy Conservation Promotion Act and Establishment of Local Offices

6.1.1 Organization of Headquarters

(1) Current status

- ① DEDP's organization related to energy conservation currently consists of the Energy Conservation Division and Energy Economics Division.
- ② The Energy Conservation Division formulates energy conservation plans, and its industrial and building sections separately carry out energy use audit service for factories and buildings.
- ③ The Energy Economics Division's tasks include collecting data on actual use of energy from EGAT and other organizations, regulating electricity self generation, and providing training for energy conservation.

(2) Recommendation on Organizational Reform

(2.1) First Phase of Organizational Reform (Short-term measures)

The organizational reform to meet the following three requirements of the Energy Conservation Promotion Act enacted in April 1992:

- a. Supervising and instruction of designated factories and buildings
- b. Effective use of the Energy Conservation Promotion Fund
- c. Prompt training of energy managers

Thus, the following short-term measures for the organizational reform are proposed as described in Fig. 6.1.

Figure 6.1 Recommended Organizational Reform for DEDP Headquarters (1/2)

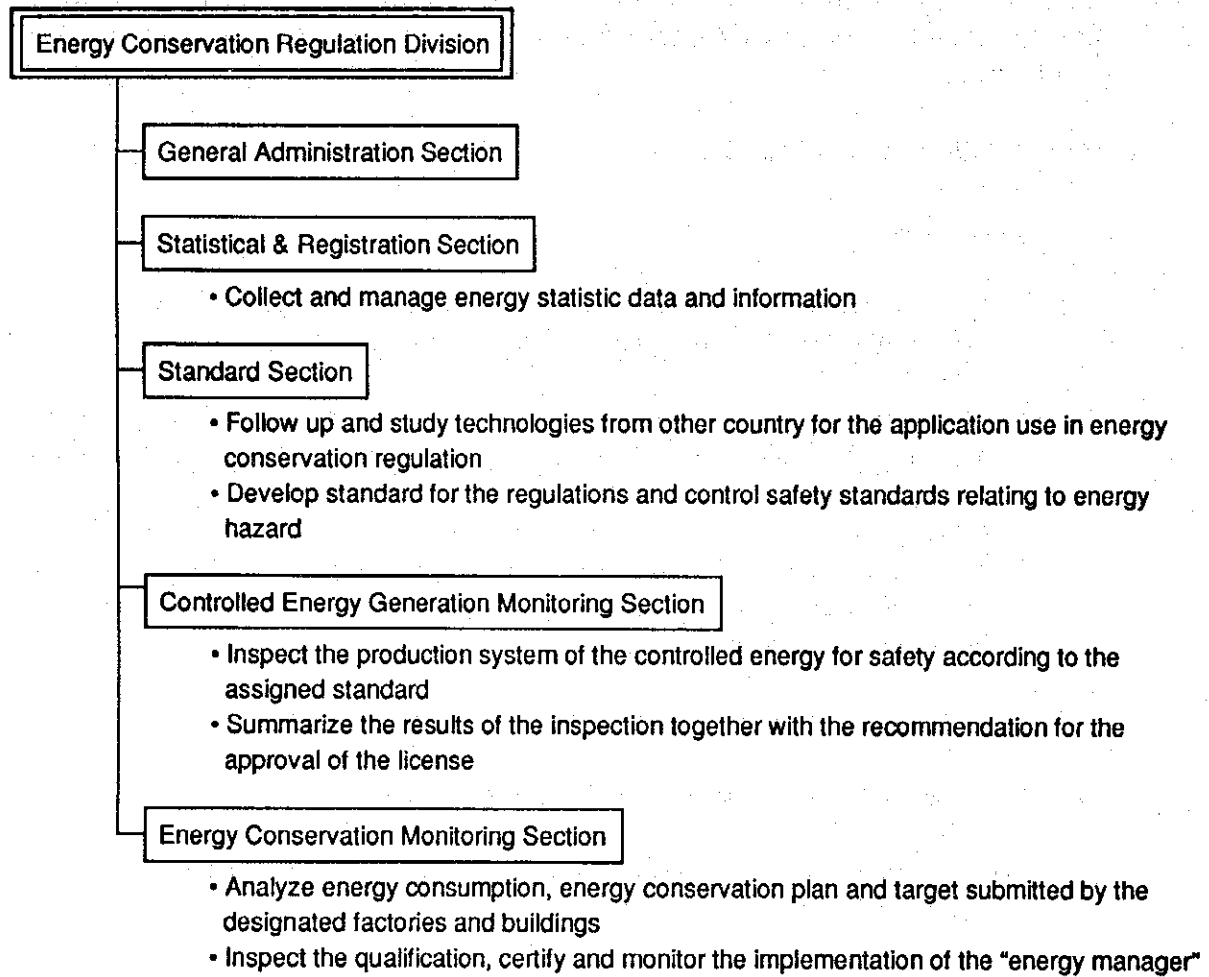
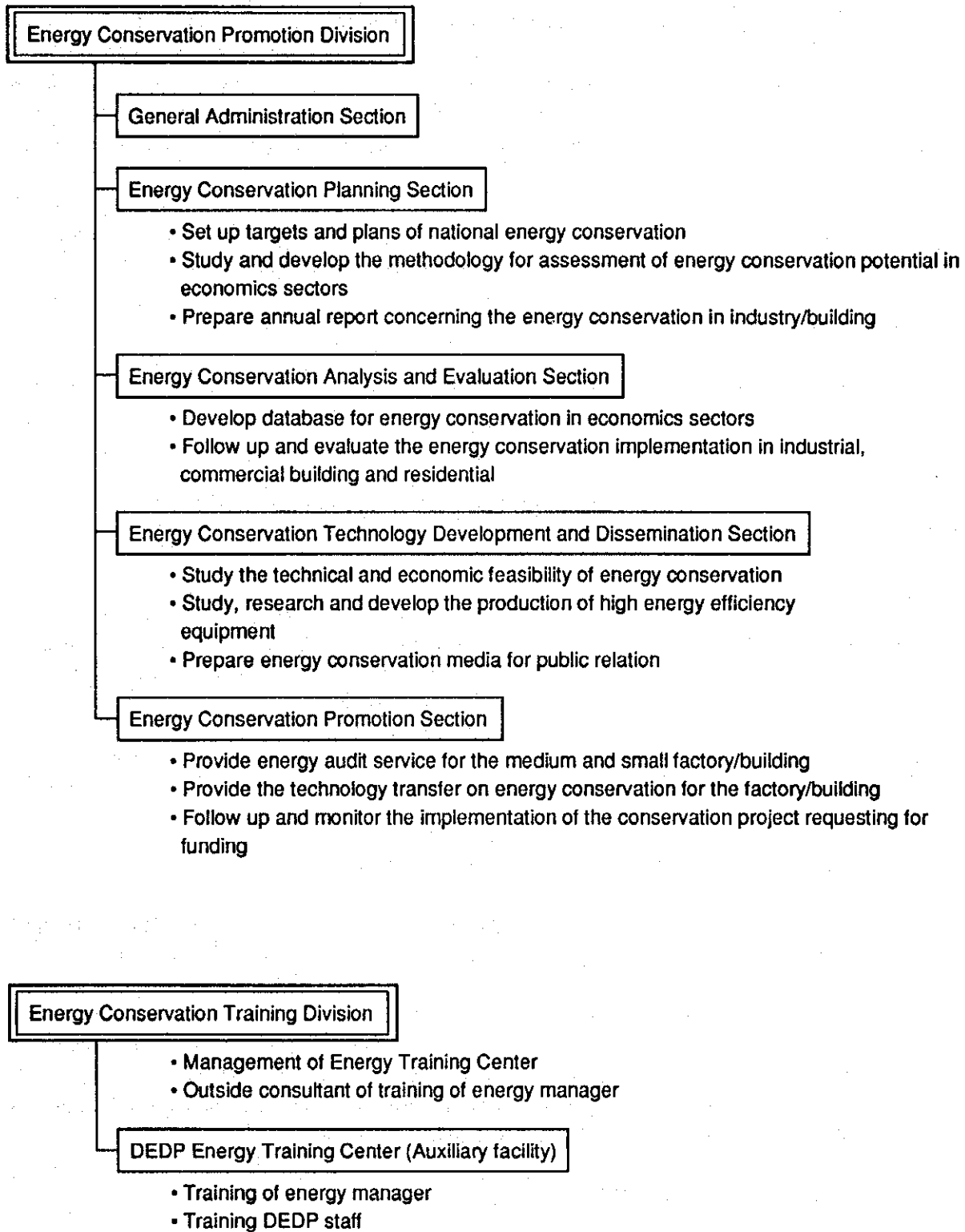


Figure 6.1 Recommended Organizational Reform for DEDP Headquarters (2/2)



(2.2) The second phase of organizational reform (medium-term measures)

The Act provides for submission of energy conservation improvement plans, in addition to technical data, and fund application by the designated factories and buildings. The anticipated increase in workload is difficult to be handled by DEDP and partial outside contract. It is recommended, therefore, to transfer energy use audit service entirely to outside consultants including ECCT, while DEDP will be responsible for management of the audit service. Separation of actual service and management is expected to improve the overall management efficiency.

It should be noted, however, that the prerequisite to the organizational reform is to increase ECCT budget and staff and to strengthen its function as an outside consultant.

(3) Upgrading ECCT

With organizational reform of DEDP, ECCT's function needs to be strengthened as shown in Table 6.1. It should be financed by Energy Conservation Promotion Fund.

Table 6.1 Strengthening ECCT's Function

Present	After amendment
(1) Energy use audit service (partially contracted)	(1) Energy use audit service (entirely contracted) (2) Expert consultant related to energy conservation plan (3) Consultation on fund application for Energy Conservation Promotion Fund
(2) Energy conservation training	(4) Energy conservation training
(3) Energy conservation public relations service	(5) Energy conservation public relations service

(4) Establishment of Eligible Designated Factories and Buildings

The number of designated factories and buildings is estimated to be around 3,600 (3,000 factories and 600 buildings), and some predict that it will double to as much as 7,000 in future.

The increase in number of designated establishments means the increase in workload required for management and supervision, both in terms of quality and quantity. Thus, the number of designated factories and buildings needs to be established as the number manageable by DEDP within its administrative service. For instance, designation may be carried out in three phases (years) to reach the target level of designation in the third year.

(5) Personnel exchange with ECCT

The upgrading of ECCT's function can be partially accomplished through personnel exchange with DEDP. In particular, DEDP's experience will be useful to energy use diagnosis service.

6.1.2 Establishment of local offices

(1) **Current state**

DEDP is now operating water gauge stations for hydropower stations, water pumping stations, and alternative energy centers. It has no local office related to energy conservation.

(2) **Recommended organizational reform in response to the enactment of Energy Conservation Promotion Act**

To deal with the increasing number of designated establishments, therefore, DEDP should have several local offices in addition to its Bangkok headquarters.

(3) **Responsibility of local offices**

Local offices will be responsible for the following tasks:

- ① Supervision and guidance on designated factories and buildings
- ② Supervision on energy use audit service contracts
- ③ Public relations in energy conservation
- ④ Communication with headquarters

(4) **Staffing of local offices**

Staff at local offices will be classified according to their rankings based on the above indices, ranging between 5 and 11 persons.

6.2 Method of Evaluating Energy Conservation Improvement Plans Submitted by Designated Factories and Buildings

The Energy Conservation Promotion Act requires the designated factories and buildings to submit energy conservation improvement plans annually.

DEDP evaluates the plans and provides guidance and advice for the designated factories and buildings in relation to promotion of energy conservation.

The guidance and advice should be given in the following procedure.

6.2.1 Evaluation of improvement project

(1) Evaluation of the improvement plan

The improvement plan should consist of the following items and is accompanied by the following documents.

- 1) Energy conservation improvement plan
- 2) Drawings of buildings and factories
- 3) Production (value/volume) in the past 5 years or land area (total or air-conditioned)
- 4) Energy consumption (heat and electricity) in the past 5 years
- 5) Content and result of energy conservation activity
- 6) Future plan and target for energy conservation activity, and role of the present plan
- 7) Documents and records to be kept at factories and buildings

(2) Technical evaluation

Evaluation of improvement items from technical aspects should be based on the following criteria:

- 1) Improvement of fuel combustion
- 2) Improvement of heating, cooling, and heat transfer
- 3) Prevention of heat loss due to radiation and transfer
- 4) Recovery of waste heat
- 5) Efficiency improvement by conversion of heat to motive power
- 6) Prevention of power loss due to resistance and other factors
- 7) Improvement of conversion of electric energy to motive power and heat

(3) Economic evaluation method

Economic evaluation of the improvement project is based on the criteria that the improvement cost is less than the upper limit calculated as follows.

Evaluation and guidance on improvement plans submitted by the designated factories and buildings are conducted according to the priority.

6.3 Follow-up Method for Energy Conservation Promotion Fund

The Energy Conservation Promotion Act sets forth the establishment of Energy Conservation Promotion Fund to provide financial aid for energy conservation activities. The follow-up methods include subsidy, grant and loan.

6.3.1 Subsidy and grant

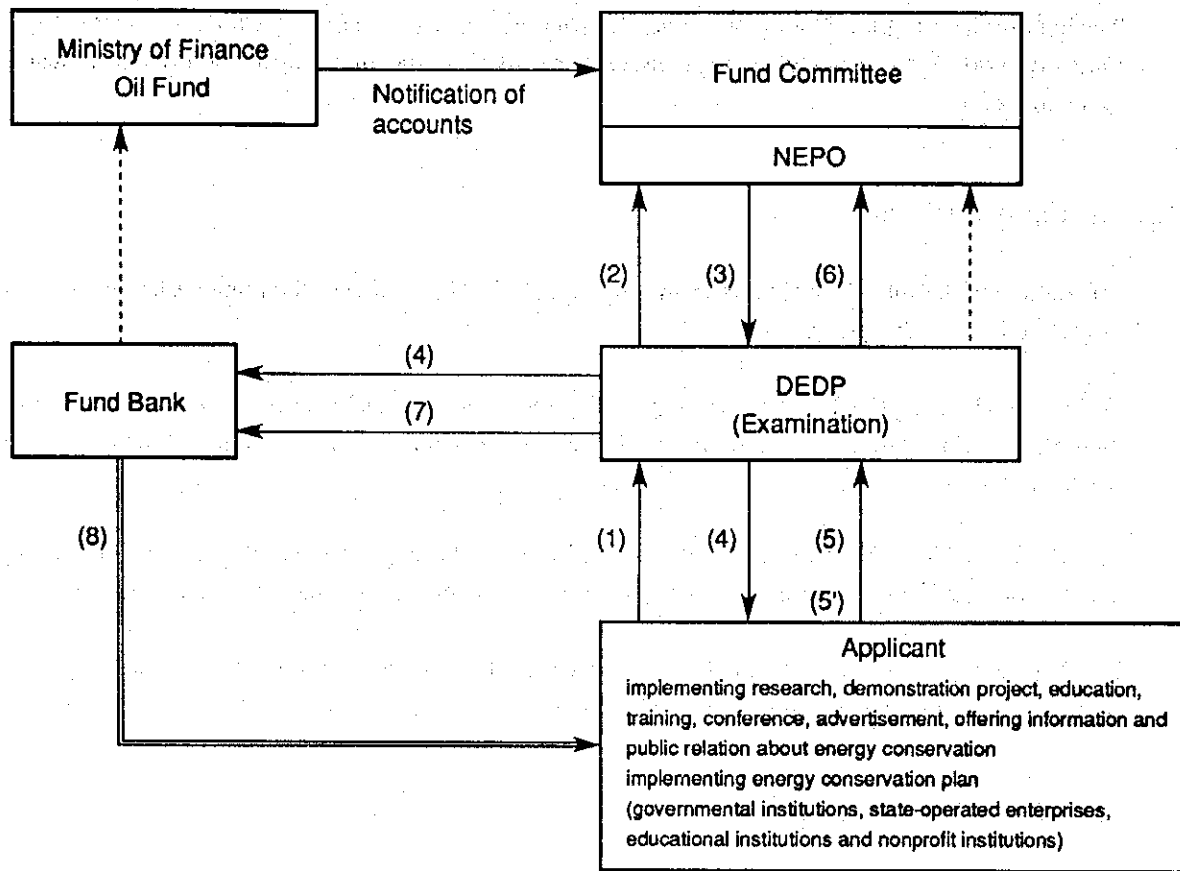
The outline of the subsidy system is shown in Figure 6.2. The outline of the grant system is the same as that of the subsidy system.

DEDP, which is responsible for receiving applications, conducts technical and economic evaluation thereof, and submits to the Fund Committee the results of evaluation in terms of improvement in energy conservation effort.

In addition, DEDP will confirm the effect resulting from the improvement efforts made for energy conservation. It is advisable to verify the said effect on the basis of the reports and the outputs.

DEDP conducts follow-up examination on the basis of documents submitted, and encourages the applicant to perform measurement and analysis required to verify the effect of the improvement.

Figure 6.2 Subsidy System for Promotion of Rational Use of Energy



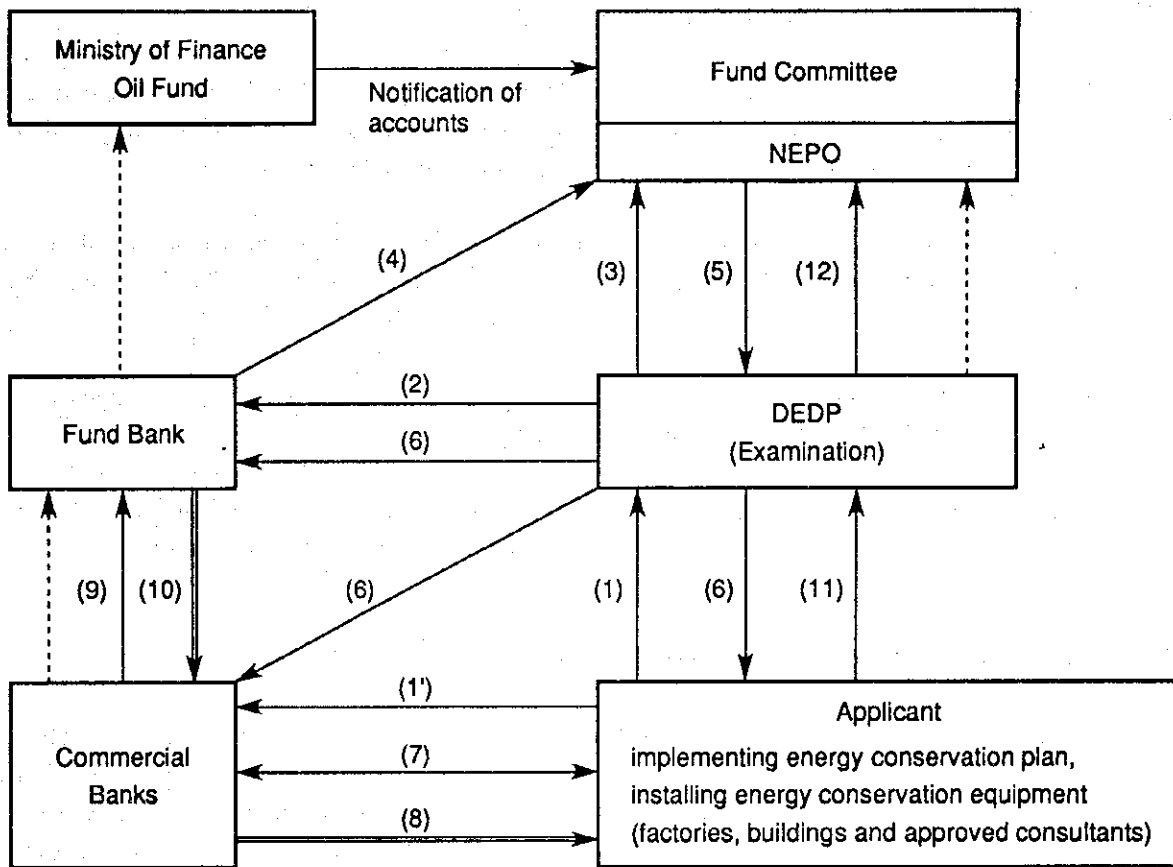
- > document flow
- =====> money flow
-> monthly report

- (1) Application report
- (2) Recommendation of application report
- (3) Approval of subsidy
- (4) Notification of approval
- (5) Implementation report
- (5') Request for payment of subsidy (Subsidy bill)
- (6) Evaluation of implementation report
- (7) Indication of payment of subsidy
- (8) Payment of subsidy

6.3.2 Loan

Loan will be rendered by governmental institutions (such as the Industrial Finance Corporation of Thailand (IFCT)) which will serve as fund banks to review financial conditions, credit standing and project feasibility of loan applicants and thereafter provide a grant for paying a fixed rate of interest on the loan from commercial banks.

Figure 6.3 Loan System for Promotion of Investment for Rational Use of Energy



- document flow
- ==→ money flow
- - -→ monthly report

- (1) Application report
- (1') Application for loan
- (2) F/S report
- (3) Recommendation of application report
- (4) Evaluation of financial affairs
- (5) Approval
- (6) Notification of approval
- (7) Contract of loan
- (8) Loan
- (9) Request for payment of interest supply
- (10) Payment of interest supply
- (11) Implementation report
- (12) Evaluation of implementation report

6.4 Recommendation for Establishment of Training Scheme for Energy Managers

6.4.1 Qualification for energy managers

The Energy Conservation Promotion Act promulgated in April 1992 in Thailand specifies that one or more "energy managers" shall be appointed at each energy management designated factory (building) and that each energy manager shall have one of the following qualifications.

- Item 1 Holding a Higher Vocational Certificate and having at least three years experience in the factory (building), with evidence of work in energy conservation verified by the owner of the designated factory (building).
- Item 2 Holding a degree in Science or Engineering, with evidence of work in energy conservation verified by the owner of the factory (building).
- Item 3 Having taken a training course in energy conservation or training course with similar objectives organized or approved by the Science, Technology and Environment Ministry.

6.4.2 Current situation of management training

The Ministry of Science, Technology and Environment has been implementing with government budget since 1991 management training, which is a qualification for energy managers at energy management designated factories (buildings), as 3-day course and 5-day course for factories and buildings. Attendance in these training courses is free of charge, and about 3,000 persons have taken these courses so far.

Courses of two types, i.e., 3-day course and 5-day course, are available, and selection of a course is made according to the qualification for attendance.

A textbook of about 400 pages uniquely drawn up by each implementing organ under the editorial supervision of DEDP is used for training. Some differences are observed in the expression of textbook among implementing organs.

Training completion tests are not conducted, and a training course completion certificate issued by the Director General of DEDP is granted to each person who finished a course.

Heat management training and electricity management training are implemented apart from management training for energy managers for energy management designated factories (buildings).

This training is conducted with government budget for enhancement of technology of personnel responsible for energy conservation in factories and buildings. No fee is required for attending the training course.

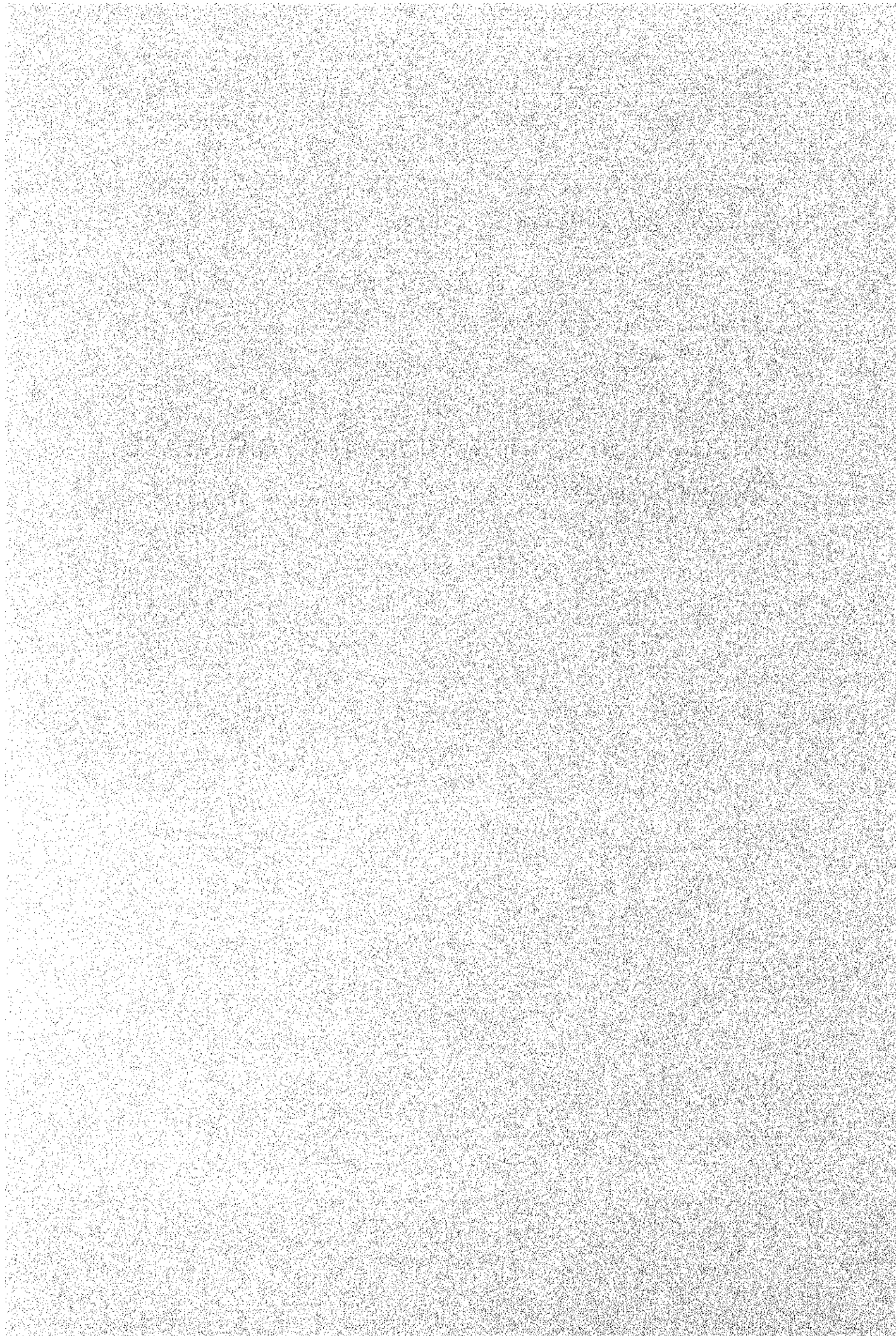
6.4.3 Recommendation on training scheme

Recommendation is made to implement management training in three stages as shown in Table 6.2 regarding the training scheme of the Energy Conservation Promotion Act.

Table 6.2 Outline of Recommendation to Implement Management Training In Three Stages

Stage	Stage 1	Stage 2	Stage 3
Time of implementation	Temporary implementation	Mid-term implementation	Long-term implementation
Outline of recommendation	To temporarily continue the currently implemented training for factory management and building management. But to use the same textbook and hour assignment even at different training organs.	To discontinue training for factory management and building management, and to start training for thermal energy management and electrical energy management. To conduct on-completion testing in addition.	To revise the Energy Conservation Promotion Act to classify energy management designated factories (buildings) into two fields, i.e., heat and electricity. To adopt qualified person for thermal energy management and electrical energy management as national qualifications. To select energy managers out of those who are holding national qualifications for qualified person for energy management.

7. RECOMMENDATIONS RELATED TO DATABASE CONCEPT DESIGN



7. RECOMMENDATIONS RELATED TO DATABASE CONCEPT DESIGN

7.1 Purpose of Use of Database

Under the Energy Conservation Promotion Act enforced in April 1992, factories and buildings (designated factories and buildings) consuming energy of a level specified or higher are obliged by a government ordinance to periodically submit to Department of Energy Development and Promotion the information concerning production, consumption and conservation of energy.

Department of Energy Development and Promotion makes effective use of such varied valuable information on energy with a "database" constructed in order to use the information for establishment of various short-term and medium-term/long-term energy policies of national level as stated below and to make use of the information for provision of guidance to business establishments.

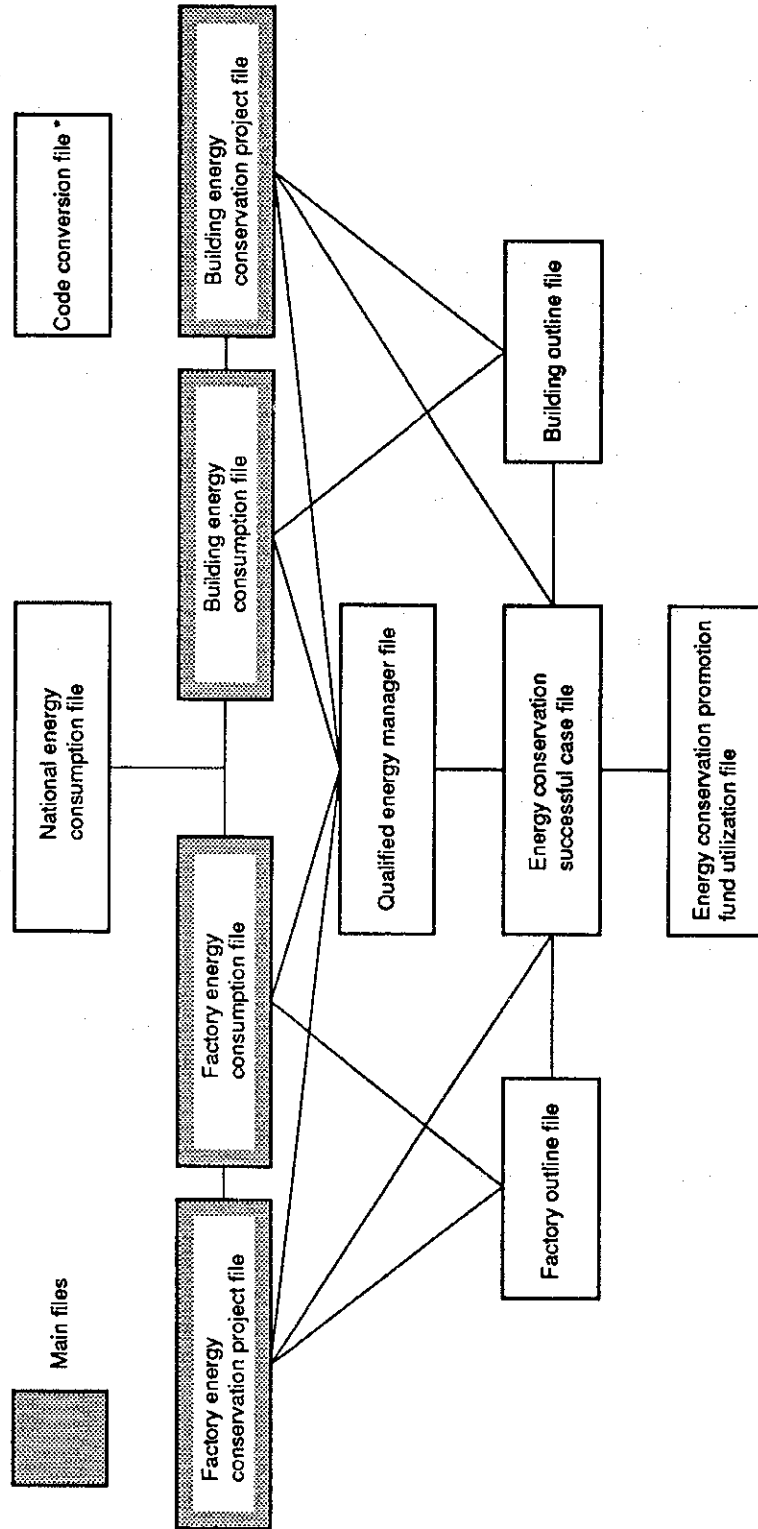
- (1) Use of the database for drafting of energy policies of the nation
 - ① It becomes possible to quickly obtain the updated energy consumption data in the field of factory and building in the whole country.
 - ② It is possible to make forecast of short-term and medium-term demand for energy when secular changes are analyzed together with the data accumulated in the past, and it is possible to adopt suitable policies for stable supply of energy.
 - ③ It is possible to make suitable selection of indices related to energy conservation at factories and buildings and to make suitable setup of these reference values when the realities of the efficiency of various energy uses at factories and buildings are grasped statistically.
 - ④ It is possible to make effective use of the energy conservation fund when the relation between cost and effect of improvement of energy conservation at factories and buildings is statistically seized.
- (2) Use of the database for providing guidance on energy conservation to user of individual factories and buildings

The energy efficiency and its secular change at individual factories and buildings can be monitored, and advice and guidance can be provided as required.

7.2 Database System

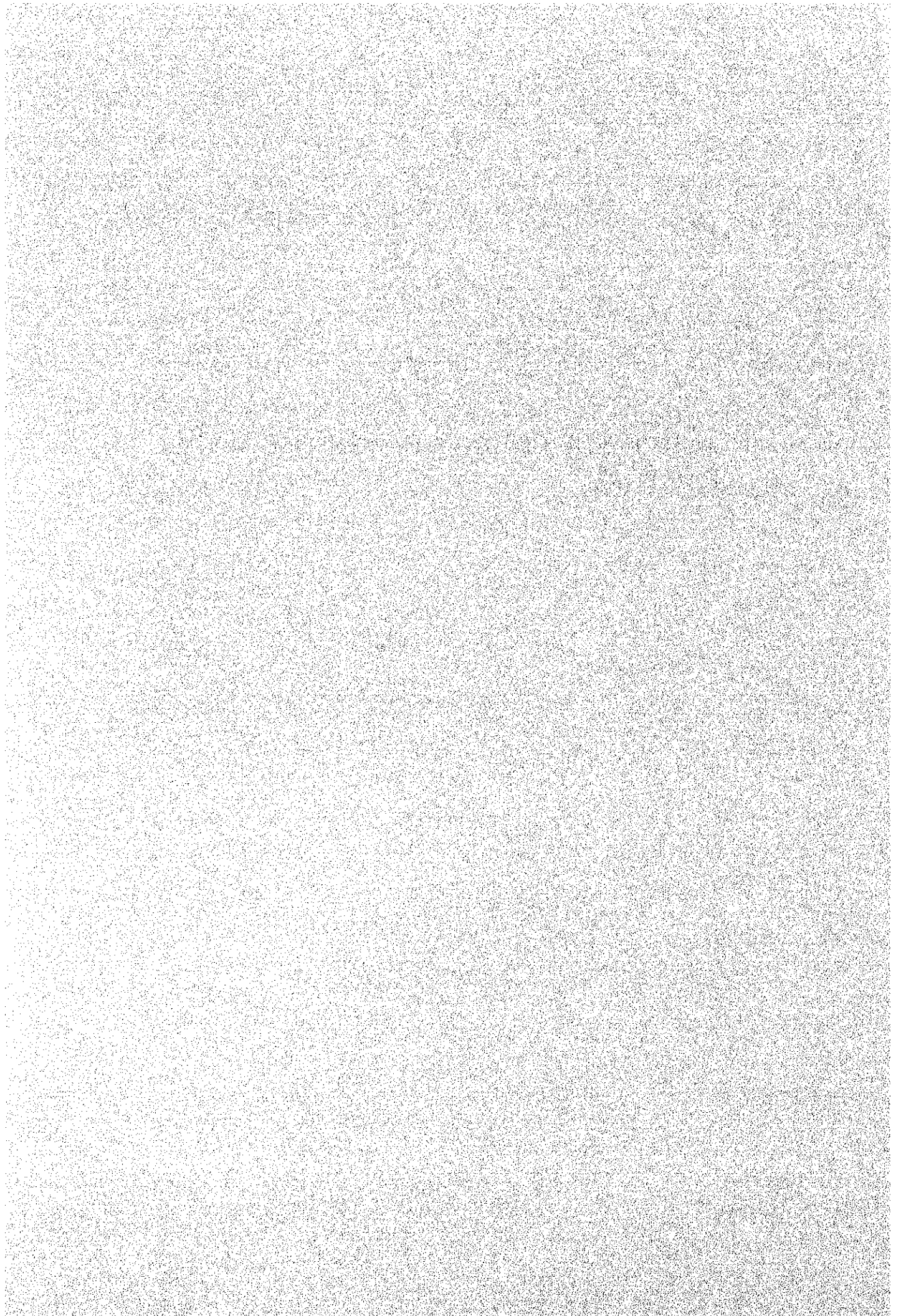
The conceptual diagram of the database system is shown in Figure 7.1.

Figure 7.1 Conceptual Diagram of Data File



* Code conversion file is commonly used for all files.

8. SURVEY OF ENERGY USE IN THE MODEL FACTORY



8. SITUATION OF ENERGY USE IN THE MODEL FACTORIES

8.1 Outline of the Factories to be Studied

Table 8.1 shows the outline of the two factories which we studied.

Table 8.1 Overview of Factories to be Studied

Factory name	Y Co., Ltd.	Z Co., Ltd.
Industry type	Steelmaking	Pulp and paper
Product	Rolling section bar Shape steel	Printing & writing paper Board paper
Number of employees	400	441
Production in 1993	Shape steel: 90,000 t/y	Printing paper: 26,000 t/y Board paper: 15,000 t/y
Production ratio to capacity	83%	100%
Energy consumption/year		
Fuel oil	4,500 kl	7,235 kl
Saw dust	—	13,112 ton
Coal	—	0
Electricity	60,000 MWh	44,231 MWh
Size level	Medium	Medium

The both factories are private enterprises funded by Chinese merchants of Thai descent. Since their products occupy a high market share, they enjoy large profits, keeping a high level of production.

8.2 Situation of Energy Management

Since energy costs occupy a high percentage of the production cost in the both factories, they have their energy conservation target. However, such systematic energy conservation activities participated in by all the employees have not been started so far.

The greatest problem in proceeding with energy conservation activities is the shortage of energy measuring instruments. Since the paper mill is not provided with a steam flow meter, no information on the steam consumption is available.

The factory with a boiler has a boiler operation record per hour, which shows a good energy management situation. Although energy consumption seems to be understood in terms of the whole factory, the actual energy consumption in each production process is not grasped.

Therefore, there is no information available on the evaluation of the energy consumption level, detection of faults, effects of countermeasures, etc. Thus, no energy conservation target nor improvement activities can be set up or implemented.

Secondly there were poor maintenance and installation found at many places. In the process industries such as paper manufacturing and steelmaking industries, a large energy loss is caused by the shutdown of the equipment, resulting in an increased unit energy consumption rate.

In the preliminary survey of this factory study, we made an inquiry about problems in promoting energy conservation activities, which are shown in Table 8.2.

Table 8.2 Problems in Promotion of the Energy Conservation

Item	Number
Little room for promoting further improvement	1
Difficulty in obtaining good energy conservation equipment	1
Uncertainty about return on investment in equipment	2
Lack of personnel who can educate the employees	1
Shortage of measuring equipment	2
No time to analyze the energy consumption rate	1
Shortage of information on government's measures	1
Shortage of government's subsidiary measures	1

8.3 Problems in Energy Use

8.3.1 Steelmaking factory

This factory melts and refines scraps by means of an electric furnace to produce billets using the continuous casting machine, thus producing channel steels and angle steels. The factory is provided with energy conservation equipment including continuous casting machine, equipment for preheating the materials for the electric furnace using recovered exhaust gas, etc.

(1) Billet reheating furnace

- 1) Prevention of intrusion of air
- 2) Improvement of combustion conditions
- 3) Prevention of a heat loss from openings
- 4) Improvement of the billet charging method
- 5) Enforcement of measurements
- 6) Recovery of waste heat of exhaust gas

(2) Electric furnace

- 1) Change of the fuel for preheating of a furnace body (from diesel oil to fuel oil "A" 80 grade)

(3) Electricity

- 1) Improvement of the transformer power factor

- 2) Change of the transformer load
 - 3) Installation of a wattmeter and a power factor meter on the power receiving panel
 - 4) Change of the transformer tap
 - 5) Adoption of the high efficiency illumination lamps
 - 6) Control of the number of operating compressors
- (4) Improvement effects

The foregoing improvements will allow saving of fuel oil by 3%, expensive diesel oil and electric power by 0.25%, the cost required for which is estimated to be paid back in 0.24 year.

Table 8.3 Improvement Effect for Steelmaking Factory

Improvement Item	Installation Costs (Baht)	Energy Saving (Baht/year)	Payback Period (Year)
1. Heat Management			
1.1 Oxygen reduction in furnace	100,000	476,582	0.2
1.2 Changing to substitute "A" heavy oil	300,000	1,934,774	0.15
2. Electric Management			
2.1 Improvement of transformer power factor	228,648	266,700	1.17
2.2 Changing of transformer tap	2,083	—	—
Total	630,731	2,678,056	0.24

8.3.2 Paper and pulp mill

The paper and pulp mill, a medium-scaled factory, has the energy conservation process of deinking and bleaching waste paper/waste newspaper to produce pulps.

The problems or points to be improved are given below.

(1) Paper manufacturing process

- 1) Continuous operation of the paper machine
- 2) Prevention of paper breaking
- 3) Decrease of down-time due to machine faults
- 4) Prevention of power failures due to factors inside/outside the factory
- 5) Prevention of quality dispersion of purchased materials
- 6) Introduction of high efficiency equipment
- 7) Installation of a steam flow meter
- 8) Improvement of the white water circulation rate
- 9) Improvement of the temperature distribution of paper machine cyclinders
- 10) Control of air exhaust from the paper machine hood

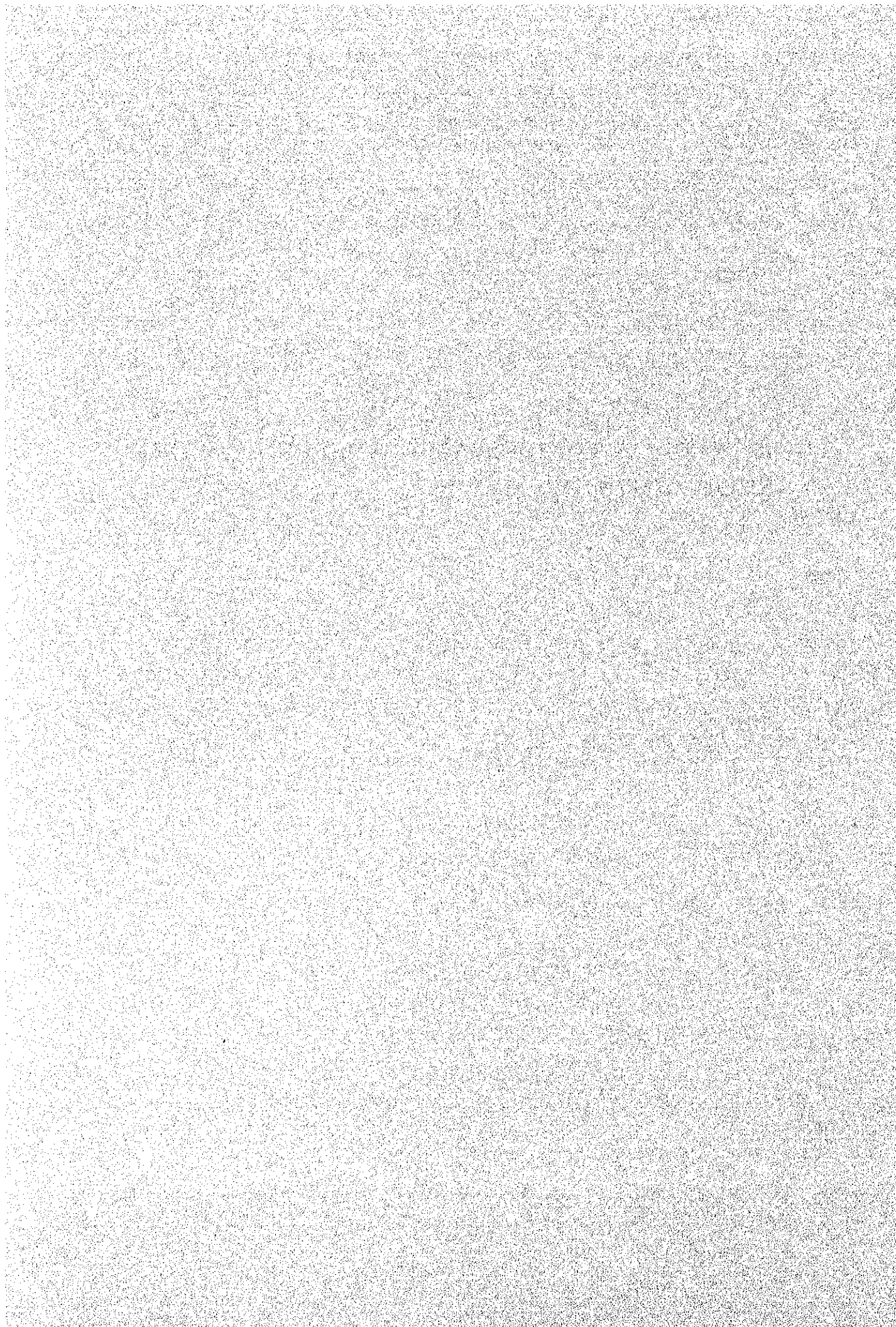
- (2) Waste paper pulping process
 - 1) Evaluation of the pulping method by kinds of waste paper
 - 2) Elimination of impurities in pulps
 - 3) Control of pulp freeness
 - 4) Decrease of the number of equipment being operated simultaneously
- (3) Steam piping
 - 1) Insufficient heat insulation of the piping and valves in the boiler room and around the paper machine
 - 2) Malfunction of the steam pressure meter of the paper machine
- (4) Boiler
 - 1) Control of the boiler water electricity conductivity
 - 2) Control of the temperature of exhaust gas
- (5) Electricity
 - 1) Improvement of power factor of a transformer
 - 2) Separation of transformer load
 - 3) Installation of a wattmeter and a power factor meter on the power receiving panel
 - 4) Change of the transformer tap
- (6) Improvement effects

The above improvements will allow saving of 3.0% of fuel oil and 12.5% of electric power. The investment cost for these improvements is estimated to be paid back in 0.53 year.

Table 8.4 Improvement Effect for Paper and Pulp Mill

Improvement Item	Installation Costs (Baht)	Energy Saving (Baht/year)	Payback Period (Year)
1. Heat Management			
1.1 Heat insulation of the steam pipe	10,978	29,240	0.38
1.2 Reduction of paper breaking	Nil	509,040	—
1.3 Improvement of ventilation and the hood equipment	2,500,000	3,193,380	0.78
1.4 Effective use of dryers and efficiency	500,000	2,260,800	0.22
1.5 Enhancement of dehydration efficiency	1,200,000	467,280	2.59
1.6 Increase of finishing freeness	Nil	2,543,400	—
2. Electric Management			
2.1 Improvement of transformer power factor	770,140	330,497	2.33
2.2 Changing of transformer tap	Nil	3,907	—
Total	4,981,118	9,337,544	0.53

**9. REPORT ON TECHNICAL TRANSFER BY WORK-
SHOP METHOD**



9. REPORT ON TECHNOLOGY TRANSFER BY WORKSHOP METHOD

9.1 Purpose

The purpose is to conduct technology transfer for the promotion of energy conservation including the concrete methods thereof to the counterpart through workshop method by the effective use of the equipment carried by the study team for the purpose of improving the technology required for the counterpart when the Government of Thailand enforces various regulations relevant to the Energy Conservation Promotion Act. The foregoing technology includes the technique for factory/building energy audit, method of working out plans for improving energy conservation in factories/buildings and the technique for evaluation of energy conservation promotion plans submitted by factories/buildings.

9.2 Period

From 7 March to 25 March 1994 (15 days)

9.3 Place

Conference room of the Department of Energy Development and Promotion.

9.4 Description

Workshop was conducted by way of case study described below.

- (1) Explanation of specifications and operation method of the audit equipment
- (2) Report on energy use audit of factories and buildings (Thai side)
- (3) Lecture by the Japanese experts

The Japanese experts gave lectures on factory/building energy conservation technology.

- 1) Factory energy management
- 2) Energy conservation measures for existing buildings
- 3) Heat management
- 4) Electricity management
- 5) Energy management for buildings
- 6) Computerized data processing

(4) **Presentation of case study (Thai side)**

The Thai side made a presentation on the energy conservation improvement method for the supposed factory/building. This was made based on the Thai side's experience and the knowledge of energy conservation improvement methods and the knowledge obtained through lectures given by the Japanese experts.

In connection with this, the Japanese experts provided guidance and evaluation.

9.5 Attendees

(1) **Thai side**

32 members from DEDP and ECCT

(2) **Japanese experts**

- 1) Teruo Nakagawa
- 2) Norio Fukushima
- 3) Mitsuo Iguchi
- 4) Yukio Nozaki
- 5) Toshio Sugimoto
- 6) Kenjiro Yamaguchi

9.6 Text Materials

English texts and OHP

9.7 Outputs and Future Theme

- (1) Giving instruction in the method of handling the latest measuring equipment for energy conservation audit, data collection and analysis method improved the level of the counterpart's technology for energy conservation audit.
- (2) Making a case study on the supposed factory/building allowed the counterpart to acquire a practical auditing technology for energy conservation and the improvement method.
- (3) The counterpart could obtain knowledge in the operation method, lecture subjects, instruction methods, text materials, etc. necessary for the counterpart to open workshop on its own.
- (4) Regarding the handling of the measuring equipment, it is advisable for the counterpart personnel to hold a voluntary study meeting and thereby to get more familiar with the handling method.