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

The organizational reform accompanying the enforcement of the Energy Conservation Promotion Act is to be conducted in two phases, short-term and medium-term, as follows.

To fully meet requirements of the act as well as supervise and advise 3,600 designated factories and building, the organizational reform must involve not only the reorganization of DEDP itself but also the overall reform considering the effective use of institutions concerned, especially the Energy Conservation Center of Thailand (ECCT).

(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. Fig. 6.2 shows the relationship between DEDP and ECCT and local offices.

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

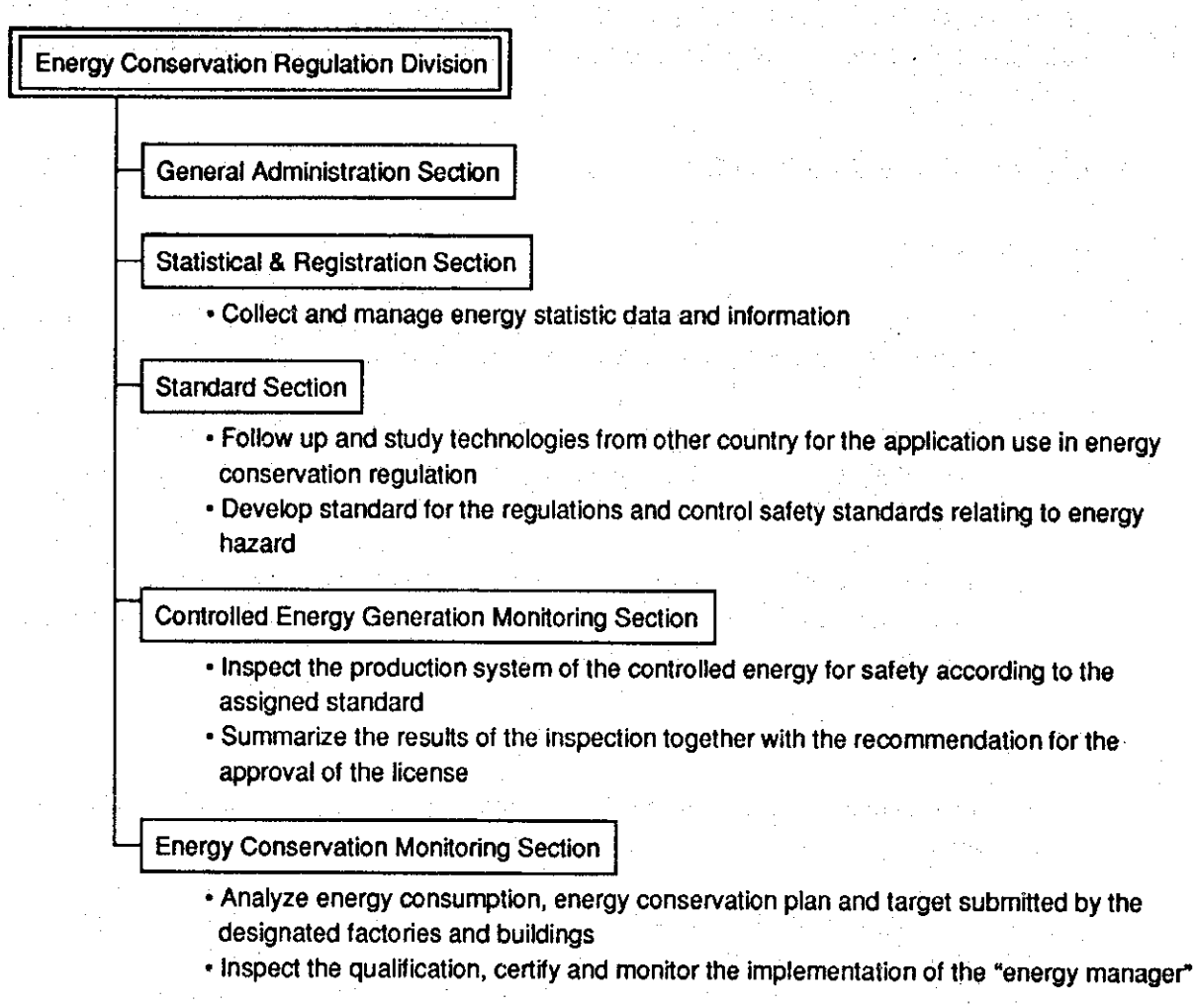


Figure 6.1 Recommended Organizational Reform for DEDP Headquarters (2/2)

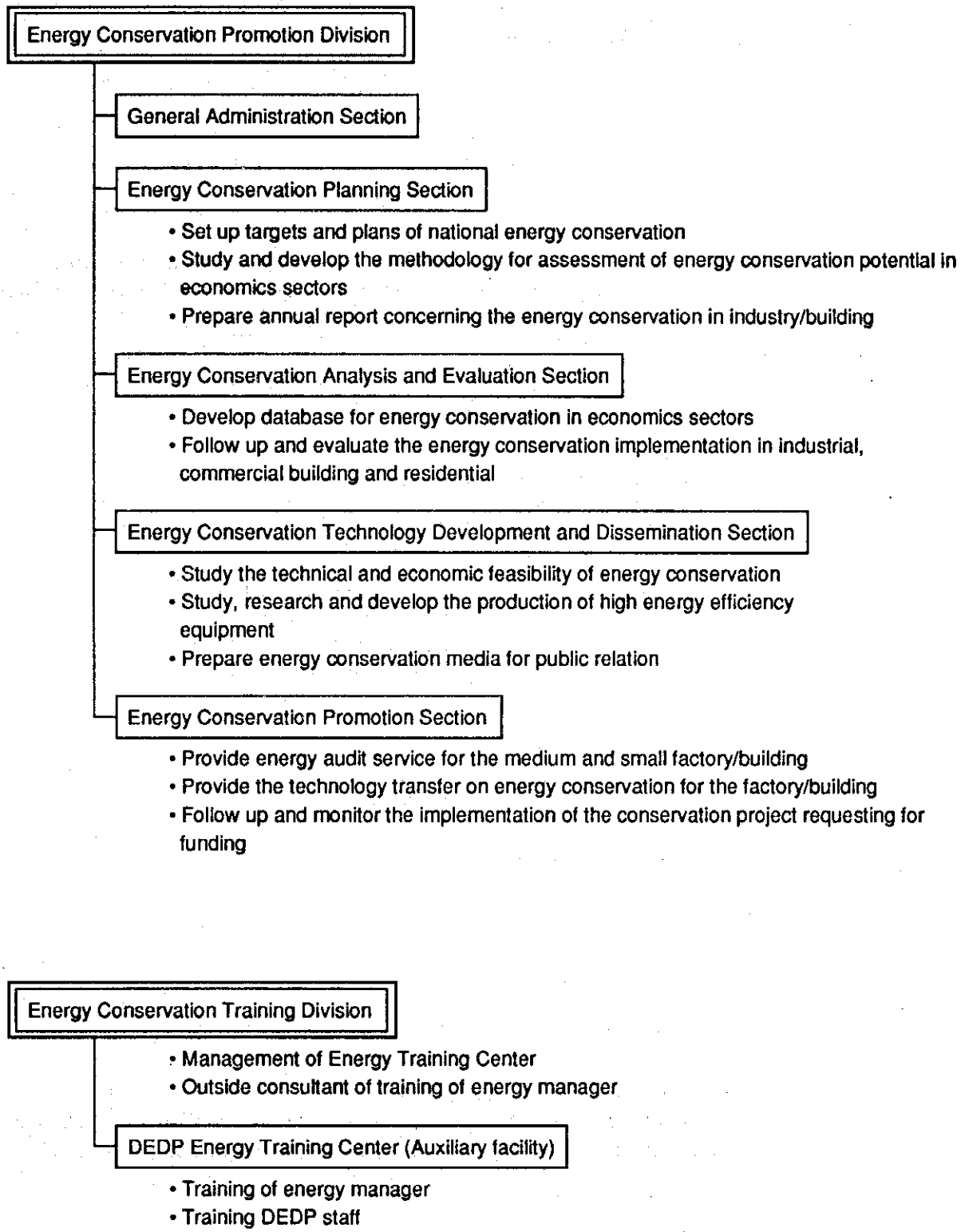
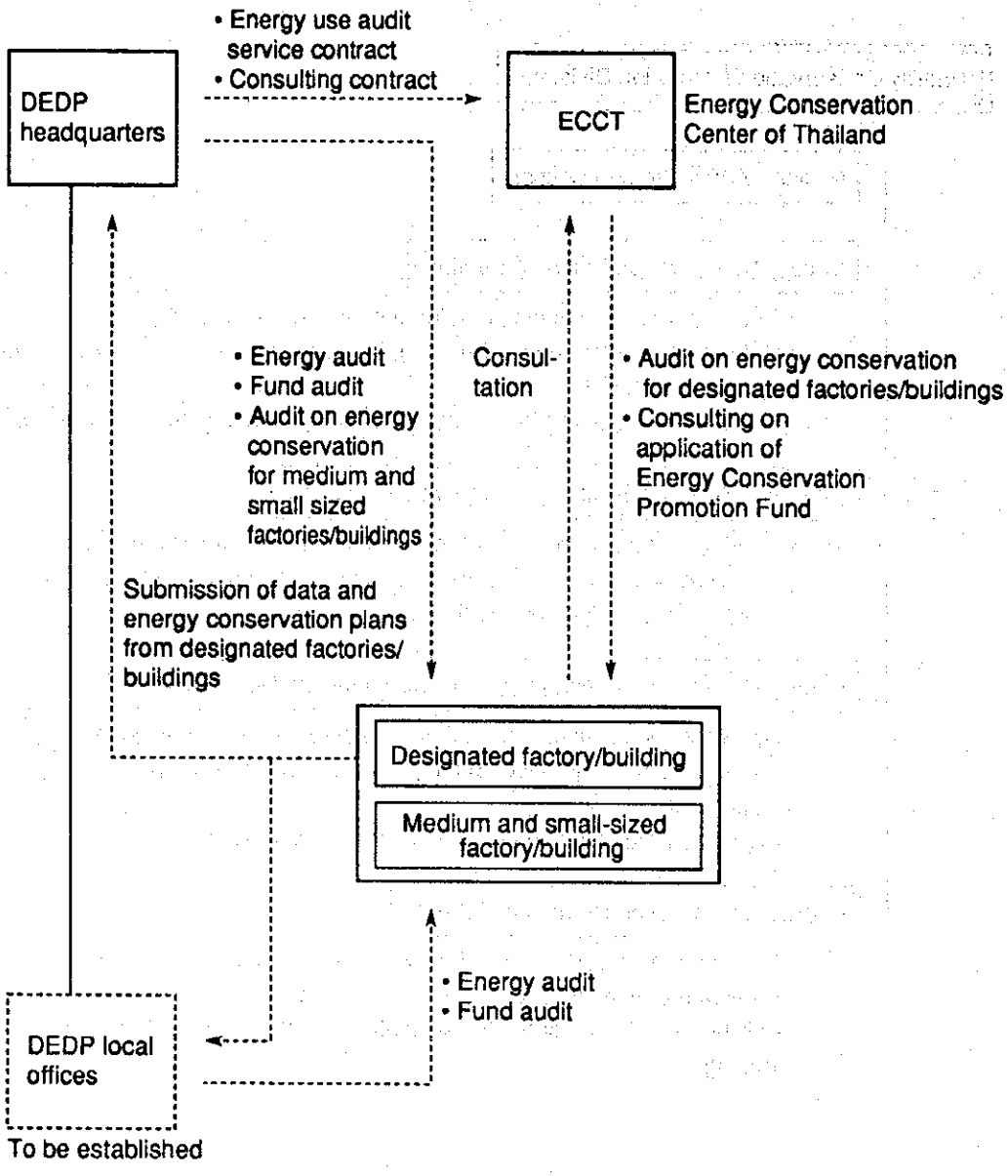


Figure 6.2 DEDP Local Divisions, and Relationship with ECCT



① 3-division Framework for the Department related to Energy Conservation

The existing division related to energy conservation will be divided into a regulatory division (Energy Conservation Regulation Division), a promotion division (Energy Conservation Promotion Division) and a training division (Energy Conservation Training Division).

a. Responsibility of Energy Conservation Regulation Division

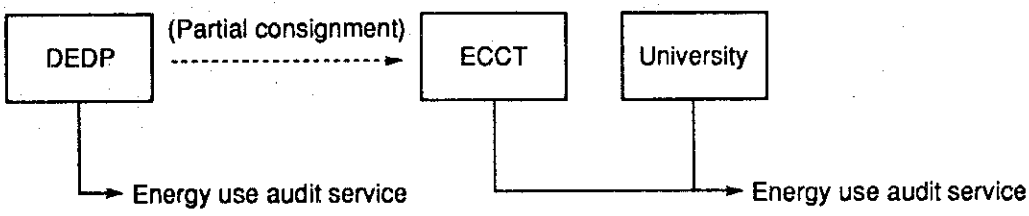
In addition to previous duties, standards management service is transferred from Energy Economy Division to centralize regulatory services under the section. Also, energy use reports and energy conservation plans submitted by the designated factories and buildings and data of energy manager will also be centralized and managed.

b. Responsibility of Energy Conservation Promotion Division

The Energy Conservation Promotion Division conducts activities including setting up of the national energy conservation target, working out of the program thereof, development of energy conservation technology and PR services for energy conservation. In addition, the division evaluates each project to utilize "Energy Conservation Promotion Fund" in technical and economic aspects.

The energy use audit service that has been provided so far will be conducted only for small and medium factories and buildings by the Department of Energy Development and Promotion (DEDP), while energy use audit services for designated factories and buildings will be entrusted to Energy Conservation Center of Thailand (ECCT) and universities as shown in Figure 6.3.

Figure 6.3 Energy Use Audit Service Procedures



c. Responsibility of Energy Training Division

To expedite training of energy managers, Energy Training Division will be established to operate the training center, provide guidance on training given at ECCT, and upgrade training in rural regions.

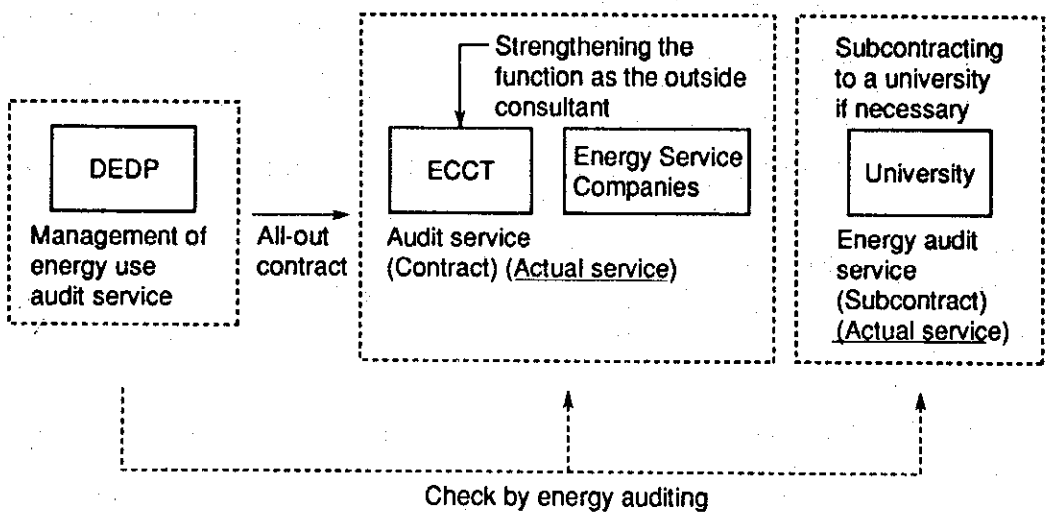
Note that DEDP Training Center will continue to conduct training for DEDP staff and energy managers.

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

DEDP's organizational reform as the medium-term measures involves transfer of all the energy use audit services to an outside consultant, as part of the improvement proposal in Fig.6.1. 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, as shown in Fig. 6.4, 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.

Figure 6.4 Contracting Entire Energy Use Audit Service



(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. Since the some 3,000 factories account for 60% of energy consumption in the industrial sector, it is understandable that the department concerned wants to designate as many eligible factories as possible after the enforcement of Energy Conservation Promotion Act.

However, 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.

Table 6.2 Phased Designation Schedule

	Factory	Building
First year	600	200
Second year	2,000	400
Third year	3,000	600

(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 (see Table 6.3). It has no local office related to energy conservation.

Note: There are 4 alternative energy centers, each employing 5 or less persons and conducting research and development in the following areas:

- Biomass (sugarcane, paddy husks, and cattle excretion)
- Solar heat energy

Table 6.3 DEDP Alternative Energy Centers

Region	Location
North	Chiang Mai
Center	Ratchaburi
East	—
Northeast	Ubon Rachatani
South	Nakorn Srithamaraj

On the other hand, the Ministry of Industry has local offices in all the 73 provinces to supervise factories. (each employing around 10 persons, responsible for review, safety/environmental auditing)

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

At present, there are around 100,000 factories and 200,000 buildings throughout the country, of which 3,000 factories and 600 buildings will be designated as special establishments subject to the energy management program under the Energy Conservation Promotion Act. The number of designation may increase to around 7,000 in future.

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

Locations of local offices need to be selected in consideration of the following factors:

- Geographical distribution of factories and buildings to be designated (1,000kW or more, other indices)
- Geographical distribution of factories (manufacturing industries)
- Geographical distribution of electricity consumption
- Geographical distribution of GDP
- Geographical distribution of industrial estates (decentralization policy, 9 industrial promotion areas, and Southern Seaboard Industrial Zone development scheme)
- Distribution of PEA's local bases
- Direction of future regional development (including road construction plan)

① Decentralization policy

At present, around 60% of factories and buildings are concentrated in the state capital, Bangkok. The National Economic and Social Development Board sets forth correction of economic inequality between the central and rural regions in the 7th National Economic and Social Development Plan (NESDP), and decentralization of factories is one of national policies.

② Industrial decentralization and development of regional cities

The Ministry of Industry, under the decentralization policy, has designated 8 cities having high potential of industrial development as "Industrial Development Centers", namely Chiang Mai, Phitsanulok, Nakhon Sawan, Khon Kaen, Nakhon Ratchasima, Ratchaburi, Saraburi Surat Thani, and Song Khla. It is building infrastructure in these areas and is promoting collective subcontracting by small- and medium-sized enterprises.

As for development of regional cities, a guideline for economic development is prescribed for each region, while constructing infrastructure including transportation, electricity, gas, communication, and housing.

- In North, economic development based on tourism, production of handicrafts, and agriculture is planned with Chiang Mai and Phitsanulok as growth centers.
- In Northeast, while assuming to develop an industrial zone linked to the Eastern Seaboard Zone, development based on tourism and support for Indochina is planned, with Khon Kaen, Udon Thani, and Nakhon Ratchasima as growth centers.

- In East, a national project "Eastern Seaboard Zone" using natural gas produced in the Gulf of Siam is under way, including a petrochemical complex in Rayong, and petrochemical, electronics, precision equipment, and food processing industries in neighboring Laem Chabang industrial estates.

- In Center, "Bangkok Metropolitan Area and New Economic Zone" project connecting Bangkok and the eastern seaboard area is under way, with Saraburi as a regional center. Also, in the western area, industrial development based on food processing and automobile assembly is in progress, with Nakorn Sawan and Ratchaburi as growth centers.

- In South, economic development based on tourism and the Southern Seaboard Industrial Zone project is being promoted, with Surat Thani, Phuket, Song Khla, and Hat Yai as nuclei.

③ Construction of regional road networks

To decentralize population and economic activity from Bangkok and to promote balanced regional development, construction of regional road networks is considered to be a governing factor. In Thailand, road construction is carried out in a planned manner. In particular, the government has been actively building the Asia Highway planned under United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) in 1959, contributing greatly to the development of wayside areas.

④ In consideration of the above local conditions, it is recommended that DEDP establish 5 local offices, which may be increased to 10 with the increase in number of designated factories and buildings.

Table 6.4 Establishment of DEDP Local Offices

		Phase 1 (short-term, immediate measures)	Phase 2 (medium-term measures)
No. of designated factories/ buildings		3,600	7,000
Local offices	North	Chiang Mai	
	Center	Nakorn Sawan	
	East	Rayong	
	Northeast	Khon Kaen	
	South	Song Khla	
		5	10

(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

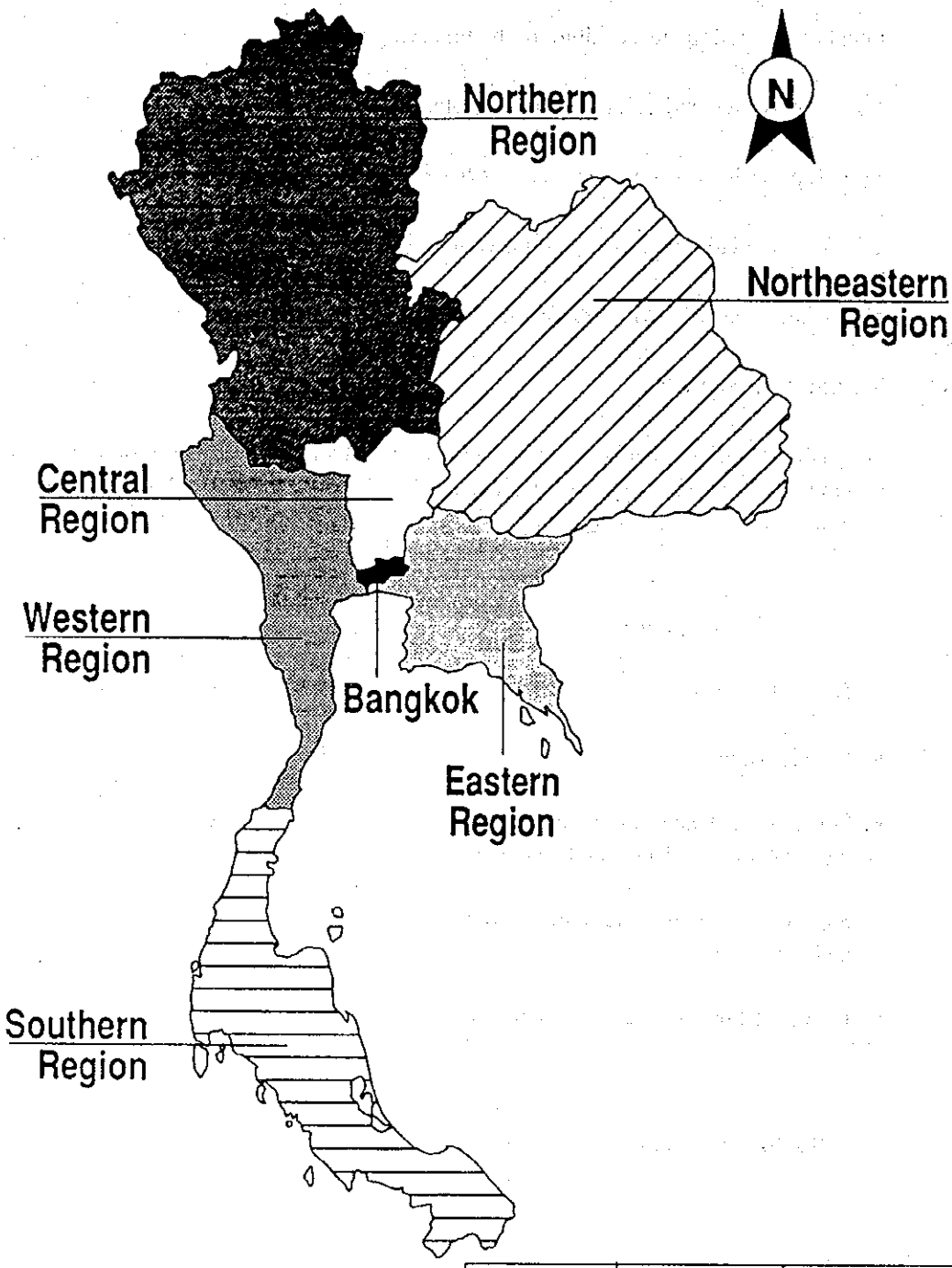
(4) Staffing of local offices

Staff at local offices will be classified according to their rankings based on the above indices, ranging between 5 and 11 persons. For instance, Chiang Mai, the second largest city in the country, is positioned as a large office with 11 staff.

(Duties)	Staffing		
	Large	Medium	Small
• General manager	1	1	1
• General affairs	1	1	1
• Supervision of factories/buildings to be designated and liaison with headquarters	2	2	1
• Supervision of energy use audit service and contractor	6	4	2
• Public relations in energy conservation	1	1	*0
	11	9	5

* handled by general affairs personnel

Figure 6.5 DEDP's Proposed Local Offices for Promotion of Energy Conservation Activity



Region	Location of local office	(Reference) Alternative energy center
North	Chiang Mai	Chiang Mai
Center	Nakorn Sawan	Ratchaburi
East	Rayong	—
Northeast	Khon Kaen	Ubon Rachatani
South	Song Khla	Nakorn Srithamaraj

Table 6.5 Regional Distribution of Factories and Buildings

Item / Region	Number of Factories/ buildings consuming 1,000 kW or 20 million MJ/year and over (Total) [%]	Number of manufacturers [%]	Land area of industrial estate [Rai, %]	Power consumption (light in total) [GWh, %]	Population [thousand persons, %]	Gross regional product [million Bahts, %]	State of regional development (including future plan)
North	(3.4%) 82	(11.8%) 23,816	(2.6%) 1,132	(7.1%) 3,081	(19.5%) 10,994	(11.6%) 202,923	
Northeast	(5.0%) 119	(14.8%) 29,787	(1.1%) 472	(6.9%) 3,010	(35.3%) 19,889	(19.1%) 229,832	
Center	(72.5%) 1,744	(57.5%) 115,994	(51.4%) 22,805	(46.7%) 20,279	(26.1%) 14,678	(57.4%) 1,005,090	
Bangkok (included in Center region)	(29.2%) (700)	(43.7%) (88,091)	(8.4%) (3,745)		(9.8%) (5,547)	(35.9%) (628.034)	
East	(11.3%) 272	(5.2%) 10,416	(41.7%) 18,500	(32.4%) 14,052	(6.5%) 3,690	(8.7%) 152,627	Eastern Seaboard Zone (under way)
South	(7.8%) 184	(10.7%) 21,548	(3.2%) 1,440	(6.9%) 2,977	(12.6%) 7,113	(9.2%) 161.283	Southern Seaboard Zone (under study)
Total	(100.0%) 2,401	(100.0%) 201,606	(100.0%) 44,349	(100.0%) 43,399	(100.0%) 56,362	(100.0%0 1,751,735	

Source: Factories/buildings consuming 1,000 kW or 20 million MJ/year and over (Total) — prepared by DEDP
Number of manufacturers — Thailand in Figures 1992 - 1993 (totaling reports to the Ministry of Labor, covering all manufacturing industries)
Land area of industrial estates — Thailand in Figures 1992 - 1993
Power consumption (commercial) — PEA
Population — Thailand in Figures 1992 - 1993
Gross regional product — Thailand in Figures 1992 - 1993

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

① Name of equipment to be improved
② Improvement method
③ Improvement effect
④ Investment requirements
⑤ Financing method
⑥ Improvement work schedule

2) Drawings of buildings and factories

① Main equipment layout
② Single-line diagram
③ Fuel piping diagram
④ Service water piping diagram
⑤ Building structure drawing

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

① Facility and equipment drawings
② Wiring and piping drawings
③ Maintenance record
④ Operation record (production and operating hours)
⑤ Energy consumption record

(2) Technical evaluation

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

1) Improvement of fuel combustion

① Adjustment of combustion load
② Selection of appropriate burners
③ Improvement of ventilators
④ Installation of combustion control equipment
⑤ Installation of regenerators

2) Improvement of heating, cooling, and heat transfer

① Evaluation and improvement of conditions related to the use of heat source and heat supply
② Evaluation and improvement of heat pattern
③ Load adjustment
④ Conversion to direct heating
⑤ Multi-stage use of heat
⑥ Introduction of equipment with high thermal efficiency
⑦ Continuation, merging, short-cutting, and omitting of processes

3) Prevention of heat loss due to radiation and transfer

① Reinforcement of heat insulation
② Reduction of opening
③ Enclosure for exposed equipment
④ Improvement of piping route

4) Recovery of waste heat

① Prevention of temperature drop in the transport process
② Improvement of heat transfer surface for waste heat recovery equipment
③ Installation of waste heat recovery equipment according to the use

5) Efficiency improvement by conversion of heat to motive power

① Improvement of turbines to reduce minimum allowable pressure
② Use of waste steam for power generation and motive power

6) Prevention of power loss due to resistance and other factors

① Operation of transformer at appropriate load
② Selection of appropriate capacity for transformers
③ Equalization of load
④ Improvement of power receiving and transforming equipment layout
⑤ Improvement of power factor
⑥ Improvement of 3-phase imbalance

7) Improvement of conversion of electric energy to motive power and heat

① Prevention of motor idling
② Appropriate load allocation
③ Checking of head
④ Speed control
⑤ Installation of motors with appropriate capacity

(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.

1) Simple method

The upper limit for investment is determined by multiplying the amount of energy conservation obtained from an improvement project by the number of years required to recover the initial investment.

The amount does not include maintenance cost, tax, and interest, but it offers a quick and simple measurement of improvement effect.

$$C = S \cdot n$$

where C: Upper limit for investment (Baht)
S: The monetary value of energy conservation on an annual basis (Baht)
n: The number of years required to recover investment (year)

2) Investment recovery method

In this method, maintenance cost, tax and interest are treated as one element of investment. The method may be more complex than the above method, but it shows a more reliable result.

$$C = S \frac{1-(1+r)^{-n}}{r}$$

where C: Upper limit for investment (Baht)
S: The monetary value of energy conservation on an annual basis (Baht)
r: Maintenance cost, interest, tax
n: Number of years required to recover investment (year)

6.2.2 Priorities of evaluation and guidance

Evaluation and guidance on improvement plans submitted by the designated factories and buildings are conducted according to the priority which is set forth as follows.

(1) Value of improvement in energy conservation

The improvement project with higher energy conservation

(2) Energy consumption

The improvement project with larger energy consumption

(3) Number of years required to recover investment

The improvement project with a shorter period of recovering investment

(4) Financing method

The improvement project with more detailed financing plan

The above criteria are summarized in Table 6.6.

Table 6.6 Priorities of Evaluation and Guidance on Improvement Plans

Factory/ building name	Improvement effect of energy conservation	Energy consumption	No. of years required for recovery of investment	Financing method	

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 subsidies for implementation of the energy conservation plan and for installation of energy conservation equipment will be granted to governmental organs, state-run enterprises, educational institutions and nonprofit private organizations.

Governmental institutions (such as the Industrial Finance Corporation of Thailand (IFCT)) will serve as fund banks to review financial conditions, credit standings and project feasibility of loan applicants.

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

The Fund Committee makes final decision on rendering financial aid based on the recommendation of DEDP and the result of review by the bank.

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.

The outline of the subsidy system is shown in Figure 6.6. The outline of the grant system is the same as that of the subsidy system.

(1) Verification of Loan Application and Examination Report (evaluation of technical items in the document)

1) Loan application document

2) Planning documents (drawings showing improvements in buildings and equipment, statement on method of improvement, and construction schedule)

3) Estimation of the effect of energy conservation effort

4) Estimation of economic benefits

5) Financial estimation for investment

6) Examination report

(2) Verification of Project Implementation (evaluation of technical items in the document)

1) Approval document for loan application

2) Description document of financial aid

3) Report on completed improvement project

4) Final inspection report (specifications, drawings, and bill of quantities for building and equipment work)

(3) Verification of Energy Conservation Effect

The result of improvement work should be reported from the applicant to DEDP, which analyzes it to verify the energy conservation effect.

If any doubt arises in connection with the content of the report, a more detailed report is requested for further analysis and evaluation.

As required, DEDP visits the site to inspect the conservation project and measure the result.

1) To request submission of periodical measurement of energy consumption after the implementation of the improvement project.

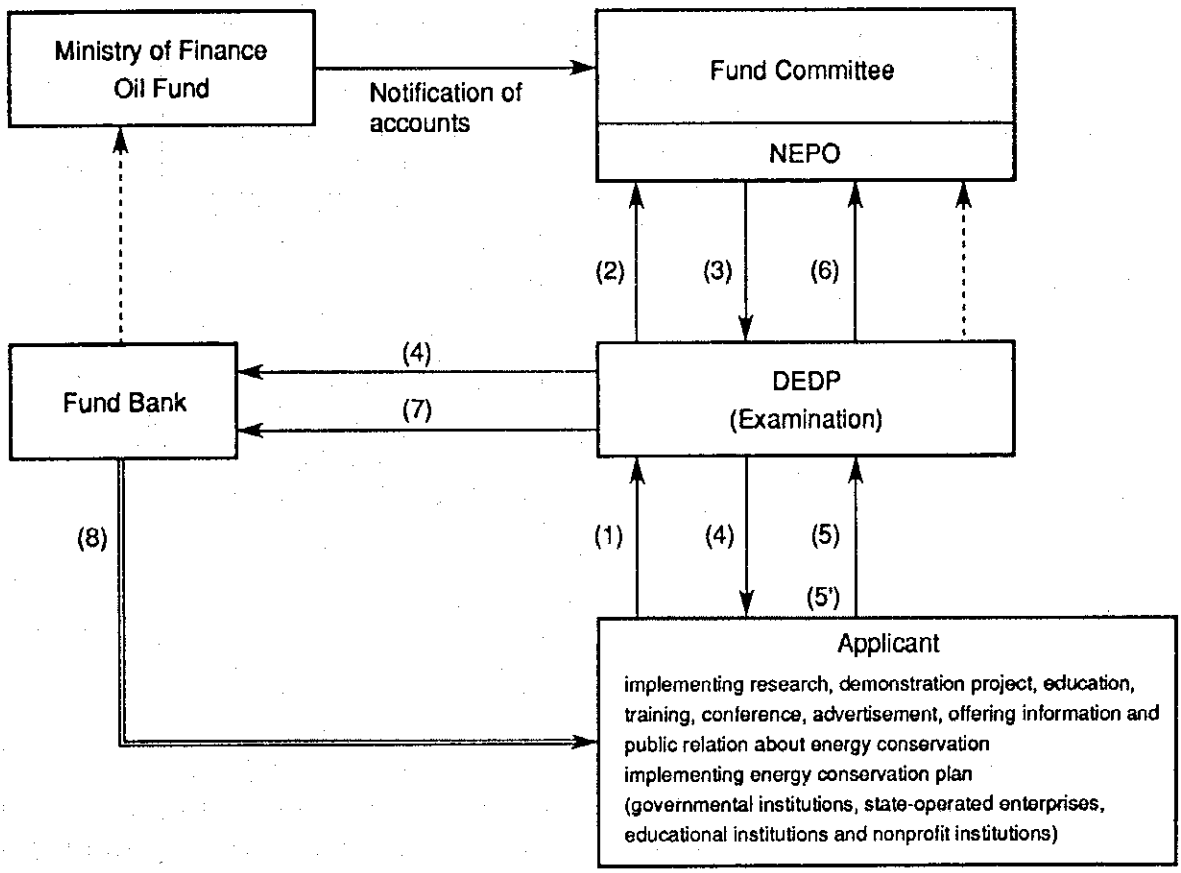
2) To request the report on difference of operation condition before and after the improvement.

3) To compare energy consumptions before and after the improvement.

4) To verify the effect of the improvement.

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 6.6 Subsidy System for Promotion of Rational Use of Energy

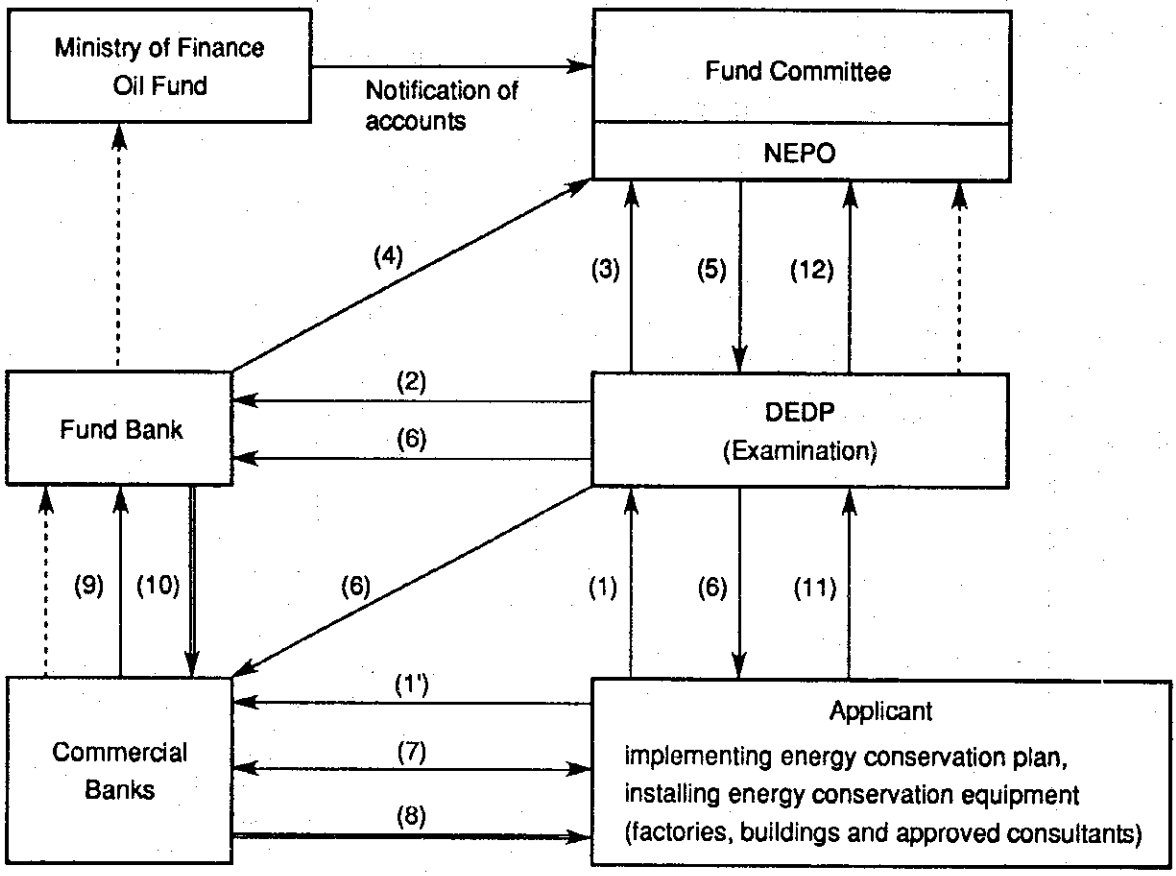


(1) Application report
(2) Recommendation of application report
(3) Approval of subsidy
(4) Notification of approval
(5) Implementation report
(5') Request for payment of subsidy (Subsidy bill)
(6) Evaluation of implementation report
(7) Indication of payment of subsidy
(8) Payment of subsidy

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. Examination of loan applications and confirmation of implementation of the plan will be conducted in the same manner as that for the subsidy, or grant system.

Figure 6.7 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 and duties of energy managers

(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.

(2) Duties of energy managers

Item 1 Periodically maintain and inspect the efficiency of machinery and equipment that use energy.

Item 2 Improve upon energy consumption in line with the principle of energy conservation.

Item 3 Verify the information the owner of designated factory (building) submits to the Energy Development and Promotion Department under Section 11 (2).

Item 4 Oversee record keeping of information under Section 11 (3) so that the competent officer may inspect and verify the accuracy of such records.

Item 5 Assist the owner of the designated factory (building) in setting the goals and plans for energy conservation of the designated factory (building) under Section 11 (4).

Item 6 Verify the result of the inspection or analysis under Section 11 (5).

Item 7 Assist the owner of the designated factory (building) to comply with the advice of the Director General under Section 16.

6.4.2 Current situation of management training

(1) Implementing organs

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 as indicated below. Attendance in these training courses is free of charge, and about 3,000 persons have taken these courses so far.

1. DEDP Energy Training Center (DEDP ETC)

(DEDP ETC entrusts training to the following three organs.)

2. Energy Conservation Center of Thailand
3. Chulalongkorn University
4. Chieng Mai University

(2) Outline of courses

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 as shown in Table 6.7.

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.

The lecture subjects are as shown in Table 6.8, and there seems to be differences observed in the hour assignment among implementing organs.

Experts of DEDP ECT, universities and of private enterprises act as lecturers.

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.

Table 6.7 Qualifications for Attending Energy Management Training Courses

Course name	Qualification for attendance (common to factory management and building management)
3-day course	Person holding a degree in Science or Engineering and having at least three years experience in a factory (building). Attendance should be permitted by his superior officer.
5-day course	Person holding a Higher Vocational Certificate and having at least three years experience in a factory (building). Attendance should be permitted by his superior officer. or Person who has finished a management training course in heat or electricity implemented by the Ministry of Science, Technology and Environment. Attendance should be permitted by his superior officer.

Table 6.8 Lecture Subjects of Energy Management Training Courses

Factory management	Building management
1) Operations related to energy	1) Operations related to energy
2) Energy use audit technology and case study	2) Energy use diagnosis technology and case study
3) Introduction of equipment for energy use audit	3) Introduction of equipment for energy use audit
4) Efficiency of solar energy	4) Efficiency of solar energy
5) Energy conservation in solar power	5) Energy conservation in solar power
6) Energy conservation with boilers	6) Energy conservation with boilers
7) Energy conservation with compressors	7) Energy conservation with compressors
8) Energy conservation with motors	8) Energy conservation with motors
9) Energy conservation with furnaces	9) Method for modification for energy conservation of buildings
10) Cogeneration	10) Automatic control systems
11) Energy conservation with steam systems	11) Maintenance
12) Heat insulation	
13) Recycling of energy	
14) Maintenance	

(3) Heat management and electricity management courses

Heat management training and electricity management training are implemented by DEDP ETC and three entrusted organs 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.

The qualification for attending this training course and lecture subjects are shown in Table 6.9 and Table 6.10 respectively.

Table 6.9 Qualifications for Attending Heat (Electricity) Management Training Course

Course name	Qualifications for attendance (common to heat and electricity)
3-day course	Managers, supervisors and engineers of factories implementing practical works related to heat (electrical) energy

Table 6.10 Lecture Subjects of Heat (Electricity) Management Training Course

Heat management	Electricity management
1) Method for thermal energy conservation and audit equipment	1) Method for electrical energy conservation and audit equipment
2) Energy conservation in fuel	2) Energy conservation with transformers
3) Boilers	3) Efficiency of solar energy
4) Steam utilization method	4) Efficiency of motors
5) Boiler water pre-treatment method	5) Energy conservation with air conditioners
6) Heat insulation	6) Energy conservation with compressors
7) Safety of boilers	7) Control of electrical energy
8) Solar energy	8) Case study of investigation technology
9) Safety of valves and tubes	
10) Case study of investigation technology	

6.4.3 Problems in current management training

It is essential for energy managers who are in charge of promotion of energy conservation at factories and buildings to have abundant knowledge on the management technology and application technology for promotion of energy conservation, as well as to perform economical evaluation before implementation of improvement of equipment.

Energy conservation promoting technologies can be roughly divided into two fields, i.e., heat and electricity. The contents of technologies of these fields are entirely different.

The management training for qualification of energy managers currently implemented in Thailand is of two types, i.e., factory management and building management.

There are problems in the present training regarding the following points.

(1) Training of professional technologies of heat and electricity is required for each one of factory management and building management.

The currently implemented management training is of two fields, i.e., factory management and building management, and both of thermal energy and electrical energy are used in each one of these two fields.

However, since technologies are different in the fields of thermal energy and electrical energy, it is impossible to learn technologies of these two fields in a short length of time during training for factory management or building management.

(2) Training of energy conservation management method that is common to heat and electricity is required.

Management of heat or electricity at each factory (building) is important for promotion of energy conservation. It is also necessary to teach the contents of laws.

(3) Fundamental training is required for each one of heat and electricity.

It is necessary to provide training in fundamental contents from the viewpoint of each one of thermal energy and electrical energy.

(4) Training related to energy utilizing equipment is required for each one of heat and electricity.

More specific training is required regarding energy utilizing equipment for each one of heat and electricity.

(5) The training textbook and training time assignment are different among training implementation organs.

(6) Differences in the technological level are observed among three qualifications for energy managers.

When those who satisfy any one out of three qualifications are reported to the relevant authorities, they are registered as energy managers under the law. But differences in the technological level are observed among three qualifications.

6.4.4 Recommendation on training scheme

The management training for acquisition of qualification to become energy managers implemented by DEDP of Thailand at the present time involves some problems as stated earlier. Under these circumstances, recommendation is made to implement management training in three stages as shown in Table 6.11 regarding the training scheme of the Energy Conservation Promotion Act.

Table 6.11 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.

(1) Stage 1 (Temporary implementation)

DEDP estimates that the number of energy management designated factories (buildings) will be around 3,600, and accordingly, around 10,000 energy managers (2~3 times of number of designated factories (buildings)) may be required.

About 3,000 persons have taken management training courses up to the present time, and this figure is not sufficient yet.

It is therefore necessary to urgently cultivate human resources having the qualifications for energy managers specified in the law.

Thus, it is recommended to continue the currently implemented training courses as a temporary measure.

However, since it is necessary to standardize the level of training conducted at four organs, the entire training should be conducted using the same textbook and with the hour assignment at all of four organs under the control of DEDP.

(2) Stage 2 (Mid-term implementation)

The training of Stage 1 are insufficient in both of contents of training and training period to acquire the technology for promotion of energy conservation in practice.

Present training is divided into the factory management course and the building management course. But it is hard for energy managers to function as experts of energy conservation in the fields of both of heat and electricity of factories (buildings) due to the special nature of technologies.

Therefore, it is recommended to discontinue training for factory management and building management and to start training of two types, i.e., heat management and electricity management, according to Table 6.12, Table 6.13 and Table 6.14.

Besides, present management training is regarded to be completed only with attendance, which prevents checking the extent of attendants' understanding of training contents.

It is therefore recommended to conduct an on-completion testing on the last day of the training course to check how far the lectures have been understood and to determine that attendants have completed the training courses upon their passing the testing.

Table 6.12 Recommendation on Classification of Training and on Qualification for Attendance

Classification of training	Qualification for attendance
Thermal energy management training	Person having at least three years experience related to heat in a factory (building). And person holding a degree in Science or Engineering related to heat, or person holding a Higher Vocational Certificate or a person who has finished specified heat management training.
Electrical energy management training	Person having at least three years experience related to electricity in a factory (building). And person holding a degree in Science or Engineering related to electricity, or person holding a Higher Vocational Certificate or a person who has finished specified electricity management training.

Table 6.13 Recommendation on Thermal Energy Management Training

Training subject	Lecture subject	No. of classes
I. Outline of heat management and "Energy Conservation Promotion Act"	1. Outline of heat management	4
	2. Outline of "Energy Conservation Promotion Act"	4
II. Thermodynamics	1. Fundamentals of thermodynamics	10
	2. Application to thermal engines	3
	3. Evaluation of thermal energy	3
	4. Recovery of thermal energy	4
III. Heat transfer and flow of fluids	1. Fundamentals of heat transfer and application	7
	2. Flow of fluids, transport of fluids	5
IV. Outline of fuel, combustion theory, combustion calculation, combustion method, combustion equipment	1. Outline of fuel, fuel testing method	5
	2. Combustion theory, combustion calculation	7
	3. Combustion method, combustion equipment	4
V. Measurement and control	1. Measurement	6
	2. Automatic control	6
VI. Heat utilizing equipment, etc.	1. Boilers and relevant equipment	6
	2. Steam power plant	2
	3. Steam transport, storage, drain recovery	2
	4. Industrial furnaces	3
	5. Distilling equipment	2
	6. Evaporating and concentrating equipment	2
	7. Drying equipment	3
	8. Heating equipment, heat exchangers	2
	9. Carbonization and gasifying equipment	2
	10. Refrigerating and air conditioning equipment	4
	11. Internal combustion engines, gas turbines	2
	12. Thermal equipment materials	2
Total		100

Note: One class is of 45 minutes, and eight classes (4 classes in the morning and 4 classes in the afternoon) are provided per day.

Table 6.14 Recommendation on Electrical Energy Management Training

Training subject		Lecture subject	No. of classes
I. Outline of electricity management and "Energy Conservation Promotion Act"		1. Outline of electricity management 2. Outline of "Energy Conservation Promotion Act"	4 4
II. Electric theory, control theory		1. Electric theory, electric circuits 2. Control theory	10 6
III. Factory power distribution		1. Distribution method, demand and load 2. Design and operation 3. Maintenance and management 4. Energy conservation in factory power distribution	6 4 2 2
IV. Electrical machinery and apparatus		1. Transformers, synchronous machine, induction and DC machines 2. Control equipment, static converters 3. Instrumentation 4. Energy conservation for electrical machinery and apparatus	8 4 4 6
V. Application of electrical power		1. Application of electrical power in general 2. Conveying machines 3. Fluid machines 4. Industrial machines and other equipment	4 2 2 2
VI.	Electric heating	1. Electric heating theory, equipment 2. Energy conservation in electric heating	4 4
	Electro-chemistry	1. Electro-chemistry theory, equipment 2. Energy conservation in electro-chemistry	3 3
	Lighting	1. Lighting theory, equipment 2. Energy conservation in lighting	4 4
	Air conditioning	1. Air conditioning theory, equipment 2. Energy conservation in air conditioning	4 4
Total			100

Note: One class is of 45 minutes, and eight classes (4 classes in the morning and 4 classes in the afternoon) are provided per day.

(3) Stage 3 (Long-term implementation)

When those who satisfy any one out of three qualifications are reported to the relevant authorities, they are registered as energy managers under the law. But differences in the technological level are observed among three qualifications.

Therefore, it is recommended to partly revise the law and abolish the system in which those who satisfy any one out of three qualifications become energy managers and instead to establish the system for qualified person for thermal (electrical) energy management of national qualification, out of whom thermal (electrical) energy managers will be selected.

This system requires some technological levels and also attaches importance to experiences.

Furthermore, under the present law, the condition for designation of energy management designated factories (buildings) is energy consumption and the number of energy managers to be selected is one per factory (building) regardless of the energy consumption level.

Improvement in the condition for designation and in the number of energy managers is required because there are portions different between heat field and electricity field in the energy conservation technologies. Accordingly, experts in the heat field and in the electricity field should be different, and in addition, there are cases where a factory (building) of large energy consumption can be hardly managed by a single energy manager.

The contents of the improvement mentioned above are recommended as indicated below as partial revision to the law.

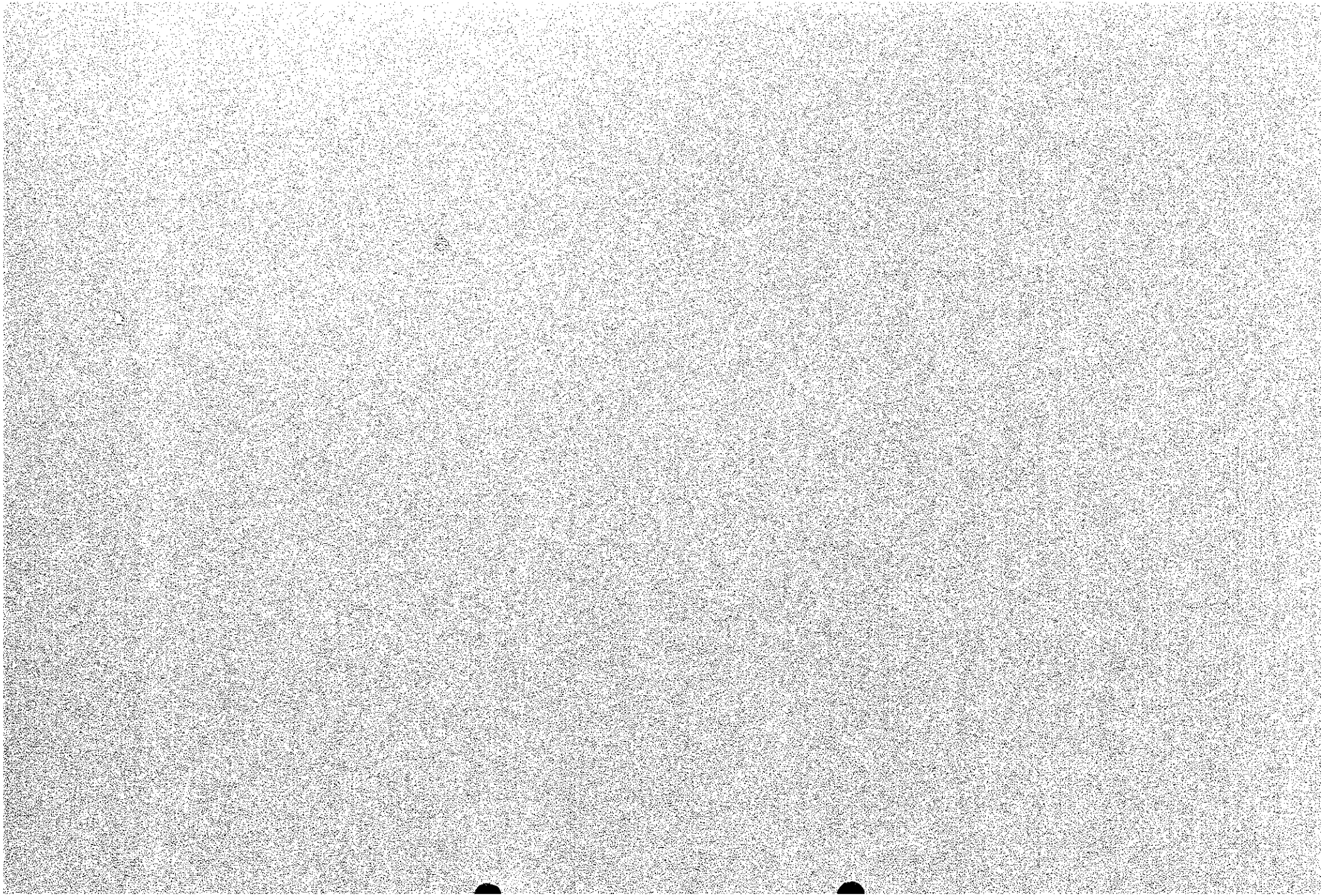
Description of revision

1. To make distinction between heat and electricity in designated factories (buildings) and to specify the criteria for designation for each of thermal (electrical) energy management designated factories (buildings).

2. To select thermal (electrical) energy managers out of those who are qualified for thermal (electrical) energy management, which are national qualifications, for thermal (electrical) energy management designated factories (buildings) and to determine the number of energy managers to be selected depending on the of energy consumption.

3. To permit acquisition of the qualified person for thermal (electrical) energy management persons, which are national qualifications, by applying for license upon completion of designated management training indicated in Tables 6.12, 6.13 and 6.14.

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 as a core of promotion of energy rationalization in Thailand, factories and buildings ("designated factories and buildings") consuming energy of a level specified based on this Act 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 submitted from "designated factories and designated buildings" 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.

After this "database" was constructed, its online connection with external "databases" should also be achieved.

(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 when this database is used.

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.

To make use of this database for the energy policies stated above, however, the trend of energy consumption at all of the designated factories and buildings should be closely related to the trend of energy consumption at factories and buildings in the whole country. For this objective, it may be one method to set the criteria for selection of designated buildings apart from those for designated factories and to increase the number of designated buildings. Since rather small-scaled buildings will be included as the object in this case, however, simplification of reported data is considered to be necessary depending on the building scale.

(2) Use of the database for providing guidance on energy conservation to user of individual factories and buildings

When this database is used, 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

7.2.1 Software

As the basic software, dBASE IV will be used for spreadsheet and CHART-MASTER will be used for graph representation. Eleven files indicated below will be generated on the dBASE IV software as database files.

(1) Factory energy consumption file
(2) Factory energy conservation project file
(3) Building energy consumption file
(4) Building energy conservation project file
(5) Energy conservation promotion fund file
(6) Factory outline file
(7) Building outline file
(8) Qualified energy manager file
(9) National energy consumption file
(10) Energy conservation successful case file
(11) Code conversion file

7.2.2 Outline of database file system

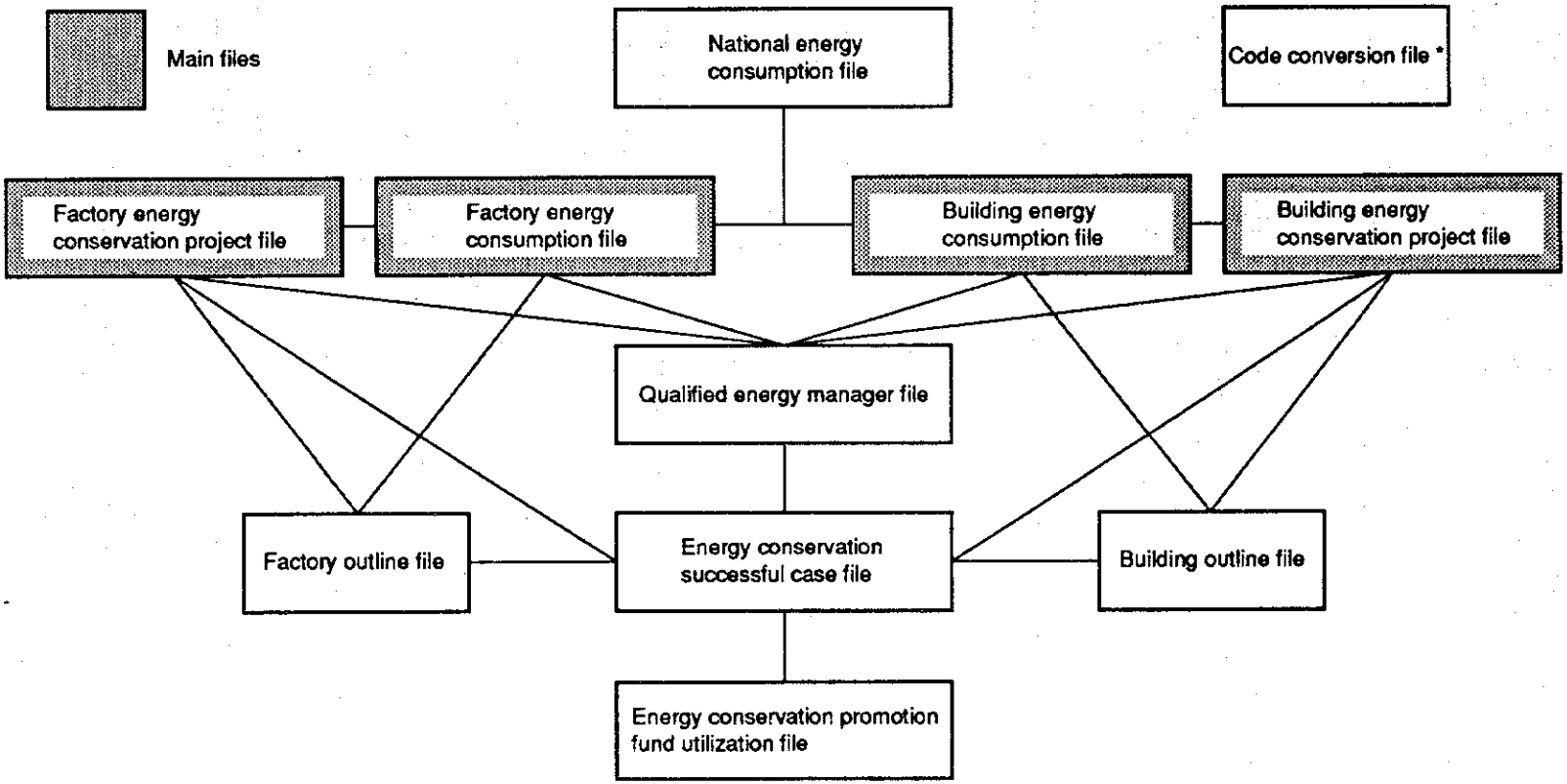
The conceptual diagram of the database system is shown in Figure 7.1.

This database system will be constructed for the purpose of providing data which are useful for decision of energy policies of the nation as stated earlier. In concrete, the purposes of construction of this database system are summarized as follows.

① Grasping of energy conservation amount
② Grasping of trend of energy demand
③ Promotion of energy conservation activities

Factories and buildings become subject to study as the establishments for energy use. Since the purpose of factories is to produce products, their energy consumption is largely affected by the production quantity. Businesses implement increase/decrease of production quantity, expansion/modification/demolishment/integration of equipment and other measures based on their business management policies, and the energy consumption varies accordingly. Energy management is generally made by energy efficiency (energy consumption/production quantity). In the case of a factory, both of production quantity, which is the denominator, and energy consumption, which is the numerator, change.

Figure 7.1 Conceptual Diagram of Data File



* Code conversion file is commonly used for all files.

For a building, on the other hand, once it is constructed, its basic structure will remain unchanged in units of decades. Its energy consumption, therefore, is affected by internal thermal load changes, energy equipment renewal/modification, etc. Generally, energy management is implemented by the energy consumption per building unit area. But the building area, which is the denominator, remains unchanged in general.

In a database file, therefore, it is recommended that factories and buildings are separately managed because of these differences between factories and buildings.

For the objectives of the database system, energy consumption files, energy conservation project files and energy conservation promotion fund files for both of factories and buildings are provided as main files; and six files, i.e., factory outline file, building outline file, qualified energy manager file, national energy consumption file, energy conservation successful case file and code conversion file, are provided as auxiliary files.

The specified output is obtained by combining a main file with auxiliary files in correspondence to the objective.

(1) Factory energy consumption file

This is the file for grasping in time series the energy consumption (total energy, by energy), production quantity (total, by product type) and proceeds of each factory. Upon entry of these data, the energy intensity is calculated and the result is preserved together with the factory registration number. The effect obtained as a result of output of this file is as follows.

① It is possible to grasp the trend of energy consumption by category when the numeric values of factories are selectively totaled in the whole nation or by factory scale, by area, by industry group or by product type in correspondence to the purpose of use.

② It is possible to grasp the category to be targeted for achieving effective energy conservation when weighting of energy conservation by category is made.

③ It is possible to grasp the weight of designated factories in the whole nation when comparison is made with "national energy consumption file", and a material for designation of business establishments in the future is obtained.

④ The best ten factories and worst ten factories in the energy intensity become clear, and a material for awarding excellent factories and for provision of guidance to inferior factories is obtained.

⑤ It is possible to grasp the trend of energy consumption at each individual factory, and it is possible to check abnormal values.

1) Items to be entered

Factory registration number (factory/building identification code — area code — industry type code — product code — serial number — designated factory identification code), monthly energy consumption of the whole factory (total energy, by energy), monthly production quantity of the whole factory, monthly proceeds of the entire factory, monthly energy consumption of principal products and monthly production quantity of principal products.

2) Items to be calculated after entry

Calculation is made for the following items after entry of items indicated above.

- Annual energy consumption of the whole factory (totaling is made by quarter or by two quarters as required)
- Annual energy consumption of principal products (totaling is made by quarter or by two quarters as required)
- Annual production quantity of the whole factory (totaling is made by quarter or by two quarters as required)
- Annual production quantity of principal products (totaling is made by quarter or by two quarters as required)
- Annual proceeds of the whole factory (totaling is made by quarter or by two quarters as required)
- Monthly energy intensity of the whole factory (energy consumption/production quantity)
- Monthly energy intensity of principal products (energy consumption/production quantity)
- Annual energy intensity of the whole factory (energy consumption/production quantity) (totaling is made by quarter or by two quarters as required)
- Annual energy intensity of principal products (energy consumption/production quantity) (calculation is made by quarter or by two quarters as required)
- Annual energy consumption/annual proceeds of the whole factory (calculation is made by quarter or by two quarters as required)

3) Check for abnormal data

An alarm is issued and processing is stopped when any abnormal value is found in items of entry and items of calculation indicated above. In concrete, energy consumption, production quantity and energy use efficiency are compared with those for the previous year or previous month; proceeds, annual energy consumption/annual proceeds are compared with those for the previous year; and if rapid increase or decrease is found, the cause for it is checked.

Furthermore, whether the submitted annual or 6-month total values are matched with calculated values is checked. The electric power consumption can be checked by customer number of MEA or PEA.

4) Output

Output is made to the CRT screen or to paper by a chart or graph for each item. Factories other than those designated are also included as required. (Selection is made by "designated factory identification code".)

A graph of broken lines, bar graph, circle graph or correlation graph is used in correspondence to the purpose.

① Single factory

- Principal products

Monthly and annual — energy consumption (total energy, by energy)	line graph, bar graph
Monthly and annual — energy intensity (total energy, by energy)	line graph, bar graph
Energy consumption by month and by year — energy intensity (total energy, by energy)	correlation graph
Production quantity by month and by year — energy intensity (total energy, by energy)	correlation graph
Annual — energy consumption/proceeds	line graph
Annual report and monthly report	chart

Factory name and necessary items selected out of "factory outline file" are output in the form of a list.
Year/month, product name, production quantity, electric energy, consumption by fuel, consumption of total energy, electric power use efficiency, use efficiency by fuel, energy intensity

- Entire factory

Monthly and annual — energy consumption (total energy, by energy)	line graph, bar graph, circle graph
Monthly and annual — energy intensity (total energy, by energy)	line graph, bar graph
Energy consumption by month and by year — energy intensity (total energy, by energy)	correlation graph

Production quantity by month and by year — energy intensity (total energy, by energy)	correlation graph
Annual — energy consumption/proceeds	line graph
Annual report and monthly report	chart

Year/month, electric energy, consumption by fuel, consumption of total energy, electric power intensity, intensity by fuel, energy intensity

② Totaling by scale (energy consumption, proceeds, capital, number of employees, etc.)

Selective totaling by energy consumption and proceeds. Selective totaling of capital and number of employees is made based on "factory outline file".

Monthly and annual — energy consumption (total energy, by energy)	line graph, bar graph, circle graph
Annual — energy consumption (total energy, by energy)/proceeds	line graph, bar graph
Number of factories — distribution by area	histogram
Number of factories — distribution by subsector of industry	histogram
Number of factories — distribution by product	histogram
Annual energy consumption (total energy, by energy) — distribution by area	histogram
Annual energy consumption (total energy, by energy) — distribution by industry subsector	histrogram
Annual energy consumption (total energy, by energy) — distribution by product	histogram
Annual energy consumption (total energy, by energy)/ proceeds — distribution by area	histogram
Annual energy consumption (total energy, by energy)/ proceeds — distribution by subsector of industry	histogram
Annual energy consumption (total energy, by energy)/ proceeds — distribution by product	histogram

Annual report and monthly report — chart

Year/month, electric energy, consumption by fuel, consumption of total energy, energy consumption (total energy, by energy)/proceeds

Annual ranking (electric energy, consumption by fuel, total energy consumption/proceeds) — chart

Rank, factory name, proceeds, electric energy, consumption by fuel, consumption of total energy
Ranking is made from low order to high order, and also from low order to high order.

③ Totaling by area

Selective totaling is made by area. Others correspond to (2) Totaling by scale.

However, "distribution by area, distribution by subsector of industry and distribution by product" in ② are replaced by distribution by scale, distribution by subsector of industry and distribution by product".

④ Totaling by subsector of industry

Selective totaling is made by industry subsector code. Others correspond to (2) Totaling by scale.

However, "distribution by area, distribution by industry subsector and distribution by product" in ② are replaced by "distribution by scale, distribution by area and distribution by product".

⑤ Totaling by product

Selective totaling is made by product code.

Monthly and annual — energy consumption (total energy, by energy)	line graph, bar graph, circle graph
Annual — energy intensity (total energy, by energy)	line graph, bar graph
Number of factories — distribution by scale	histogram
Number of factories — distribution by area	histogram
Number of factories — distribution by industry subsector	histogram

Annual energy consumption (total energy, by energy) — distribution by scale	histogram
Annual energy consumption (total energy, by energy) — distribution by area	histogram
Annual energy consumption (total energy, by energy) — distribution by industry subsector	histogram
Annual energy intensity (total energy, by energy) — distribution by scale	histogram
Annual energy intensity (total energy, by energy) — distribution by area	histogram
Annual energy intensity (total energy, by energy) — distribution by industry subsector	histogram
Annual report and monthly report	chart

Year/month, factory name, electric energy, consumption by fuel, consumption of total energy, energy intensity

Annual ranking (electric energy, consumption by fuel, total energy consumption, energy intensity)	chart

Rank, factory name, proceeds, electric energy, consumption by fuel, consumption of total energy, energy intensity
Ranking is made from low order to high order, and also from low order to high order.

⑥ Combination of ②, ③, ④, ⑤

Reduced selective totaling is made by each code. Such a method that menu setup is made for the reduced selection like "by scale → by area → by industry subsector" from the beginning and selection is made on the screen can also be considered.

⑦ Totaling of all factories

Totaling is made to all factories.

Monthly and annual — energy consumption (total energy, by energy) (The energy consumption in the whole country is transcribed from "national energy consumption file".)	line graph, bar graph, circle graph

Annual — energy consumption (total energy, by energy)/ proceeds	line graph, bar graph
Number of factories — distribution by scale	histogram
Number of factories — distribution by area	histogram
Number of factories — distribution by industry subsector	histogram
Number of factories — distribution by product	histogram
Annual energy consumption (total energy, by energy) — distribution by scale	histrogram
Annual energy consumption (total energy, by energy) — distribution by area	histrogram
Annual energy consumption (total energy, by energy) — distribution by industry subsector	histrogram
Annual energy consumption (total energy, by energy) — distribution by product	histrogram
Annual energy consumption (total energy, by energy)/ proceeds — distribution by scale	histrogram
Annual energy consumption (total energy, by energy)/ proceeds — distribution by area	histrogram
Annual energy consumption (total energy, by energy)/ proceeds — distribution by industry subsector	histrogram
Annual energy consumption (total energy, by energy)/ proceeds — distribution by product	histrogram
Annual report and monthly report	chart

Year/month, electric energy, consumption by fuel, consumption of total energy, energy consumption (total energy, by energy)/proceeds

Annual ranking (electric energy, consumption by fuel, consumption of total energy/proceeds) — chart

Rank, factory name, proceeds, electric energy, consumption by fuel, total energy consumption, energy consumption/proceeds
Ranking is made from low order to high order, and also from low order to high order.

⑧ Factories + buildings

Totaling is made by add-up of electric energy, consumption by fuel and consumption of total energy.

Monthly and annual — energy consumption (total energy, by energy, by factory and by building) (The energy consumption in the whole nation is transcribed from "national energy consumption file".) — line graph, bar graph, circle graph

Annual energy consumption (total energy, by energy, distribution by area, by factory and by building) — histrogram

Annual report and monthly report — chart

Year/month, electric energy, consumption by fuel, consumption of total energy

(2) Factory energy conservation project file

This is used to arrange the energy conservation project implementation programs of each factory and implementation effect. The individual numeric values of each project and the energy consumption (planned value) of the whole factory attained when these programs are implemented are compared with the present energy consumption. The effect obtained as a result of output of this file is as follows.

① It is possible to grasp the trend of energy consumption (planned value) by category when the numeric values of factories are selectively totaled in the whole country or by factory scale, by area, by industry group or by product type in correspondence to the purpose of use.

② It is possible to grasp the trend of energy consumption at each individual factory.

③ It is possible to judge the effect of each individual project.

④ When cases of success are registered in the "energy conservation successful case file", this file can be used as a reference for other energy conservation projects and will assist in promotion of energy conservation activities.

1) Items to be entered

Factory registration number, product code, project number, project name, project details, energy conservation measure classification (corresponds to the classification specified by the Energy Conservation Promotion Act), target of energy conservation, energy conservation rate, date of implementation, investment amount (the amount to use the energy conservation promotion fund is transcribed from "energy conservation promotion fund use file"), energy conservation effect, annual profit, investment payback period

For individual projects, the achieved values against planned values are described in the report to be written after completion of the project.

Annual production program (for the whole factory, by principal product), annual proceeds program (whole factory, by principal product), annual energy consumption program (whole factory, by principal product), result of annual energy consumption (whole factory, by principal product), annual investment amount (whole factory, by principal product)

2) Items to be calculated after entry

Calculation is made for the following items after entry of items indicated above.

- Total of planned value of investment amount for all projects
- Amount to use energy conservation promotion fund out of the above total
- Total of planned value of energy conservation effect of all projects
- Total of planned value of profit from all projects
- Planned investment payback period of all projects
- Ratio of achieved value to planned value of investment amount for each individual project
- Ratio of achieved value to planned value of energy conservation effect of each individual project
- Ratio of achieved value to planned value of profit from each individual project
- Ratio of achieved value to planned investment payback period of each individual project
- Ratio of achieved value in the previous year to annual production program (whole factory, by principal product)
- Ratio of achieved value in the previous year to annual proceeds program (whole factory, by principal product)
- Ratio of achieved value in the previous year to planned annual energy consumption (whole factory, by principal product)
- Planned value of annual energy use efficiency of the whole factory (energy consumption/ production quantity)
- Planned value of annual energy use efficiency for principal products (energy consumption/ production quantity)
- Planned value of annual energy consumption/annual proceeds of the whole factory

3) Check for abnormal data

An alarm is issued and processing is stopped when any dissociation occurs between the project total value and factory energy consumption planned value.

4) Output

① Individual projects and their total

A chart that indicates comparison of planned values with actual values for the fiscal year immediately before implementation of the project is drawn up.

② Planned values and actual values of individual factories ~ all factories

A chart is drawn up in accordance to (1) 4). (Actual values are transcribed from "factory energy consumption file" as required.)

(3) Energy consumption file for buildings

This is the file for grasping in time series the energy consumption (total energy, by energy), production quantity (total, by product type) and proceeds of each building. Upon entry of these data, the energy use efficiency is calculated and the result is stored together with the building registration number. The effect obtained as a result of output of this file is as follows.

① It is possible to grasp the trend of energy consumption by category when the numeric values of buildings are selectively totaled in the whole country or by building scale, by area, by building application or by process type according to the purpose of use.

② It is possible to grasp the category to be targeted for achieving effective energy conservation when weighting of energy conservation by category is made.

③ It is possible to grasp the weight of designated buildings in the whole country when comparison is made with "national energy consumption file", and a material for specification of establishments in the future is obtained.

④ The best ten buildings and worst ten buildings in the energy use efficiency become clear, and data for awarding excellent buildings and for provision of guidance to inferior buildings is obtained.

⑤ It is possible to grasp the trend of energy consumption at each individual building, and it becomes possible to check abnormal values.

1) Items to be entered

Building registration number (factory/building identification code — area code — building application code, serial number — designated building identification code), monthly energy consumption of the whole building (total energy, by energy), energy consumption by month of the whole building (total energy, by energy), energy consumption by month for principal processes, air conditioner running time, illumination lighting time, number of patients in the hospital, number of used guest rooms in the hotel

2) Items to be calculated after entry

Calculation is made for the following items after entry of items indicated above.

- Annual energy consumption for the whole building (totaling is made by quarter or by two quarters as required)
- Annual energy consumption for principal processes (totaling is made by quarter or by two quarters as required)
- Monthly energy use efficiency of the whole building (energy consumption/building area, etc.)
- Monthly energy use efficiency of principal processes (energy consumption/building area, etc.)
- Annual energy use efficiency of the whole building (energy consumption/building area, etc.) (calculation is made by quarter or by two quarters as required)
- Annual energy use efficiency of principal processes (energy consumption/building area, etc.) (calculation is made by quarter or by two quarters as required)

3) Check for abnormal data

An alarm is issued and processing is stopped when any abnormal value was found with items of entry and items of calculation indicated above. More specifically, energy consumption and energy use efficiency are compared with figures of the previous year or previous month; and if rapid increase or decrease is found, the cause for it is checked.

Furthermore, whether the submitted annual or 6-month total values are matched with calculated values is checked. The electric power consumption can be checked by customer number of MEA or PEA.

4) Output

Output is made to the CRT screen or to paper by a chart or graph for each item. Buildings other than those designated are also included as required. (Selection is made by designated building identification code.)

A graph of broken lines, bar graph, circle graph or correlation graph is used according to the purpose.

① Single building

- Principal process

Monthly and annual — energy consumption (total energy, by energy)	line graph, bar graph
Monthly and annual — energy use efficiency (total energy, by energy)	line graph, bar graph
Energy consumption by month and by year — energy use efficiency (total energy, by energy)	correlation graph
Annual report and monthly report	chart

Building name and necessary items selected out of "building outline file"
Year/month, process name, electric energy, consumption by fuel, consumption of total energy, electric power use efficiency, use efficiency by fuel, energy use efficiency

- Entire building

Monthly and annual — energy consumption (total energy, by energy)	line graph, bar graph, circle graph
Monthly and annual — energy use efficiency (total energy, by energy)	line graph, bar graph, circle graph
Energy consumption by month and by year — energy use efficiency (total energy, by energy)	correlation graph
Annual report and monthly report	chart

Year/month, electric energy, consumption by fuel, total energy consumption, electric power use efficiency, use efficiency by fuel, energy use efficiency

② Totaling by scale (energy consumption, building area, number of beds, number of guest rooms, etc.)

Selective totaling by energy consumption, building area, by number of beds (hospital), by number of guest rooms (hotel). Selective totaling of building area, number of beds and number of guest rooms is made based on "building outline file".

Monthly and annual — energy consumption (total energy, by energy)	line graph, bar graph, circle graph

Number of buildings — distribution by area	histogram
Number of buildings — distribution by application	histogram
Number of buildings — distribution by process	histogram
Annual energy consumption (total energy, by energy) — distribution by area	histrogram
Annual energy consumption (total energy, by energy) — distribution by application	histrogram
Annual energy consumption (total energy, by energy) — distribution by process	histrogram
Annual energy use efficiency (total energy, by energy) — distribution by area	histrogram
Annual energy use efficiency (total energy, by energy) — distribution by application	histrogram
Annual energy use efficiency (total energy, by energy) — distribution by process	histrogram
Annual report and monthly report	chart

Year/month, electric energy, consumption by fuel, total energy consumption

Annual ranking (electric energy, consumption by fuel, total energy consumption, energy use efficiency)	chart

Rank, building name, electric energy, consumption by fuel, total energy consumption
Ranking is made from low order to high order, and also from low order to high order.

③ Totaling by area

Selective totaling is made by area. Others correspond to (2) Totaling by scale.

However, "distribution by area, distribution by application and distribution by process" in ② are replaced by "distribution by scale, distribution by application and distribution by process".

④ Totaling by application

Selective totaling is made by application code. Others correspond to (2) Totaling by scale.

However, "distribution by area, distribution by application and distribution by process" in ② are replaced by "distribution by scale, distribution by area and distribution by process".

⑤ Totaling by process

Selective totaling is made by process code. Others correspond to (2) Totaling by scale.

However, "distribution by area, distribution by application and distribution by process" in ② are replaced by "distribution by scale, distribution by area and distribution by process".

⑥ Combination of ②, ③, ④, ⑤

Reduced selective totaling is made by each code.

Such a method that menu setup is made for the reduced selection like "by scale → by area → by application" from the beginning and selection is made in a picture can also be considered.

⑦ Totaling of all buildings

Totaling is made for all buildings.

Monthly and annual — energy consumption (total energy, by energy) (The energy consumption in the whole country is transcribed from "national energy consumption file".)	line graph, bar graph, circle graph
Annual — energy consumption (total energy, by energy)/ proceeds	line graph, bar graph
Number of buildings — distribution by scale	histogram
Number of buildings — distribution by area	histogram
Number of buildings — distribution by application	histogram
Number of buildings — distribution by process	histogram
Annual energy consumption (total energy, by energy) — distribution by scale	histrogram

Annual energy consumption (total energy, by energy) — distribution by area	histogram
Annual energy consumption (total energy, by energy) — distribution by application	histogram
Annual energy consumption (total energy, by energy) — distribution by process	histogram
Annual energy use efficiency (total energy, by energy) — distribution by scale	histogram
Annual energy use efficiency (total energy, by energy) — distribution by area	histogram
Annual energy use efficiency (total energy, by energy) — distribution by application	histogram
Annual energy consumption (total energy, by energy) — distribution by process	histogram
Annual report and monthly report	chart

Year/month, electric energy, consumption by fuel, total energy consumption, energy use efficiency

Annual ranking (electric energy, consumption by fuel, consumption of total energy, energy intensity)	chart

Rank, building name, electric energy, consumption by fuel, total energy consumption, energy use efficiency.
Ranking is made from low order to high order, and also from low order to high order.

(4) Building energy conservation project file

This is used to arrange the energy conservation project implementation programs of each building and implementation effect. The individual numeric values of each project and the energy consumption (planned value) of the whole building attained when these projects are implemented are compared with the present energy consumption. The effect obtained as a result of output of this file is as follows.

① It is possible to grasp the trend of energy consumption (planned value) by category when the numeric values of buildings are selectively totaled in the whole country or by building scale, by area, by application or by process in correspondence to the purpose of use.

② It is possible to grasp the trend of energy consumption at each individual building.

③ It is possible to judge the effect of each individual project.

④ When successful cases are registered in the "energy conservation successful case file", this file can be used as a reference for other energy conservation projects and will assist in promotion of energy conservation activities.

1) Items to be entered

Building registration number, process code, project number, project name, project details, energy conservation measure classification (corresponds to the classification specified by the Energy Conservation Promotion Act), target of energy conservation, energy conservation rate, date of implementation, investment amount (the amount to use the energy conservation promotion fund is transcribed from "energy conservation promotion fund file"), energy conservation effect, annual profit, investment payback period

For each individual project, the actual values against planned values are described in the report after completion of the project.

Annual energy consumption program (whole building, by principal process, result of annual energy consumption (whole building, by principal process), annual investment amount (whole building, by principal process)

2) Items to be calculated after entry

Calculation is made for the following items after entry of items indicated below.

- Total of planned value of investment amount for all projects
- Amount to use energy conservation promotion fund out of the above total
- Total of planned value of energy conservation effect of all projects
- Total of planned value of profit from all projects
- Planned investment payback period of all projects
- Ratio of actual value to planned value of investment amount for each individual project
- Ratio of actual value to planned value of energy conservation effect for each individual project
- Ratio of actual value to planned value of profit from each individual project
- Ratio of actual value to planned investment payback period of each individual project
- Ratio of actual value in the previous year to planned annual energy consumption (whole building, by principal process)
- Planned value of annual energy intensity of the whole building (energy consumption/building area, etc.)
- Planned value of annual energy intensity for principal processes (energy consumption/ building area, etc.)

3) Check for abnormal data

An alarm is issued and processing is stopped when any large dissociation occurs between the project total value and decrease of building energy consumption planned value.

4) Output

① Individual projects and their total

A chart that indicates comparison of planned values with actual values of the fiscal year just before implementation of the project is drawn up.

② Planned values and actual values of individual buildings ~ all buildings

A chart is drawn up in correspondence to (3) 4). (Actual values are transcribed from "energy consumption file for building" as required.)

(5) Energy conservation promotion fund utilization file

How the energy conservation promotion fund is used in energy conservation projects is checked, and the effect of this fund is also checked.

The follow-up method for energy conservation promotion fund includes subsidy, grant and loan; however this section describes loan, which also applies to subsidy and grant.

1) Items for entry

Project approval application number, enterprise name, representative's name, location, telephone number, date of establishment, number of employees, capital or amount of investment, composition of capital or of invested money, organization chart, business report, date of implementation of business, target of business activities, name of establishment, location of establishment, name of person responsible for establishment, name of liaison staff, name of energy manager, telephone number, FAX number, product code, factory•building registration number, outline drawing of production processes of the whole factory, applicable equipment name, specific equipment classification, outline of applicable equipment, outline of processes, energy consumption, energy conservation amount, equipment drawing, outline of energy conservation operations other than introduction of equipment and energy conservation amount, expected effect (production level, energy consumption, energy conservation amount), funding program (amount of fund required for business activities and method for raising the said fund), interest subsidy, result of examination (date of completion of examination, result of examination, reason for permit), business implementation report (date of acceptance of report, date of implementation of business activities, applicable equipment and processes, energy conservation amount, loan amount, date of implementation of loan, bank name

2) Items to be calculated after entry

If there are multiple projects which make use of the energy conservation promotion fund in the same factory or building, they are totaled and stored.

3) Check for abnormal data

None in particular.

4) Output

Necessary items are selected out of the items of entry, and they are output in the form of a list.

(6) Factory outline file

The fundamental data of the factory are stored separately as an auxiliary file. The data in this file are selected and are transcribed to another file as required.

1) Items for entry

Factory registration number, factory name, designated factory or not, industry type, principal product names, TISI code number, area, address, telephone, FAX, date of establishment, date of designation, representative's name, energy manager (name, date of appointment), MEA (PEA) customer number, work shift, operation time (days and hours), electric power contract type, power receiving and transforming facilities, boiler equipment, private power generation equipment, air conditioning equipment, air compressor equipment, industrial furnaces, kiln, drying furnace, steam using equipment, electric power using equipment, waste heat recovery/utilization equipment, number of employees, annual energy consumption

- Company outline

  Company name, industry type, address, telephone number, FAX number, date of establishment, representative's name, capital, number of employees

2) Items to be calculated after entry

None in particular.

3) Check for abnormal data

Energy managers are checked by "qualified energy manager file" and new managers are registered in "qualified energy manager file".

4) Output

Necessary items are selected out of the items of entry, and they are output in the form of a list.

(7) Building outline file

The fundamental data of the building are stored separately as an auxiliary file. The data in this file are selected and are transcribed to another file as required.

1) Items for entry

Building registration number, building name, a designated building or not, application of the building, area, address, telephone, FAX, date of establishment, date of designation, name of owner of the building, energy manager (name, date of appointment), MEA (PEA) customer number, electric power contract type, structure, scale, site area, building area, total floor area, air conditioned area, building heat insulation performance, building operation time, air conditioned time, number of persons in the building (offices), number of beds (hospital), number of guest rooms (hotel), store area (store), electrical equipment, air conditioning equipment, sanitary equipment, transportation equipment, lighting equipment

- Company outline

  Company name, industry type, address, date of establishment, representative's name, capital, number of employees

2) Items to be calculated after entry

None in particular.

3) Check for abnormal data

Energy managers are checked by "qualified energy manager file" and new managers are registered in "qualified energy manager file".

4) Output

Necessary items are selected out of the items of entry, and they are output in the form of a list.

(8) Qualified energy manager file

This is the auxiliary file for management of energy managers. It is used for grasping and management of the situation for selection and sufficiency of energy managers at designated factories and buildings, and it is also used as a material for planning training (and national examination) implementation programs based on the data on the person who finished training (and the person who cleared national examination).

1) Items for entry

Manager number, name, sex, date of birth, applicable qualification item, certificate number, training completion certificate number, specialized field, whether appointed as an energy manager, registration number of designated establishment where appointed as an energy manager, belonging, position, telephone number, date of appointment, date of displacement, reason for displacement

2) Items to be calculated after entry

None in particular.

3) Check for abnormal data

Energy managers are checked at the time of entry of "factory outline file", "building outline file", "factory energy consumption file" and "building energy consumption file"; and new managers are registered in "qualified energy manager file".

4) Output

① Necessary items are selected out of the items of entry, and they are output in the form of a list.

② Statistics concerning such as energy manager repletion rate, breakdown of requirements for applicable qualification of registered persons and full-time persons, ratio of full-time persons/registered persons, etc. are output.

(9) National energy consumption file

This is the auxiliary file for grasping the ratio of energy consumption of designated factories and designated buildings to the energy consumption in the whole Kingdom of Thailand. It is generated through picking up necessary items out of the national energy statistics by energy and by area.

1) Items for entry

Fiscal year, annual primary energy final consumption (whole country, by area, by energy), GNP, GDP

2) Items to be calculated after entry

Energy final consumption to GNP unit consumption (energy final consumption in the subject fiscal year/GNP), GDP unit consumption (energy final consumption in the subject fiscal year/ GDP)

3) Check for abnormal data

None in particular.

4) Output

Necessary items are selected out of the items of entry, and they are output in the form of a list.

(10) Energy conservation successful case file

Results of energy audit conducted at factories and buildings by DEDP and ECCT in the past are transcribed to accumulate results of implementation of energy conservation projects (including projects which make use of the energy conservation promotion fund) for factories and buildings. This file is used as a material for planning concrete measures for promotion of energy conservation activities in the future. Excellent cases outside of Thailand will also be contained in the future.

1) Items for entry

Factory/building registration number, project number (product code or building process code - energy conservation measure classification code - utilization technology code), project name, staff in charge, essential data (technical data, energy data, environment data, economy data)

Data are transcribed from "energy conservation promotion fund utilization file", "factory energy conservation project file" or "building energy conservation project file" as required.

2) Items to be calculated after entry

None in particular.

3) Check for abnormal data

Those projects of long investment payback period are checked, and examination is made regarding whether it is necessary to make fund support.

4) Output

Necessary items are selected out of the items of entry, and they are output in the form of a list.

(11) Code conversion file

Since data in data files are handled by various codes, a code conversion file is created to permit easy indexing and transcription of codes at the time of entry.

1) Items for entry

① Factory/building identification code

Codes for identification of factories and buildings are created and a chart is drawn up.

② Area code

Areas are determined by classification of administration areas, and an area code cross-reference chart is drawn up.

③ Industry group code

A cross-reference chart is drawn up from TISI codes.

④ Product code

A cross-reference chart is drawn up from TISI codes.

⑤ Designated establishment identification code

Codes for identification of designated establishments and non-designated establishments are created and a chart is drawn up.

⑥ Energy conservation measure classification code

A code cross-reference chart is drawn up in correspondence to the energy conservation measure classification specified in the Energy Conservation Promotion Act.

⑦ Building application code

A code cross-reference chart is drawn up using "CODE FOR BUILDING" of the DEDP database.

However, "Others" is added to the codes.

⑧ Building process code

A code cross-reference chart is drawn up in accordance with air conditioning, sanitation, illumination, conveyance and other classifications.

It is also possible to create a more detailed code chart if diversification can be made.

⑨ Utilization technology code

A code cross-reference chart is drawn up in accordance with the classification of IEA/CADDET.

7.2.3 Function Keys

The function keys indicated below are provided for this database to facilitate data input/output and file operation.

INPUT: To produce the status that permits entry.

CORRECT: To produce the status that permits correction.

SELECT: To permit selection when select conditions are entered for each item.

UNIT CHANGE: Actual data unit ←→ conversion unit (GJ)

SORT: For creation of best ten and worst ten

PREVIOUS DATA: To move to the previous data.

NEXT DATA: To move to the next data.

BY PRODUCT (BY PROCESS): To move to the data by product in the case of a factory.
To move to the data by process in the case of a building.

FILE REFERENCE: To display another file in the window.

TOTAL: To permit specification of the totaling range.

OUTPUT: To specify the method for data output. (CRT, printer) (Graph or chart)

ESCAPE: To return to the previous picture. (Termination of database in the case of the basic picture.)

7.2.4 Flowchart

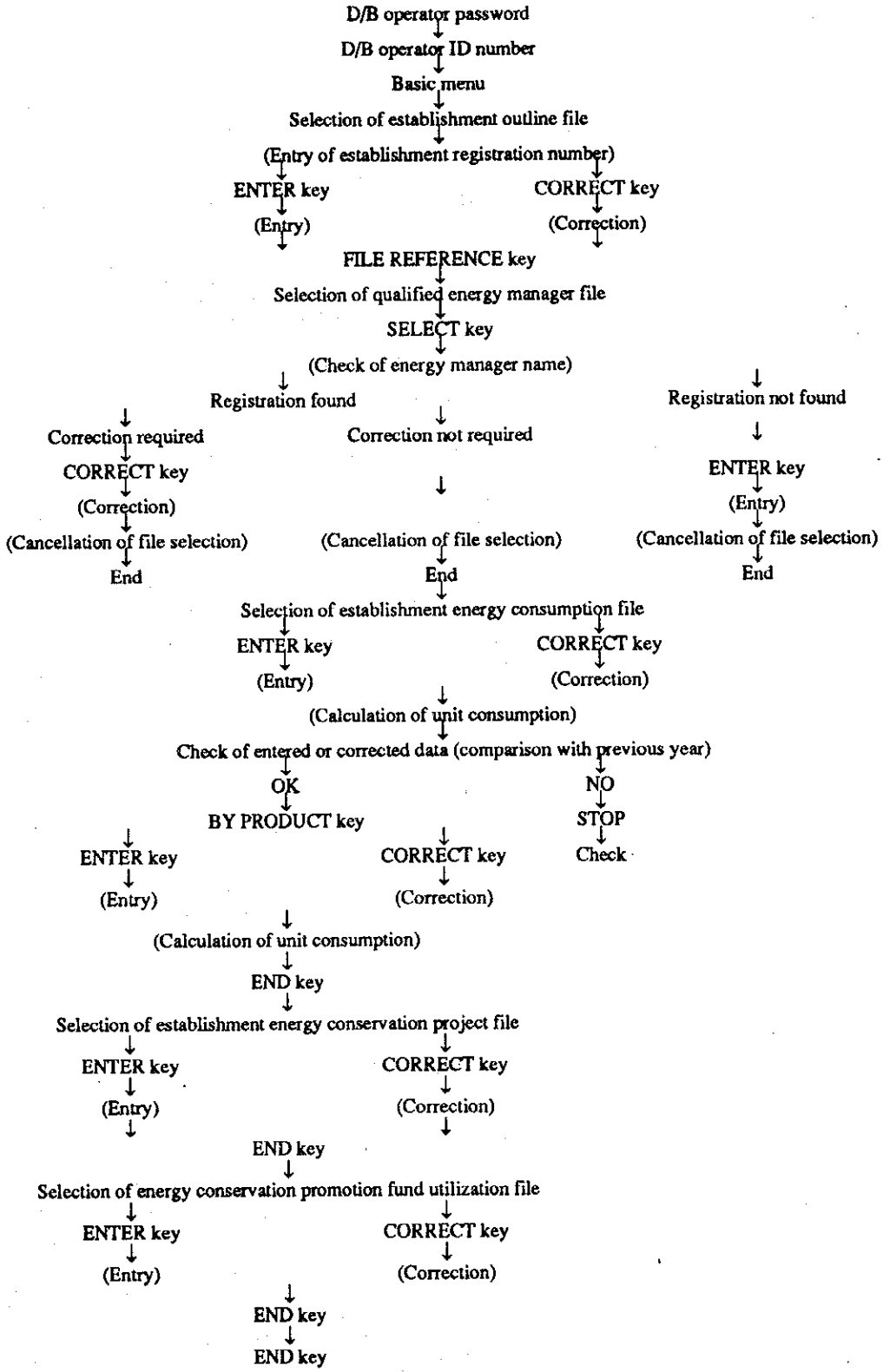
A sample of the flowchart of this database is shown below.

[Database Flowchart (Sample)]

D/B: Database

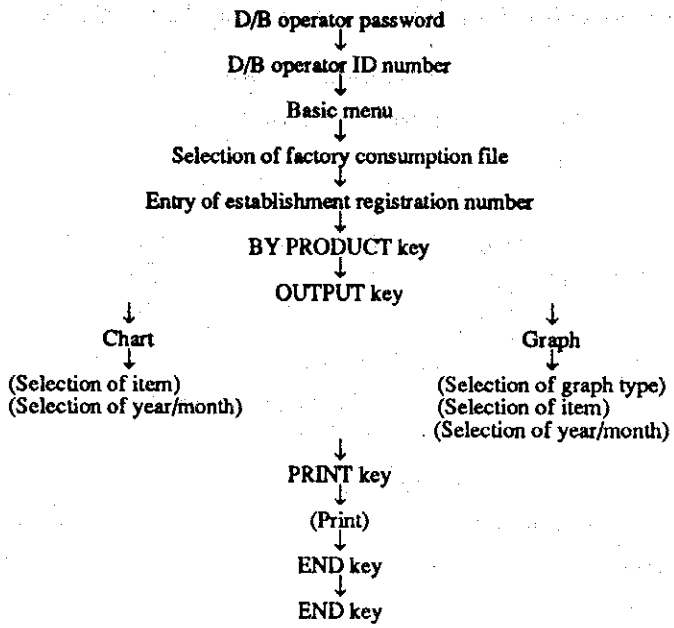
I. Data entry

① Factory (building) data registration and correction ... Factory (building) is expressed by the establishment.

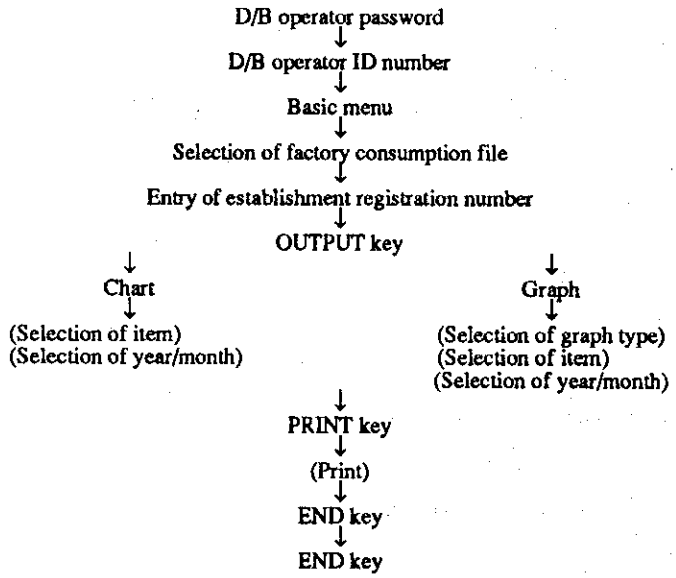


II. Data output

① Principal products (of a factory)

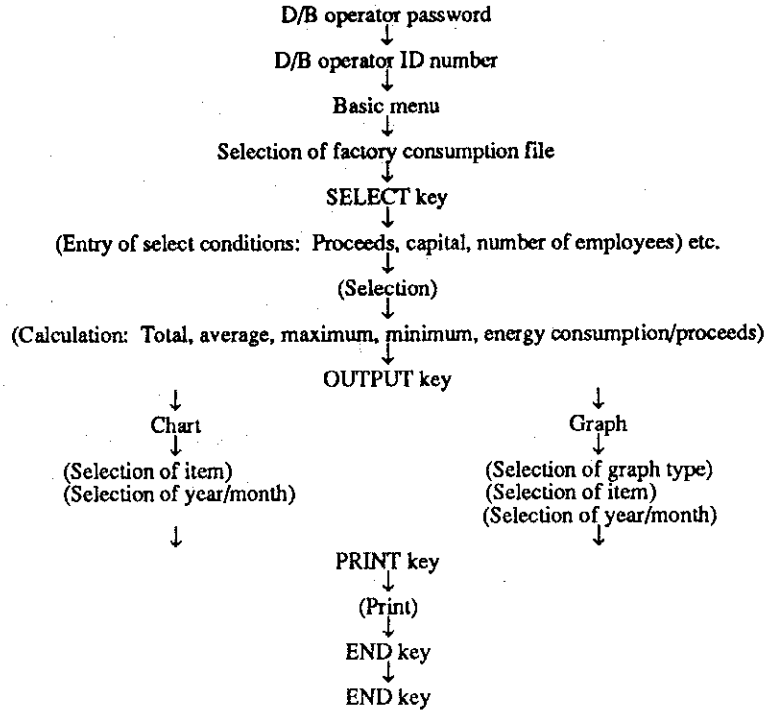


② Single factory

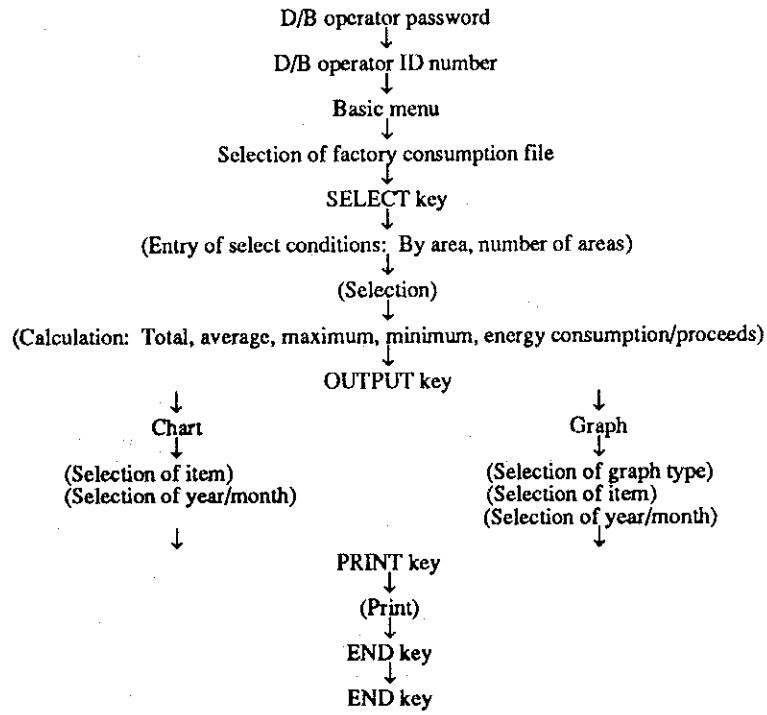


③ Multiple factories

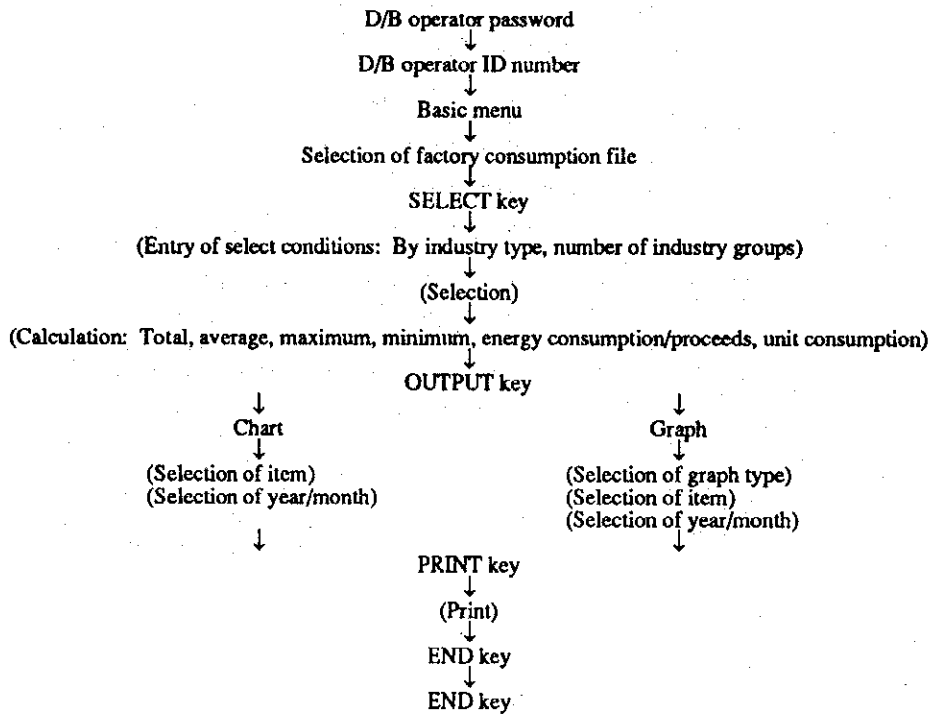
(1) Selection by scale



(2) Selection by area



(3) Selection by industry type



(4) Selection by product