

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DEPARTMENT OF ENERGY DEVELOPMENT AND PROMOTION
MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT
THE KINGDOM OF THAILAND

**THE STUDY (AFTER-CARE)
ON
THE ENERGY CONSERVATION PROJECT
IN
THE KINGDOM OF THAILAND**

**FINAL REPORT
(SUMMARY)**

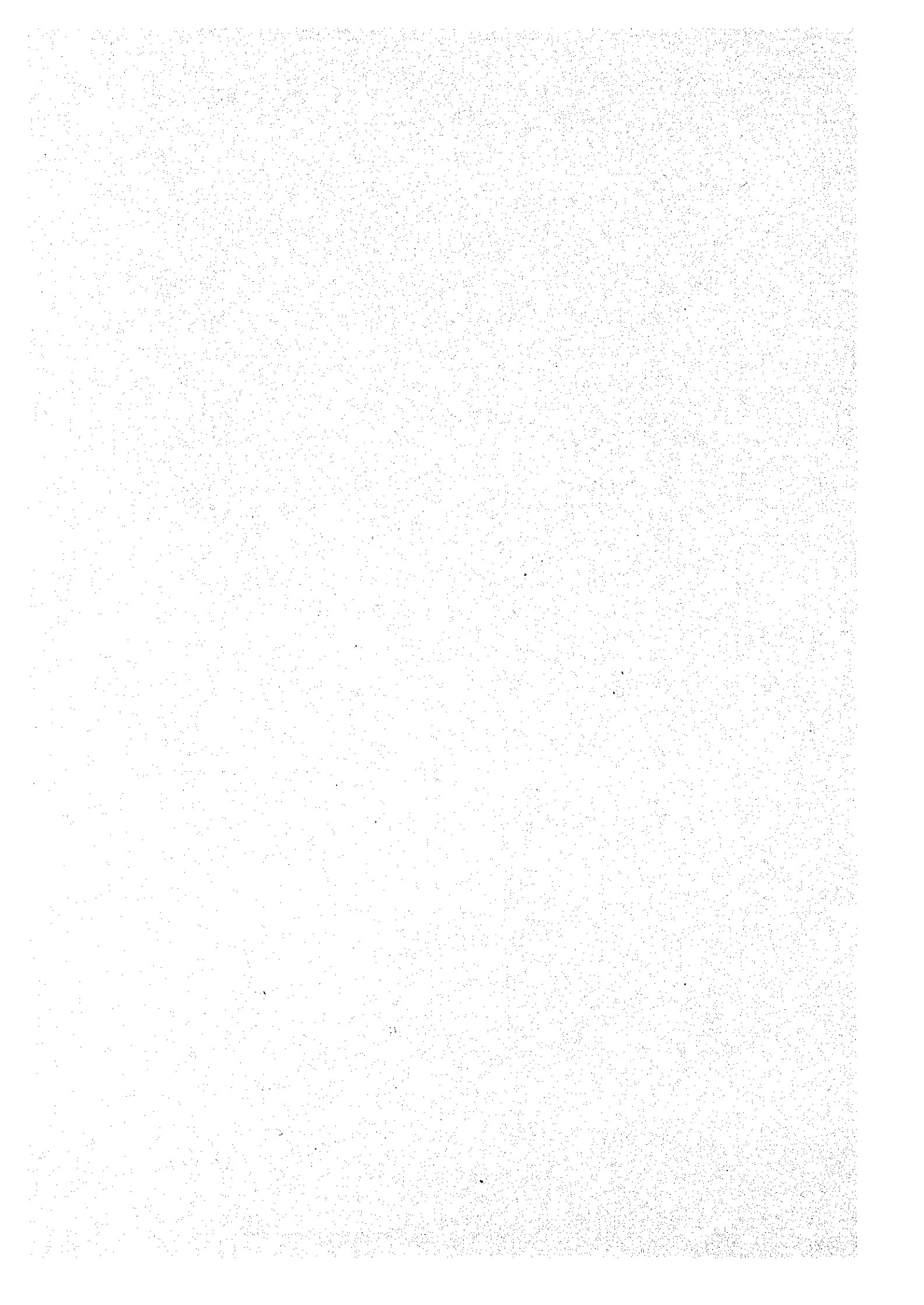
MARCH 1995

THE ENERGY CONSERVATION CENTER, JAPAN

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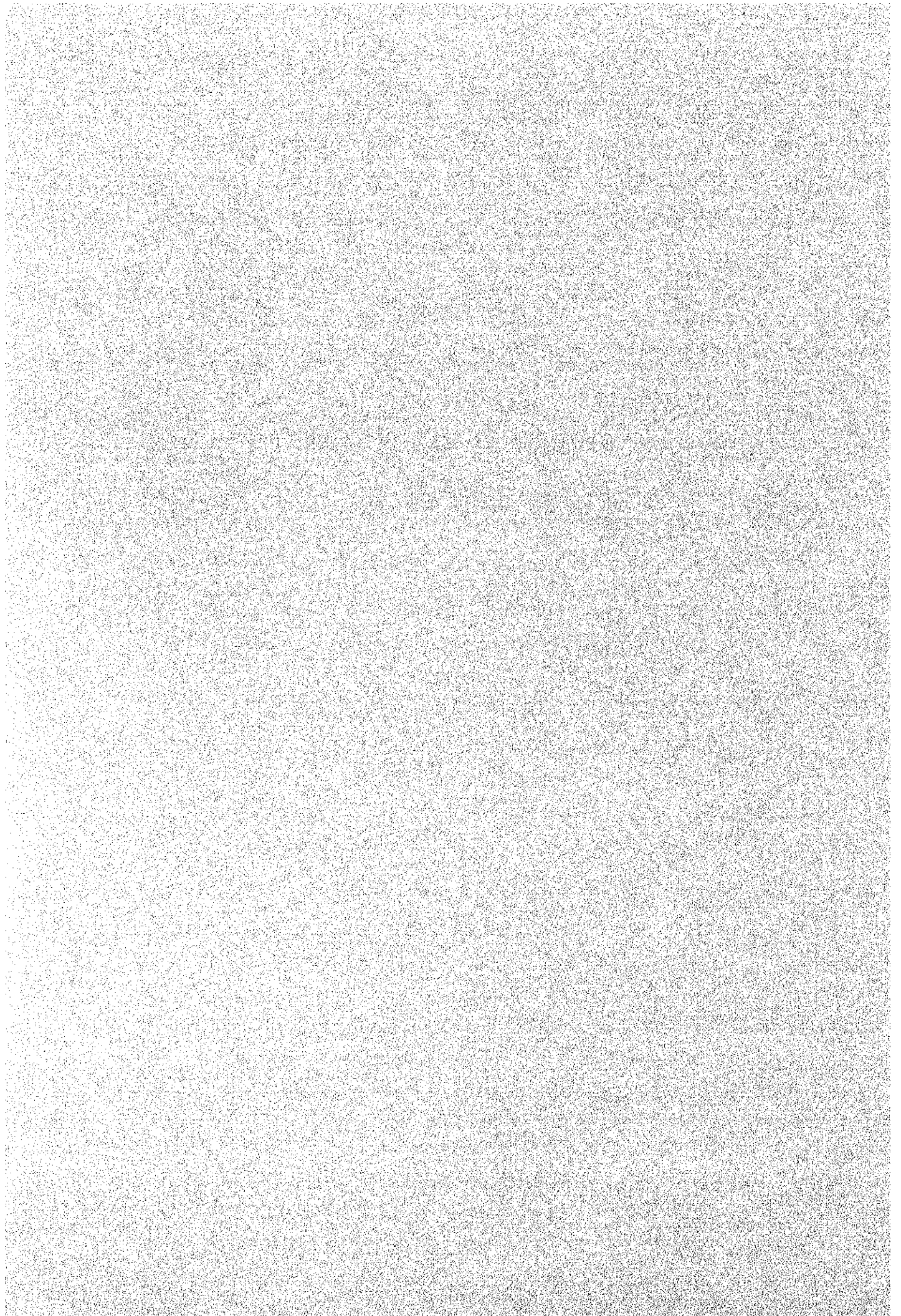
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1. OVERVIEW OF THE STUDY



1. OVERVIEW OF THE STUDY

1.1 Background of the Study

- (1) In 1980, the Government of Thailand requested the Government of Japan to cooperate in the rational use of energy in order to cope with the impact of the steep rise in oil prices on its economy. In response to this request, the Japan International Cooperation Agency (JICA) conducted a study on "Energy Conservation Project in the Kingdom of Thailand" for the period of 1982 to 1984 with the then Ministry of Science, Technology and Energy in Thailand as its counterpart.

The above study and the recommendations covered the following:

- 1) Recommendation on the enactment of an energy conservation act, and offering of financial support, etc. to clarify policies for the promotion of the rational use of energy.
- 2) Recommendation on establishment of semigovernmental organizations for energy conservation promotion, and offering of specific technical supports to disseminate the energy conservation concept in the industrial field, etc.
- 3) An energy conservation study was conducted on 55 factories in 6 industrial sectors as the model factories for energy conservation promotion in the industrial field, and thereafter recommendation was made on working out the technical guideline for energy conservation improvement methods and energy conservation promotion for each industrial sector.

The technology related to the method for energy conservation improvement was transferred to the counterpart personnel in the course of the factory study.

- (2) The Government of Thailand set up the Energy Conservation Center (NEA ECC) under the National Energy Administration (NEA) in 1981 to form the framework for the promotion of the rational use of energy, and then in 1985, the Energy Conservation Center of Thailand (ECCT) under the leadership of the Industrial Federation of Thailand, thus preparing for the establishment of the system for the promotion of energy conservation in the private and industrial sectors through these organizations.

(NEA ECC was reorganized into Ministry of Science, Technology and Environment/ Department of Energy Development and Promotion (DEDP) according to the organizational reform in Autumn 1992.)

- (3) Thereafter, the Thai Government promulgated the "Energy Conservation Promotion Act" in April 1992 on the basis of the 7th National Economic and Social Development Plan to aim at further promotion of energy conservation activities.

This Energy Conservation Promotion Act has, however, not operated effectively so far since no relevant regulations, enforcement ordinances and standards have been enacted.

- (4) Under these circumstances, JICA dispatched a Project Finding Team to Thailand in October 1992 to exchange views with the personnel concerned of the Ministry of Science, Technology and Environment. This led the Thai Government to a better understanding of the necessity for an after-care study of the energy conservation project. Thus, in January 1993, the Thai Government requested the Japanese Government to conduct an after-care study.
- (5) Based on the results of the above study, JICA sent a preparatory study team to Thailand in April 1994 in order to have discussions on various matters required for implementation of the study of this project, and to confirm the details of the request of the Thai side. Thereafter, an agreement on Scope of Work (S/W) was concluded between JICA and the Ministry of Science, Technology and Environment, a counterpart agency of this study.

1.2 Purpose of the Study

This study is regarded as an after-care study of the "Study on the Energy Conservation Project in the Kingdom of Thailand" implemented by JICA for the period of 1982 to 1984. Its purpose is to work out an action plan for the promotion of the rational use of energy related to the Energy Conservation Promotion Act promulgated in April 1992 on the basis of the 7th National Economic and Social Development Plan, and to transfer the technology for energy conservation promotion to the counterpart.

1.3 Counterpart Governmental Organization and Objects to be Studied

1.3.1 Counterpart governmental organization

Ministry of Science, Technology and Environment/Department of Energy Development and Promotion (DEDP)

1.3.2 Objects to be studied

- (1) Relevant organizations
 - a. Department of Energy Development and Promotion (DEDP)
 - b. The Energy Conservation Center of Thailand (ECCT)
 - c. DEDP Energy Training Center (DEDPETC)

- d. Ministry of Industry (MOI)
- e. Ministry of Finance (MOF)
- f. Ministry of Interior (MOI)
- g. Department of Environment Promotion
- h. National Energy Policy Office (NEPO)
- i. National Economic and Social Development Board (NESDB)
- j. The Industrial Finance Corporation of Thailand (IFCT)
- k. Thai Industrial Standard Institute (TISI)
- l. Electric Generating Authority of Thailand (EGAT)
- m. Metropolitan Electricity Authority (MEA)
- n. The Federation of Thai Industries (FTI)
- o. Technological Promotion Association (Thai-Japan) (TPA)
- p. JETRO Bangkok Center
- q. Japanese Chamber of Commerce, Bangkok
- r. Thai Obayashi Co., Ltd.

(2) Universities and Institutes

- a. Chulalongkorn University
- b. King Mongkut's Institute of Technology Thonburi

(3) Factories

- 1) A Factory (Glass)
- 2) B Factory (Glass)
- 3) C Factory (Iron and Steel)
- 4) D Factory (Cannery)
- 5) E Factory (Rice cleaning)
- 6) F Factory (Automobile parts)
- 7) G Factory (Plastic)
- 8) H Factory (Dyeing)
- 9) I Factory (Dyeing)
- 10) J Factory (Chemical)
- 11) K Factory (Tire)

(4) Buildings

- 1) a Building (Department store)
- 2) b Building (Department store)
- 3) c Building (Department store)
- 4) d Building (Bank)
- 5) e Building (Bank)
- 6) f Building (Hospital)
- 7) g Building (Hospital)
- 8) h Building (Hotel)
- 9) i Building (Office)

1.3.3 Factories to be studied for energy use audit

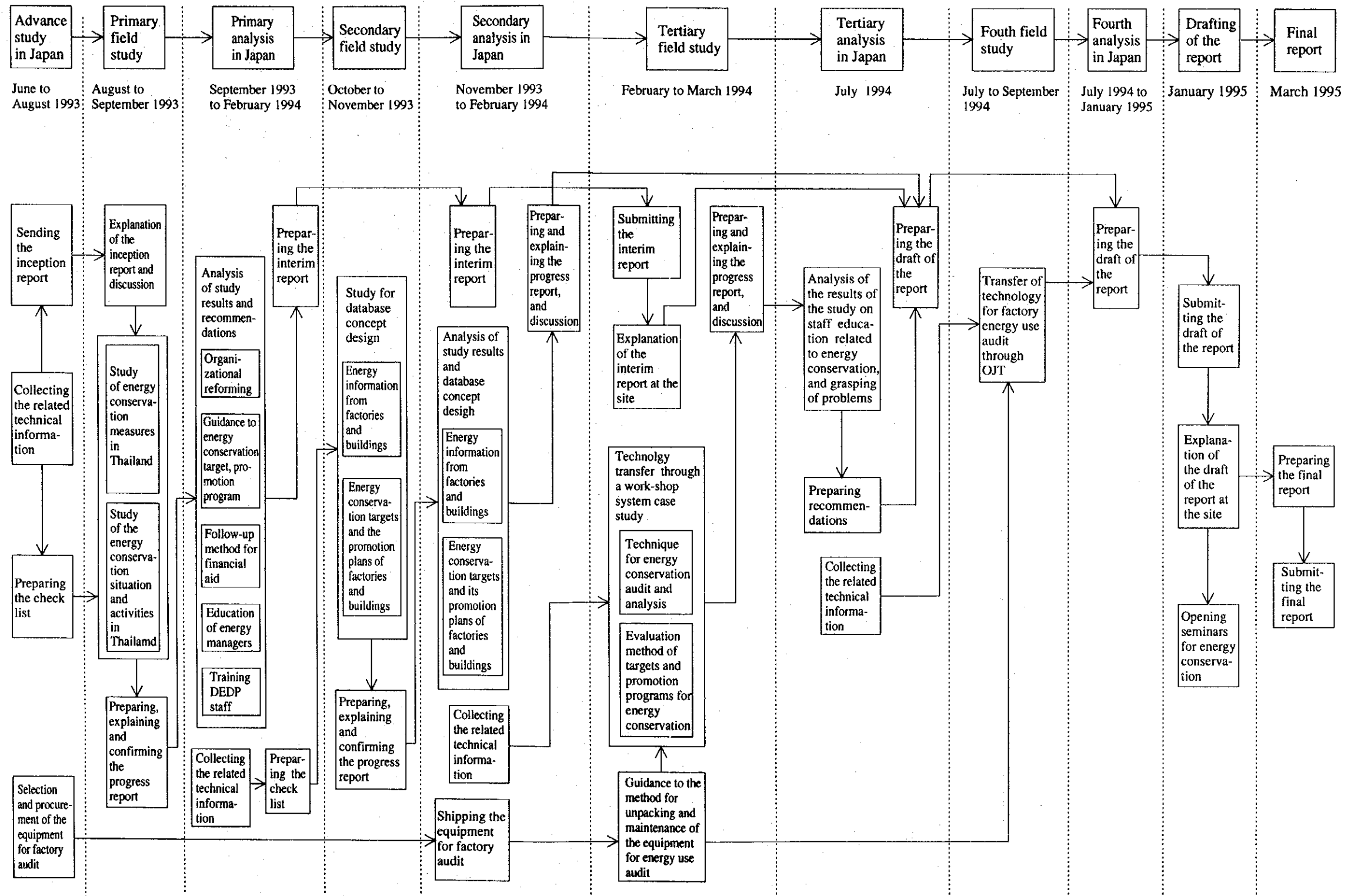
Type	Name
Steel	Y Co., Ltd.
Paper & Pulp	Z Co., Ltd.

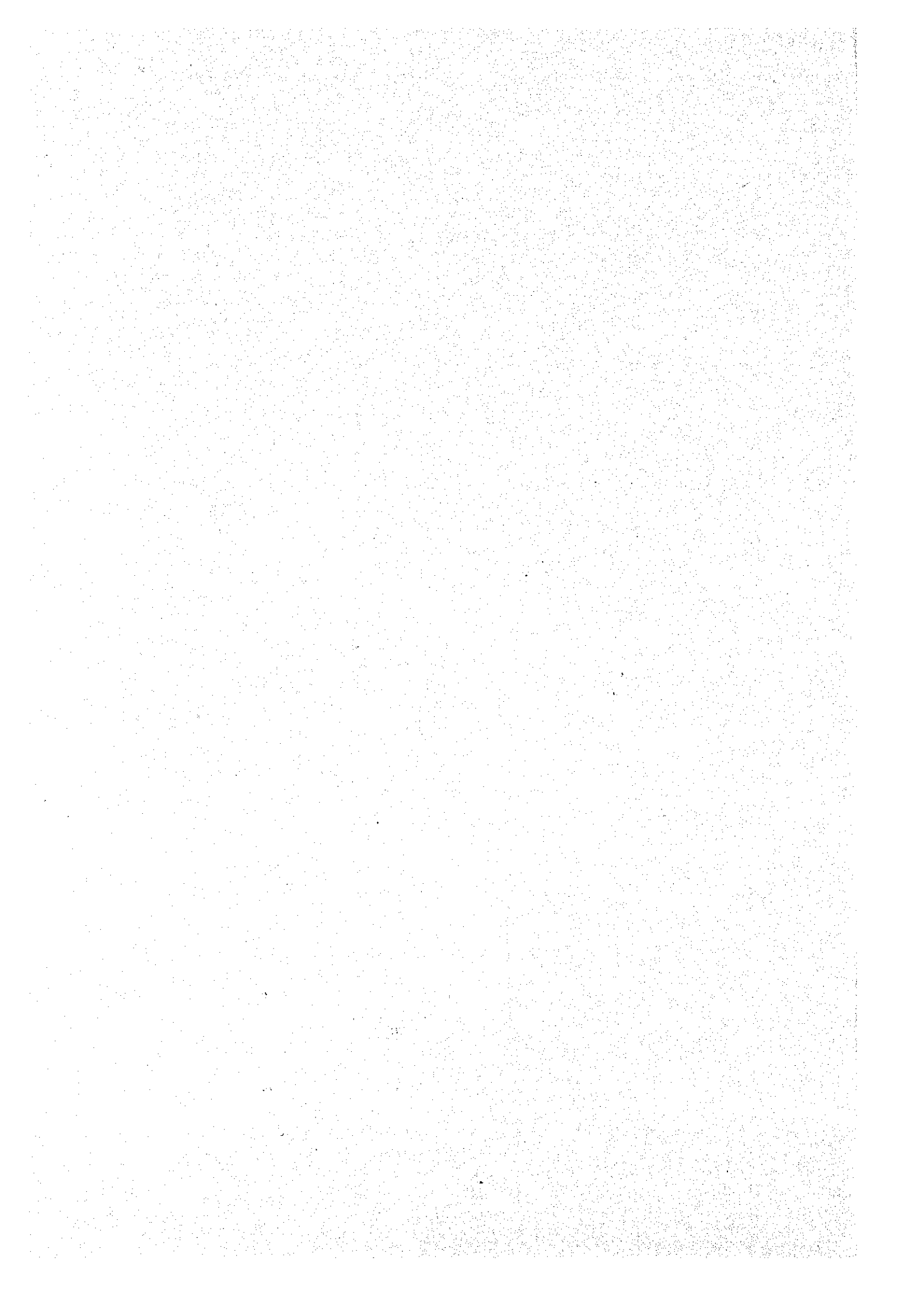
1.4 Method of Study

The overview of the study is shown into Figure 1.1.



Figure 1.1 Overview of the Study (After-care) on the Energy Conservation Project in the Kingdom of Thailand





1.5 Progress in Implementation of the Field Study

1.5.1 Study on energy situation, energy conservation promotion situation and database concept design

A study was made with regard to the energy situation, the energy policy of the Government and the current implementation status for energy conservation promotion measures in the Kingdom of Thailand. This was conducted on the basis of interviews with energy-related organs, factories and buildings, data collection and inspections. Before starting the study, the details of the study were explained to the counterpart by the use of a prepared inception report. Moreover, appropriate arrangement by the counterpart and cooperation offered by energy-related organs, factories and buildings allowed a smooth study, thus leading to the successful achievement of the expected results. On the basis of the results of the field study, recommendations were prepared on such measures as would be applicable to the current situation in the Kingdom of Thailand.

1.5.2 Technology transfer by workshop method

Concrete methods related to the technology for energy conservation promotion were transferred to the counterpart through workshop system by the effective use of the equipment and instruments carried by the study team.

1.5.3 Guidance to factory study and drafting of improvement plans for rational use of energy

- (1) Prior to the implementation of the factory study, instruction in the study method was provided to the counterpart according to the checklist prepared in advance.

On the basis of this, the counterpart explained the method of the study to the persons in charge of the factories to be studied, and at the same time asked them to prepare the reference data and to work the position to install the measuring instruments.

- (2) The outlines of the factories and the energy management situation were studied through interviews based on the check list, data collection, book examination and visual inspections to have a correct understanding of the current situation, problems and the future plan.

Studies on energy consuming equipment and problems in the energy use were conducted through measurement by the factory audit equipment brought from Japan, survey of drawings and diagrams, inspection of past data, and observation of actual operation, to identify and understand the actual situation and problems in the operation method and the performance of the equipment.

These factory studies were implemented led by the counterpart, while the transfer of the technology for energy use audit was the main concern of the Japanese team.

- (3) At the end of the factory study, the counterpart and the Japanese side reported the results of the measurement and the comments on factory observation to the factory management to exchange opinions.
- (4) After the end of the factory study, the Japanese side instructed the counterpart to sort out and analyze the data for the study and to draft improvement plans.
- (5) Regarding problems in the energy management and the improvement measures, the study was focused on the overall energy conservation promotion system including energy management organization, target setup, the record and utilization of actual energy consumption data and employee education, in the light of the particular local circumstances and the measures successfully adopted by the same kinds of Japanese factories. Thus, recommendations were made on improvement measures which would possibly be applicable to the factory.

Regarding the problems involved in energy use and their countermeasures, minor modification of existing equipment without changing the current process or more efficient energy conservation measures by additional installation of equipment were evaluated in terms of economy, and thus appropriate improvement measures for the factory were proposed.

1.5.4 Counterpart

In the factory study, referring to the text and note used at workshop, the counterpart operated the audit equipment to collect the measured data.

Further, its members had a high morale, and were very cooperative in the work.

1.5.5 Equipment for audit

All of the audit equipment operated normally, and the study was successfully carried out without any trouble.

1.5.6 Preparation of reference data for the technical guideline

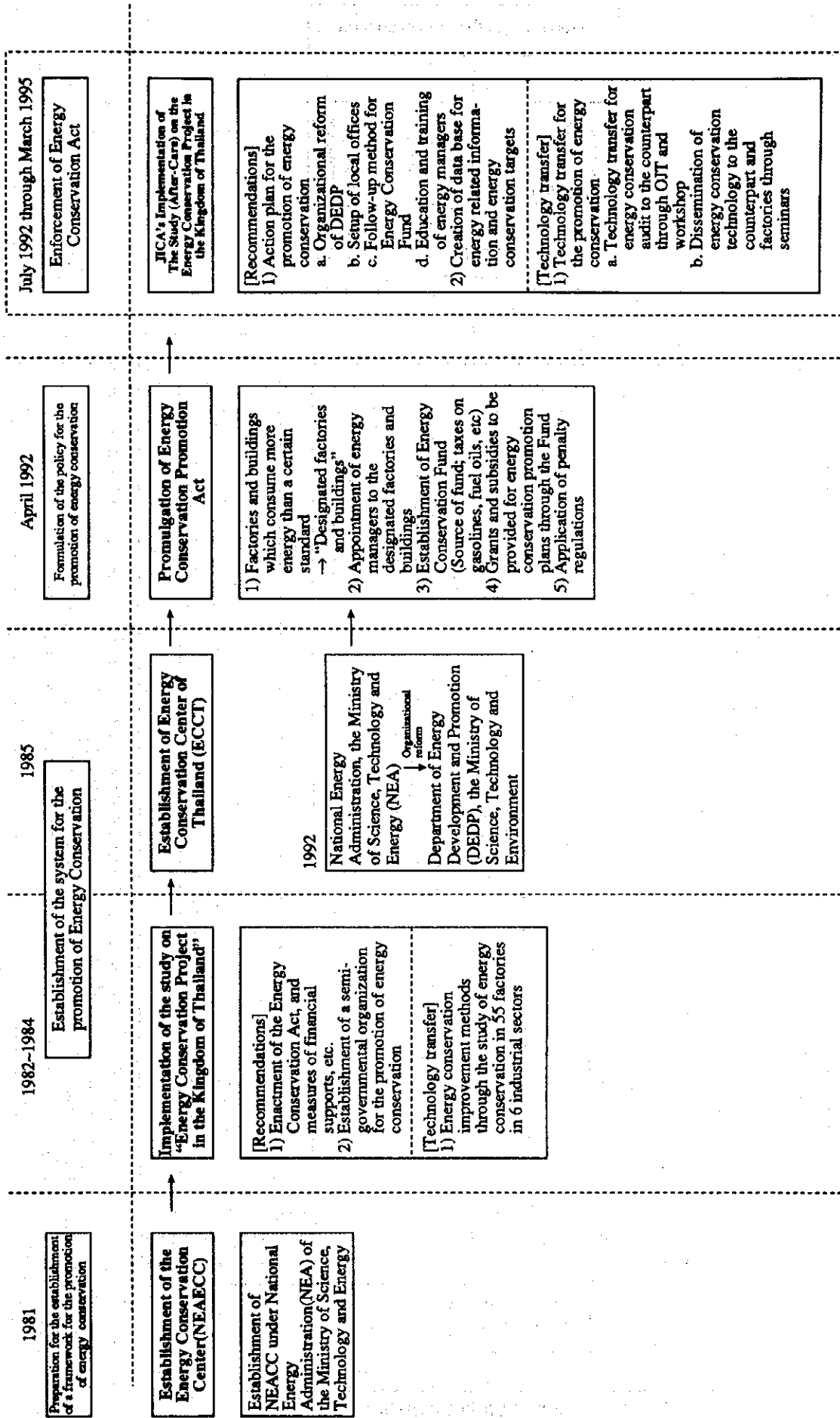
Major points to be noted on energy management and energy use for each sector of industry to be studied were picked up on the basis of the results of the factory study.

The main energy conservation technology and the actual implementation examples were presented to prepare the reference data on the basis of which the counterpart could prepare its own technical guideline for energy conservation.

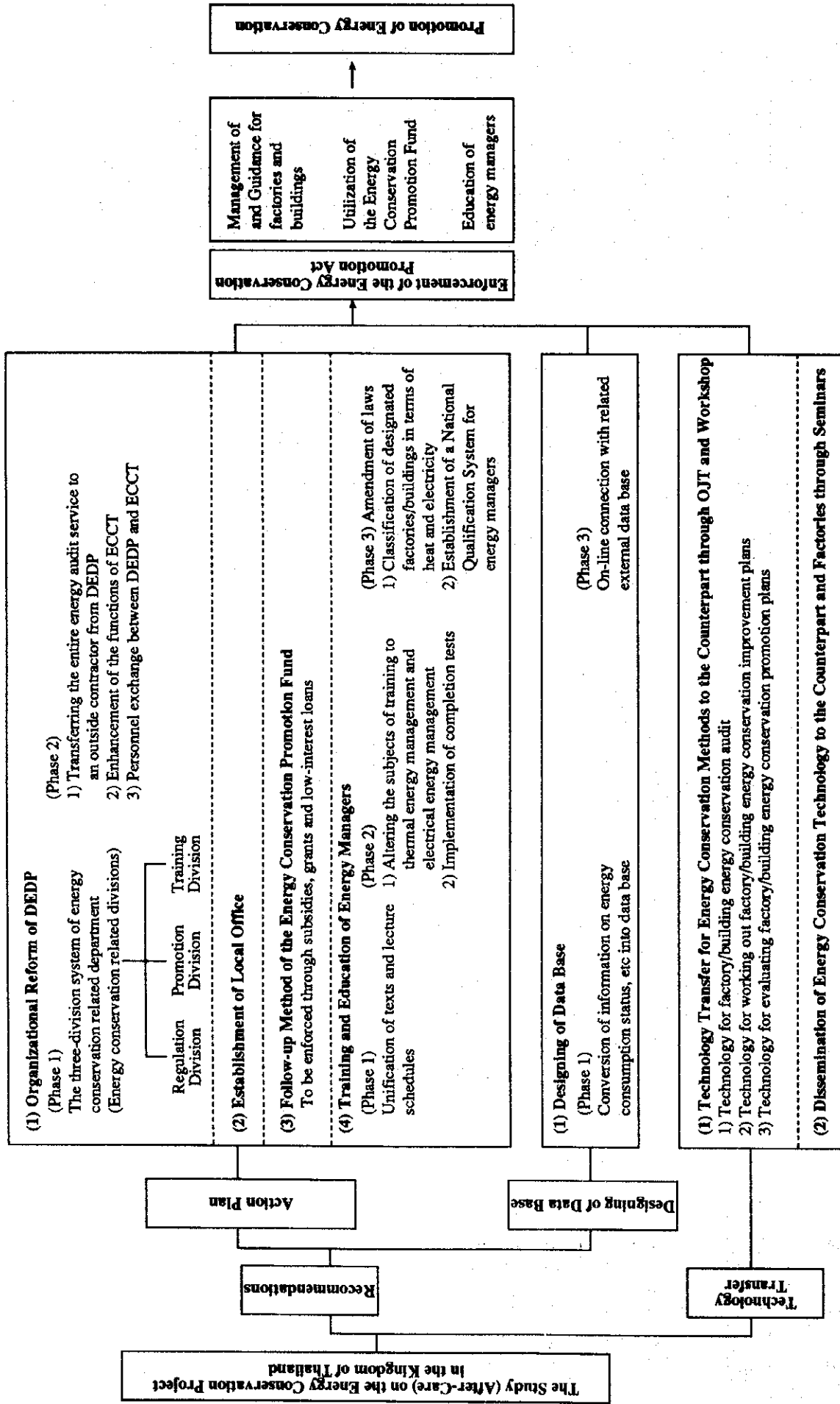
1.6 Composition of the Study Team, and the Counterpart, Schedule of the Field Study and List of Measuring Instruments

See Appended Data (1) through (4).

Overview of the study



The Concept of the Study



2. THE BACKGROUND FOR ENERGY CONSERVATION IN THAILAND



2. THE BACKGROUND FOR ENERGY CONSERVATION IN THAILAND

2.1 Economy and Industries in the Kingdom of Thailand

(1) Recent Economy of Thailand

The economy of Thailand has maintained "vigorous two-digit growth" in general since 1987, which is the higher figure in the West Pacific area enjoying the highest growth in the world. The national income level is positively increasing with such growth of economy. The national income per capita was US\$500, which was less than 1/3 of the level in NICs, and Thailand had a strong coloring of an agricultural nation in 1978.

About ten years later, however, Thailand emerged as an industrial nation and the national income per capita reached the level of US\$1,600, which was far higher than levels of Indonesia and Philippines and was comparable to that of Malaysia among ASEAN nations, in 1991.

The national income in Thailand slipped out of the level of many developing nations and approached the levels of South Korea and Taiwan, which are called NIES nations.

It is necessary to solve the following subjects, which are bottlenecks involved in vigorous economic growth.

- 1) Shortage of infrastructure (roads –in Bangkok in particular–, electric power, etc.)
- 2) Shortage of man-power, engineers of middle standing in particular
- 3) Elimination of differences between areas
- 4) Upbringing of supporting industries (industries which supply production machinery and parts to export-oriented industries)

In the 7th NESDP (1992 to 1996), the following goals were set with due regard to correction of the strains arising from the rapid economic growth and solution of environmental problems.

- 1) To upkeep suitable economic growth (to achieve 8% growth).
- 2) To distribute income and to disperse fruits of development to local areas.
- 3) To develop human resources.
- 4) To secure quality of life and environmental conservation.

(2) **Economy of Thailand in the Future**

Thailand is expected to grow into an entity having a large sweep as a leader of the Indo-China regional economy with a population of 170 million, emerging from the conventional one-nation economy. How development was made in many nations in the past involved a strong trend of limping growth to leave agriculture behind because of speeding up of industrialization. In Thailand, however, the primary industries including agriculture and fisheries were successfully industrialized, and acquisition of foreign currency with industries such as cultured shrimps, broilers and canned pineapples led to formation of domestic markets, and industrialization supported by agriculture became fixed. Thus, Thailand is particularly featured with well-balanced growth occurring concurrently in both of agriculture and industrialization.

2.2 Energy Demand and Supply Situation and Its Forecast

(1) Primary energy supply

a. General situation

The primary energy supply in 1993 was 58.6 Mtoe (equivalent to one million ton in oil), increasing by 11.6% over that in 1992. Moreover, energy supply has expanded by approximately 2.4 times for ten years since 1984.

The energy self-sufficiency in 1993 was approximately 58%, with the remaining 42% energy resources imported from other countries. The exported energy is approx. 1%, consisting mainly of condensate.

Table 2.1 Trend of Energy Supply

	Unit:1000toe									
Sources	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Production	14,294	17,951	19,172	21,037	22,698	25,269	27,207	29,716	31,670	34,132
Import	10,600	9,401	9,543	11,368	12,123	15,792	18,810	19,361	22,279	25,893
Export	169	474	596	523	693	799	803	958	1,016	987
Total	24,780	26,899	28,433	31,706	34,592	40,010	45,122	48,361	52,535	58,616

Source:Thailand Energy Situation 1993

In 1984, the traditional energy resources such as charcoal, firewood, paddy husks and bagasse accounted for 60% or more of the total energy resources, while in 1993 the energy resource composition was petroleum (32%), lignite (13%) and traditional energy resources including charcoal, etc. (51%).

b. Electric power

With the rapid industrialization since the latter half of the 1980's, electric power demand in Thailand has registered a remarkable annual growth at a 10% level in recent years. The power demand in 1993 is 64,000 Gwh, an 11.2% increase over the previous year.

Table 2.2 Trend of Electric Power Supply

	Unit:GWh									
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Generation	21,024.6	23,074.4	24,716.8	28,652.2	32,464.4	37,406.4	44,175.0	50,185.9	57,098.4	63,404.8
Import	709.7	723.0	758.4	415.5	429.8	643.1	652.3	594.8	481.2	644.5
Export	22.0	20.1	17.2	18.0	19.9	23.1	30.7	39.9	41.1	48.6
Total	21,712.3	23,777.3	25,458.0	29,049.7	32,874.3	38,026.4	44,796.6	50,740.8	57,538.5	64,000.7

Source:Electric Power in Thailand 1993

Note:excluding private self-generation including electric purchase

from small power producers since 1991

In 1993, energy resources for electric power generation include natural gas (44%), lignite (21%), petroleum (28%) and hydro power (5%), which shows an increasing use of natural gas.

2.3 Current Situation of Final Energy Consumption in Industries, and Future Plans

(a) Final energy consumption rate by sectors

The final energy consumption in 1993 is $39,328 \times 10^3$ toe, an increase by 2.2 times that in 1984. The industrial sector accounts for 30.3% of energy consumption. In recent years, energy demand is remarkably increasing in the transportation sector.

Table 2.3 Trend of Energy Consumption by Economic Sectors

	Unit:1000toe									
Sources	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Industry										
Mining	86	74	53	49	49	56	58	53	42	42
Manufacturing	4,929	5,219	5,249	5,599	6,062	7,712	8,541	9,288	10,238	11,687
Construction	100	125	123	111	99	109	147	194	220	182
Sub Total	5,115	5,418	5,425	5,759	6,210	7,877	8,746	9,535	10,500	11,911
Aguriculture	1,292	1,355	1,405	1,441	1,523	1,639	1,803	1,827	1,897	1,618
Res. & Com.	5,097	5,756	6,376	6,932	7,496	8,114	8,725	9,135	10,055	11,218
transportation	5,916	6,025	6,492	7,428	8,520	10,169	11,368	11,910	12,652	14,581
Total	17,420	18,554	19,698	21,560	23,749	27,799	30,642	32,407	35,104	39,328
Industry %	29.4	29.2	27.5	26.7	26.1	28.3	28.5	29.4	29.9	30.3

Source:Thailand Energy Situation 1993

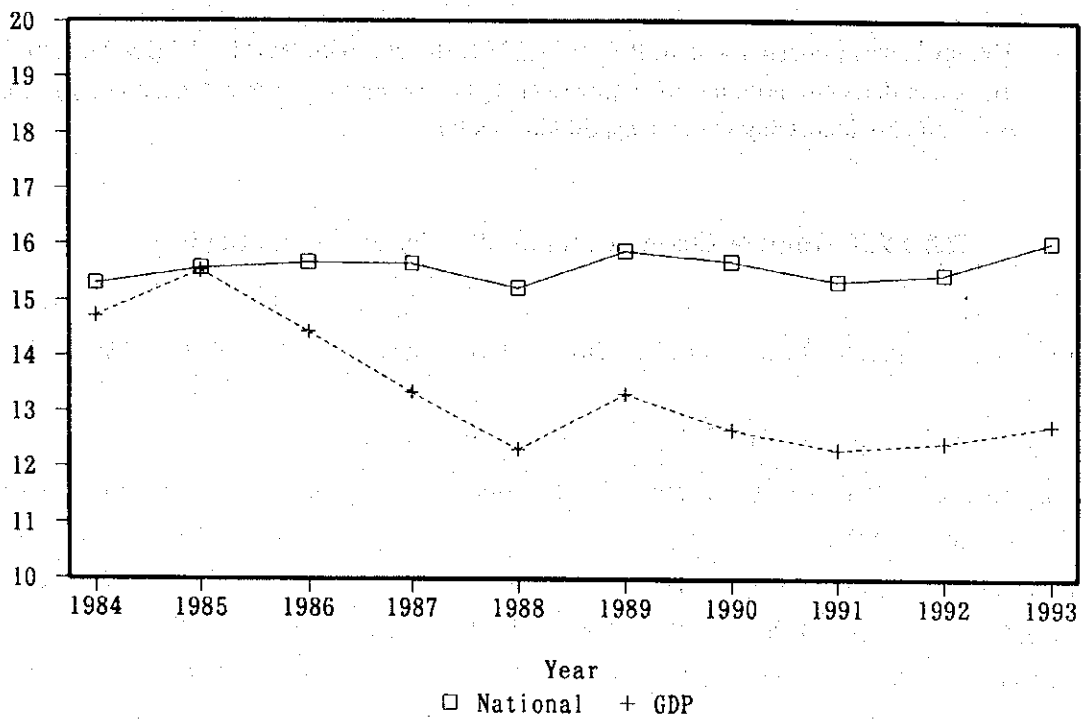
(b) Energy consumption rate

Figure 2:1 shows energy consumption rate of each sector per its GDP.

Thai entire domestic energy consumption versus GNP remains on the same level (shows no marked fluctuations), whereas the energy consumption of the industrial sector versus GNP in 1993 is 12.8 kgoc/1,000 Baht, which is 0.87 times as much as that in 1984. Thus, energy conservation in the industrial sector may well be said to have progressed for these 10 years.

Figure 2.1 Trend of Final Energy Consumption of the Sectors per GDP

Unit : kgoe/1000Baht



2.4 Number of Factories Classified by Types of Product and Their Outputs

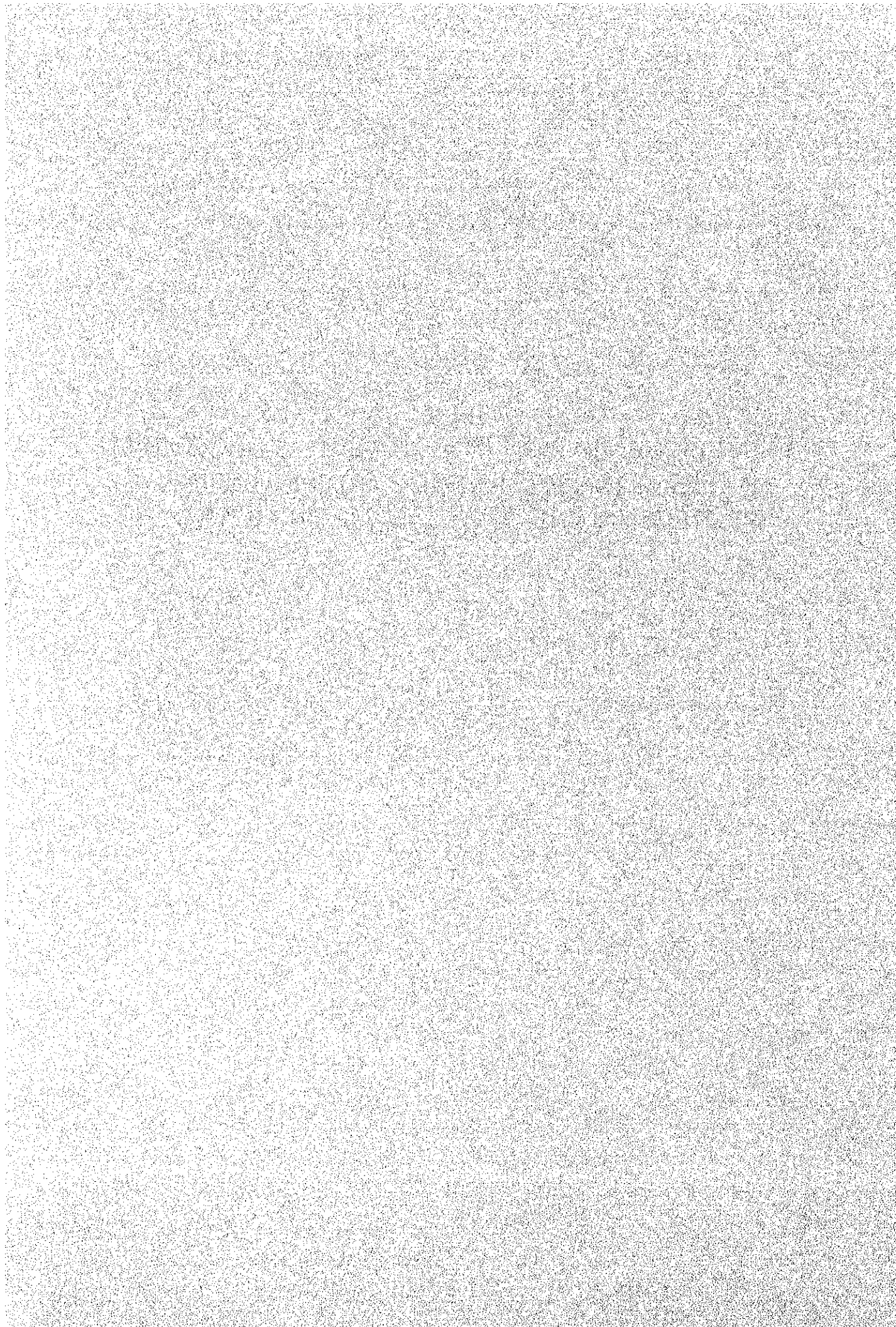
(1) Number of factories classified by types of product

Table 2.4 Number of Factories Classified by Types of Product In Thailand (1993)

	Bangkok	Outside Bangkok
Beverage	60	181
Food	944	52,952
Textiles	448	805
Clothing	2,087	258
Leather	13	172
Wood & Furniture	1,367	3,347
Paper	7	215
Printing	99	-
Chemical	27	110
Rubber	237	403
Resin	8	46
Metal	4,216	2,292
Equipment	279	176
Auto Mobiles	755	1,283
Others	11,722	20,009
Total	22,269	82,240

Source : Industrial Statistics Yearbook 1993

3. IMPLEMENTATION STATUS OF THE RECOMMEN- DATIONS IN THE “ENERGY CONSERVATION PROJECT IN THE KINGDOM OF THAILAND”



3. IMPLEMENTATION STATUS OF THE RECOMMENDATIONS IN THE "ENERGY CONSERVATION PROJECT IN THE KINGDOM OF THAILAND"

3.1 Study of the Energy Conservation Project in the Kingdom of Thailand

The Japan International Cooperation Agency (JICA) conducted a study on "Energy Conservation Project in the Kingdom of Thailand" with the National Energy Agency (NEA), the Ministry of Science, Technology and Energy in Thailand with its counterpart from 1982 to 1984.

The study and the recommendations covered the following.

- 1) Recommendation on the enactment of an energy conservation act and financial support measures, etc. to embody the policies for the promotion of energy conservation
- 2) Recommendation on the establishment of semigovernmental organizations for energy conservation promotion and on offering of specific technical supports to disseminate the energy conservation concept in the industrial field, etc.
- 3) The factory energy conservation study was conducted on 55 factories in 6 industrial subsectors as the model factories for energy conservation promotion in the industrial sector. As a result, energy conservation methods and guidelines were recommended, and the technology related to energy conservation improvement methods was transferred to the counterpart.

3.2 Implementation Status of Recommendations

- (1) The Energy Conservation Act was enforced in April 1992.
 - a. Outline of the Energy Conservation Act
 - 1) Factories and buildings consuming more energy than a certain standard should be designated and required to periodically submit their actual status of energy consumption as well as their energy conservation plans.
 - 2) Designated factories and buildings should appoint energy managers, and submit a report thereof.
(Those who violate the rules in the item 1 and 2 above may be punished.)
 - 3) The Energy Conservation Promotion Fund should be established to provide grants and subsidies to such plans for promoting energy conservation as described below:
 - ① Investment for and implementation of energy conservation plans
 - ② Research and development
 - ③ Demonstration project

- ④ Education, training and meeting
- ⑤ Advertisement, information supply and PR services
- ⑥ Management of energy conservation promotion services

Also manufacturers and sellers of high-efficiency machines and equipment, facilities and materials are financially supported through this fund.

(2) Establishment of the Energy Conservation Center of Thailand (ECCT)

In 1985 the Energy Conservation Center of Thailand was established under the leadership of the Federation of Thai Industries. At the time of its establishment, the fund of 40 million bahts was raised by the government and the private sector, to take the budgetary measure for rendering 8 million bahts per year for the limited period of 5 years from its establishment of ECCT.

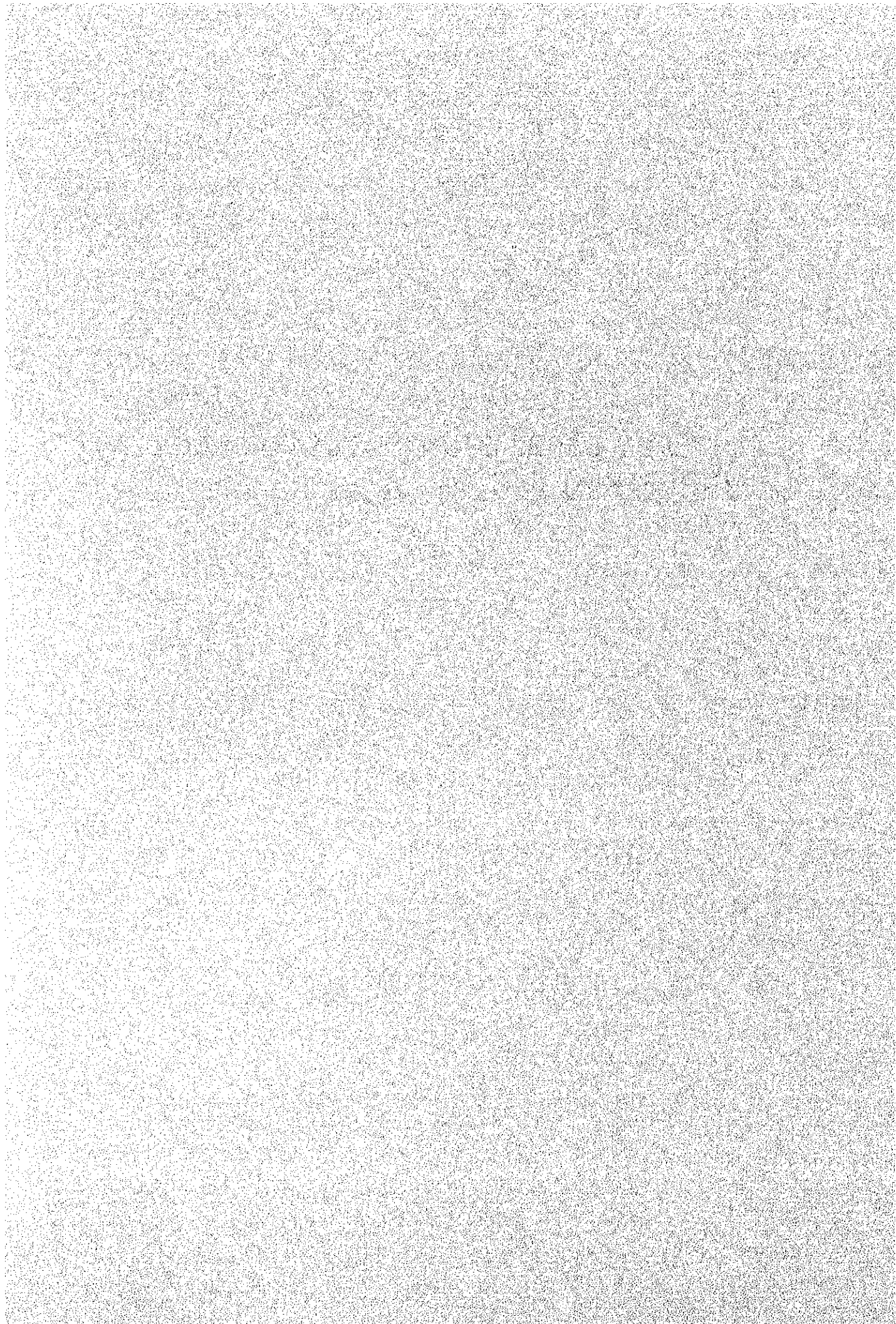
ECCT conducts energy audit and energy management/training services which are entrusted by the Department of Energy Development and Promotion, as well as energy audit requested by enterprises, consultant service, P.R. activities, opening of seminars, supply of information, etc. with regard to energy conservation. Thus, ECCT is highly evaluated in the industrial field as a core organ for implementing the promotion of energy conservation in Thailand.

(3) Others

In response to the recommendations, the following tasks as well as those mentioned above are conducted.

- a. Energy audit
- b. Training for energy management
- c. Opening of seminars for energy conservation
- d. Information services for energy conservation technology
- e. Dissemination of information on energy conservation and arousing of consciousness for energy conservation
- f. Development and research on the energy conservation technology
- g. Lowering of customs duties on the energy-conservation equipment
- h. Low-interest loan

4. ENERGY UTILIZATION STATUS FOR EACH INDUSTRIAL SECTOR



4. ENERGY UTILIZATION STATUS FOR EACH INDUSTRIAL SECTOR

4.1 Energy Consumption Status by Industrial Subsector

Table 4.1 shows the transition of the energy consumption by industrial subsector in the industrial sector.

Energy consumption in the overall industrial sector in 1993 was 2.3 times as large as that in 1984. Particularly, the growth of consumption in the Nonferrous Metals is outstanding.

Table 4.1 Trend of Energy Consumption in the Industrial Sector

Subsector	Unit:1000toe									
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Food & Beverages	2,536	2,730	2,710	2,675	2,704	3,542	3,483	3,673	3,782	3,954
Textiles	411	417	449	513	616	724	731	842	936	998
Wood & Furniture	37	52	63	71	87	87	81	85	103	129
Paper	120	177	168	216	244	305	305	390	360	490
Chemical	205	245	236	298	388	497	691	802	946	989
Non-Metalic	1,035	1,137	1,081	1,277	1,404	1,839	2,108	2,240	2,773	3,571
Basic Metal	182	179	191	199	224	278	329	381	510	555
Fabricated Metal	63	62	68	113	123	163	222	293	259	303
Others	340	220	283	237	272	277	591	582	569	698
Total	4,929	5,219	5,249	5,599	6,062	7,712	8,541	9,288	10,238	11,687

Source:Thailand Energy Situation 1993

Figure 4.1 shows energy consumption by industrial subsector in 1993. The great consumers include Food and Beverages and Nonferrous Metals. These two industrial subsectors consume approximately 64% of the energy in the overall manufacturing sector.

Figure 4.1 Energy Consumption in the Industrial Sector in 1993

