JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

GENERAL DIRECTORATE OF ELECTRICAL POWER
RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION,
EIE
MINISTRY OF ENERGY AND NATURAL RESOURCES,
THE REPUBLIC OF TURKEY

THE STUDY ON THE RATIONAL USE OF ENERGY IN THE REPUBLIC OF TURKEY

FINAL REPORT (MAIN REPORT)

JANUARY 1997

TECHNO CONSULTANTS, INC.
MITSUBISHI CHEMICAL ENGINEERING CORPORATION

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PREFACE

In response to the request from the Government of the Republic of Turkey, the Government of Japan decided to conduct the Study on the Rational Use of Energy in the Republic of Turkey.

JICA sent a study team, led by Koji TANAKA of Techno Consultants, Inc. (Techno) and organized by Techno and Mitsubishi Chemical Engineering Corporation to the Republic of Turkey five times from November 1995 to December 1996.

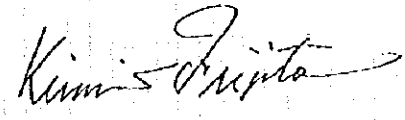
The team held discussions with the officials concerned of the Government of the Republic of Turkey, and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

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

I with to express my sincere appreciation to the officials concerned of the Government of the Republic of Turkey for their close cooperation throughout the study.

January 1997

Kimio Fujita
President
Japan International Cooperation Agency



January, 1997

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

Dear Mr. Fujita

Letter of Transmittal

We respectfully submit the final report for "THE STUDY ON THE RATIONAL USE OF ENERGY IN THE REPUBLIC OF TURKEY."

This study consists of two aspects: policy study and technical study. The policy study analyzed the policy of the Government of the Republic of Turkey with respect to rationalization of energy use and presented recommendations deemed effective in promotion of energy use rationalization in the field of medium- and small-scale manufacturing industries. The technical study conducted energy audits on four factories located in Izmir -- detergent and edible oil factory, brick factory, electric furnace steel mill, and cotton cloth printing factory --, and formulated recommendations on several measures to improve energy efficiency.

As a result of the study, the study team submitted to the GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION, EIE, THE MINISTRY OF ENERGY AND NATURAL RESOURCES of the Republic of Turkey a series of policy measured to promote energy use rationalization. The study team also conducted detailed energy audits on the four factories and presented effective measures to improve energy efficiency. The study team also endeavored to transfer technology to the counterparts on the job and through seminars held in Ankara and Izmir. The study team believes that the study has contributed to laying the cornerstone for promotion of energy use rationalization. The study team sincerely hope that this report will make further contributions to rationalization of energy use in the future.

We express sincere appreciation to your agency, the Ministry of Foreign Affairs, the Ministry of International Trade and Industry, the Embassy of Japan to Turkey. We also express our deepest gratitude to EIE, concerned authorities of the Republic of Turkey, and the managements and staffs of the four factories in Izmir for their devoted support and cooperation.

We add that this report reflects the outcomes of the draft final report presentation held in December last year.

Yours respectfully,

K. Tanaka

Koji Tanaka
Team Leader for the Study on Rational Use of Energy in Industry in the Republic of Turkey

Contents

List of Table & Figure

List of Abbreviations

A	Ampere
AQP Regulation	Air Quality Protection Regulation
Atm	Atmosphere, a unit of pressure
BFW	Boiler Feed Water
BOTAS	Turkish Pipeline Company
CHP	Combined Heater Power System
DGO	Diesel Gas Oil
EAF	Electric Arc Furnace
ECCB	Energy Conservation Coordination Board
EIE	General Directorate of Electrical Power Resources Survey and Development Administration
EU	European Union
FDF	Forced Draft Fan
GDP	Gross Domestic Products
GWh	Giga Watt hour
Gcal	Giga calories
HHV	High Heating Value
IBF	Izmir Basma Fabrikasi
IDC	Izmir Demir Celik Sanyai
IDF	Induced Draft Fan
IEA	International Energy Agency
IRR	Internal Rate of Return
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
KOSGEB	Small and Medium Industry Development Organization
KUSGET	Small Industry Development Organization
LHV	Low Heating Value
LIC	Level Indicating Controller
MENR	Ministry of Energy and Natural Resources
MITI	Ministry of International Trade and Industry of Japan
MMKcal	Million kilocalories
MTA	Mineral Exploration and Research Directorate
MWh	Thousand kilocalories

MkWh	Thousand kiloWatt hour
NECC	National Energy Conservation Center
NKK	Nippon Kokan Corporation
OECD	Organisation for Economic Co-operation and Development
PIGM	General Directorate of Petroleum Affairs
RH	Relative Humidity
RPCB	Research, Planning and Coordination Board
SEGEM	Industrial Training and Development Center
SPH	Scrap Pre-heater
SPO	State Planning Office
SUS	Stainless Steel
TEAS	Turkish Electricity Generation and Transmission Company
TEDAS	Turkish Electricity Distribution Company
TFC	Total Final Consumption of Energy
TKI	Turkish Coal Enterprise
TOE	Ton Oil Equivalent
TPAO	Turkish Petroleum Corporation
TPER	Total Primary Energy Resource
TPES	Total Primary Energy Supply
TSI	Turkish Standards Institute
TTK	Turkish Hardcoal Enterprise
TUBITAK	Scientific and Technical Research Council of Turkey
TWh	Trillion Watt hour
V	Volt
Wh	Watt hour
atm	Atmosphere, a unit of pressure
c.p.	Centipoise, a unit of viscosity
kVA	kiloVolt-Ampare
kW	kiloWatts
kgOE	kilogram Oil Equivalent
kl	kiloliter
mmHg	Head of mercury in millimeter
ppb	parts per billion
ppm	parts per million
vol%	volume percentage
wt%	weight percentage

Chapter 1 Introduction

Chapter 1 Introduction

This is the main report version of the Final Report for the Study on the Rational Use of Energy in the Republic of Turkey. Consigned by the Japan International Cooperation Agency (JICA), a consortium of TECHNO CONSULTANTS, INC. and MITSUBISHI CHEMICAL ENGINEERING CORPORATION, an international consulting company and an international engineering company both based in Japan, has executed this study for the General Directorate of Electrical Power Resources Survey and Development Administration (EIE) of the government of the Republic of Turkey and has prepared this report. Along with this main report, the consortium also presents a summary version of the Final Report. In addition, the consortium presents five copies of four different factory versions of the main report, each binding selected chapters of the main report relevant to each of the factories mentioned below.

The consortium started the study in November 1995 and has executed it basically according to the Scope of Work agreed upon between EIE and JICA on June 30, 1995, including a major addition to the Scope of Work while the study was in progress, measurement of the operating conditions of the electric arc furnace of Izmir Demir Celik Sanayi A.S. for the purpose of developing its energy balance.

The study aims at presenting legal and administrative reforms that would permit the government to promote effective use of energy in manufacturing industries on a nation-wide scale, medium- and small-scale manufacturing industries in particular, and diagnosing selected manufacturing factories and presenting recommendations for improving their energy use, as indicated in the Scope of the Study attached. Accordingly, the study may be broken down into two aspects: policy study and technical study; the former analyzes the administrative operation and legal structure of Turkey and presents recommendations deemed effective in promoting rational use of energy in industry, and the latter presents an energy audit of the four selected factories and makes recommendations for achieving better use of energy. The four factories audited are Henkel Turyag A.S., Dev Blok A.S., Izmir Demir Celik Sanayi A.S. (IDC), and Izmir Basma Fabrikasi A.S. (IBF), manufacturers of detergent and edible oil, bricks, steel and printed cotton cloths, respectively, all located in the Izmir area.

The consortium achieved the above objectives as explained in this report. The study took 15 months, from November 1995 to January 1997, during which period four field surveys and one draft final report presentation were done in Turkey. Two seminars, one in Ankara and the other

in Izmir, were done during the period of the draft final report presentation. The field surveys and the presentation of the Draft Final Report and seminars were done during the period shown below.

The first field survey:	November to December 1995
The second field survey:	February 1996
The third field survey:	July 1996
The fourth field survey:	July to September 1996
Draft final report presentation and seminars:	December 1996

Throughout the entire course of this study, the study team timely presented EIE the following reports:

Report	Submission	Content of Report
Inception Report	November 1995	Plan for the study execution
Progress Report-1	December 1995	Results of the first field survey
Interim Report	February 1996	Interim results
Measurement and Modification Plans for Energy Audit	April 1996	Plan for factory energy audit
Progress Report-2	September 1996	Results of the second field survey
Draft Final Report	December 1996	Explanation of the Final Report
Final Report (Main Report and Summary Report)	January 1997	Results of the entire study

The results of the study indicate that there is room for improvement both in the policy and factory operation as enumerated in subsequent chapters. The summary version and the factory versions also explain problems and give recommendations for improvements. The four factory versions are prepared to protect confidential information particular to individual factories. Each factory version does not contain information relevant to the other factories. The contents and distribution of the full main report and the factory versions are as follows.

Chapter	Main report to EIE	Henkel-Turyag	Dev Blok	IBF	IDC
	Preface				
1	Introduction	X	X	X	X
2	Background of the Study	X	X	X	X
3	Purpose of the Study	X	X	X	X
4	Achievements of the Study				
5	Summary of the Result of the Study				
6	Energy Situations				
7	Energy Conservation Policy and Activities				
8	Factory Audit	X	X	X	X
9	Technical Study for Henkel-Turyag	X			
10	Technical Study for Dev Blok		X		
11	Technical Study for IBF			X	
12	Technical Study for IDC				X
13	Overall Conclusions and Recommendation				
14	Socio-economic Evaluation of the Recommendations				

The experts engaged in this study are shown below.

	Name	Belonging	Assignment
1	Koji Tanaka	TECHNO CONSULTANTS, INC.	Team Leader
2	Akinori Hashimoto	TECHNO CONSULTANTS, INC.	Energy Policy
3	Shun-ichi Iizuka	MITSUBISHI CHEMICAL ENGINEERING CORPORATION	Medium- and Small-scale Manufacturing Industries
4	Kazumitsu Mitani	MITSUBISHI CHEMICAL ENGINEERING CORPORATION	Process A (Detergent)
5	Yukio Nishimura	TECHNO CONSULTANTS, INC.	Process B (Brick)
6	Ryo Endo	TECHNO CONSULTANTS, INC.	Process C (Textile)
7	Isamu Kawakami	NKK Corporation	Process D (Iron and Steel)

8	Hironobu Yamada	MITSUBISHI CHEMICAL ENGINEERING CORPORATION	Process E (Vegetable Oil)
9	Muneteru Yoshizawa	TECHNO CONSULTANTS, INC.	Energy Management A (Heat)
10	Hirotaka Tokano	MITSUBISHI CHEMICAL ENGINEERING CORPORATION	Energy Management B (Heat)
11	Masao Kominami	MITSUBISHI CHEMICAL ENGINEERING CORPORATION	Energy Management C (Electricity)
12	Hisaichi Inoue	NIPPON OIL ENGINEERING AND CONSTRUCTION CO., LTD.	Energy Management D (Electricity)
13	Tetsuya Nimura	MITSUBISHI CHEMICAL ENGINEERING CORPORATION	Measuring Equipment
14	Tokuyosi Kawai	KOKAN KEISOKU K.K.	Measuring Equipment A (Iron and Steel)
15	Shinya Kinoshita	KOKAN KEISOKU K.K.	Measuring Equipment B (Iron and Steel)
16	Hironobu Honda	KOKAN KEISOKU K.K.	Measuring Equipment C (Iron and Steel)
17	Hirofumi Takahasi	CHUGAI TECHNOS CO., Ltd.	Measurement

Chapter 2 Background of the Study

Chapter 2 Background of the Study

The government of Turkey, being heavily dependent on import for the supply of energy, has been keenly promoting energy saving since the energy crises. EIE has been playing the central roles in this effort. In December 1992, the Energy Resources Supply Department under EIE was appointed to the National Energy Conservation Center (NECC).

The following table, which was provided to the Preparatory Study Team of JICA in 1995, shows the consumption of various types of energy and their projections. The forecast consumption has been revised since then but here the then official table is shown. This table shows that consumption of commercial energy increased very rapidly. During the three year period from 1992 to 1995 the consumption of the total commercial energy and petroleum increased at a rate of 6.29 and 4.58 percent per year, respectively.

Types of Energy	1992	1995	2000	2005	2010
Coal, thousand tons	8,841	9,498	9,272	19,708	46,824
Lignite, thousand tons	50,659	63,259	112,849	144,823	181,664
Natural asphalt, thousand tons	197	750	750	750	750
Petroleum, thousand tons	23,729	27,142	30,061	34,196	39,599
Natural gas, 10^6 cubic meters	4,612	8,501	19,988	25,879	30,594
Hydro electric power, GWh	26,568	35,841	41,633	63,852	76,365
Geothermal electric power, GWh	70	90	90	90	90
Geothermal energy, thousand tons of oil equivalent	30	285	1,540	3,570	6,500
Solar energy, thousand tons of oil equivalent	32	116	335	628	1,075
Nuclear power, GWh				7,017	14,035
Imported electricity, GWh	-125				
Total, Commercial energy, thousand tons of oil equivalent	49,161	59,041	81,948	108,395	147,180
Firewood, thousand tons	18,070	18,374	19,487	19,627	19,767
Other biomass, thousand tons (unit not shown)	10,922	10,682	9,839	9,045	8,260
Total, Non-commercial energy, thousand tons of oil equivalent	7,933	7,969	8,109	7,968	7,830
Total, thousand tons oil equivalent	57,094	67,010	90,057	116,363	155,010

This table vividly explains energy policy of the republic. The government wished to increase the consumption of lignite, a resource domestically available, and to hold down the consumption of petroleum, which is chiefly imported. By the year 2000, the consumption of lignite would have

exceeded that of petroleum in calorific value, according to this table. Natural gas consumption will catch up that of petroleum; it will become comparable with petroleum in the period from 2005 to 2010.

Understandably, the government of Turkey wishes to make the most of the domestic energy resources. The rate of increase of the commercial energy consumption between 1995 and 2000 is very high at 6.8 percent. With such high growth of energy consumption, it is quite natural that the government should be quite concerned about consumption of energy.

EIE has promoted conservation of energy in various sectors, of its own and also under the cooperation of international organizations. The activities of EIE were however oriented towards large-scale industries and limited mainly to energy audits. The legal structure necessary for the promotion of energy saving was not established.

Under such circumstances, the government of Turkey has requested the government of Japan to conduct a master plan study on rational use of energy in the industrial sector. In response to the request, the government of Japan sent to Turkey two missions of JICA, once in March 1995 and again in June in 1995. On June 30, 1995, the government of Turkey and JICA agreed and signed the SCOPE OF WORK FOR THE STUDY and the MINUTES OF MEETING ON SCOPE OF WORK FOR THE STUDY; the former stipulates the scope of work, schedule and the undertakings by the government of Turkey, the latter contains appendage to the SCOPE OF WORK, list of participants in the meeting and filled-in questionnaire.

JICA has selected a consortium of TECHNO CONSULTANTS, INC. and MITSUBISHI PETROCHEMICAL ENGINEERING CO., LTD. and entered into contract with the consortium for the execution of the study. The consortium has formed a study team consisting of the members shown in Chapter 1. The consortium executed the study basically according to the agreement between the government of Turkey and JICA.

EIE has selected the four factories mentioned in Chapter 1 to be examined by the study team. A steering committee consisting of the representatives of EIE, the Ministry of Energy and Natural Resource, the State Planning Committee, the Ministry of Industry, the State Statistical Institute and the Turkish Standard Institute was formed to support this study.

Chapter 3 Purpose of the Study

Chapter 3 Purpose of the Study

The SCOPE OF WORK agreed on June 30, 1995, between the government of Turkey and the Preparatory Study Team of JICA defines the objectives of the study as follows.

Quote.

II. OBJECTIVE OF THE STUDY

The objective of the Study is to contribute to the promotion and strengthening of the rational use of energy in the fields of industries in the Republic of Turkey (hereinafter referred to as "Turkey") by studying the technical and managerial applicability of the rational use of energy and formulating the report for the promotion of the rational use of energy in the industrial sectors stated below:

1. Brick
2. Textile
3. Metallurgy (Steel rolling mill, Arc furnaces)
4. Food (Vegetable oils)
5. Cleaning material

Unquote.

This statement certainly sums up the objectives of the study. This objective however can only be achieved successfully by achieving step by step the objectives of the all work ingredients constituting the entire work.

Important work units and their objectives are shown below in a chronological order.

1. Prepare the Inception Report in an intelligible manner and present it to EIE during the preparation period.
2. Discuss the Inception Report fully with EIE and establish a thorough understanding between EIE and the study team.
3. Form a framework in which EIE, the subject factories and the study team work together in an cooperative way.
4. Collect sufficient information and data during the first field survey to be able to proceed to the first home-office work and prepare the Interim Report.
5. Collect information necessary to justify modification of the SCOPE Of WORK. In the case of this study, addition of measurement of the electric furnace of IDC was found

necessary.

6. Present the Progress Report-1 to record the findings, understanding between the concerned parties. Sign Minutes of Meeting to confirm mutual understanding of EIE and the study team.
7. Prepare the Interim Report in an intelligible manner during the first home-office work period.
8. Present the Interim Report during the second field survey and discuss the subsequent course of the study, methods of energy audit and study on the policy matters in particular.
9. Prepare "Measurement and Modification Plans for Energy Audit" and send it to EIE so that the factories to be audited may have enough time to prepare for the energy audit.
10. Execute the third home-office work and prepare the method for measurements for the added work of measurement on the electric arc furnace.
11. Present the measurement plan of the electric arc furnace to EIE and IDC and discuss it in detail with them so that the study team may be able to prepare a more detailed plan.
12. Prepare a detailed measurement plan during the fourth field survey for the electric arc furnace and send it to EIE and IDC.
13. Procure and lease necessary equipment and send them by air to Turkey in time for the measurement.
14. Execute the fourth field survey. Conduct audit on the four selected factories. Collect information on the policy matter. Prepare the Progress Report-2 to record the findings, to present the result of preliminary analysis done during the survey period, propose the structure and content of the Final Report. Prepare for the conferences in Ankara and Izmir. Sign Minutes of Meeting to confirm the mutual understanding of EIE and the study team.
15. Prepare the Draft Final Report during the fifth home-office work which satisfies the SCOPE OF WORK. Submit the Draft Final Report to EIE. Make preparation for the Draft Final Report presentation and conferences.
16. Present the Draft Final Report to EIE and the Steering Committee. Discuss it with EIE, the Steering Committee and the factories. Hold conferences in Ankara and Seminar. Sign Minutes of Meeting to confirm the mutual understanding of EIE and the study team.
17. Prepare the Final Report incorporating the comments by EIE and submit the report to JICA.

The study team fulfilled these objectives to arrive at the ultimate objective of the study.

Chapter 4 Achievements of the Study

Chapter 4 Achievements of the Study

The major achievements of this study may be summarized as follows.

1. The study clarified and analyzed the energy situation of Turkey.
2. The study reviewed the policy, administrative organizations of the government of Turkey concerned with the medium- and small-scale manufacturing industries and made appropriate recommendations.
3. The study conducted energy audits on the four selected factories in Izmir.
4. The study identified the problems with respect to consumption of energy of the four factories and presented recommendations for modifications of operation and facilities to correct these problems, but limited to not changing their main processes.
5. The study estimated the costs required for recommended modifications and the savings of energy realizable by the proposed modifications and estimated their economics.
6. The study evaluates effects of these recommended modifications.
7. The study determined energy balances of the four factories.
8. The study developed energy flowcharts of the four factories.
9. The study prepared technical guidelines for the four factories.
10. The study team conducted two conferences on the results of the study, one in Ankara and the other in Izmir.
11. The study team presented to EIE the Inception Report at the very beginning of the first field survey and established a thorough understanding between EIE and the study team.
12. The study team presented to EIE the Progress Report-1 and Progress Report-2 at the closing stages of the first and fourth field surveys, respectively, to explain the activities of the study team and those of and the counterparts, achievements, results of the fields surveys and understandings established between EIE and the study team.
13. The study team presented to EIE the Interim Report at the beginning of the second field survey to explain the interim results achieved at that time.
14. The study team presented to EIE "Measurement and Modification Plans for Energy Audit" in April 1996 to explain the methods of audits.
15. EIE, IDC and the study team discussed method for measurement of the electric furnace of IDC in June 1996.
16. The study team presented to EIE the Draft Final Report in December 1996. EIE and the study team discussed the Draft Final Report and basically agreed in the content of the Final Report.

17. EIE and the study team held a conference in Ankara and another in Izmir. These conferences helped the substance of the study and importance of energy saving to be understood by the concerned government offices, concerned industries, academic societies and general populace.
18. EIE and the study team prepared and signed minutes on completion of the first, second, fourth field surveys, and presentation of the Draft Final Report and two conferences to confirm the agreements between EIE and the study team.
19. EIE, the factories audited and the study team established rapport among themselves and realized smooth execution of the surveys.

Chapter 5 Summary of the Results of the Study

Chapter 5 Summary of the Results of the Study

The study achieved its objectives Chapters 3 and 4 explain. Major results of the study are briefed as follows.

5-1 Energy Situations

5-1-1 Demand and Supply

The government of Turkey developed a Long-range energy supply forecast. The forecast supply depends very much upon lignite, understandably from the viewpoint of utilization of domestic resources. Presently, various kinds of energy are made available to the consumers as needed, although there are short time occasional power failures because of the inability of the supply system to the demand surges. The consumer prices of energy are reasonable. The problem with lignite is that its resource is large but is poor in quality.

5-1-2 Recent Trends

There are evident trends towards using more natural gas imported either in the form of gas or LNG. Concrete steps are being made towards securing more supply of natural gas.

5-2 Energy Policy

5-2-1 Organizations Relating to Rationalization of Energy Use

The government has all the organizations necessary for the promotion of energy saving. The activities of EIE and the Ministry of Energy and Natural Resources needs to be intensified in order to be able to effectively implement energy saving policies.

5-2-2 Existing Laws and Policy

Turkey does not have a basic law for conservation of energy. Instead, the Ministry of Energy and Natural resources has issued a regulation whereby organizations consuming more than 2,000 TOE energy should report to the government their consumption.

5-3 Medium- and Small-scale Manufacturing Industries

5-3-1 Energy Consumption by Medium- and Small-scale Manufacturing Industries

If the border line between the large manufacturing industries and medium- and small-scale manufacturing industries is set at 2,000 TOE, the combined consumption of energy by a large number of manufacturing industries accounted for less than 30 percent of the total consumption by the manufacturing industries.

5-3-2 Policy towards Medium- and Small-scale Manufacturing Industries

No concrete action has been taken to improve energy efficiency in the medium- and small-scale manufacturing industry sector. Since the total consumption by this sector is small, any measures to save energy would not be effective in terms of total energy conservation. Nevertheless, the study team recommends a set of inexpensive policy measures to achieve better use of energy.

5-4 Audit of Selected Factories

The study team conducted energy audits on four selected factories; (1) detergent, oil and fats factory, (2) brick factory, (3) textile printing factory, and (4) electric-arc furnace steel mill. These four factories are quite different from each other and have very little in common.

As a results of the energy audits, the study team developed a energy balance and energy flowchart for each factory. Based on the audits the study team presents recommendations for improving energy efficiency for all four factories, but limited not to altering the main processes.

The recommendations the study team presents are financially and economically justifiable. Chapter 13 gives the details of the recommendations and Chapter 14 presents evaluation of the recommendations.

Chapter 6 Energy Situation

Chapter 6 Energy Situation

In this chapter, the world energy situation, the socio-economic conditions of Turkey in brief and the energy situation including long-term energy demand and supply of Turkey are described.

6-1 World Energy Situation

This section shows world energy consumption and energy consumption in selected countries using mainly the data and information issued by IEA.

6-1-1 World Energy Consumption

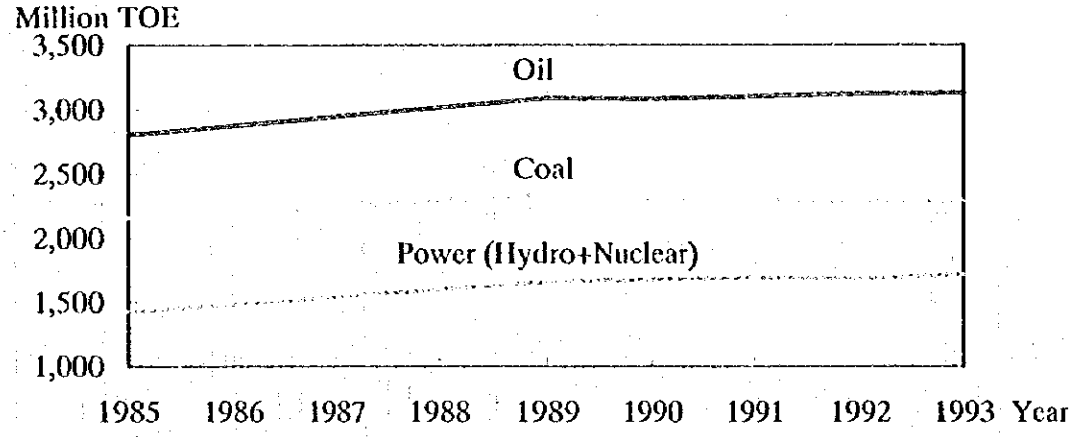
(1) Total Primary Energy Supply (TPES) in the World

Consistent energy data are available in the period 1971 to 1993. According to the data based on IEA, the world primary energy supply was 4,893 and 7,956 million TOE in 1971 and 1993 respectively as shown in Table 6-1. The primary energy supply has been increasing at a rate of approximately 2.2 percent per annum during 1971 and 1993 mainly as a result of the increase of energy consumption in developing countries. In recent years, for example in the period between 1990 and 1993, the average increase rate of energy supply was approximately 0.6 percent per annum . By type of product, petroleum collectively accounted for 39 percent of the total supply in 1993. The rest came from natural gas, coal and lignite, hydro electricity, wood fuel and agricultural wastes. Energy supply by products is illustrated in Figure 6-1.

Table 6-1 Total Primary Energy Supply in the World

	Levels (Billion TOE)							Growth Rates (% p.a.)		Fuel Shares (%)	
	1971	1980	1985	1990	1991	1992	1993	1971 -1993	1990 -1993	1971	1993
TPES	**4.89**	**6.48**	**6.97**	**7.82**	**7.89**	**7.88**	**7.96**	**2.2**	**0.6**	-	-
Solids	1.52	1.90	2.16	2.31	2.31	2.28	2.29	1.9	-0.3	31.1	28.8
Oil	2.33	2.99	2.80	3.08	3.10	3.12	3.13	1.4	0.5	47.6	39.3
Gas	0.90	1.24	1.43	1.68	1.69	1.69	1.72	3.0	0.8	18.4	21.6
Nuclear	0.03	0.19	0.39	0.53	0.55	0.55	0.57	14.3	0.2	0.6	7.2
Hydro	0.10	0.15	0.17	0.19	0.19	0.20	0.21	3.4	3.4	2.0	2.6
TPES per Capita (TOE)	1.31	1.46	1.44	1.48	1.47	1.45	1.44	0.4	-0.9	-	-
Energy Intensity	437	425	407	395	402	401	402	-0.3	0.6	-	-

Source: Based on IEA Data
Note: TPES (Total Primary Energy Supply)
Energy Intensity (TPES/Million US$)



Unit: Million TOE

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
Total Energy Consumption	6,972	7,130	7,417	7,669	7,827	7,812	7,889	7,878	7,956

Source: Based on IEA Data

Figure 6-1 Energy Supply by Products

(2) Total Final Consumption of Energy (TFC) in the World

The world TFC in 1971 was 3,796 million TOE; per capita consumption was 1.01 TOE. The world TFC in 1993 was 5,609 million TOE; per capita consumption was 1.02 TOE. The difference between TPES and TFC consists of energy losses in the production of electricity and synthetic gas, refinery use and other energy sector uses and losses. In recent years, energy consumption has been increasing at a rate of approximately 0.1 percent per annum mainly as a result of the increase in consumption by transportation and other sectors in contrast to a decrease in the industry sector as shown in Table 6-2.

Table 6-2 Total Final Consumption of Energy in the World

	Levels (Billion TOE)							Growth Rates (% p.a.)		Shares (%)	
	1971	1980	1985	1990	1991	1992	1993	1971 -1993	1990 -1993	1971	1993
TFC	3.80	4.83	5.05	5.59	5.57	5.56	5.61	1.8	0.1	100.0	100.0
Industry	1.64	2.04	2.05	2.25	2.19	2.17	2.18	1.3	-1.1	43.2	38.9
Transportation	0.87	1.15	1.23	1.43	1.43	1.45	1.48	2.4	1.2	22.9	26.4
Other Sectors	1.21	1.64	1.77	1.91	1.95	1.94	1.95	1.9	0.7	31.9	34.7
TFC per Capita (TOE)	1.01	1.09	1.04	1.05	1.04	1.02	1.02	0.0	-	-	-
TFC/GNP	339	317	295	282	284	283	283	-0.8	-	-	-

Source: Based on IEA Data
Note: TFC (Total Final Consumption of Energy)

6-1-2 Energy Consumption in Selected Countries

The energy consumption of Turkey, Japan, Germany, UK, France, Canada, the U.S. and OECD countries are described here.

(1) Trends in Energy Demand and GDP in Selected Countries

In Turkey, as shown in Table 6-3, average annual rates of growth in TPES varied from 8.7 percent in 1971-1981 to 4.7 percent in 1981-1994. However, GDP growth was higher in the 1980s than in the 1970s, partly due to the implementation of economic reforms. TPES in the OECD countries increased at an average annual rate of only 1.4 per cent during 1981 to 1994.

Table 6-3 TPES and GDP Growth Rates

	TPES (Million TOE)			GDP (Billion 1990 US$)			TPES Growth		GDP Growth	
	1971	1981	1994	1971	1981	1994	1971-1981	1981-1994	1971-1981	1981-1994
Turkey	13.66	31.51	57.58	64.30	95.10	164.60	8.7	4.7	4.0	4.3
Japan	269.93	337.98	481.85	1315.10	2030.00	3100.20	2.3	2.8	4.4	3.3
Germany	307.98	346.96	336.49	1041.20	1327.60	1752.60	1.2	-0.2	2.5	2.2
UK	211.07	193.84	220.27	631.70	742.20	1009.50	-0.8	1.0	1.6	2.4
France	154.72	186.24	234.16	728.70	968.20	1235.40	1.9	1.8	2.9	1.9
Canada	142.81	188.29	229.73	289.20	443.10	601.40	2.8	1.5	4.4	2.4
USA	1581.42	1751.27	2037.98	3314.90	4297.90	6027.10	1.0	1.2	2.6	2.6
OECD	3188.48	3715.24	4457.43	9628.40	12990.50	17920.50	1.5	1.4	3.0	2.5

Source: Based on IEA Data

(2) Trends in Energy Intensity (TPES/GDP)

The concept of energy intensity is a useful measure of changes in the relationship between energy consumption and GDP. The definition of energy intensity is the ratio of TPES to GDP. Changes in intensity reflect the combined effects of changes in the structure of economic output, energy efficiency improvements or losses, and changes in the fuel mix. None of these effects is separately identifiable at this level of aggregation, however, the measure remains a simple descriptive tool. Table 6-4 compares energy intensities using GDP estimates in selected countries.

Energy intensity has increased in 1970s, but kept at the same level since 1980s in Turkey. The average of commercial energy intensity in OECD countries has declined continuously since the early 1970s at an average rate of about 1.1 per cent per year due to efficiency improvements, structural change and fuel substitution.

Table 6-4 Energy Intensities

	Energy intensity (TOE)				Increase Rate (%)	Increase Rate to Previous Year (%)
	1971	1981	1993	1994	1981-94	1993-1994
Turkey	0.2124	0.3314	0.3381	0.3498	0.4	3.5
Japan	0.2053	0.1665	0.1490	0.1554	-0.5	4.3
Germany	0.2958	0.2613	0.1982	0.1920	-2.4	-3.1
UK	0.3341	0.2612	0.2254	0.2182	-1.4	-3.2
France	0.2123	0.1924	0.2003	0.1895	-0.1	-5.4
Canada	0.4938	0.4249	0.3839	0.3820	-0.8	-0.5
USA	0.4771	0.4075	0.3465	0.3381	-1.4	-2.4
OECD	0.3312	0.2860	0.2515	0.2487	-1.1	-1.1

Source: Based on IEA Data

(3) Per Capita Energy Consumption

As outlined in Table 6-5, per capita TPES in Turkey in 1994 was 0.95 TOE and considerably less than the average for the OECD counties, Japan, Germany, the United Kingdom, France, Canada, the U.S.A. It is clear that there is a relationship between per capita energy demand and per capita GDP.

Table 6-5 Per Capita Energy Demand

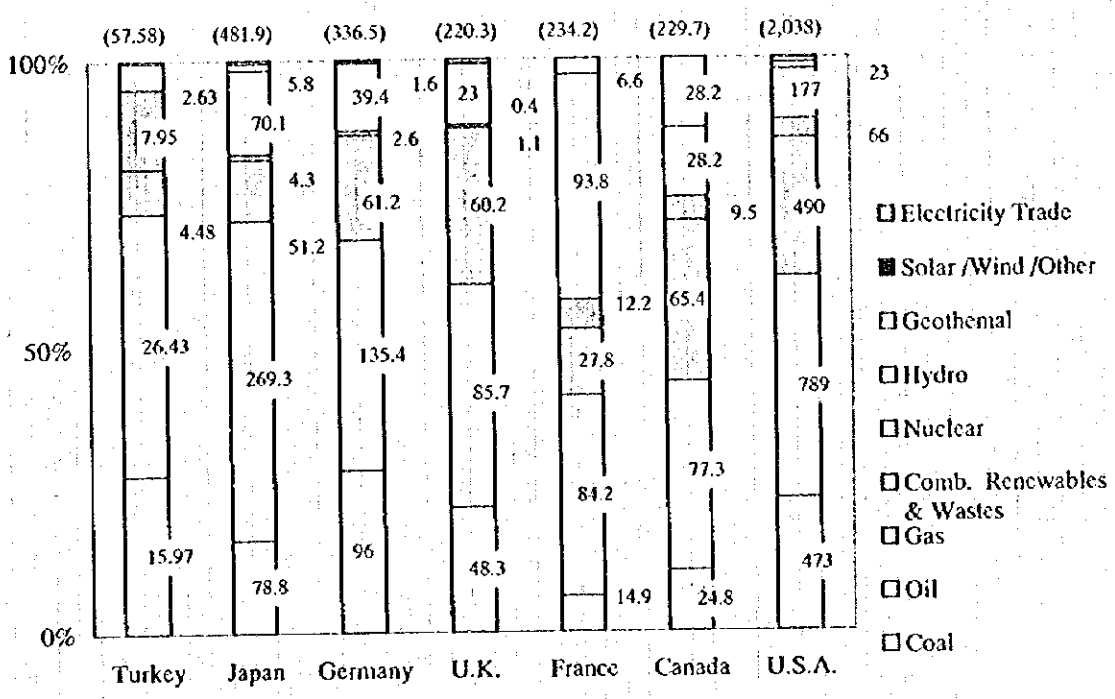
	Per Capita Energy Demand (TOE)				Increase Rate (%)	Increase Rate to Previous Year (%)
	1971	1981	1993	1994	1981-94	1993-94
Turkey	0.3736	0.6871	0.9895	0.9505	2.5	-4.1
Japan	2.5769	2.8727	3.6864	3.8561	2.3	4.6
Germany	3.9313	4.4256	4.1588	4.1333	-0.5	-0.6
UK	3.7740	3.4399	3.7663	3.7739	0.7	0.2
France	3.0189	3.4373	4.1801	4.0441	1.3	-3.4
Canada	6.4838	7.5617	7.6272	7.8547	0.3	3.0
USA	7.6154	7.6153	7.7729	7.8083	0.2	0.5
OECD	4.0214	4.2459	4.5415	4.5826	0.6	0.9

Source: Based on IEA Data

(4) The Fuel Structure of Energy Demand

As shown in Figure 6-2, trends in the fuel structure of energy demand have varied significantly between countries and regions, depending largely on the indigenous resource base. In Turkey coal and lignite have been used widely in the industrial and residential sector, but there have been shifts from coal and lignite to imported natural gas considering environmental problems. The German fuel structure remains heavily weighted toward coal. In North America, the share of oil in the TPES is rather high among OECD countries.

One notable trend observable across all regions has been the rapid penetration of electricity as a final energy source. This has been associated with growth in industrial activity and with the increasing proportion of the population living in urban centers.



Source: Based on IEA Data

Figure 6-2 Primary Energy Supply in 1994

(5) Total Final Consumption of Energy by Sector in Selected Countries

The TFC by sectors such as industry, transport and others (including agriculture, household and commercial and public enterprises) are illustrated in Figure 6-3.

In OECD countries, the industry sector's contribution to growth in TFC slowed over the 1980s, reflecting structural shifts in the major economies toward services and less energy intensive industries.

Increases in transport sector demand were important in all regions, contributing 24 percent of TFC in Turkey and 33 per cent in OECD countries. The sectoral composition of Turkey's TFC is different from that of OECD countries with respect to the shares of road transportation and other sectors. Though Turkey's transportation sector is growing relatively and shows a higher share

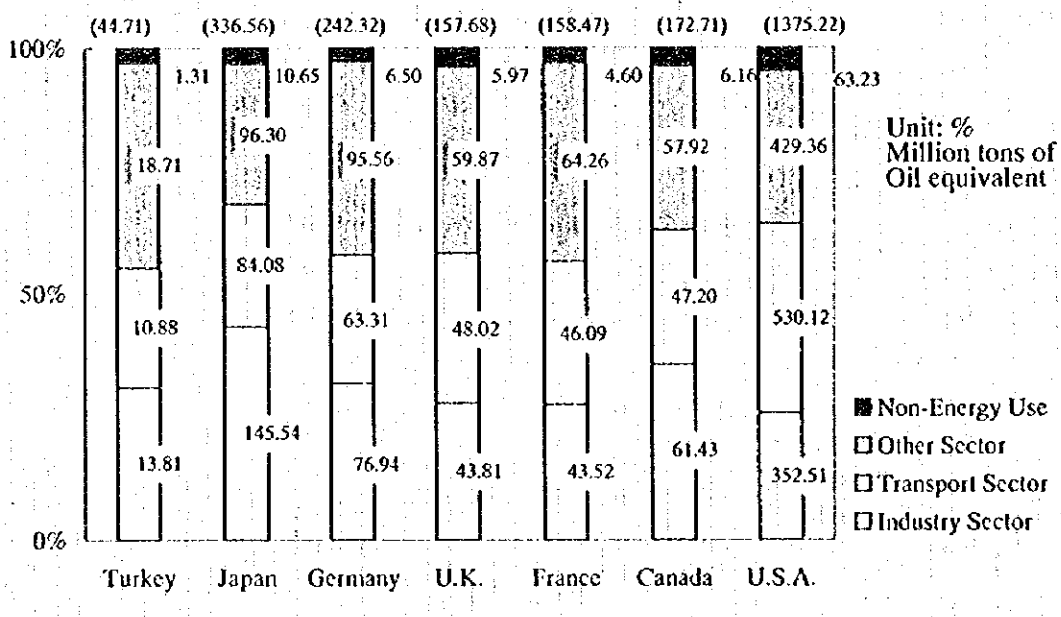
of Turkey's TFC today than in the past, it is still smaller in Turkey than in OECD countries due to the small per capita car population.

Table 6-6 Final Energy Consumption by Sectors

Unit: Million TOE

	1993				1994			
	Industry	Transport	Other	Total	Industry	Transport	Other	Total
Turkey	14.80	11.22	21.10	47.12	13.81	10.88	20.02	44.71
Japan	141.80	80.32	102.57	324.68	145.54	84.08	106.95	336.56
Germany	75.92	63.78	103.13	242.84	76.94	63.31	102.06	242.32
UK	40.59	47.80	67.21	155.61	43.81	48.02	65.84	157.68
France	44.23	45.54	69.27	159.03	43.52	46.09	68.86	158.47
Canada	60.26	45.62	63.21	169.08	61.43	47.20	64.08	172.71
USA	345.93	515.24	485.21	1346.38	352.51	530.12	492.59	1375.22
OECD	938.83	1003.49	1123.31	3065.62	959.77	1028.46	1133.42	3121.64

Source: Based on IEA Data



Source: Based on IEA Data

Figure 6-3 Final Energy Consumption by Sectors

The transport sector has played a historically important role in America, due largely to the long distances involved, high rates of urbanization and higher per capita incomes. The other sectors, which are agriculture, households and commercial and public enterprises, have contributed around one-third in final energy consumption, with the residential sector representing the most important component of this demand.

6-2 Energy Situation in Turkey

This section 6-2 "Energy Situation in Turkey", describes socio-economic conditions and energy situation which consists of resources and reserves, primary energy supply and consumption, import and export, etc.

6-2-1 Socio-economic Conditions of Turkey in Brief

(1) Natural Conditions

Turkey is a country covering over 814,578 square km in total, with 97 percent lying in Asia (Anatorian plateau) and three percent resting in Europe (Thrace). The Black Sea borders Turkey to the north; Iraq, Syria and the Mediterranean sea the south; the Aegean Sea the west, along with Greece and Bulgaria; and Armenia. Iran is on the eastern border. Turkey's coastline stretches approximately 8,333 km.

Turkey's land features is predominantly an elevated plateau. It is surrounded by mountains on all sides except the west which consists of mountainous on all sides except the west which consists mostly of fertile, flat land broken up by numerous river valleys.

The diverse nature of the landscape and the existence of mountains parallel to the coasts cause varying climatic conditions throughout Turkey. With four seas on its boundaries, it has both continental and temperate climates with enormous rainfall and temperature variations. The average altitude of the country is 1,132 meters and only one-fifth of the land lies lower than 500 meters. The south and west coasts are humid but tend to have little summer rainfall and high summer temperatures. Northern Anatolia, bordered by the Black Sea coast, is usually humid and rainy. Rainfall is sparse in Eastern and Central Turkey which also experiences extremes of climate: very hot, dry summers, very cold winters with snowfall.

(2) Population

According to the 1990 General Census of Population, Turkey's population was 56,473 thousands as shown in Table 6-7. Istanbul is the most populous metropolitan area with 12.9 percent of the total population of Turkey; Ankara is second with 5.7 percent; Izmir is third with 4.8 percent.

Table 6-7 Population of Turkey

Year	Mid-year population estimate (Unit: 1,000)		
	Total Mid-year population estimate	Annual increase rate (%)	Population in census year
1927	13,562		13,648
1945	18,664		18,790
1960	27,509		27,755
1970	35,321		35,605
1980	44,438		44,737
1985	50,306	2.49	50,664
1990	56,098	2.17	56,473
1991	57,326	2.19	
1992	58,584	2.19	
1993	59,869	2.19	
1994	61,183	2.19	
1995	62,526	2.19	
2000	69,694		

Source: Statistical Yearbook of Turkey

(3) Economic Conditions

After 1980, Turkey undertook a number of market reform measures and these reforms precipitated a great deal of structural change in the Turkish economy. Since 1980, the high growth rates economic continued until 1993. In 1994, in constant 1987 prices, GDP decreased by 5.4 percent.

Agriculture, industry, transportation and trade are the prime engines of the Turkish economy. The industry and transportation sectors enjoyed high growth among these sectors. Table 6-8 shows the economic indicators of Turkey.

Table 6-8 Economic Indicators

(Trillion TL)

	1990	1991	1992	1993	1994
GDP Current price	**393.1**	**630.1**	**1,093.4**	**1,981.9**	**3,883.8**
GDP Constant price (1987)					
1. Agriculture	14.2	14.0	14.7	14.5	14.4
2. Industry	22.3	22.9	24.3	26.3	24.8
3. Construction	5.4	5.5	5.8	6.3	6.1
4. Trade	16.9	16.7	17.9	20.0	18.5
5. Transportation and communication	10.1	10.1	10.9	12.1	11.8
6. Financial institutions	2.5	2.5	2.5	2.5	2.4
7. Ownership of dwelling	4.6	4.7	4.8	5.0	5.1
8. Business and personal services	1.9	1.9	2.1	2.2	2.1
9. (Less) bank service charges	2.2	2.2	2.1	2.1	2.1
10. Sectoral total (1-9)	75.8	76.3	80.8	86.6	83.1
11. Government services	4.0	4.1	4.3	4.3	4.4
12. Private non-profit institutions	0.4	0.4	0.4	0.4	0.4
13. Total (10 + 11 + 12)	80.1	80.8	85.4	91.3	87.9
14. Import duties	3.4	3.6	4.0	5.3	3.4
15. GDP (13+14)	83.5	84.4	89.4	96.6	91.3

Source: SIS

6-2-2 Energy Situation in Turkey

(1) General

The population, GDP, primary energy consumption, energy consumption per unit of GDP, and primary energy consumption are summarized in Table 6-9.

Table 6-9 Energy Situation in Turkey

	1985	1990	1991	1992	1993	1994
Population, (Million)	50.3	56.1	57.3	58.6	59.9	61.2
GDP, (Trillion TL)	35.1	393.1	630.1	1,093.4	1,981.9	3,883.8
GDP Constant, (Trillion TL)	63.8	83.5	84.4	89.4	96.6	91.3
TPEP, (MM TOE)	21.7	25.8	25.8	27.1	26.8	26.9
TPEC, (MM TOE)	39.2	53.3	54.6	57.0	60.6	59.5
TPEC/GDP, (TOE/MMTL)	0.61	0.64	0.65	0.64	0.63	0.65
TPEC/Capita, (kgOE)	779	951	953	973	1,013	973
Total Electric, (TWh)	29.7	46.8	49.3	54.0	59.3	61.4

Note: TPEP: Total Primary Energy Production
TPEC: Total Primary Energy Consumption

From the above table, it may be noted that:

1. Population increased at an annual average growth rate of 1.4 percent in the period 1985 - 1994.
2. GDP at a constant price base increased at an annual average growth rate of 4.1 percent in the period 1985-1994.
3. Total energy consumption increased at the level of real GDP growth; however, energy consumption per unit GDP remained at a constant level during 1985-1994.

(2) Resources and Reserves

Primary energy resources such as hard coal, lignite, asphaltite, oil, natural gas, hydro energy, geothermal energy, wood, animal and plant wastes and solar energy, and secondary energy resources such as coke and briquettes are produced and consumed in Turkey. Table 6-10 shows the primary energy reserves of Turkey.

1) Coal

Coal is the most important domestic resources, accounting for 46 percent of the domestically produced primary energy in 1995. However, they were mostly low quality coal with hard coal comprising 11 percent and lignite 89 percent.

Turkey has large quantities of lignite resources, which are estimated to be 7.3 billion tons. Lignite is inferior in quality to coal.

Table 6-10 Primary Energy Reserves of Turkey

Unit: Million Tons as of 1995

Reserves	Proven	Probable	Possible	Total
Hard Coal	428 [a]	449	249	1,126
Lignite [c]				
Elbistan	3,357	-	-	3,357
Other	3,982	626	110	4,718
Total	7,339	626	110	8,075 [b]
Asphaltite	45	29	8	82
Bituminous	555	1,086		1,641
Hydro (MW) [c]	34,736	-	-	34,736
Crude Oil [c]	35	-		35
Natural Gas (Billion m^3) [c]	9	-	-	9
Nuclear				
Energy Sources (tons)				
Uranium	9,129	-	-	9,129
Thorium	380,000	-	-	380,000
Geothermal (MW)				
Electricity	200	-		200
Heat	2,250	-		2,250
Solar				
(Million TOE/Year)				
Electricity	-	-	-	8 .8
Heat	-	-	-	26 .4

Note: [a] Available reserves are included
[b] Increases to 8,375 million tons with addition of identified and potential sources of 300 million tons
[c] 1995 PIGM Oil Activities Newsletter

Source: MENR (Turkey Energy Report 1994)

Hard coal is already consumed intensively in the iron and steel sector, other industrial sectors, the heating sector, the power plants and the transportation sector (in small amounts).

Hard coal importation increased as the coal demand of the industrial sector expanded. Furthermore, in order to reduce air pollution in cities such as Ankara and Bursa, coal is imported for use in the heating sector. In years to come, it is estimated that consumption patterns will be within the same allocations, yet the metallurgy sector will gain priority, and in case that imported-coal-fired thermal plants are realized in the near future, the plants' consumption will increase.

The main lignite consuming sectors are the residential, power and industrial sectors. While

lignite with low calorific value is consumed in power plants, high quality lignite is used in residential and industrial sectors.

2) Oil

In accordance with theoretical calculations, 958.1 million tons of oil reserves (in place) exist in Turkey in already known areas. According to PIGM 1995 statistics, 131.8 million tons of this reserve is extractable oil. As of the end of 1995, 96.4 million tons of this total was extracted and the remaining recoverable reserve is 35.3 million tons.

Compared to last year, crude oil production declined to 3.5 million tons with a decrease of 5.4 percent in 1995. Seventy six percent of this was extracted by TPAO, and 23.9 percent by foreign and 0.1 percent by domestic companies.

There are five refineries in Turkey. In 1995, 27 million tons of crude oil was processed in these refineries and 25.6 million tons of production was realized.

Crude oil transportation capacity of the Iraq-Turkey Crude Oil Pipeline of two mains reached 70.9 million tons per year. This 1,876 km-long pipeline has not been in service since the Gulf crisis. In addition, there are other crude oil pipelines: one transmits crude from Batman Refinery to Iskenderun Gulf (Batman-Dortyol Pipeline) with 3.5 million tons per year capacity and the other, Yumurtalik-Kirikkale Pipeline with 5 million tons per year capacity.

Oil produced by Turkish refineries and imported oil are distributed by oil distribution companies. The number of these companies reached 13 in 1994. According to liberalization arrangements which were initiated in 1989, sale prices of oil products have been determined by oil distribution companies.

3) Natural Gas

As of the end of 1995, total natural gas reserve of Turkey is 16.7 billion m^3 and recoverable total gas is 11.3 billion m^3. Cumulative production of natural gas was 2.5 billion m^3 and the remaining recoverable gas is 8.7 billion m^3.

In 1995, with a decrease of 9 percent compared to the previous year, 182,262,201 m^3 of natural gas was produced.

The use of natural gas has grown rapidly, since gas imports started from the former USSR in

1987. Moreover, Liquid Natural Gas was imported from Algeria in 1994.

Natural Gas consumption reached 6,833 million m^3 in 1995, 26 percent higher than the previous year.

The natural gas main distribution pipeline of 842 km from Malkoclar to Ankara supplies power plants, several large industries and the cities of Ankara, Istanbul and Bursa. Studies are going on to supply gas to pollution threatened cities such as Izmir and Eskisehir. Another new natural gas main distribution pipeline which will service the Izmir-Karadeniz Ereglisi and Aegean regions of Turkey is under construction.

As a result of increasing demand, it is expected that the natural gas requirement of Turkey will reach 30 billion m^3 in 2010.

4) Electricity

Fifty three percent of the total installed capacity is obtained from thermal resources (11,089 MW) and the rest (47 percent, 9,862.8 MW) from hydro resources. Lignite power plants have the largest share of total thermal capacity since 1982. The share of oil plants decreased gradually and there is a rapid increase in natural gas plants. In 1995, the share of installed capacity of lignite and coal plants in the total installed electricity capacity is 31 percent, followed by oil (6.7 percent) and natural gas (13.8 percent).

Hydropower generation reached 35.5 billion kWh, increasing of 7 percent annually during 1980-1995. It had a share of 41 percent in the total 1995 generation.

The share of oil plants decreased gradually from 25 percent to 6.7 percent during 1980-1995 as a result of the energy policies implemented over these years due to the oil shocks of the 1970s. The generation shares of natural gas plants and coal plants were 19 percent and 33 percent in 1995, respectively

(3) Primary Energy Situation

Turkey is an energy importing country; more than half the energy requirement has been imported. The total primary energy requirement (TPER) was 53.33 million TOE and 63.09 million TOE in 1990 and 1995, respectively, showing an annual average growth rate of 3.4 percent during that period. In 1995, oil showed the biggest share in the total primary energy consumption, representing almost 46.5 percent.

The primary energy production was 26.26 million TOE in 1995 as shown in Table 6-11.

Table 6-11 Primary Energy Consumption and Production

Unit: Million TOE

	1990		1993		1994		1995	
	Consump-tion	Produc-tion	Consump-tion	Produc-tion	Consump-tion	Produc-tion	Consump-tion	Produc-tion
Hard coal	6.15	2.08	5.83	1.72	5.51	1.64	5.91	1.32
Lignite	9.77	9.52	9.92	9.79	10.30	10.47	10.57	10.74
Asphaltite	0.12	0.12	0.04	0.04	0.00	0.00	0.03	0.03
Natural Gas	3.11	0.19	4.63	0.18	4.92	0.18	6.22	0.17
Oil	23.90	3.90	28.4	4.09	27.14	3.87	29.32	3.69
Hydro Energy	1.99	1.99	2.9	2.92	2.63	2.63	3.06	3.06
Geothemal	0.09	0.09	0.10	0.10	0.12	0.12	0.14	0.14
Solar	0.02	0.02	0.04	0.04	0.05	0.05	0.05	0.05
Wood	5.36	5.36	5.45	5.45	5.48	5.48	5.51	5.51
Dung	2.55	2.55	2.49	2.49	2.48	2.48	1.56	1.56
Elec. Import	0.02		0.02		0.00		0.00	
Elec. Export	-0.08		-0.05		-0.05		-0.06	
Total	53.33	25.82	60.64	26.81	59.49	26.90	63.09	26.26
Consumption per Capita	951		1,013		973		1,015	

Source: Based on MENR

6-2-3 Primary Energy Supply and Consumption

(1) Primary Energy Production and Supply

Primary energy production in Turkey as shown in Table 6-12 grew at an annual average rate of 4.4 percent in the 1980s; production reached 26,255 thousand TOE in 1995, showing an annual average growth rate of 0.3 percent during 1990 - 1995.

Total solid fuel production accounted for 76 percent in 1990 and 73 percent in 1995.

The total primary energy supply in 1995 was 63,085 thousand TOE, which consists of energy imports of 39,684, exports of 1,947, marine bunkers of 464, stock changes of -213, and statistical differences of -260. The indigenous production was 26,255 thousand TOE and others (out of refinery products) was 30 thousand TOE.

(2) Primary Energy Consumption

Primary energy consumption in Turkey, as shown in Table 6-13, grew at an annual growth rate of 5.2 percent in the 1980s, and the consumption reached 63,085 thousand TOE in 1995, showing an annual average growth rate of 3.4 percent during 1990 - 1995. Primary energy consumption per capita was 718 kgOE, 779 kgOE, 951 kgOE and 1,015 kgOE in 1980, 1985, 1990 and 1995 respectively.

In 1994, while GDP in Turkey decreased by 5.4 percent, primary energy consumption also decreased by 1.9 percent. As much as 45 percent of the primary energy consumption was met by domestic resources.

In 1995, primary energy consumption increased by 6.0 percent. Oil represented 46.5 percent of the primary energy consumption, followed by lignite representing 16.8 percent, natural gas 9.9 percent and hardcoal 9.4 percent.

Table 6-12 Primary Energy Production

Unit: 1,000 TOE

Years	Hardcoal	Lignite	Asphaltite	Natural Gas	Oil	Hydro Energy	Geothermal Heat	Geothermal Elec.	Solar	Wood	Dung	Total
1980	2195	3738	240	21	2447	976	-	-	-	4730	2953	17298
1985	2199	8212	225	62	2216	1036	-	5	-	5210	2539	21703
1986	2151	8949	261	416	2514	1021	-	38	5	5271	2622	23247
1987	2111	9827	271	270	2762	1601	-	50	10	5308	2586	24795
1988	2212	8603	268	90	2692	2490	-	59	13	5313	2614	24354
1989	2027	10564	179	158	3020	1543	5	54	16	5345	2580	25490
1990	2080	9524	119	193	3902	1991	16	69	21	5361	2548	25824
1991	1827	9117	60	185	4674	1951	16	70	27	5391	2530	25847
1992	1727	10299	92	180	4495	2285	30	60	32	5421	2512	27132
1993	1722	9790	37	182	4087	2920	30	67	38	5451	2494	26818
1994	1636	10466	0	182	3871	2630	47	68	45	5482	2475	26902
1995	1319	10735	29	166	3692	3057	64	74	52	5512	1556	26255

References : MENR / RPCB / PFD

Table 6-13 Primary Energy Consumption

Unit: 1,000 TOE

Years	Hardcoal	Lignite	Asphaltite	Natural Gas	Oil	Hydro Energy	Geothermal		Soiar	Wood	Dung	Elect Ex-Imp Balance	Consumption	
							Heat	Elec.					Total	Per Capita
1980	2824	3970	240	21	16074	976	-	-	-	4730	2953	115	31913	718
1985	3775	7933	225	62	18134	1036	-	5	-	5210	2539	184	39167	779
1986	3992	8879	261	416	19622	1021	-	38	5	5271	2622	67	42181	820
1987	4404	9189	271	669	22301	1601	-	50	10	5308	2586	49	46601	887
1988	5204	7932	268	1115	22590	2490	-	58	13	5313	2614	33	47657	887
1989	4722	10207	176	2877	22865	1543	5	54	16	5345	2580	48	50440	919
1990	6150	9765	123	3110	23901	1991	16	69	21	5361	2548	-63	53334	951
1991	6501	10572	60	3827	23315	1951	16	70	27	5391	2530	21	54624	953
1992	6243	10743	85	4197	24865	2285	30	60	32	5421	2512	-11	57022	973
1993	5834	9918	44	4630	28412	2920	30	67	38	5451	2494	-33	60641	1013
1994	5512	10296	0	4921	27142	2630	47	68	45	5482	2475	-46	59489	973
1995	5905	10570	28	6218	29324	3057	64	74	52	5512	1556	-60	63085	1015

References : MENR / RPCB / PFD

(3) Import and Export

Table 6-14 gives the total energy import and export using the unit of TOE for 1994 and 1995. It should be noted that crude oil, representing 71.4 percent of the total import of energy and 23.5 million tons of crude oil, was imported from various countries and 2.9 billion dollars was spent for this purpose in 1995. Furthermore, oil products of 3.4 million tons were imported. For this importation, 674 million dollars was paid. Conversely, oil products of 1.6 million tons were exported and 164.9 million dollars of income was realized.

Table 6-14 Import and Export of Energy in 1994 and 1995

Unit: 1,000 TOE

	Hard Coal	Second Coal	Petro Coal	Lignite	Oil	Natural Gas	Electricity	Total
1994								
Import	3,951	55	754	2	25,689	4,891	3	35,344
Export	0	0	0	0	2,231	0	49	2,280
1995								
Import	4,347	127	715	3	28,345	6,147	0	39,684
Export	0	0	0	0	1,888	0	60	1,947

6-2-4 Aggregate Trends in Energy Demand

(1) Trends in Energy Demand and GNP

Total primary energy supply in Turkey increased by averages of 9.6 percent a year during the 1970's, 5.2 percent a year during the 1980's and 2.8 percent a year during 1990-1994. Though TPES showed a drop of 1.9 percent, reflecting decrease of growth in GDP in 1994, TPES grew 6 percent in 1995.

In the early 1980s the solid fuel share in TPES was approximately 50 percent and in 1995 it was about 37 percent. Many of Turkey's major power plants burn hard coal or lignite; households use coal. The oil share remained at the level of 40-50 percent in the 1980s and 46 percent in 1995. The gas share increased from 0.05 percent in 1981 to 9.9 percent in 1995 due to rapid growth in power generation.

(2) Per Capita Energy Consumption

In 1981, Turkey's energy use per capita was 0.7 TOE, about 16 percent of that of OECD countries. In 1994, Turkey was below about 21 percent of OECD in this respect.

(3) Energy Intensity per GDP

According to the data from IEA, the energy intensity in Turkey increased from an estimated 0.33 TOE per unit of GDP in 1990 US dollars in 1981 to an estimated 0.35 TOE in 1994, that is by a total of 6 percent or an average of almost 0.5 per cent a year growth. As energy use in the OECD was 0.29 TOE per unit of GDP in 1981 and an estimated 0.25 TOE per unit of GDP in 1994, it can be recognized that Turkey used 1.6 times more energy than the average of OECD countries to produce one unit of GDP at the beginning of this period, and 1.4 times more at the end of it.

It should be noted that, because of difficulties in estimating GDP and in expressing GDP in a common currency as well as differences in end-use structure, for example in the share of energy intensive industry output in GDP and climate, such comparisons can only be approximate.

(4) Energy Consumption by Sector

Sectoral energy consumption is shown in Table 6-15. The share of energy consumption in industry increased while that of residential/commercial is decreasing as a result of the economic development of the country in the period of 1985-1990, but the share was at the same level between 1990 and 1995. In the industry sector, steel and cement are the big energy consuming sub-sector.

Table 6-15 Sectoral Energy Consumption

	1985		1990		1994		1995	
	MM TOE	%	MM TOE	%	MM TOE	%	MM TOE	%
Resident/ commercial	14.21	44	15.70	37	16.74	37	17.42	35
Industry	9.78	30	14.54	35	14.97	33	17.00	34
Transport	6.20	19	8.72	21	9.91	22	11.12	23
Agriculture	1.51	5	1.96	5	2.48	5	2.50	5
Non energy	0.81	2	1.03	2	1.35	3	1.40	3
Final energy consumption	32.50	100	41.96	100	45.45	100	49.38	100

Source: MENR

Note: Industrial sub-sectoral energy consumption

	1994	1995
	MM TOE	MM TOE
Iron and steel	3.08	3.21
Chemicals	1.21	1.22
Petrochemicals	1.57	1.57
Fertilizer	0.71	0.88
Cement	2.65	2.44
Sugar	0.39	0.43
Non-ferrous	0.55	0.69
Others	4.81	6.50

6-2-5 Long-Term Energy Demand Supply Projections

MENR projects energy demand supply up to 2010. The projection is summarized in Table 6-16 which indicates that primary energy demand would be 90.1 million TOE in 2000, 155.6 million TOE in 2010. Indigenous production to meet the energy demand is projected to be 44 percent in 2000 and 38 percent in 2010, which shows that the share will decrease progressively. According to the projection, 95.7 million TOE of energy is required from outside which is about 2.4 times the energy import in 1995.

Sectoral energy demand projection by MENR is summarized in Table 6-17, which shows higher growth in the industrial sector.

Table 6-16 Projected Energy Demand

		1995	2000	2005	2010
Primary Energy Production	(MMTOE)	26.63	39.50	48.85	59.87
Primary Energy Demand	(MMTOE)	62.22	90.08	116.92	155.59
Hard Coal	(MT)	8.39	10.12	21.23	49.12
Lignite	(MT)	54.60	112.85	147.10	183.94
Asphaltite	(MT)	0.09	0.75	0.75	0.75
Oil	(MT)	26.99	29.93	34.16	39.81
N. Gas & LNG	(10^6m^3)	7.28	19.99	25.88	30.59
Hydro	(TWh)	31.73	41.93	64.99	77.56
Geothermal					
Elec.	(TWh)	0.08	0.09	0.09	0.09
Heat	(MMTOE)	0.22	1.16	2.69	4.90
Solar	(MMTOE)	0.05	0.09	0.17	0.31
Nuclear	(TWh)	-	-	7.02	14.04
Elect. Imports	(TWh)	0.39	-	-	-
Central Heating	(MMTOE)	0.07	0.24	0.46	0.77
Wood	(MMT)	18.37	19.49	19.63	19.77
Dung	(MMT)	10.68	9.84	9.05	8.26

Source: MENR

Table 6-17 Projected Sectoral Energy Demand

Unit: Million TOE

	1995	2000	2005	2010
Industry	18.18	28.68	40.76	57.49
Resident	17.48	23.90	28.24	33.19
Transportation	10.83	14.23	17.56	21.72
Agriculture	2.79	3.68	4.72	5.86
Non-Energy	1.51	1.63	1.75	1.88
Final Energy Consumption	50.79	72.11	93.04	120.15
Convers. Sector	11.44	17.97	23.89	35.44
Primary Energy Consumption	62.22	90.08	116.92	155.59

Source: MENR

6-2-6 Energy Saving Potential

The total energy saving potential for the end-use sectors have been identified to be approx. US 2.6 billion dollars or 13.2 million TOE annually as explained in Table 6-18.

Table 6-18 Energy Saving Potential for Three End Use Sectors
(in 1993)

	Million TOE	Million US$	Percentage
Industry	5.3	1,130	30
Building	5.1	1,190	30
Transport	2.8	262	27
Total	13.2	2,582	-

Source: Turkey Energy Report 1994(MENR)

6-3 Energy Situation in Medium- and Small-scale Manufacturing Industries

(1) Overview of Manufacturing Industries

According to data provided by the State Institute of Statistics, Department of Energy, the total number of establishments in the manufacturing industry sector in Turkey amounts to nearly 200,000; the number of employees involved in the sector was 1,250,000 in 1992, as shown in Table 6-19. This shows that Turkish manufacturing industries are small on average. The total annual average of employees is 6.33 persons per establishment; 94.34 percent of establishments belong to the micro-sized group, 4.03 percent to the small-sized, 0.71 percent to the medium-sized, 0.92 percent to the large-sized. Energy consumption rate and value added figures by size are inversely distributed from the above-mentioned trend.

	Micro-	Small-	Medium-	Large-
Number of Establishments, %	94.34	4.03	0.71	0.92
Fuel consumption, %	10.06	3.93	5.21	67.70
Electricity, %	7.58	6.08	4.53	81.81
Value Added, %:	7.32	6.42	5.43	80.84

In these data, the annual average number of persons engaged in establishments is commonly used as a measure for industrial establishments in Turkish statistics.

Establishments with 1-9 employees:	Micro-sized
Establishments with 10-49 employees:	Small-sized
Establishments with 50-99 employees:	Medium-sized
Establishments with 100 + employees:	Large-sized

The consumption of energy and value added by size group are more clearly understandable by referring to Figure 6-4.

Table 6-19 Manufacturing Industry Statistics Size Group in 1992

		SIZE GROUP							
	(UNIT)	1 - 9 micro-sized	10 - 49 small-sized	50 - 99 medium-sized	100 - 199 large-sized	200 - 499 -ditto-	500 - 999 -ditto-	1000 + -ditto-	TOTAL
Number of establishment		186,752	7,973	1,406	844	642	215	124	197,956
Average number of employees		274,872	170,130	97,103	116,591	200,908	148,370	246,165	1,254,139
Total capacity of power equipment installed at the end of the year	(HP)	2,073,154	1,545,723	739,089	1,596,735	2,240,526	1,882,783	4,057,143	14,135,153
Input	(1,000 TL)	32,640,118,567	42,640,026,849	30,333,342,020	36,126,738,108	77,986,453,698	52,895,589,975	100,476,479,735	373,098,748,952
Raw materials	(1,000 TL)	29,771,162,815	35,215,086,757	24,679,750,137	28,997,039,711	56,288,964,271	41,710,636,252	83,368,348,262	300,030,988,205
Electricity	(1,000 TL)	1,069,610,288	857,688,443	639,778,605	927,966,354	3,641,536,661	3,425,081,278	3,549,493,420	14,111,155,049
Fuel consumption	(1,000 TL)	998,679,694	389,888,377	516,910,949	750,890,792	2,360,003,104	2,293,361,697	2,616,444,042	9,926,178,655
Output	(1,000 TL)	52,324,966,156	59,914,156,393	44,897,773,864	57,390,690,416	136,657,308,032	98,274,516,095	192,637,392,313	642,096,803,269
Value Added	(1,000 TL)	19,684,847,589	17,274,129,546	14,564,431,844	21,263,952,308	58,670,854,334	45,378,926,120	92,160,912,578	268,998,054,319

(Courtesy of STATE INSTITUTE of STATISTICS, Department of Energy. 21 Dec. 1995)

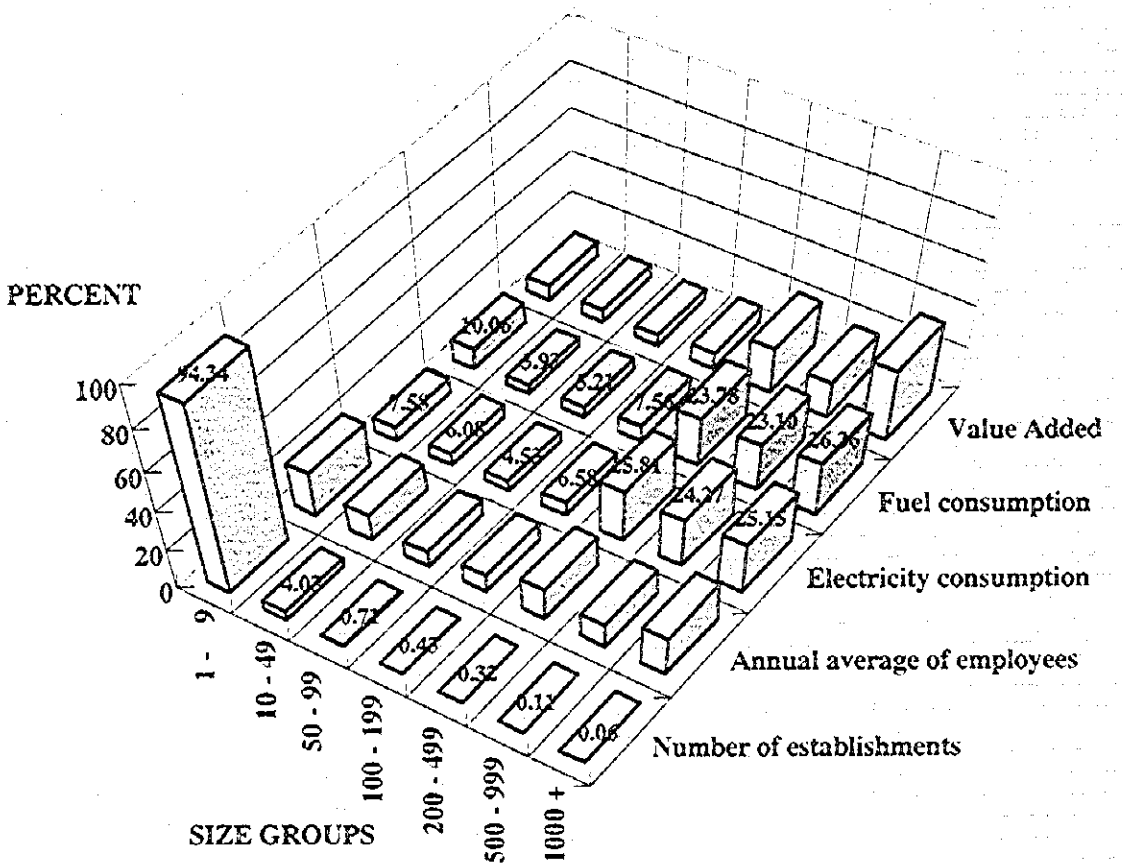


Figure 6-4 Shares of Manufacturing Industry by size in 1992

(2) General Outlook of the Medium- and Small-scale Manufacturing Industries

Here the medium- and small-scale manufacturing industries are portrayed in contrast to large-scale industries. Shifts occurring from 1987 to 1990 are given. As shown in Figure 6-5, a large number of manufacturing industries in the private sector are small-scale while those in the public sector are large-scale.

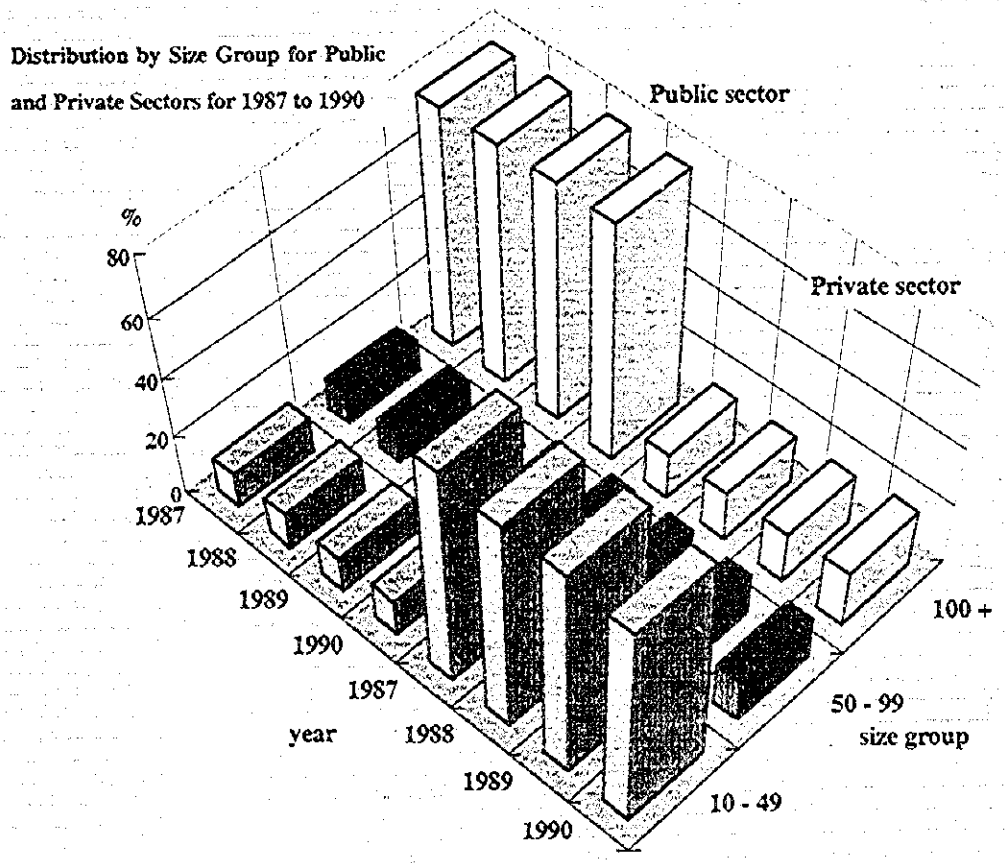
In 1987, the small-scale manufacturing industries accounted for 71.72 percent of the total number of establishments, 19.88 percent of employment; however, they contributed 9.87 percent of the total value added in the private sector. Medium-scale manufacturing industries accounted for 12.92 percent of the total number of establishments, provided 11.33 percent of employment and contributed 7.82 percent of the value added in the private sector. In large-scale manufacturing industries, these ratios are respectively as follows: 15.36 percent of the total number of establishments, 68.78 percent of employment, 82.31 percent of the total value added.

The information the study team obtained indicates that the share of private small-scale manufacturing industries' indicators mentioned above declined from 1987 to 1990. They accounted for 67.53 percent of the total establishments, 16.98 percent of employment, 7.97 percent of the total value added.

Although the number of medium-scale manufacturing industries increased, they suffered decreases in employment and contribution to value added. They represented 13.91 percent of establishments, 10.50 percent of employment, 7.37 percent of the value added.

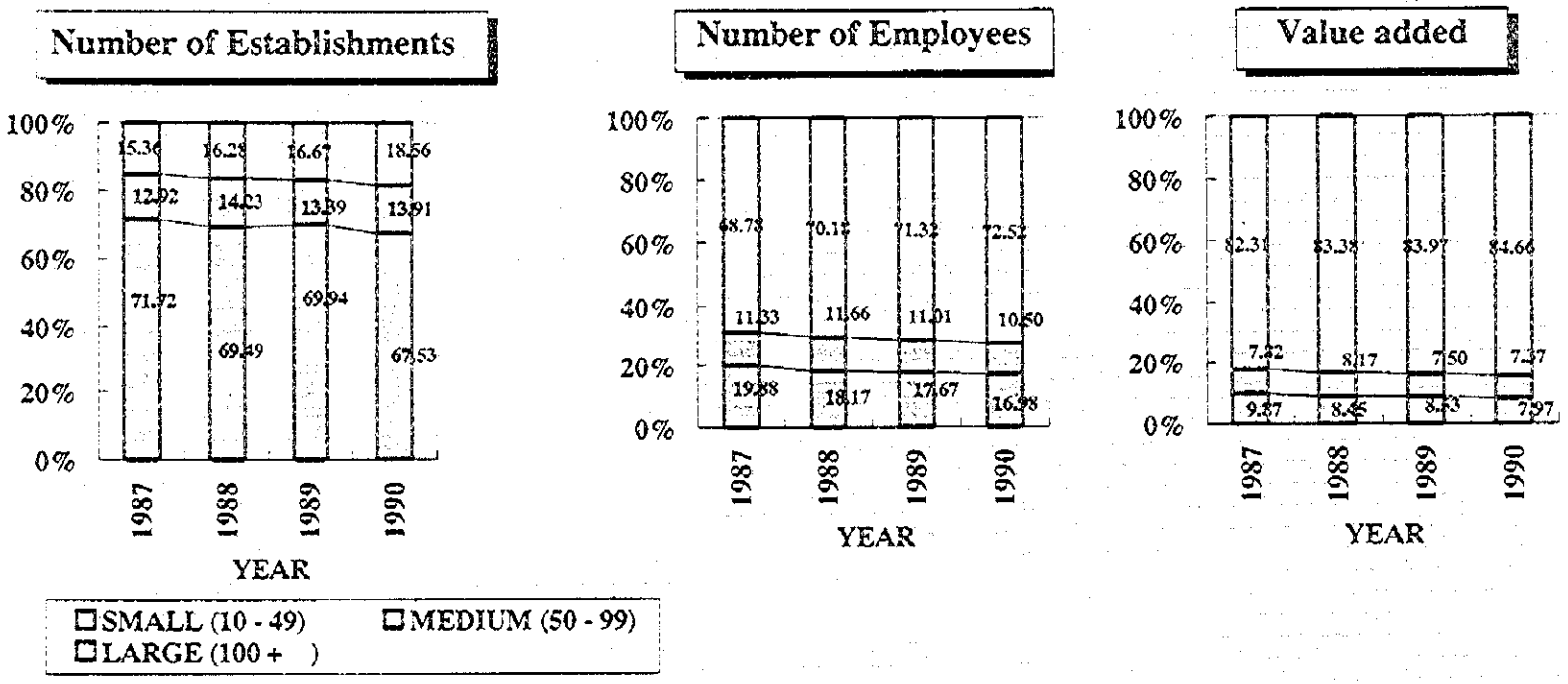
Large-scale manufacturing industries accounted for 18.56 percent of establishments, 72.52 percent of employment, 84.66 percent of the value added in 1990, as shown in Figure 6-6.

In Japanese manufacturing industries, distribution by size has almost the same pattern as in Turkey. In 1993, medium- and small-scale manufacturing industries accounted for 99.07 percent of the total number of establishments (413,563) and 71.73 percent of the total number of employees (10,879,000), while large-scale ones accounted for 0.93 percent and 28.27 percent, respectively. In this case, medium- and small-scale industries are defined as establishments with 4 to 299 employees.



(DATA: S.I.S SMALL-AND MEDIUM-SIZED ESTABLISHMENTS IN THE TURKISH MANUFACTURING INDUSTRY 1991)

Figure 6-5 Numbers of Establishments in Private Sector and Public Sector (%)



(DATA: S.I.S SMALL-AND MEDIUM-SIZED ESTABLISHMENTS IN THE TURKISH MANUFACTURING INDUSTRY 1991)

Figure 6-6 Number of Establishments, Employment, Value Added in Private Sector Manufacturing Industry by Size Group of Establishments, 1987-1990 , percent

(3) Sectoral Distribution of the Manufacturing Industries by Size

The sectoral distribution by size of establishments in the Turkish manufacturing industry is given in Table 6-20.

Table 6-20 Sectoral Distribution of the Manufacturing Industry by Size

Size		Food, beverages, tobacco	Textile, apparel, leather	Wood-products, furniture	Paper	Chemicals	Non-metallic mineral product	Basic metal industry	Fabricated metal product	Others	TOTAL
1-9	establishments	20,092	53,904	43,317	6,342	4,807	6,553	1,789	46,733	3,037	186,574
	employment	74,018	151,287	114,416	19,203	19,217	21,859	6,485	130,351	8,973	545,809
10-24	establishments	1,156	1,475	274	173	372	335	158	1,235	52	5,230
	employment	16,468	22,829	3,890	2,609	5,784	5,453	2,457	18,921	836	79,247
25+	establishments	1,008	1,842	203	222	577	526	266	1,279	53	5,976
	employment	168,237	265,968	18,730	81,601	89,183	64,905	68,678	194,290	4,262	905,854
Total	establishments	22,256	57,221	43,794	6,737	5,756	7,414	2,213	49,247	3,142	197,780
	employment	258,723	440,084	137,036	103,413	114,184	92,217	77,620	343,562	14,071	1,530,910
Share (%)	establishments	11	29	22	3	3	4	1	25	2	100
	employment	16	28	9	6	7	6	5	22	1	100

(Source: KOSGEB Brochure October 1995)

The sectors which have large numbers of establishments are as follows:

Textiles, wearing apparel and leather, percent:	29
Fabricated metal products, percent:	25
Wood products including furniture, percent:	22
Food, beverages and tobacco, percent:	11

The other sectors collectively constitute 13 percent of the establishments.

High employment is realized by the following sectors.

Textiles, wearing apparel and leather, percent	28
Fabricated metal products, percent:	22
Food, beverages and tobacco, percent:	16

The above sectors provide 66 percent of employment in the manufacturing industry.

(4) Energy Consumption in Medium- and Small-scale Manufacturing Industries

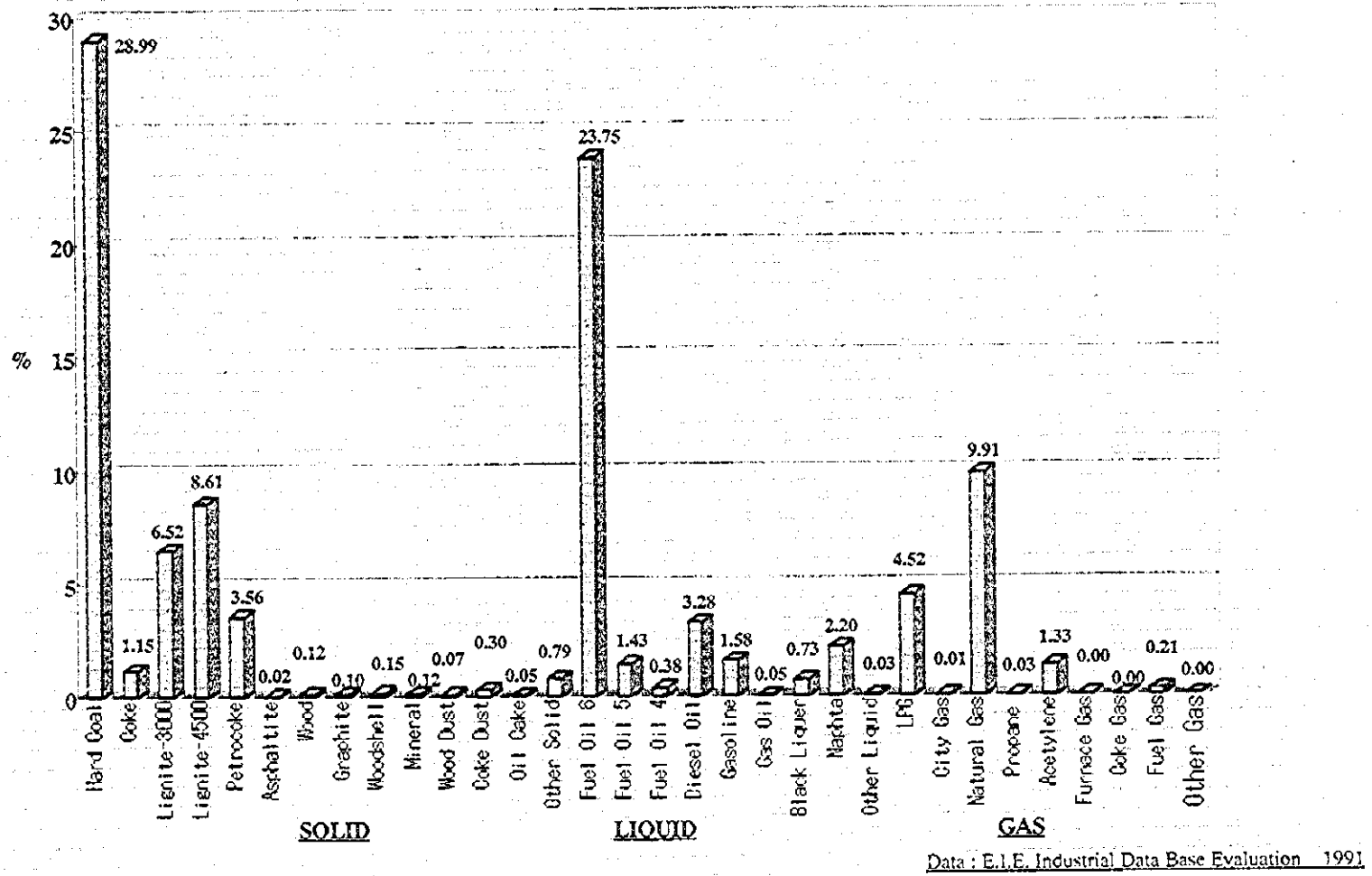
After a tenacious search for information on consumption of energy by the medium- and small-scale manufacturing industries, there seems to be no printed information on this matter. EIE is establishing an energy data base as a means for monitoring energy consumption in the industrial sector through sending a questionnaire to about 1,000 establishments out of their 1,500 establishments list every two years starting from 1991. The information on the energy consumption and production of approximately 700 industrial plants are compiled, evaluated and issued.

The Energy Conservation Regulation issued in November 1995 now helps EIE to build the energy data base. Some medium- and small-scale industries are now obliged to send EIE their energy audit reports.

By using the available data base received from EIE "Industrial Data Base Evaluation 1991 by EIE", the study team tried to examine the present situation of energy consumption by sectors/subsectors and energy consumption by kinds of fuel in medium- and small-scale manufacturing industries. Since the data base does not seem to represent exactly all the medium- and small-scale industries, only distribution ratios are analyzed here.

(a) Total Fuel Use by Type of Fuel

Solid fuels such as coal, lignite and petrocoke are widely used and account for about 51 percent of total fuel consumption. The second largest group is liquid fuels such as fuel oil, diesel oil and gasoline and accounts for 33 percent; gas fuel including natural gas accounts for only 16 percent. Of all kinds of fuels, hard coal accounts for 28.99 percent, followed by fuel oil at 25.56 percent and lignite at 15.13 percent. Figure 6-7 portrays the fuel consumption pattern.



Data : E.I.E. Industrial Data Base Evaluation 1991

Figure 6-7 Total fuel use by type of fuel (Industry-Wide)

(b) Energy Consumption by Sectors/Subsectors based on EIE Study

A large portion of fossil fuel is consumed by the iron & steel industry which accounts for 35 percent of fuel consumption by the industrial sector. The second largest is the cement industry that accounts for 19 percent, the third largest is the petrochemical industry accounting for 9 percent.

More than half of the solid fuel is consumed by the iron & steel industry, consuming mainly hard coal; the second largest consumer of solid fuel is the cement industry consuming mainly lignite-4500/3000.

Fuel oil is used mainly in the petrochemical, iron & steel and cement industries. Natural gas and LPG are the two main gaseous fuels, used mainly in fertilizers, iron & steel and cement industries.

Electricity consumption also follows a pattern similar to fossil fuel; the iron & steel industry is the first and the cement and petrochemical industries the second and third, as may be noted from Table 6-21.

6-4 Energy Prices

All energy prices except oil product prices are determined by the Turkish government. Oil product prices have been determined by refineries, importing companies and distributing companies since 1989. Coal prices are set annually by TKI and TTK, which are state enterprises. For electricity, there also exists a two-rate tariff for peak-period and non peak-period consumption, the latter is approximately 10 percent less expensive. The energy prices on a heat equivalent basis in Turkish Lira are summarized in Table 6-22 and those for industry in US dollars are shown in Table 6-23.

Table 6-21 Energy Consumption (%) by Sectors/Subsectors

		Fossil Fuel				Electricity
Sectors	Subsectors	Solid	Liquid	Gas	Fuel Total	
Metal	Iron & Steel	50.26	17.85	23.76	35.18	22.35
	Aluminum	0.50	2.92	0.13	1.25	7.47
	Copper	0.02	0.36	0.06	0.14	1.19
	Others	1.39	1.20	1.35	1.32	4.47
Non-metal	Cement	26.05	10.53	13.38	18.86	15.63
	Glass	0	2.49	8.52	2.20	1.54
	Bricks/Tiles	0.81	1.44	0.20	0.92	0.38
	Ceramics	0.17	1.18	8.86	1.90	1.48
	Other	0.56	0.80	0.14	0.57	0.40
Chemicals	Fertilizers	2.22	0.94	25.42	5.50	2.44
	Petrochemicals	0	22.94	7.57	8.88	7.72
	Main Chemicals	0.53	3.74	0	1.52	0.41
	Tires	0	0.95	0	0.32	0.71
	Pharmaceuticals	0	0.39	0	0.13	0.14
	Cleaning Materials	0.16	0.32	0.23	0.22	0.20
	Dyes/Varnish	0.02	0.24	0.01	0.09	0.14
	Others	0.66	1.00	0.97	0.62	0.75
Food	Sugar	10.14	2.84	0.05	6.08	2.53
	Edible Oils	1.15	1.29	0	1.01	0.95
	Alcoholic Bev.	0.06	1.37	0	0.49	0.43
	Tea	1.25	0.09	0	0.66	0.32
	Flour & Product	0.12	0.35	0.31	0.23	0.35
	Milk & Products	0	0.24	0	0.08	0.10
	Others	0.09	2.29	0.20	0.54	0.93
Textile	Weaving	2.29	8.50	5.66	4.90	5.63
	Carpets	0.01	0.08	0.37	0.09	0.31
	Knitting & Ready	0	0.44	0	0.15	0.17
	Others	0	0.77	0.28	0.30	0.78
Paper	Paper & Pulp	0.56	9.13	0.75	3.46	6.86
	Cardboard	0.20	0.10	0.01	0.14	0.27
Metals Fabricated	Auto Spares	0.01	0.45	0.30	0.20	1.15
	Machines Products	0.15	0.38	0.01	0.21	0.24
	Automotives	0.07	0.83	0.25	0.35	5.25
	Durable Goods	0.01	0.50	0.78	0.29	0.95
	Others	0.03	0.46	0.11	0.19	0.56
Forest	Wood	0.51	0.52	0.33	0.49	0.64

(Source: EIE Industrial Data Base Evaluation 1991)

Table 6-22 Energy Prices on Heat Equivalent Basis in Turkey

Unit: Turkish Lira per TOE

	Heavy Fuel Oil		Natural Gas		Steam Coal	
	Incl. Tax	Excl. Tax	Incl. Tax	Excl. Tax	Incl. Tax	Excl. Tax
1985	124638	n.a.	n.a.	n.a.	38353	n.a.
1986	145594	n.a.	n.a.	n.a.	49412	n.a.
1987	156624	n.a.	n.a.	n.a.	49412	n.a.
1988	237018	44146	215531	205269	111176	n.a.
1989	367783	157886	268069	255303	182353	n.a.
1990	640368	381866	365747	348190	297059	n.a.
1991	778801	430521	633087	597251	490588	n.a.
1992	1176198	617584	1024052	966087	857569	779805
1993	1748906	993043	1904996	1797163	1103400	980000
1994	3746723	2281015	4656094	4311169	2205941	1922353
1995 3Q	8627083	4822917	8210589	7602400	3896471	3388235

Electricity Generation

	Heavy Fuel Oil		Natural Gas		Steam Coal	
	Incl. Tax	Excl. Tax	Incl. Tax	Excl. Tax	Incl. Tax	Excl. Tax
1985	124638	n.a.	n.a.	n.a.	25000	n.a.
1986	145594	n.a.	n.a.	n.a.	43750	n.a.
1987	156624	n.a.	n.a.	n.a.	45500	n.a.
1988	237018	44146	259208	246838	657775	n.a.
1989	367783	157886	294134	280129	100250	n.a.
1990	640368	381866	410952	391383	118750	n.a.
1991	778801	430521	645069	608556	238750	n.a.
1992	1176198	617584	1044382	985266	459265	410060
1993	1748906	993043	1951953	1841481	888725	788960
1994	3746723	2281015	4771060	4417649	1958315	1702565
1995 3Q	8627083	4822917	8344100	7726022	4140000	3600000

Households

	Light Fuel Oil		Natural Gas		Electricity	
	Incl. Tax	Excl. Tax	Incl. Tax	Excl. Tax	Incl. Tax	Excl. Tax
1985	205742	n.a.	n.a.	n.a.	226163	215349
1986	241627	n.a.	n.a.	n.a.	347558	300465
1987	264354	n.a.	n.a.	n.a.	413605	351744
1988	466121	171590	350446	333758	572209	495465
1989	967370	430419	350446	333758	962558	833372
1990	1694947	837177	619216	589729	1539302	1325000
1991	2748599	1289673	1130299	1066320	3219535	2737674
1992	4525362	1920084	2058378	1941866	7334651	6236977
1993	6354280	2601894	3216822	3034738	12571860	10631279
1994	14212397	5600331	6881486	6371746	26292442	21774302
1995 3Q	26543062	9952153	10163627	9410766	43312093	35869186

Source: Data from MENR and IEA

Table 6-23 Energy Prices for Industry in US Dollars

Unit: US$/TOE

	1981	1991	1992	1993	1994
Turkey					
Natural Gas	-	151.9	149.3	173.7	156.4
Heavy Fuel Oil	292.8	186.8	171.4	159.5	125.8
Steam Coal	146.3	117.7	125.0	100.6	74.1
Electricity	715.4	971.3	1075.7	1102.8	891.0
Japan					
Natural Gas	553.2	471.9	484.6	516.6	518.0
Heavy Fuel Oil	279.8	250.5	219.1	225.9	187.3
Steam Coal	121.0	99.6	90.3	86.3	82.7
Electricity	1159.6	1538.9	1652.0	1892.7	2031.8
Germany					
Natural Gas	181.4	223.5	222.8	208.1	205.4
Heavy Fuel Oil	218.6	140.4	136.6	121.0	128.1
Steam Coal	156.8	253.1	285.9	271.4	277.7
Electricity	602.2	1019.8	1081.6	1039.0	1072.5
France					
Natural Gas	207.1	168.1	169.8	158.9	157.5
Heavy Fuel Oil	204.9	119.3	123.3	107.7	147.5
Steam Coal	110.2	131.5	141.3	133.3	135.9
Electricity	475.9	625.8	664.4	636.0	617.6
UK					
Natural Gas	186.2	180.0	175.1	143.4	140.3
Heavy Fuel Oil	225.8	124.8	115.9	100.5	118.3
Steam Coal	126.7	123.0	121.3	96.9	97.8
Electricity	733.2	830.6	887.4	787.4	794.2
USA					
Natural Gas	134.4	112.3	118.2	127.0	125.9
Heavy Fuel Oil	192.1	87.3	89.3	97.1	103.1
Steam Coal	69.0	58.6	57.4	56.9	56.9
Electricity	498.8	565.1	564.0	565.1	548.8
OECD					
Natural Gas	144.6	139.2	142.0	142.9	142.3
Heavy Fuel Oil	211.3	149.8	139.9	131.8	132.0
Steam Coal	91.9	95.4	107.7	96.9	97.5
Electricity	607.0	834.4	874.3	876.9	899.2

Source: Based on data from IEA (Energy Prices and Taxes)

Chapter 7 Energy Conservation Policy and Activities

Chapter 7 Energy Conservation Policy and Activities

In this chapter, the energy conservation policy in Turkey considering medium- and small-scale manufacturing industries is studied. This chapter consists of six elements shown as follows:

1. Concept of Government Policy on Energy
2. Organization related to Energy Conservation
3. Medium- and Small- Scale Manufacturing Industry
4. Institutional Functions such as Pricing of Energy, Energy Conservation Laws and Regulations, Incentives and Awareness
5. Organization and Activities of EIE and NECC
6. Conclusions and Recommendations on Energy Conservation Policy

7-1 Concept of Government Policy on Energy

The basic energy policy of Turkey is concentrated on assurance of energy supply; reliably, sufficiently, on time, in economic terms, considering environmental impact and in a way that will support targeted growth and social development. The government has focused its efforts on improvement of domestic production by utilizing public, private and foreign investments, and increasing efficiency by rehabilitation and acceleration of existing construction programs to initiate new investments. The policies for coal, petroleum and natural gas, and electric power are summarized in Appendix 7-1.

Energy saving is another principle in Turkish energy policy. Nevertheless Turkish energy strategy is aimed at satisfying demand without hampering economic growth. In order to meet this aim, along with enhanced recovery of domestic sources, energy management, rational utilization and conservation of energy are also adopted as other elements of the Turkish national policy to secure the supply and to protect the environment.

To ensure these policy objectives, the Turkish Government has been promoting energy conservation on a national scale and accelerating development of alternative energy resources since the early of 80's.

7-2 Organization and Role related to Energy Conservation

Organizations in charge of energy conservation in Turkey are the Ministry of Energy and Natural Resources (MENR) and the General Directorate of the Electrical Power Resources Survey and Development Administration (EIE). Besides MENR and EIE, several organizations are related to energy conservation activities.

7-2-1 Existing Organization

(1) Organization related to Energy Conservation in Turkey

Organizations related to energy conservation in Turkey are listed below.

1) Ministry Energy and Natural Resources (MENR)
   (a) General Directorate of Energy Affairs
      a) Fuel and Energy Conservation Division and the Energy Conservation Coordination Board (ECCB)
      b) Energy Technology and R&D Division
      c) Pricing Division
      d) Fuel Oil and Environmental Affairs Division
   (b) Research, Planning and Coordination Board (RPCB)
   (c) Other Organizations
      Organizations reporting directly to the Undersecretary such as General Directorate of Electrical Power Resources Survey and Development Administration (EIE)

2) Other Ministries and Institutions

Main ministries and institutions other than MENR involved to some extent in the energy conservation activities are listed below.

   (a) State Planning Office
   (b) State Institute of Statistics
   (c) Turkish Standards Institute (TSI)
   (d) Under Secretary of Treasury
   (e) Ministry of Industry and Commerce
   (f) Ministry of the Interior
   (g) Ministry of Reconstruction and Resettlement
   (h) Turkish Scientific and Technical Research Institute
   (i) General Directorate of Environmental Affairs

(2) Review of Main Organizations Related to Rational Use of Energy in Industry

The main organizations related to energy conservation in manufacturing industry are reviewed below.

1) Ministry of Energy and Natural Resources (MENR)

The Ministry of Energy and Natural Resources (MENR) is the main body of the Turkish energy sector and is responsible for the preparation and implementation of energy policies, plans and programs in coordination with its dependent and related institutions and other public and private entities. Figure 7-1 illustrates the organization of MENR and its related organizations.

(a) General Directorate of Energy Affairs

a) Fuel and Energy Conservation Division

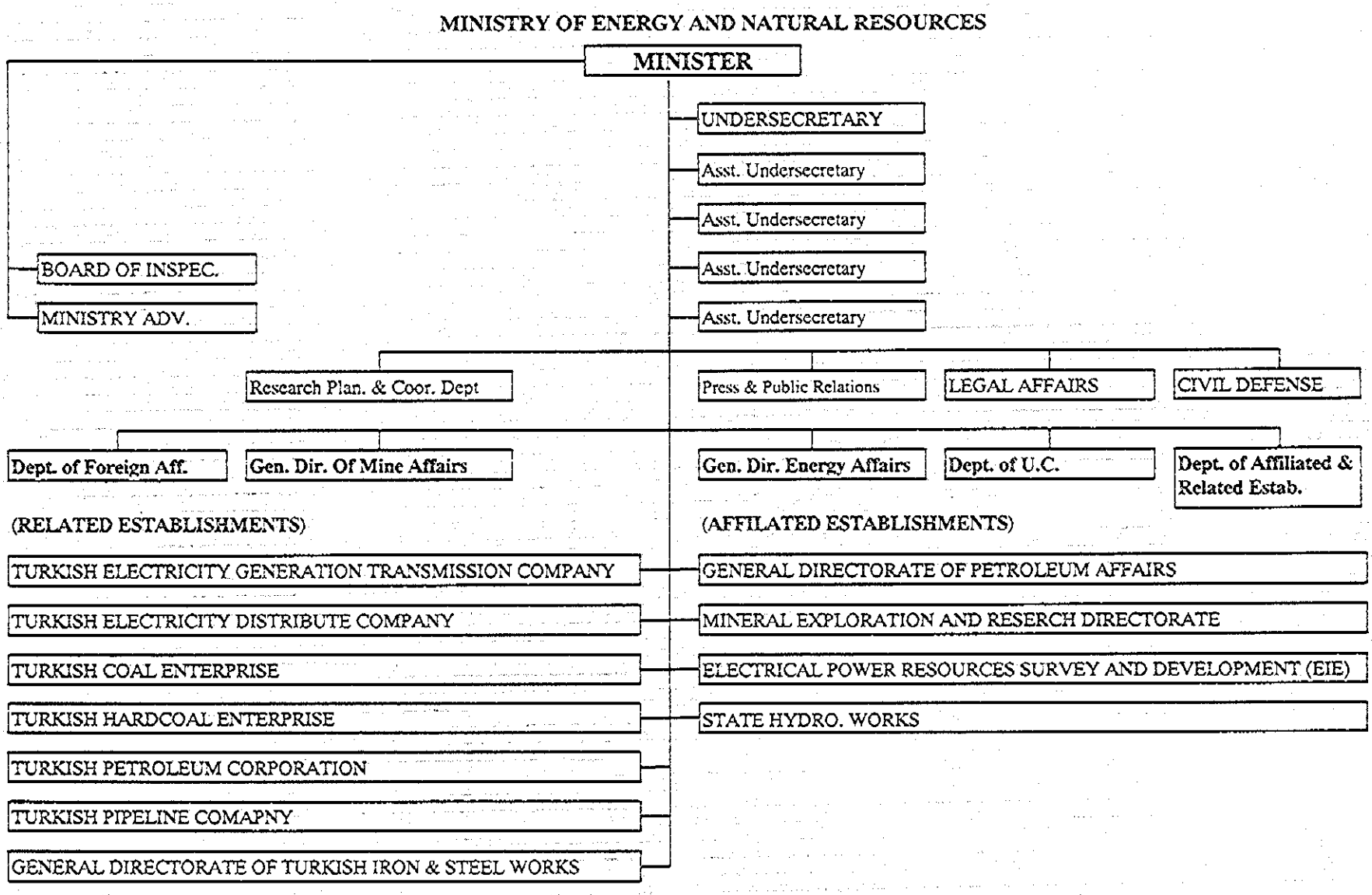
Officials of the Fuel and Energy Conservation Division work directly on energy conservation matters. Activities such as policy making, secretarial work of the ECCB, and technical advice of the board are included. Figure 7-2 illustrates the organization of the General Directorate of Energy Affairs of MENR.

b) Energy Conservation Coordination Board (ECCB)

ECCB, which is under the responsibility of the General Directorate of Energy Affairs, was created in April 1981 by a Prime Minister's decree to coordinate the rational use of energy activities of ministries, institutions and agencies to enhance energy conservation awareness. These roles were modified in 1984 when all of the government's coordination boards were abolished. ECCB now works on a voluntary basis with no legal mandate. As a result, the board has no authority over the actions taken in other ministries and institutions. Also the board has no role to play in coordinating energy conservation and R&D.

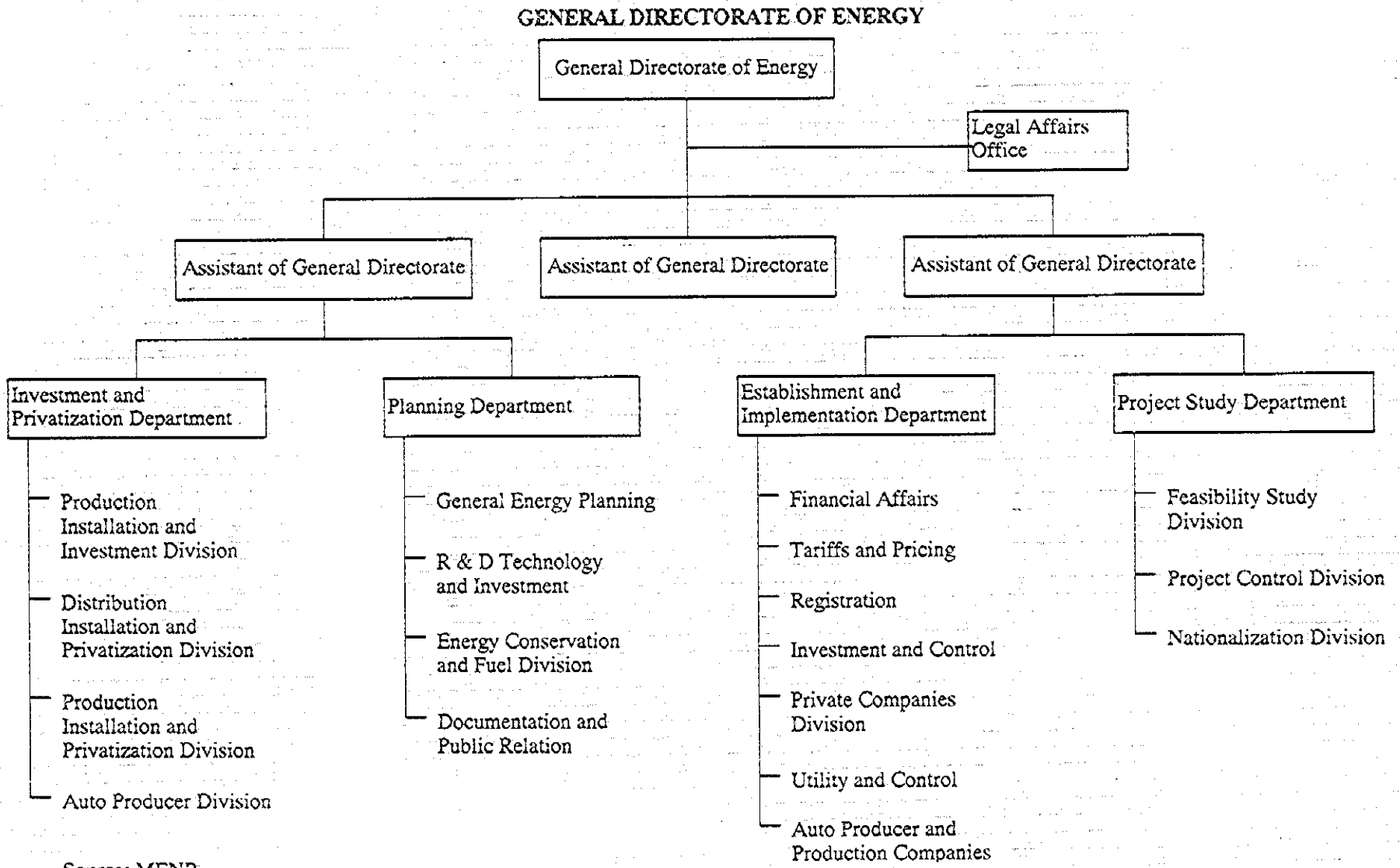
In the past there was reporting system to send to MENR as one of the major activities of ECCB; before 1984 the report had been sent to the Office of the Prime Minister. The current primary activities of ECCB are as follows:

1. Coordination of energy conservation campaigns
   Coordination of government energy conservation awareness campaigns, including an annual Energy Week held in the second week of January, preparation of posters, brochures, etc.
2. Coordination of energy conservation studies
   Meetings are held every one or two months on average. Almost all related ministries



Source : MENR

Figure 7-1 Organization Chart



Source: MENR

Figure 7-2 Organization Chart

and agencies except the State Planning Organization (SPO) participate in the meetings. In addition, representatives from institutions, associations, universities, and private companies are also present.

The reports, memorandum, recommendation, programs prepared by ECCB on energy conservation have no legal authority.

(b) Energy Technology, R&D and Environment Division

This division is responsible for coordination and setting priorities for energy R&D in the Ministry. It coordinates R&D planning prior to submission of requests to the SPO.

(c) Research, Planning and Coordination Board (RPCB)

The role of the RPCB is to provide coordination and advice. It has three departments:

1. Planning and Finance Department
   The Planning and Finance Department prepares medium- and long-term energy utilization plans and projections.
2. Research and Development Department
   This department is responsible for organization and method analysis on the research work. This department coordinates and evaluates energy R&D. This department is also involved in the development of the 7th 5-year plan.
3. Coordination Department
   This department coordinates investments among MENR and other institutions.

2) Organizations Related to MENR

Related organizations which attend ECCB meetings on rational use of energy are described in this section.

(a) Related Establishments

There are the following related establishments.

1. Turkish Electricity Distribution Company (TEDAS) and Turkish Electricity Generation and Transmission Company (TEAS)
   These organizations are responsible for generation, transmission and distribution of electrical energy, project formulation, construction, and operation and maintenance of power systems in Turkey.
2. Turkish Coal Enterprise (TKI)
   TKI is responsible for exploration of domestic coal (lignite and asphaltite) and also for

exploitation and marketing of these resources.

3. Mineral Exploration and Research Directorate (MTA)
   MTA is the oldest and leading organization, responsible for systematic investigation and research on all kinds of mineral resources.
4. Turkish Hardcoal Enterprise (TTK)
   This enterprise carries out exploration, exploitation and marketing of domestic hard coal.
5. Turkish Petroleum Corporation (TPAO)
   TPAO's main activity is oil and gas exploration and production.
6. Turkish Pipeline Company (BOTAS)
   This company is responsible for installation of oil and gas pipelines throughout the country. The company is also authorized to sign and execute natural gas import contracts, to prepare plans and programs for utilization of natural gas in various sectors and for distribution of gas to urban areas and consumer sectors.

(b) Affiliated Establishments of MENR

a) General Directorate of Petroleum Affairs (PIGM)

The main activity of this organization is to give licenses to Turkish and foreign companies to explore, produce and refine oil; monitoring price of oil and oil products is also among its responsibilities.

b) Electrical Power Resources Survey and Development Administration (EIE)

This administrative body, a major organization under MENR, carries out investigations and surveys with the aim of identifying the energy potential of water resources of the country, and prepares dam and hydropower plant projects.

EIE became involved in energy conservation as early as 1980 and established its own energy conservation team backed up by the necessary equipment and vehicles to carry out various energy conservation activities. The Energy Conservation Division of EIE was nominated as National Energy Conservation Center (NECC) of Turkey by the end of 1992. NECC's activities include Energy Bus Programs, Training Bus Program, Publications, Data Base, etc. Various studies on energy conservation and new and renewable energy resources are also carried out by NECC.

There are letters of mandate to EIE, one dated March 30, 1981, to establish the new administration for energy conservation and renewable energy written by the Minister of Energy

and an approval letter by SPO dated July 2, 1981.

3) Other Ministries and Institutions

(a) State Planning Office (SPO)

SPO is responsible for overall economic planning of the energy related sectors through MENR. SPO prepares recommendations for budgets and policy priorities. SPO has three major functions with respect to energy conservation. These are:

1. Preparing national five year development plans and one-year implementation plans which give the overall policy framework and thus reveal the priority given to energy conservation.
2. Preparing action plans
3. Evaluating the effectiveness of state investment

(b) State Institute of Statistics (SIS)

The State Institute of Statistics bears the important responsibility of collecting, analyzing, and publishing data on Turkey's social and economic conditions. The aim of SIS publications is to offer statistical data to public and private institutions, both foreign and domestic, in order to present a clear picture of Turkey, both its current condition and its future potential. The Energy Statistic Division of SIS has close contact with EIE to compile a new data base system for information on plants consuming 500 TOE or more energy annually.

The study team expects that this division will play an important role in establishing an energy data base system collaborating with EIE's Industrial Energy Conservation Division.

(c) Turkish Standards Institute (TSI)

TSI is responsible for preparing all technical standards in Turkey. Standards are developed by using boards of technical experts. A standard is developed on the initiative of TSI after surveying both private and public sectors.

In Article 9 of the Regulation on Energy Efficiency Improvement at Industrial Plants, it is stated that measuring equipment for the plant management should be periodically controlled and calibrated by TSI to make sound monitoring of the energy consumption by the plants possible.

The study team expects that this Institute will prepare more standards in the field of rational use of energy and energy conservation.

(d) **Ministry of Industry and Commerce**

The ministry had been involved in several aspects of industrial energy conservation in the 1980s; however, no activity for conservation is currently undertaken except for participating in meetings of ECCB. The Ministry of Industry and Commerce organization chart is shown in Figure 7-3.

(e) **KOSGEB**

In the Ministry, there is an organization called KOSGEB. KOSGEB was established in April 1990 by a special Act No. 3624 for this purpose, incorporating the former Small Industry Development Organization (KUSGET) and Industrial Training and Development Center (SEGEM), which were established as joint projects of UNIDO and the government of Turkey to deliver all forms of non-financial services needed by small industries.

The main functions of KOSGEB are:

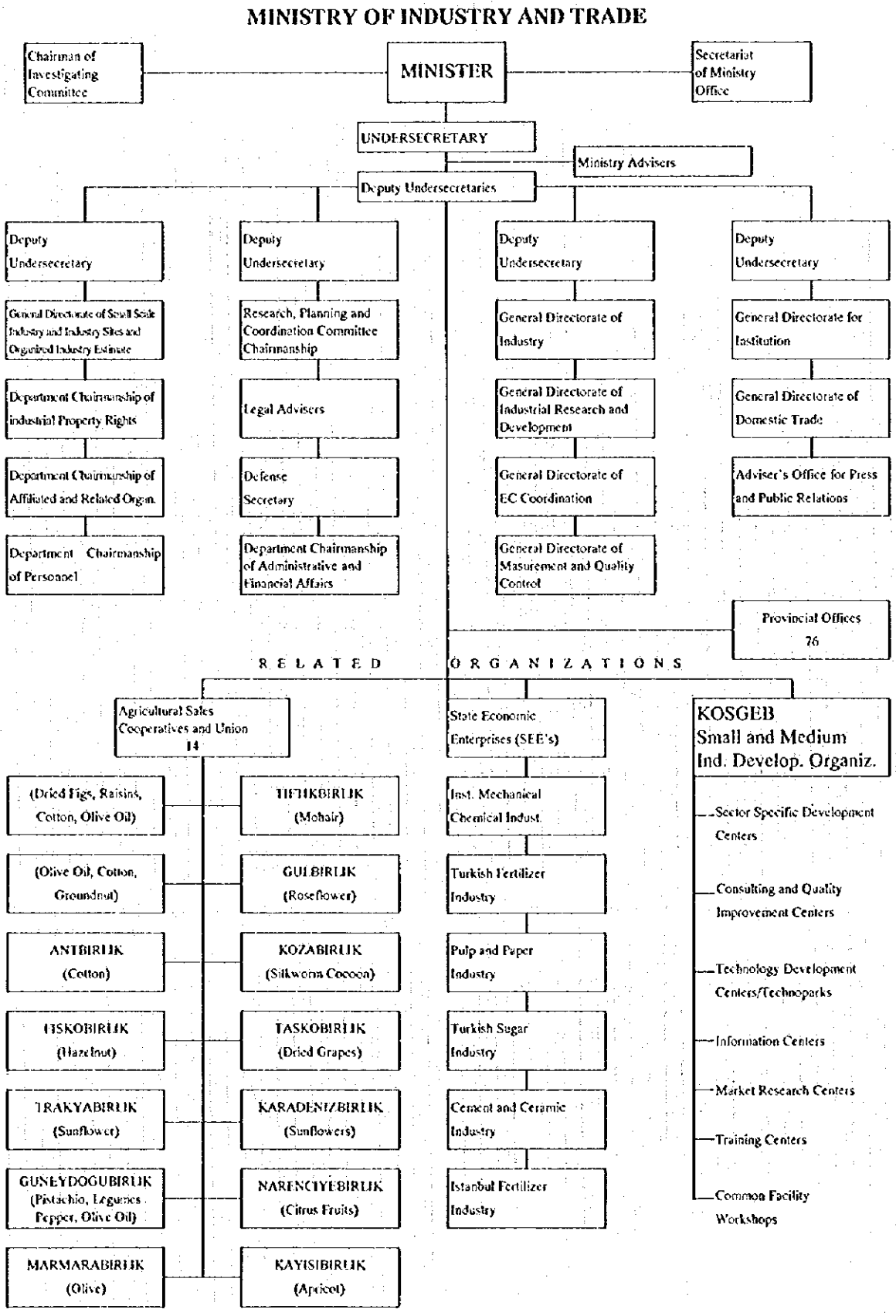
1. Access to information
2. Adoption of technological developments
3. Creation of environment for entrepreneur shop support
4. Development of ancillary industrial relations
5. Quality assurance
6. Training
7. Data Gathering and analysis

KOSGEB has the experience already accumulated by KUSGET and has 40 extension service offices equipped with competent professional staff. KOSGEB continues to provide diverse technical, management and consulting services to small- and medium-scale industries.

All functions and activities are being carried out by the KOSGEB's so-called Development Centers which are namely:

1. Sector Specific Development Centers
2. Consulting and Quality Improvement Centers
3. Technology Development Centers/Technoparks
4. European Union Information Centers
5. Market Research Centers
6. Training Centers
7. Common Facility workshops

No cooperative activities between KOSGEB and EIE/NECC exist.



Source : MOIT

Figure 7-3 Organization Chart

(f) Others

As well as SPO, SIS , TSI and the Ministry of Industry and Commerce, the Ministry of Reconstruction and Resettlements, Ministry of Transportation, Turkish Scientific and Technical Research Institute and Ministry of Public Education are involved in energy conservation activities through the activities conducted by ECCB.

7-2-3 Analysis

(1) In general

1) Effectiveness of the Turkish Organizational Structure

The single window system is good, but it is necessary to coordinate among governmental and private organizations to promote energy conservation. It is good that EIE/NECC has taken the leadership and responsibility for energy conservation activities among ministries, agencies and institutions. In industrial sector, the Ministry of Industry and KOSGEB have functions such as access to informative means, adoption of technological developments and training. Coordination among EIE/NECC, the Ministry of Industry and KOSGEB is required to promote smooth and effective energy conservation in the industrial sector as well as enhancing awareness through the activities of ECCB.

2) Government Commitment

The study on Energy Conservation in IEA member countries by the International Energy Agency concluded that: "In governments, there is a need for a strong central conservation policy group headed by a senior official who forms part of the top management of the Energy Department or a related group; there should also be effective interdepartmental coordination of conservation activities. Strong political leadership and bureaucratic commitment are, however, the key to the success of government conservation activities." Strong political leadership with bureaucratic interest is expected to promote energy conservation in such a country that is highly dependent on a foreign supply of energy.

3) Planning

Energy conservation is often cheaper than new energy supply. A general statement on energy conservation appeared in the seventh Five Year Development Plan (1996-2000) without specific target and priorities. Energy conservation activities such as regulation, energy audit, energy bus program, publication have been instituted. However, an overall energy conservation program, or a master plan, with well-defined targets, strategy, budget, and action program is not formulated yet.

4) **Financial Source for Activities**

In the government sector, the acquisition of extra budget for promoting an energy conservation program is difficult. For the measure to create a fund, expansion of existing scheme or creation of new monetary source is needed. For this purpose, strong political leadership with bureaucratic interest is needed.

(2) In View of Medium- and Small-Scale Manufacturing Industry

1) KOSGEB, Small and Medium Industry Development Organization

During the first field survey, the study team visited the Foundry Development Center located in the center of the Ankara suburban industrial park where 120 foundries have been installed. This center was established in April 1990 as one of KOSGEB's Quality Improvement Centers. It has been helping medium- and small-scale foundries to identify their problems, and proposing solutions applicable under local circumstances to improve quality and lower costs. The Center also provides extension services to upgrade the quality of foundry products, and to increase productivity and profitability through technical and management consultancy and laboratory services as well as research and development studies.

KOSGEB not only has assumed responsibility for numerous functions but also has developed new programs aimed at strengthening the medium and small establishment components of Turkey's industrial structure. It would be advisable to utilize the function of KOSGEB Development Centers to implement EIE/NECC's energy conservation programs in medium- and small-scale manufacturing industry consuming energy of less than 2,000 TOE annually, since EIE/NECC has no connections there.

1. To collaborate with EIE/NECC in selecting candidate plants for energy audits among medium- and small-scale industries
2. To collaborate with EIE/NECC in delivering technical information publications on energy conservation in order to improve awareness of energy savings among medium- and small-scale industries' management and engineers
3. To collaborate with EIE/NECC in holding seminars on energy savings programs for management and engineers of medium- and small-scale industries
4. To conduct jointly with EIE/NECC consultative services on energy savings investment for management of medium- and small-scale industries

2) Ministry of Industry and Commerce, Small Industry Department

This Department is in charge of: (1) giving loans/credits, and (2) constructing industrial parks for medium- and small-scale industries in Turkey.

With regard to energy conservation, the Department generally plans to supply industrial water and waste water/solid disposal systems in industrial parks, but normally does not provide energy supply systems. The General Director of the Department is reportedly taking the initiative to building a 50 MWh power generating plant in a regional industrial park located near Istanbul.

It is important to develop energy efficient industrial parks equipped with a central utility supply center and energy supply center. It will be beneficial if rational use of energy could be incorporated at the planning stage of factory installation.

7-3 Medium- and Small-Scale Manufacturing Industry

(1) Importance of Energy Conservation in Medium- and Small-Scale Industry

To save energy is surely to reduce production cost. This is true especially for smaller scale plants. The importance of energy conservation shall be emphasized for them. Refer again to Table 6-19 in Chapter 6 of this report, the ratio of energy consumption including raw material to input by each size group will illustrate this fact as follows.

Table 7-1 Ratio of Energy Consumption to Input

Size	1-9	10-49	50-99	100-199	200-499	500-999	1000 +	Total
Ratio(%)	97.6	85.5	85.2	84.9	79.9	89.7	89.1	86.9

Ratio = Energy and Raw Material Input / Total Input

(2) Energy Consumption Rate by Size

The Regulation on Energy Efficiency Improvement in Industrial Plants was issued on November 11 1995. This regulation is applied to industrial establishments annually consuming energy equal to or more than 2,000 TOE. It would be helpful to conduct an energy conservation program in industry since the energy consumption covered by the Regulation will be more than 70 percent of the total. But the Regulation does not cover all of the industrial sector; most medium- and small-scale manufacturing industries fall outside of the Regulation coverage.

In this regard the study team, after comprehensive discussion with EIE, concludes that more effort should be made for energy conservation in smaller scale factories which consume less than 2,000 TOE annually.

Figures 7-4 through 7-11 will illustrate this.
(Base data: Industrial Data Base Evaluation 1991 by EIE)

(3) Bottlenecks in Energy Conservation in Industry

Bottlenecks become more pronounced when industries become smaller.

1) Lack of information

Insufficient recognition of the importance of energy conservation, ambiguity of the effect of various measures for energy saving, inadequate PR activities and lack of information appear to be major bottlenecks.

2) Lack of technology and skill

Insufficient technical knowledge and experience, and low credibility of new technologies are bottlenecks. This could be coped with partially by intensification of information collection and extension activities by EE/NECC.

3) Lack of funds

An appropriate institutional financing system should be considered.

4) Insufficient availability of equipment for energy saving

Industries manufacturing and selling energy saving equipment are not full-fledged. Measures to stimulate their growth are important.

5) Return on investment in energy saving measures

Promotion activities are needed for evaluating returns on investment

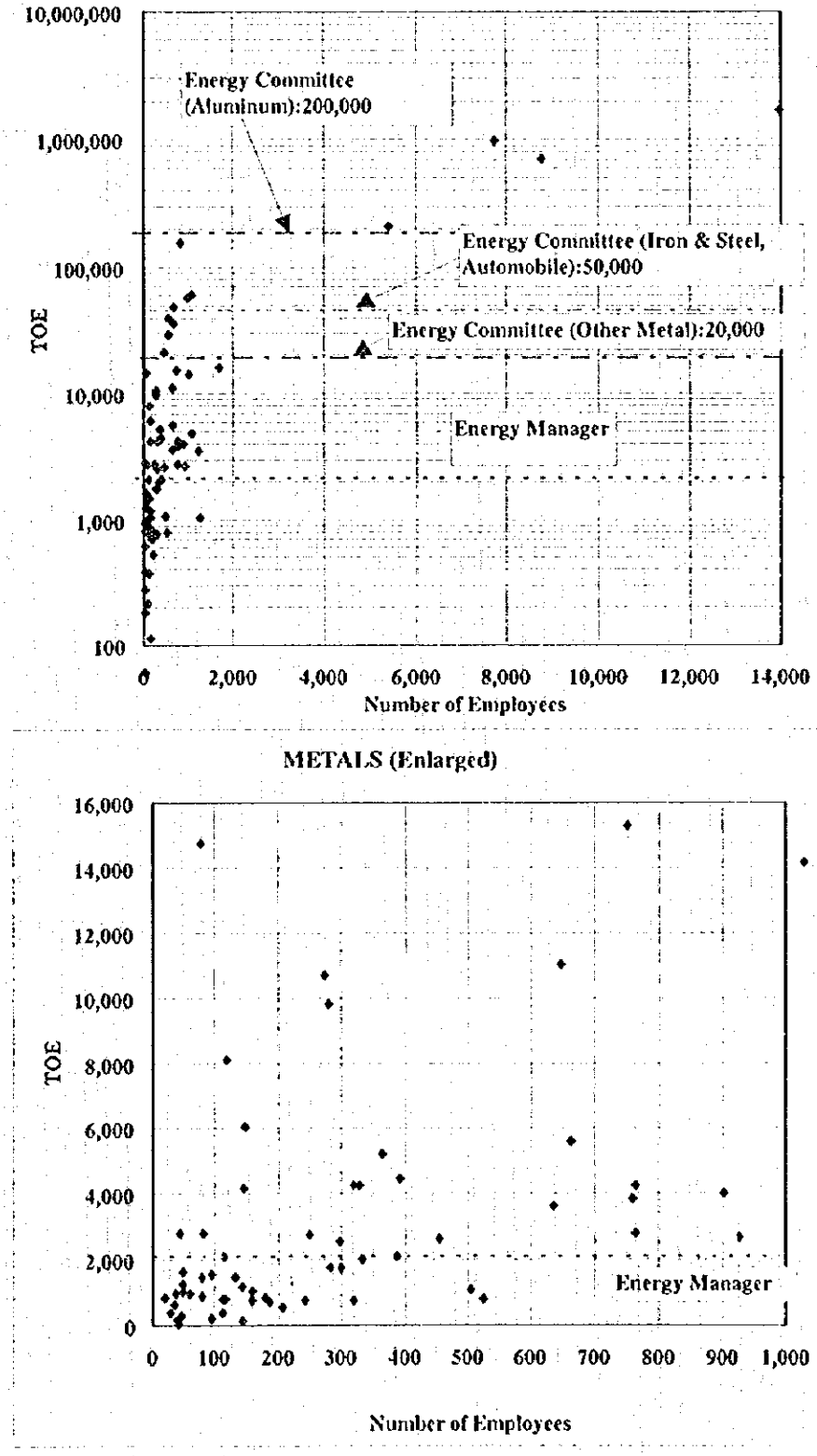
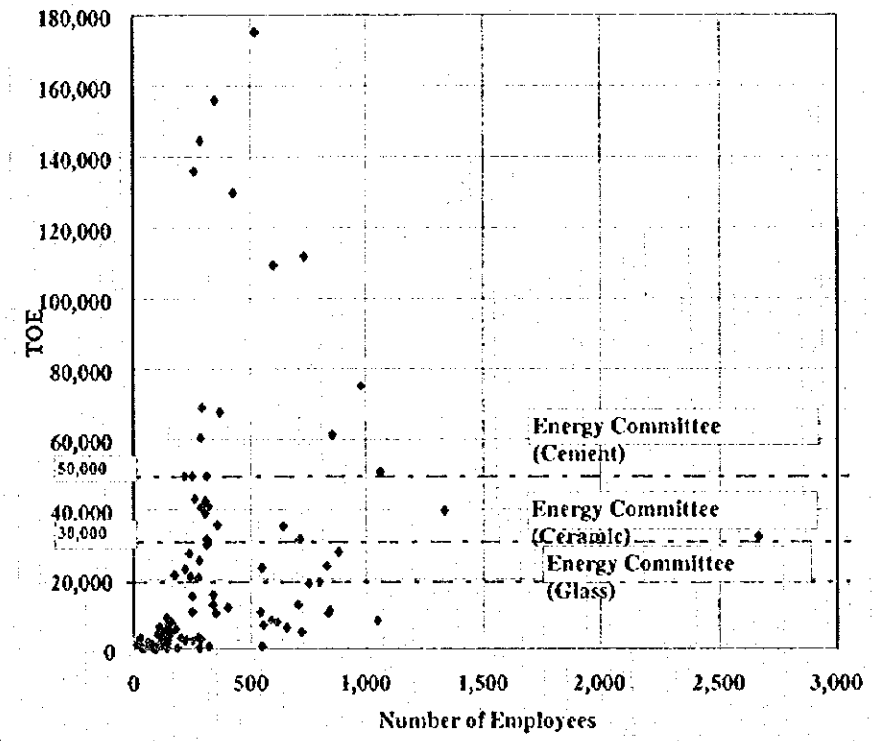


Figure 7-4 METALS Industry: Energy Consumption Rate by Size



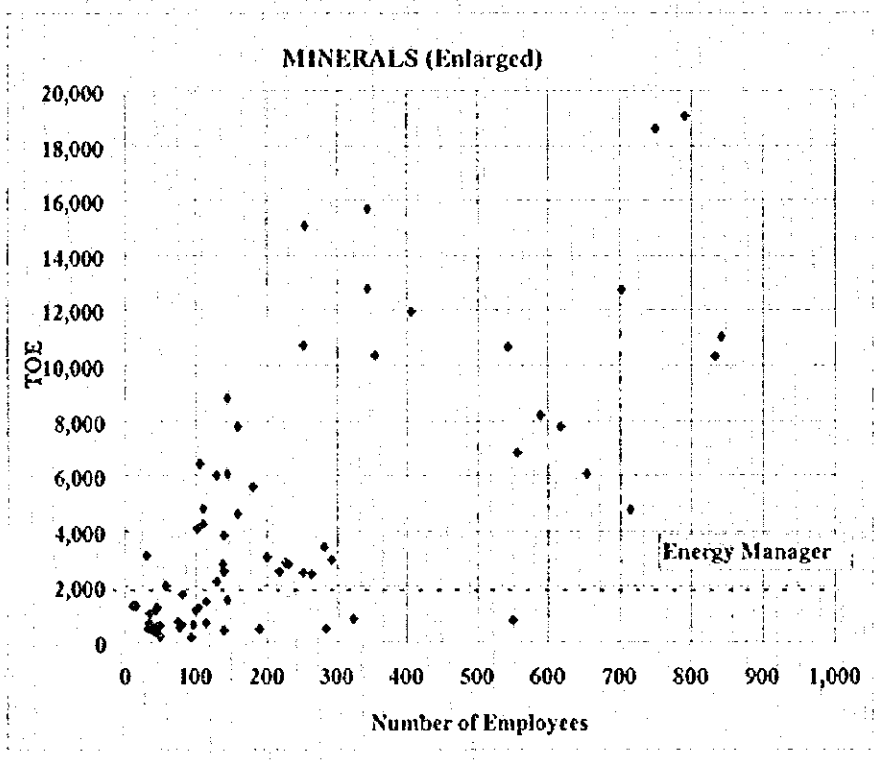


Figure 7-5 Minerals Industry: Energy Consumption Rate by Size

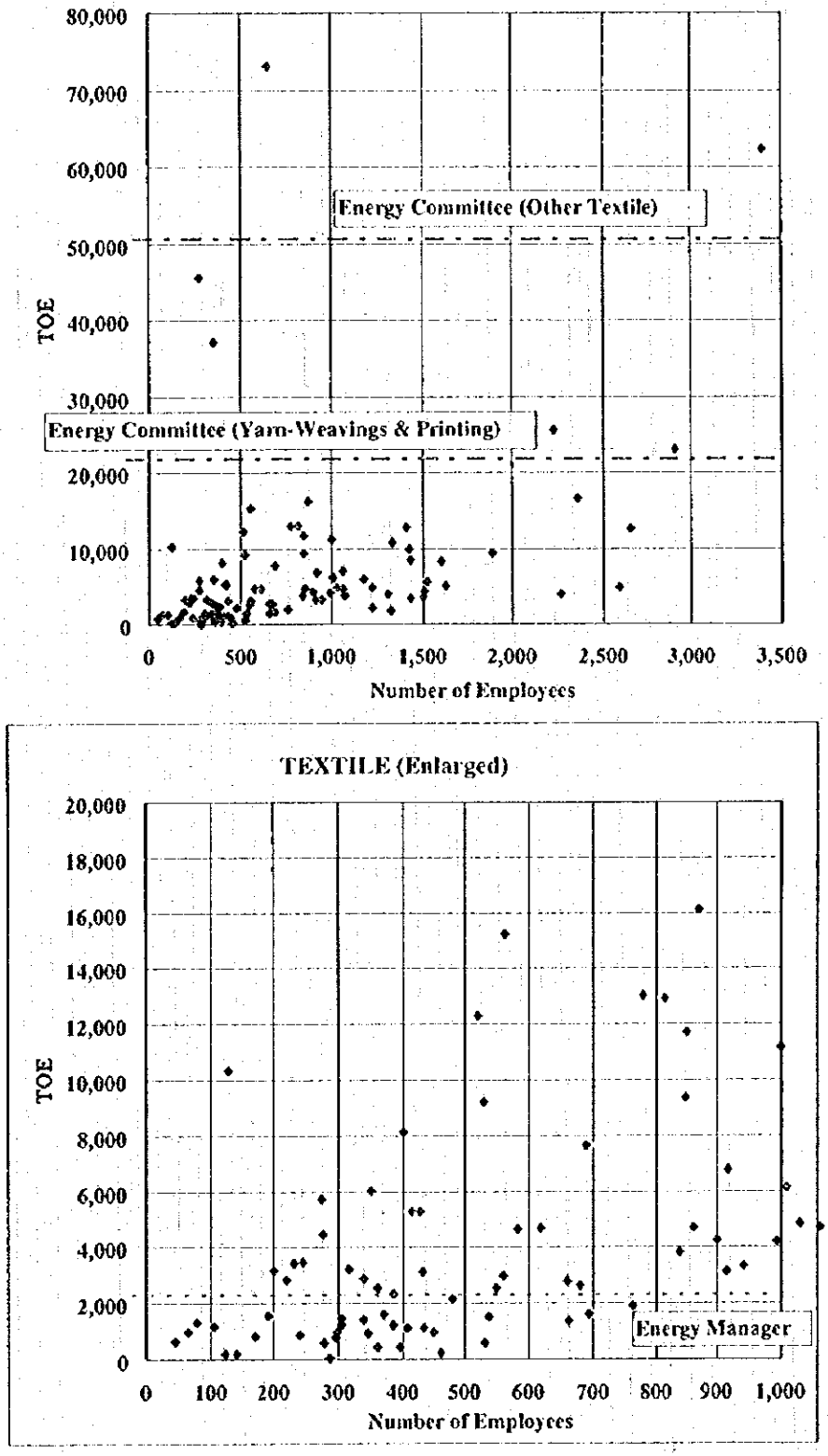


Figure 7-6 TEXTILE Industry: Energy Consumption Rate by Size

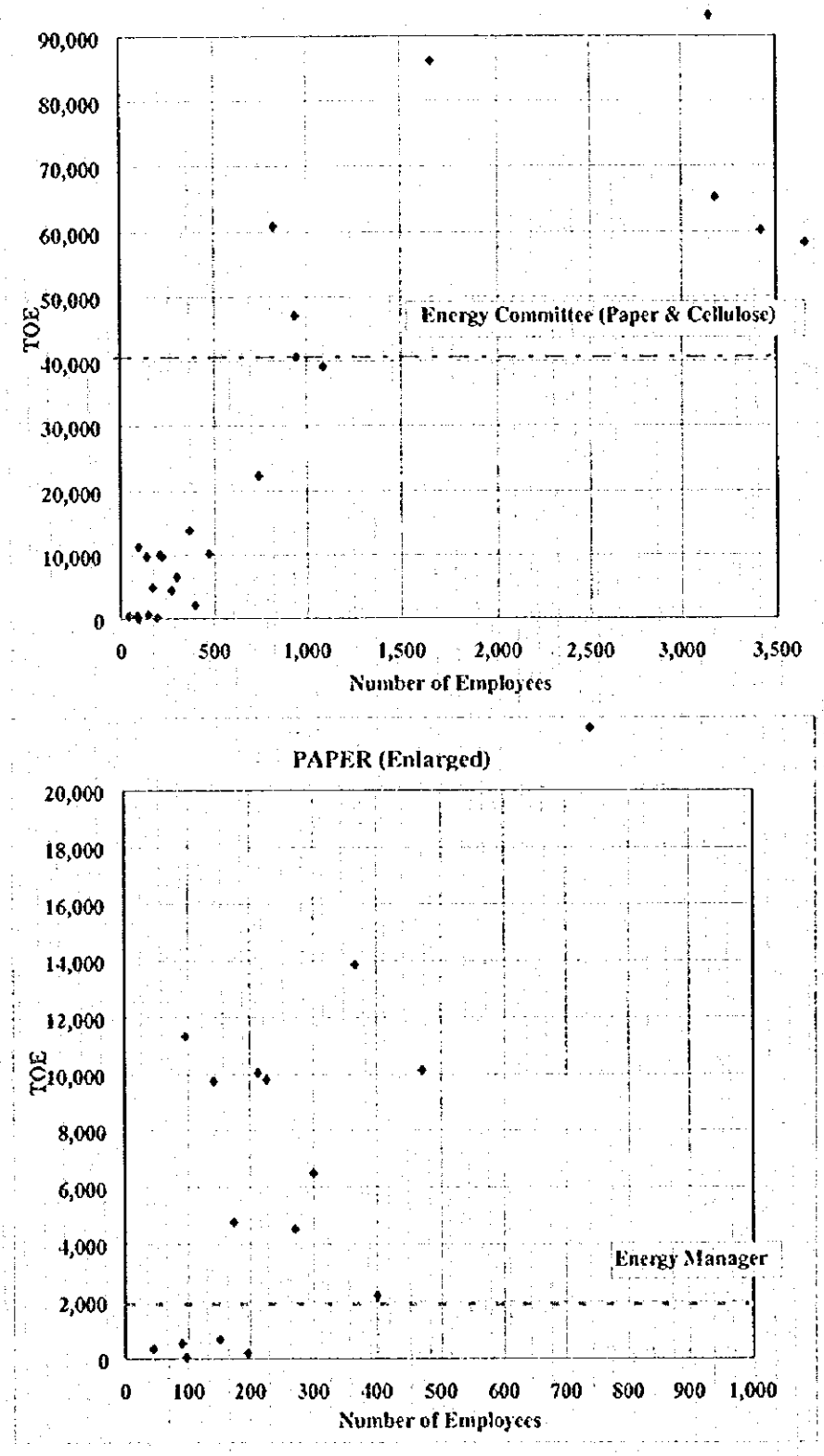
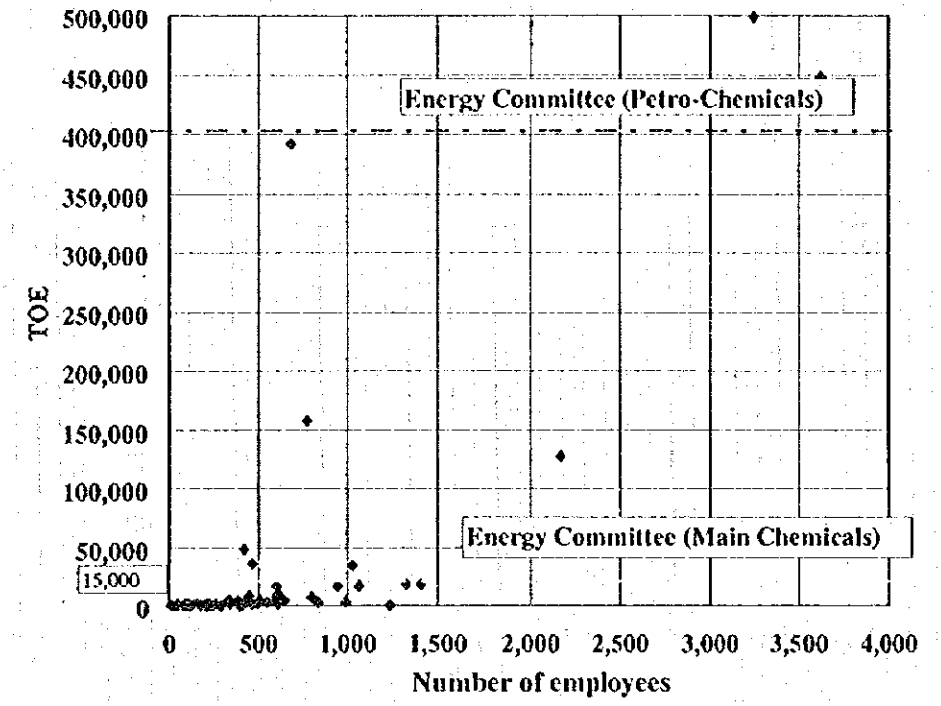


Figure 7-7 PAPER Industry: Energy Consumption Rate by Size



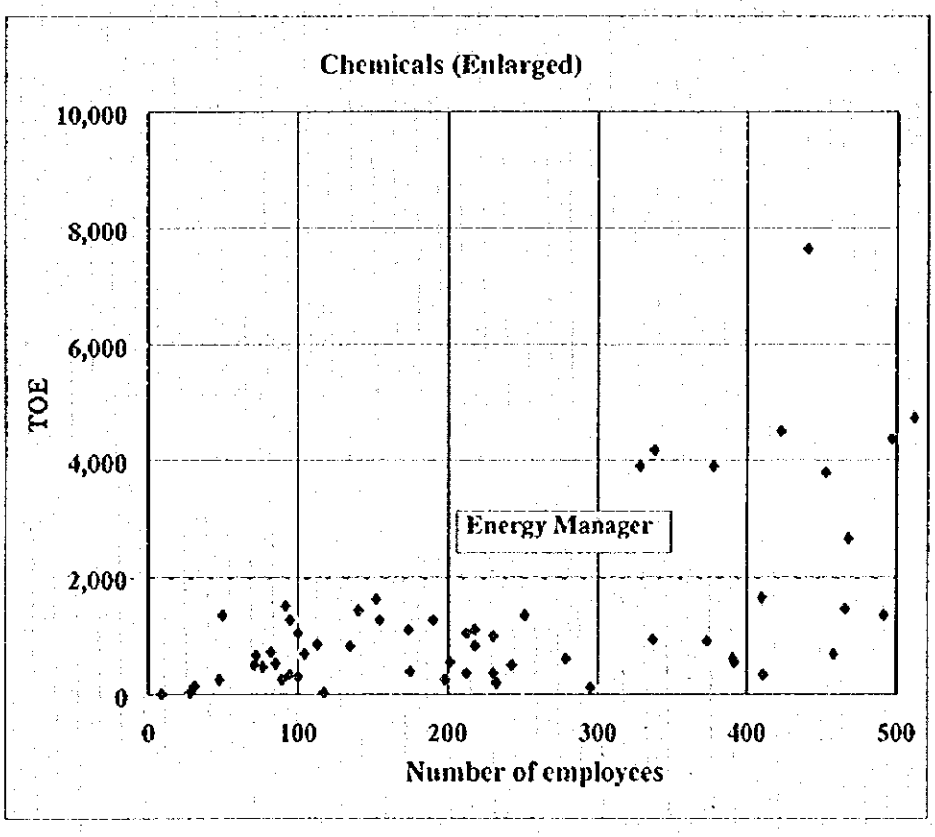


Figure 7-8 Chemicals Industry:Energy Consumption Rate by Size

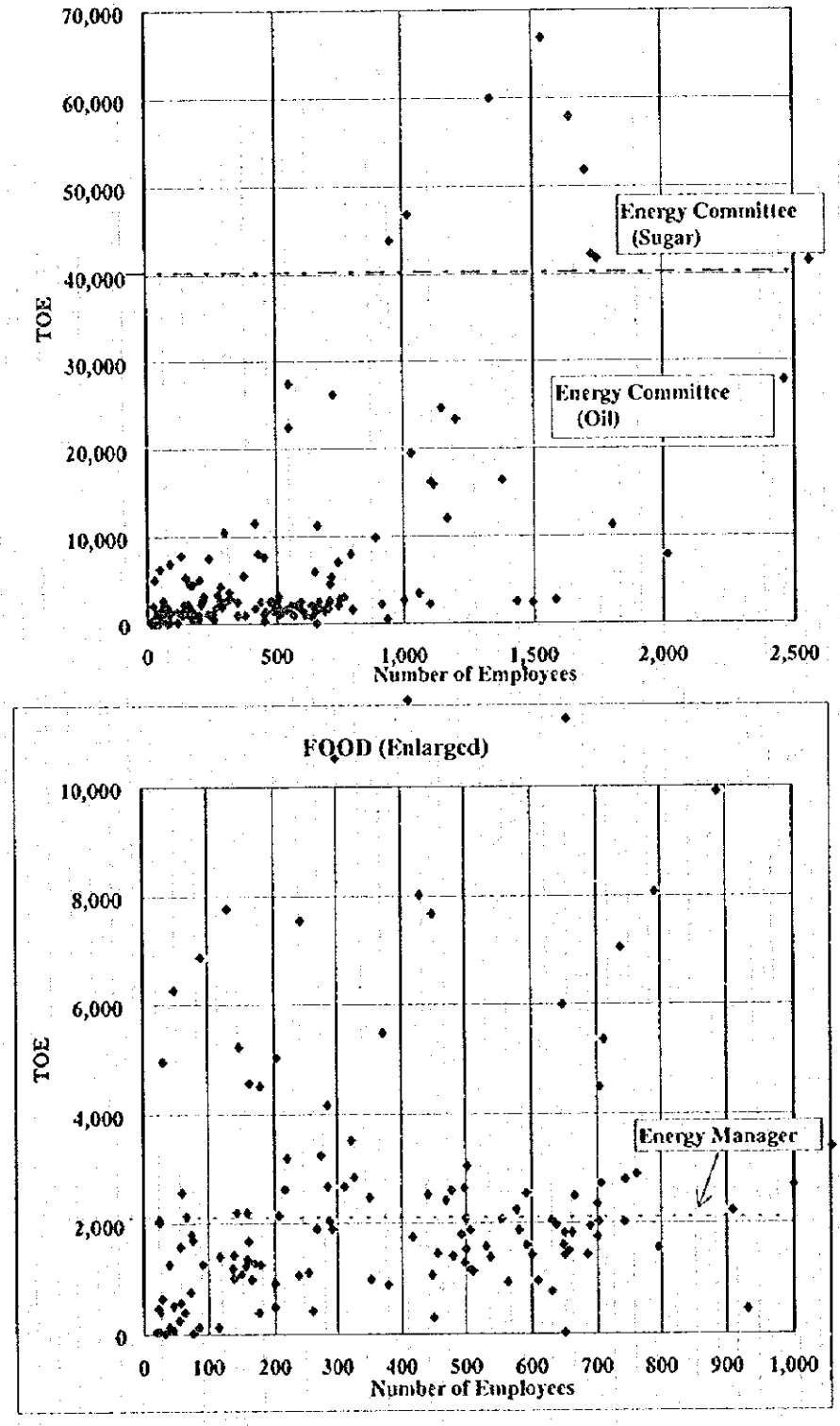
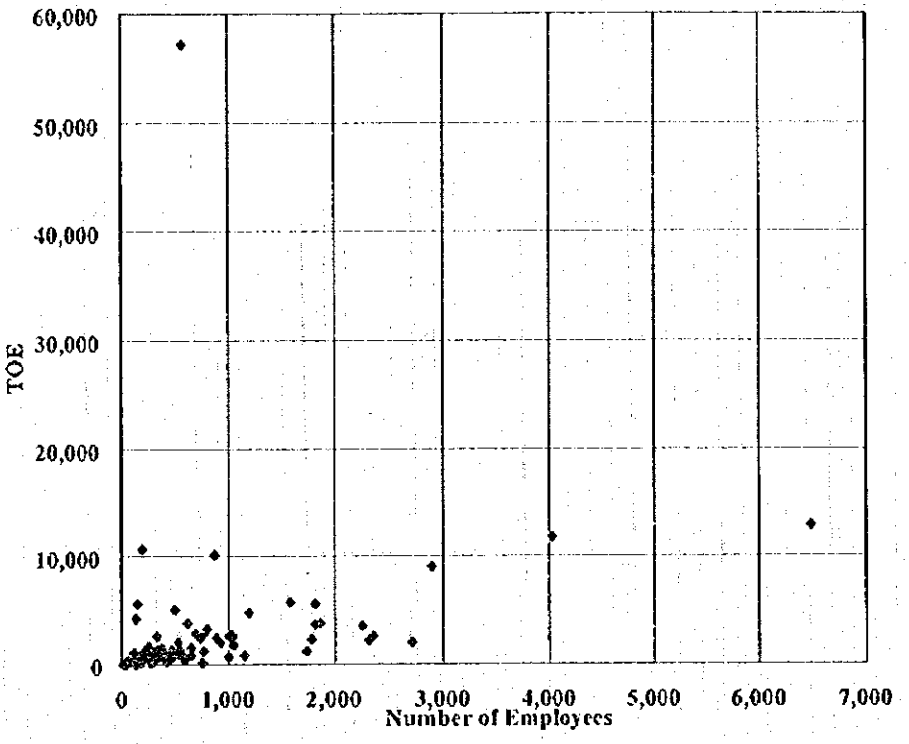


Figure 7-9 FOOD Industry: Energy Consumption Rate by Size



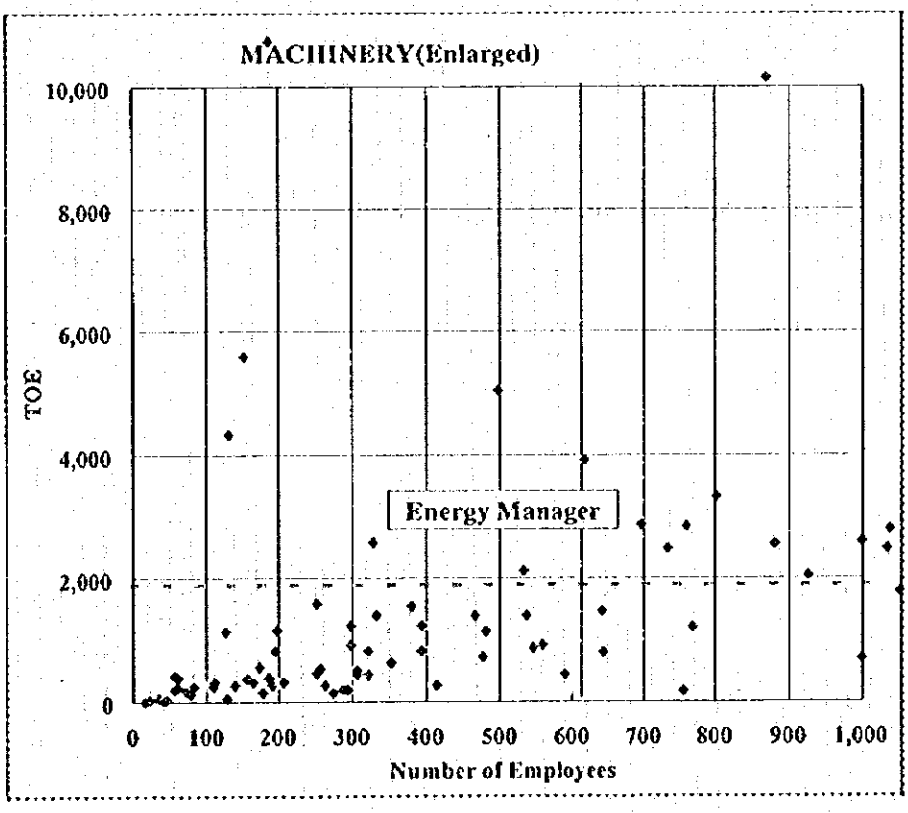


Figure 7-10 MACHINERY Industry: Energy Consumption Rate by Size

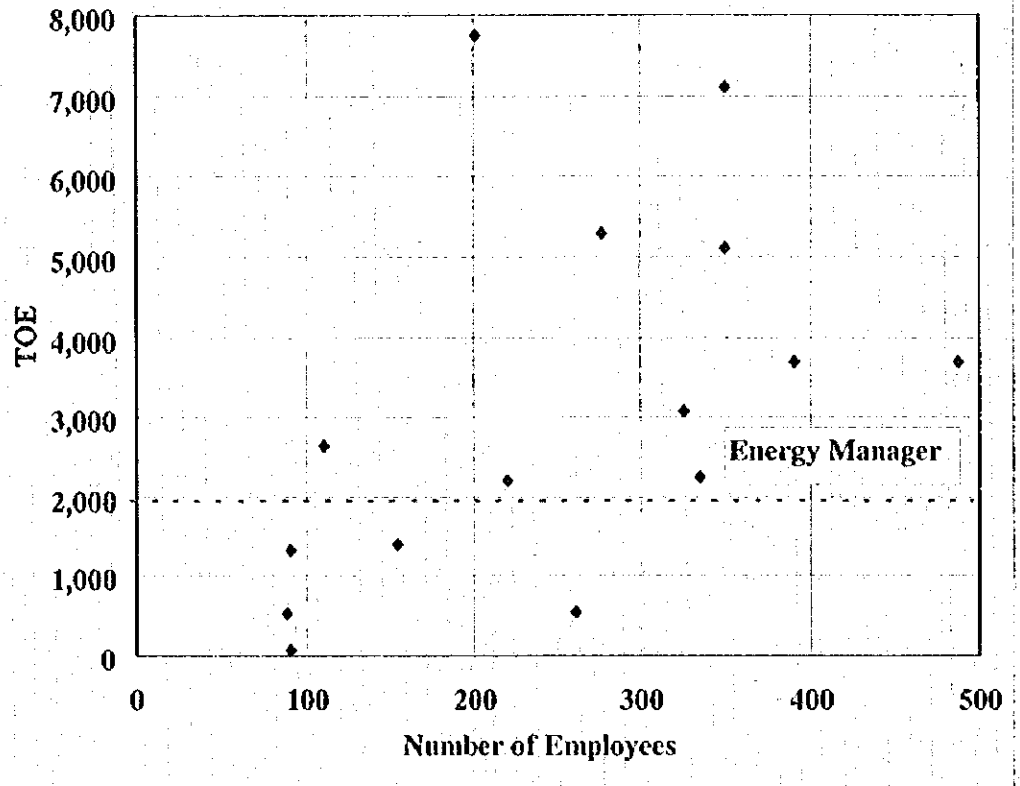


Figure 7-11 FOREST Industry: Energy Consumption Rate by Size