of view of effective utilization of domestic energy, the Turkish Government plans to continue in the future with positive development of hydroelectric power, aiming for the ratio between hydro and thermal to be 50:50 or around 45:55. Large-scale power stations which have started power generation in recent years or are scheduled to start power generation are Elbistan Thermal Power Station (4,200 MW), and large scale hydroelectric power stations of Karakaya Project (1,800 MW), Altınkaya Project (700 MW), Atatürk Project (2,400 MW), Çatalan Project (8,153 MW), Gezende Project (159 MW), and Batman Project (198 MW), while other than these large-scale projects, hydroelectric power stations of Kayraktepe Project (420 MW), Ilısu Project (1,200 MW), Boyabat Project (510 MW), Birecik Project (670 MW), and Yedigöze Project (700 MW) are undergoing preparations for start of construction in the very near future. Plans are also being made for the next targets for development. The hydroelectric potential of Turkey exists one-sidedly in the eastern part, and since hydroelectric development at sites near the load areas of Istanbul and the western part of the country has reached the final stage, development work is shifting to the eastern region far away from load areas.

Under such circumstances the Turkish Government selected the Çoruh River as a river for large-scale hydroelectric power development and has been pushing forward with development projects. As a part of these projects, master plans were prepared in 1982 and 1990 for development of the Oltu River, a major tributary on the right-bank side of the Çoruh, and preparations have been made for development. The Çoruh has more than 10% of the hydroelectric potential of Turkey, and is a river greatly suited for hydroelectric power generation.

Investigations concerning the Oltu River Hydroelectric Power Development Project were started by the EIE of Turkey at the end of 1970 and these resulted in the Master Plan Report, Çoruh-Oltu River Basin in 1982. In this Master Plan, various development alternatives were proposed and studied between high water level

of EL. 1,100 m of Olur Reservoir and high water level of EL. 710 m of Yusufeli Reservoir, and in the end, a two-stage development plant consisting of the Olur Hydroelectric Power Development Project and the Ayvalı Hydroelectric Power Development Project was taken up as being optimum.

The General Directorate of Elektrik İsleri Etüd İdaresi (EİE), with the aim of making a feasibility study for upgrading the Oltu River Hydroelectric Power Development Project, requested the Government of Japan through the Government of the Republic of Turkey to make the study, and the Japan International Cooperation Agency (JICA) was designated to undertake the study. The Japanese Government, based on the request of the Turkish Government, executed "Scope of Work for Feasibility Study on the Oltu River Hydroelectric Power Development in the Republic of Turkey Agreed upon between the Japan International Cooperation Agency and the General Directorate of Elektrik İsleri Etüd İdaresi" on September 3, 1990, and the Feasibility Study was started from November 28, 1990.

1.2 Objective of Study and Field Investigation

The objectives of the investigation work are to carry out field studies concerning the Oltu River Hydroelectric Power Development Project, gather data and perform investigation works, based on which the appropriateness of the Project would be studied technically, economically, and financially, and a feasibility report prepared.

The investigation work was carried out divided into the three stages of preliminary study, additional detailed field study, and feasibility design. The preliminary study of the first stage consisted of preparations in Japan, field investigations, data collection, review of existing plans, study of alternative plans, and planning of additional detailed field studies. Field reconnaissances, data collection, and reviews of existing reports

were carried out in Turkey, while reviews of existing development plans, formulation of alternative development plans an comparison studies, planning of additional detailed investigations and preparation of related technical specifications were carried out in Japan. The additional detailed field investigations corresponding to the second stage consisted of carrying out detailed additional investigation works regarding the plan selected upon comparison studies at the first stage. The additional detailed field studies were planned by JICA and carried out by the EIE. The third stage consisted of optimization of plans, basic designs, estimate of construction costs, formulation of construction plans, economic evaluations and financial analyses carried out based on materials obtained in preliminary studies and the additional detailed field studies.

This Report has been written as the report of the Feasibility Study on the Oltu Project planned at the middle stretch of the Oltu River, a tributary of the Çoruh River.

The Oltu Project is composed of the two projects of Olur Hydro Power Project and Ayvalı Hydro Power Project.

The contents of this Report were prepared upon adding further detailed studies of the data gathered in the First and Second Preliminary Studies carried out from November 28 to December 27, 1990, and April 22 to May 6, 1991, and the additional detailed field study carried out from July 14 to September 9, 1991, and the Interim Report putting together the results of studies based on the investigation works executed by EIE.

In November 1990, JICA began the work based on the beforementioned "Scope of Works." JICA next dispatched the following survey teams for field investigations concerning the Project.

November 28 - December 27, 1990	:	First Preliminary Investigation
April 22 - May 5, 1991	:	Second preliminary Investigation
July 14 - August 12, 1992	:	First Detailed Investigation
August 26 - September 9, 1991	:	Second Detailed Investigation
November 16 - November 29, 1991	:	Discussion of Interim Report
August 1 - August 15, 1992	:	Discussion of Draft Final Report

During this period, the Survey Team submitted the following reports to the EIE.

December 1990	:	Inception Report
April 1991	:	First Progress Report, Detailed Investigation program, and Technical Specifications
July 1991	:	Second Progress Report
November 1991	:	Interim Report
August 1992	:	Draft Final Report

From May 1991 to August 1991, the EIE carried out field investigations and investigation works based on the above mentioned Detailed Investigation Program. The outlies of the field investigation and investigation works are as shown in Table 1-1.

The members of the Survey Team and the persons of the Turkish Government who cooperated with the investigation are listed below.

Table 1-1 Investigation Works by EIE

	Olur Project	Ayvalı Project
1. Topographic Survey		
Dam 1/1,000	20,000 m^2	-
Power station 1/1,000	500,000 m^2	590,000 m^2
Tailrace 1/1,000	-	120,000 m^2
2. Geological Investigation		
i. Drilling and permeability test		
a. Damsite	10 holes 869.6 m	10 holes 1,200.2 m
b. Powerhouse site	1 holes 30 m	-
c. Headrace tunnel	4 holes (Bahçecik) 390 m	-
d. Tailrace tunnel	-	1 hole (Anzav) 70 m
ii. Seismic prospecting		
a. Damsite	3 lines (spillway) 1,530 m	
b. Power station site	4 lines (OPT Site) 1,240 m	2 lines (Access tunnel) 1,210 m
c. Headrace tunnel	3 lines (Bahçecik) 1,950 m	
d. Tailrace tunnel	-	3 lines (Anzav Dere) 1,050 m
iii. Electrical Prospecting		
a. Borrow area	30 points (kaledibi)	20 points (Bahçecik)
b. Headrace tunnel	600 m (Bahçecik)	-
3. Material Test		
i. Impervious core material	12 pits 38.5 m	18 pits 79.2 m
ii. Aggregate	7 pits 13.5 m	8 pits 17.7 m
4. Social and Environmental Aspect	Implemented	Implemented
5. Compensation	Implemented	Implemente

JICA Survey Team

Name	Assignment	Period
Sigeru HAYASHI	Team Leader (Civil Engineer)	Nov. 28, 1990 - Dec. 27, 1990 Apr. 22, 1991 - May 5, 1991 Jul. 14, 1991 - Jul. 28, 1991 Nov. 16, 1991 - Nov. 29, 1991 Aug. 1, 1992 - Aug. 15, 1992
Jyoji TASHIRO	Design (Civl Engineer)	Jul. 14, 1991 - Aug. 12, 1991 Nov. 16, 1991 - Nov. 29, 1991
Osamu Kinouchi	Design (Civil Engineer)	Nov. 28, 1990 - Dec. 27, 1990 Aug. 1, 1992 - Aug. 15, 1992
Masayuki SEINO	Planning (Civil Engineer)	Nov. 28, 1990 - Dec. 27, 1990 Apr. 22, 1991 - May 5, 1991 Nov. 16, 1991 - Nov. 29, 1991
Katsue IINO	Hydrology (Civil Engineer)	Nov. 28, 1990 - Dec. 27, 1990 Apr. 22, 1991 - May 5, 1991
Yozo FUKUTAKE	General Geology (Geologist)	Nov. 28, 1990 - Dec. 27, 1990 Apr. 22, 1991 - May 5, 1991 Aug. 26, 1991 - Sep. 9, 1991 Nov. 16, 1991 - Nov. 29, 1991
Ibrahim S. Ozil	Geological Survey (Geologist)	Jun. 1, 1991 - Aug. 15, 1991
Toshio TANAKA	Power Plant (Electrical Engineer)	Jul. 14, 1991 - Aug. 12, 1991 Nov. 16, 1991 - Nov. 29, 1991 Aug. 1, 1992 - Aug. 15, 1992
Takuya TAKAOKA	Power System (Electrical Engineer)	Nov. 28, 1990 - Dec. 12, 1990 Jul. 14, 1991 - Jul. 27, 1991
Masaaki TANAKA	Economy (Economist)	Jul. 14, 1991 - Jul. 28, 1991 Aug. 1, 1992 - Aug. 15, 1992
Kiyoshi KIKUCHI	Environment (Environmental Expert)	Apr. 22, 1991 - May 5, 1991 Jul. 14, 1991 - Aug. 12, 1991

Turkish Government and Relevant Agency

1) First Stage Preliminary Investigation (November 28 - December 27, 1990)

EİE

Mr. Süheyl Elbir	General Director
• Design Department	
Mr. Nezih Sayan	Director
Mr. Engin Erberik	Manager of Reconnaissance Division
Mr. Sükrü Karabiber	Manager of Dam and Hydropower Plant Project Division
Mr. Yildirim Varlik	Manager of Basin Planning Division
Mr. Necati Kuskonmaz	Manager of Run of River Hydropower Plant Division
Mr. Mehmet Güngör	Manager of Electrical and Mechanical Project Division
Mr. Erdem Ozyurt	Manager of Mapping Division
Mr. Yavuz Soyuer	Civil Engineer (Responsible Eng.)
Miss Hatice Turan	Civil Engineer
Mrs. Gül Esiyok	Civil Engineer
Ms. Mualla Demirdelen	Mechanical Engineer
Mr. İzzet Solmaz	Electrical Engineer
• Department of Geology and Drilling	
Mr. Aydin Kırmacıoğlu	Director
Mr. Orhan Yağcı	Director of Geotechnical Services Division
Mr. Yuksel Tan	Director of Rock and Soil Mechanics Division
Mr. Osman Demirağ	Director of Geophysical Surveying Division
Mr. Mahmut Kiris	Director of Drilling Division
Mr. Mustafa Pehlivan	Geological Engineer (Project Supervisor)

Mr. İbrahim Vardar	Geological Engineer
Mr. Sükru Bay	Geological Engineer
Mr. Murat Dinç	Geological Engineer
Mrs. Nilgun Pehlivan	Geological Engineer
Mr. Osman Ceylan	Geological Engineer
Mr. Veli Demiroğlu	Geophysical Engineer
Mr. Necati Saraç	Geophysical Engineer

- Department of Hydrological Surveys

Mr. Mete Türksoy	Director
Mr. Mehmet Tanrikulu	Manager of Hydraulic Project Section
Mr. Adil Alisik	Manager of Sedimentation Studies Section
Mr. Hayati Hançer	Hydrologist

- JICA Experts

Mr. Makoto Sato	Civil Engineer
Mr. Masashi Yasuda	Electrical Engineer

TEK (Turkish Electricity Authority)

Ms. Nese Gencyilmaz	Generation Planning Section
Mr. Erdogan Gogen	Transmission Planning Section
Mr. Fazilet Ugur	

2) Second Stage Preliminary Investigation (April 22 - May 5, 1991)

LIST OF PARTICIPANTS

EİE

Mr. Süheyl Elbir	General Director

- Design Department

Mr. Nezih Sayan	Director
Mr. Sükrü Karabiber	Manager of Dam and Hydropower Plant Project Division

Mr. Necati Kuskonmaz	Manager of Run of River Hydropower Plant Division
Mr. Erdem Ozyurt	Manager of Mapping Division
Mr. Yavuz Soyuer	Civil Engineer (Responsible Eng.)
Miss Hatice Turan	Civil Engineer
Mrs. Gül Esiyok	Civil Engineer
Mr. Hakan Kocyigit	Civil Engineer
Miss Ülkü Koçer	Responsible for Environment
Miss Özlem Küle	Responsible for Environment
Mr. Muharrem Aybakır	Electrical Engineer
Mr. Mehmet Güngör	Manager of Electrical & Mechanical Design Division
Mr. Ugurtan Onur	Electrical Engineer
Mr. İzzet Solmaz	Electrical Engineer

- Department of Geology and Drilling

Mr. Aydin Kırmacıoğlu	Director
Mr. Orhan Yağci	Director of Geotechnical Services Division
Mr. Yüksel Tan	Director of Rock and Soil Mechanics Division
Mr. Osman Demirağ	Director of Geophysical Surveying Division
Mr. Mahmut Kiris	Director of Drilling Division
Mr. Mustafa Pehlivan	Geological Engineer (Project Supervisor)
Mr. Vedat Cağlayik	Director of Division of Reconnaissance and Material Investigation
Mr. İbrahim Vardar	Geological Engineer
Mr. Sükrü Bay	Geological Engineer
Mr. Murat Dinç	Geological Engineer
Mrs. Nilgün Pehlivan	Geological Engineer

Mr. Osman Ceylan	Geological Engineer
Mr. Necati Saraç	Geophysical Engineer

- Department of Hydrological Surveys

Mr. Mete Türksoy	Director
Mr. Mehmet Tanrıkulu	Manager of Hydraulic Project Section
Mr. Adil Alisik	Manager of Sedimentation Studies Section
Mr. Hayati Hançer	Hydrologist

- JICA Experts

Mr. Makoto Sato	Civil Engineer
Mr. Masashi Yasuda	Electrical Engineer

3) First Stage Detailed Investigation (July 14 - August 12, 1991)

EIE

Mr. Süheyl Elbir	General Director

- Design Department

Mr. Engin Erberik	Manager of Reconnaissance Division
Mr. Sükrü Karabiber	Manager of Dam and Hydropower Pant Project Division
Mr. Yildirim Varlik	Manager of Basin Planing Division
Mr. Yavuz Soyuer	Civil Engineer (Responsible Eng.)
Miss Ülkü Koçer	Responsible for Environment
Miss Özlem Küle	Responsible for Environment
Mr. Muharrem Aybakır	Electrical Engineer
Mr. Mehmet Göngür	Chief of Electrical & Mechanical Design Division
Mr. Uğurtan Onur	Electrical Engineer
Mr. İzzet Solmaz	Electrical Engineer

- Department of Geology and Drilling

Mr. Aydın Kırmacıoğlu	Head of Department
Mr. Orhan Yağcı	Chief of Geotechnical Services Division
Mr. Mustafa Pehlivan	Geological Engineer (Project Supervisor)
Mr. Necati Saraç	Geophysical Engineer
Mr. İbrahim Vardal	Geological Engineer
Mrs. Nilgün Pehlivan	Geological Engineer

- Department of Hydrological Surveys

Mr. Mete Türksoy	Head of Department
Mr. Mehmet Tanrıkulu	Chief of Hydrological Project Section
Mr. Hayati Hançer	Hydrologist

JICA Expert

* Mr. Makoto Sato	Civil Engineer
* Mr. Masashi Yasuda	Electrical Engineer

4) Second Stage Detailed Investigation (August 26 - September 9, 1991)

EIE

- Department of Geology and Drilling

Mr. Vedat Cağlayik	Director of Division of Reconnaissance and Investigation
Mr. Yuksel Tan	Director of Rock and Soil Mechanics Division
Mr. Osman Demirağ	Director of Geophysical Surveying Division
Mr. Mahmut Kiris	Director of Drilling Division
Mr. Mustafa Pehlivan	Geological Engineer (Project Supervisor)
Mr. Murat Dinç	Geological Engineer
Mr. Sükrü Bay	Geological Engineer

Mr. İbrahim Vardar	Geological Engineer
Mrs. Nilgün Pehlivan	Geological Engineer
• Department of Design	
Mr. Sükrü Karabiber	Manager of Dam and Hydropower Plant Division
JICA Survey Team	
Mr. Yozo Fukutake	Geologist
Embassy of Japan	
Mr. Kiyotaka Furusawa	First Secretary
Mr. Shunsuke Otsuka	Second Secretary
EPDC Ankara Office	
Mr. Hiroshi Okabayashi	General Manager, Civil Engineer
EIE	
Mr. Süheyl Elbir	General Director
• Design Department	
Mr. Nezih Sayan	Director
Mr. Engin Erberik	Director of Reconnaissance Division
Mr. Sükrü Karabiber	Manager of Dam and Hydropower Plant Project Division
Mr. Necati Kuskonmaz	Manager of Run of River Hydropower Plant Division
Mr. Mehmet Güngör	Manager of Electro-Mechanical Division
Mr. Yavuz Soyuer	Civil Engineer (Responsible Engineer)
Miss Ülkü Koçer	Engineer, Responsible for Environment
Miss Özlen Küle	Engineer, Responsible for Environment

- Department of Geology and Drilling

Mr. Aydin Kırmacıoğlu	Director
Mr. Orhan Yağci	Director of Geotechnical Services Division
Mr. Yuksel Tan	Director of Rock and Soil Mechanics Division
Mr. Osman Demirağ	Director of Geophysical Surveying Division
Mr. Mahmut Kiris	Director of Drilling Division
Mr. Vedat Cağlayik	Director of Reconnaissance and Material Investigation Division
Mr. Mustafa Pehlivan	Geological Engineer (Project Supervisor)
Mr. İbrahim Vardar	Geological Engineer
Mr. Sükrü Bay	Geological Engineer
Mr. Murat Dinç	Geological Engineer
Mr. Nilgün Pehlivan	Geological Engineer

JICA Experts

Mr. Makoto Sato	Civil Engineer
Mr. Masashi Yasuda	Electrical Engineer

5) Third Stage Interim Report (November 15 - November 29, 1991)

EIE

Mr. Süheyl Elbir	General Director

- Design Department

Mr. Nezih Sayan	Director
Mr. Engin Erberik	Chief of Reconnaissance Division
Mr. Sükrü Karabiber	Chief of Dam and Hydropower Plant Project Division
Mr. Necati Kuskonmaz	Chief of Run of River Hydropower Plant Division
Mr. Mehmet Güngör	Chief of Electro-Mechanical Division

Mr. Yavuz Soyuer	Civil Engineer (Responsible Engineer)
Miss Ülkü Koçer	Engineer, Responsible for Environment
Miss Özlen Küle	Engineer, Responsible for Environment

- Department of Geology and Drilling

Mr. Audın Kırmacıoğlu	Director
Mr. Orhan Yağci	Director of Geotechnical Services Division
Mr. Yuksel Tan	Director of Rock and Soil Mechanics Division
Mr. Osman Demirağ	Director of Geophysical Surveying Division
Mr. Mahmut Kiris	Director of Drilling Division
Mr. Vedat Cağlayik	Director of Reconnaissance and Material Investigation Division
Mr. Mustafa Pehlivan	Geological Engineer (Project Supervisor)
Mr. İbrahim Vardar	Geological Engineer
Mr. Sükrü Bay	Geological Engineer
Mr. Murat Dinç	Geological Engineer
Mr. Nilgün Pehlivan	Geological Engineer

JICA Experts

Mr. Makoto Sato	Civil Engineer
Mr. Masashi Yasuda	Electrical Engineer

JICA Survey Team

Mr. Shigeru Hayashi	Team Leader
Mr. Yozo Fukutake	Geologist
Mr. Toshio Tanaka	Electrical Engineer
Mr. Joji Tashiro	Designer (Civil Engineer)
Mr. Masayuki Seino	Planner (Civil Engineer)

Embassy of Japan

Mr. Katsuya Ikeda	Minister

Mr. Kitotaka Furusawa	First Secretary

EPDC Ankara Office

Mr. Hiroshi Okabayashi	General Manager

6) Third Stage Draft Final Report (August 1 - August 15, 1992)

EIE

Mr. Tuncer Tuncay	General Director
Mr. Vural Selcen	Deputy General Director

- Design Department

Mr. Nezih Sayan	Director of Design Department
Mr. Sukru Karabiber	Chief of Dam and Hydropower Plant Project Division
Miss Hatice Turan	Civil Engineer

- Department of Geology and Drilling

Mr. Aydın Kırmacıoğlu	Director
Mr. Orhan Yağci	Director of Geotechnical Services Division
Mr. Osman Demirağ	Director of Geophysical Surveying Division
Mr. Mustafa Pehlivan	Geological Engineer
Mrs. Nilgün Pehlivan	Geological Engineer
Mr. İbrahim Vardar	Geological Engineer
Mr. Sükrü Bay	Geological Engineer

- Department of Hydrological Surveys

Mr. Mete Türksoy	Director
Mr. Mehmet Tanrikulu	Manager of Hydrological Survey Section
Mr. Hayati Hançer	Hydrologist

JICA Experts

Mr. Makoto Sato	Civil Engineer

Embassy of Japan

Mr. Yoichi Yamaguchi	Ambassador
Mr. Katsuya Ikeda	Minister
Mr. Kiyotaka Furusawa	First Secretary
Mr. Makoto Sakamoto	Second Secretary

Member of JICA

Mr. Hiroto Kamiishi	Energy and Mining Development Study Division

JICA Survey Team

Mr. Shigeru Hayashi	Team Leader
Mr. Toshio Tanaka	Electrical Engineer
Mr. Masaaki Tanaka	Economist
Mr. Osamu Kinouchi	Civil Engineer

1.3 Information and Data

The project studies were conducted with existing information and data mainly made available by EIE, and information and data obtained through field investigations and investigation works.

Topographic maps, hydrologic data, cost estimate data, power supply and demand data, economic and financial data, etc. which were used in the studies are listed in Appendix.

Chapter 2 GENERAL SITUATION IN THE REPUBLIC OF TURKEY

Chapter 2

GENERAL SITUATION IN THE REPUBLIC OF TURKEY

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Chapter 2 GENERAL SITUATION IN THE REPUBLIC OF TURKEY

2.1 Geography

The Republic of Turkey is geographically located between north latitudes 42°06′ and 35°51′, and east longitudes 44°48′ and 25°40′, and is situated at the connecting point between the European and Asian continents.

The country is in the shape of a rectangle, 650 km wide and 1,565 km long having a total area of 779,452 km^2. 97% of this area belongs to the Anatolian Peninsula at the westernmost tip of Asia called Asia Minor, with the remaining 3% being the Thrace Region in the southeastern part of the Balkan Peninsula located at the eastern tip of the European continent.

The land is bounded on the south by the Mediterranean Sea, on the west by the Aegean Sea and Bulgaria and Greece, on the north by the Black Sea, and on the east by the Gruzia, Armenia, Iran, Iraq and Syria.

Broadly dividing the land geographically, it consists of the Aegean-Mediterranean Region, Black Sea Coast Region, Eastern and Central Anatolia Region, and the Southern Anatolia Region. 96% of the land belongs to a steppe type climate zone called the Anatolian Plateau, and only 30% of the land is cultivated.

The mean elevation of the land is 1,132 m with no more than 20% of the land being below elevation 500 m. The mean elevation of Ankara, the capital city, is 902 m.

Representative rivers are the Kızılırmak River (1,355 km), the longest in Turkey, the Sakarya River (825 km), the Seyhan River (560 km) and the Yesilırmak River (520 km), besides these, there are the famous Tigris (523 km) and Euphrates (1,263 km) which are international rivers that rise within the boundaries of Turkey.

Lake Van (3,700 km^2) in Eastern Anatolia, and Lake Tuz (1,500 km^2) in Central Anatolia are representative lakes, and both are salt water lakes. Artificial lakes are Lake Keban (675 km^2) on the Euphrates River and Lake Hirfanli (263 km^2) on the Kızılırmak River which are well-known, and both are playing important roles as reservoirs for hydroelectric power generation, namely, as water power energy resources.

Almost all of the seashores of Turkey are of topographies where mountains fall abruptly into the sea with plains only existing in small scale at the mouths of rivers. In such a situation, there are plains such as the Adana Plain at the mouths of the Seyhan River and the Ceyhan River, the Bafra Plain at the mouth of the Kızılırmak River, the Çarçamba Plain at the mouth of the Yeşilirmak River, the plains at the mouths of medium-scale rivers emptying into the Aegean Sea, and the plain along the Ergene River at the European Continent side.

Much of the mountainlands are in the Eastern Anatolian Region bordering on Georgia, Armenia, Iran, and Iraq, with Mt. Ararat (5,165 m) the most famous, besides which there are Mr. Suphan (4,434 m), Mt. Kackar (3,932 m), and Mt. Erciyes (3,916 m) making up the greatest hydroelectric potential area of the country.

Vegetation groups differ according to climatic and topographical conditions, and broadly divided, they are the following:

Black Sea Region:	Forest areas are distributed at the mountain slope facing the shoreline, and because of comparatively high temperatures, there are large numbers of oak, elm, and beech.
Aegean-Mediterranean: Coast Region	Olive, citrus, and pine are the predominant species along the mountain areas.

Anatolian Plateau Area: The vegetation consists of natural forage and scattered forests.

2.2 Climate

Climates in the Republic of Turkey are greatly influenced by the geographical conditions of its being faced on three sides by the Black Sea at the north, the Aegean Sea at the west, and the Mediterranean Sea at the south, and being connected with the Eurasian Continent at half of its south side and at its east side, and differ considerably depending on the locations. The climate may be broadly divided into the following according to region.

The central part which is a dry region: this Central Region consists of Central Anatolia excluding the eastern part and the area in the southern part contiguous with the Eurasian Continent. The Mediterranean Region which is of Mediterranean climate: temperate but with little rain and hot in midsummer. The eastern part of continental climate, high in elevation and with extreme differences between hot and cold during the year. Further, the Black Sea Region with relatively much rain and fog.

Isolation during the year is 1,800 hours in the north to 3,200 hours in the south, there being more sunshine the further to the south.

2.2.1 Temperature

The outline of temperatures by region is as follows:

The Black Sea Region is mild with mean temperature around 14 to 15°C. Even in midsummer, in July and August, the temperature is about 22 to 24°C and comparatively easy to bear, while in the

winter, in January and February, it is 5 to 7°C, and the cold is not very severe.

Mean annual temperatures in the Aegean Sea-Mediterranean Sea Region are 18 to 20°C. However, higher than 27°C is reached in summer and is fairly hot, but winters are mild with temperatures 8 to 12°C. This is a so-called Mediterranean Sea climate.

On the other hand, the inland Central Region has mean annual temperature from 11°C to 20°C. However, in midsummer, combined with dryness, it becomes scorching hot.

The eastern part of the inland area has large differences in mean annual temperature from 4 to 18°C due to differences in elevations, and is featured by a continental climate of extreme differences between hot and cold. There are many districts which are hit by a cold wave of lower than 20°C below zero in the coldest period.

2.2.2 Precipitation

The outline of precipitation by region is as described below.

The annual rainfall in the Black Sea Region is the most plentiful in Turkey, the pattern being for slightly more rain in the wintertime, although it does rain throughout the year. Therefore, vegetation in this region shows a very good condition of growth. There is a fair amount of annual rainfall in the Mediterranean Sea Region, but the rainfall in summer is extremely small. The annual rainfall of the Central Region is less than 400 mm so that it is dry and there are places which are of semi-desert conditions. The annual precipitation in the Eastern Region is around 400 mm, and because it is mountainous, there is snowfall in the winter. The climates in the principal cities are given in Table 2-1.

Table 2-1 Climate in the Main Cities

Selected Cities	Regions	Altitude Above Sea (m)	Temperature (°C)			Average Humidity (%)	Average Precipitation (mm)
			Average	Lowest	Highest		
Istanbul	Mar.	39	14.0	-16.1	40.5	75	677.4
Ankara	Cent. A	885	11.7	-24.9	40.0	60	371.6
Izmir	Aegean	25	17.6	-8.2	42.7	65	698.0
Adana	Medet.	20	18.8	-8.4	45.6	66	641.6
Edirne	Thrace	48	13.5	-22.2	41.5	70	597.2
Bursa	Mar.	100	14.4	-25.7	42.6	69	705.8
Antalya	Madit	42	18.6	-4.6	44.6	69	1,064.8
Urfa	A. East A.	547	18.1	-12.4	46.5	48	467.5
Zonguldak	W. Black S.	136	13.5	-8.0	40.5	73	1,223.8
Rize	E. Black S.	4	14.1	-7.0	38.2	77	2,323.2
Van	East A.	1,725	6.6	-28.7	37.5	60	377.0
Ağri	N. East A.	1,632	6.1	-43.2	38.0	67	528.5
Mugla	Aegean	646	14.9	-12.6	41.2	61	1,206.4
Erzurum	East A.	1,869	7.2	-35.0	35.0	63	452.8

Source: General Directorate of Meteorology
STATISTICAL YEAR Book of Turkey 1989

The growth in per capita GNP has been eye-catching in recent years due to industrialization, and on a U.S. dollar base, it was US$2,595/capita in 1990. The per capita GNP figures for recent years are given in Table 2-3.

2.3 Population

The total population as of the end of 1990 was 56,400,000, the ratio between urban and rural areas being 59:41, and in recent years, concentration of population in urban areas has been increasing. Incidentally, the ratio of population between urban and rural areas in 1980 was 44:56.

2.4 Economy

The economy in the Republic of Turkey is a mixed system (established in the early 1930's) where private enterprises coexist with public enterprises set up with state capital. Today, approximately 55% of industrial production is by the public sector.

In 1960 the State Planning Organization was established and a Long-Range Five-Year Economic Development Plan was formulated to start from 1963. Since 1963, a planned economy has been implemented, the objective being to attain an annual average economic growth rate of a 7% level.

This target is to be realized through promoting industrialization and absorbing surplus labor of agriculture into the industrial sector.

At present, the Sixth Five-Year Development Plan (1990-1994) is being implemented. In the Fourth Five-Year Development Plan (1979-1983), it was planned to attain an economic growth of 8% annually by investing 10,595 x 10^9 TL (1983 prices), but the actual performance was as shown in Table 2-2, and the growth rate was approximately 2.0%, considerably below the planned level.

With the Fifth Five-Year Plan (1984-1989), there was a recovery from the oil crisis, and the economic growth rate according to GNP reached 6.1% as shown in Table 2-2.

Table 2-2 Growth Rates during Planned Development Period by Sectors

	1st Plan Average (1963-1967)	2nd Plan Average (1968-1972)	3rd Plan Average (1973-1977)	1978 Average	4th Plan Average (1979-1983)	5th Plan Average
1. Agriculture						
a. Target	4.2	4.1	4.6	4.1	5.3	
b. Realisation	3.1	3.5	3.5	2.7	2.2	4.8
2. Industry						
a. Target	12.3	12.0	11.2	8.0	9.9	
b. Realisation	10.8	7.8	9.8	6.6	1.7	7.6
3. Services.						
b. Realisation	7.3	7.9	7.9	4.1	2.6	5.3
4. Gross Domestic Product						
b. Realisation	6.4	6.8	7.3	4.3	2.3	5.7
5. Gross National Product						
a. Target	7.0	7.0	7.9	6.1	8.0	6.3
b. Realisation	6.6	7.1	6.5	2.9	2.1	6.1

Source: Economic Report (Turkey) 1991
Publication No. 1991/13

Table 2-3 Per Capital GNP

Year	1976	1981	1986	1987	1988	1989	1990
Per Capita GNP*	1,020	1,012	1,124	1,628*	1,690*	1,947*	2,595*

* As of new series of GNP

In the Fifth Five-Year Development Plan, it is planned to invest a total of 14,413 x 10^9 TL (1983 prices), the breakdown of which is 57% for the public sector, and 43% for the private sector. By category, the investment is to be 27.04% for manufacturing industries, 18.57% for transportation and communications, 15.20% for housing, 11.37% for agriculture, 14.89% for energy, and 12.93% for others, with which it is planned to achieve an annual average growth of 6.3%. The major economic activities during the 8-year period of 1983-1990 (with estimates partially included) are indicated in Table 2-4.

Industrial activity in Turkey in recent years has been shifting its weight from agriculture and mining to manufacturing, but the weight of agriculture is still great. In the mining and manufacturing sector, as may be seen in Tables 2-5 and 2-6, growths are prominent in vehicles such as passenger cars and trucks, chemical products such as polyethylene and polyvinyl chloride, and steel. It may be considered that sure steps are being taken by industrialization.

The recent state of foreign trade of Turkey is as shown in Table 2-7.

The principal items of export in 1990 were textiles, agricultural products such as processed foodstuffs, grains, leaf tobacco, and nuts, leather goods, and metal products. On the other hand, the principal items of import were crude oil, machinery, chemical products, steel, wheat, electrical appliances, automobiles, etc. Of the import amount, the proportion made up by machinery is about 16%, followed by crude oil with 16%.

Table 2-4 Economic Activity

Item	Unit	1983	1984	1985	1986	1987	1988	1989	1990
GNP (Current Price)	10^9TL	11,551.9	18,374.8	27,789.4	39,177.2	58,564.8	100,582.2	170,412.4	287,754.2
Foreign Deficit	10^9TL	409.5	513.3	525.0	1,023.0	818.9	-2,267.5	(-0.6)	(-3.1)
Total Resources	10^9TL	11,961.4	18,888.2	28,314.0	40,200.2	56,596.1	98,314.7	2.3	12.3
Growth Rate[1/]	%	3.3	5.9	5.1	8.1	7.4	3.6	1.9	9.2
Total Investment	10^9TL	2,311.0	3,549.9	5,795.7	9,654.8	13,947.4	24,231.4	(-1.4)	(16.1)
Fixed Capital Investment	10^9TL	2,182.0	3,285.7	5,554.1	9,120.7	13,886.2	24,182.3	(-0.8)	(8.6)
Stock Changes	10^9TL	128.9	263.2	241.7	534.2	61.2	49.1	(-0.1)	(1.8)
Total Consumption	10^9TL	9,650.4	15,339.3	22,512.7	30,545.4	42,628.7	74,083.3	(3.6)	(11.1)
GNP by Origin									
Agriculture	%	21.4	21.0	18.8	18.2	17.9	17.5	16.7	18.1
Industry	%	26.4	27.1	31.6	32.0	32.1	32.4	31.4	29.3
Services	%	52.2	51.9	49.6	49.8	50.0	50.1	51.8	52.6
Per Capita GNP[2/]	TL	241,347	37,462	550,407	762,612	1,421,000	2,413,000	4,163,000	6,837,000

1/ : Producers' VALVES at 1968 prices
2/ : Current Producers' Prices

( ) Growth rate from 1988 (1988 price)

Source : The Turkish Economy '91 (TUSIAD) Economic Report '91

Table 2-5 Production of Major Industrial Commodities

	Unit	1987	1988	1989	1900
MINING					
Hard Coal (1)	(Th.Tons)	7,084	6,688	6,259	5,604
Lignite (1)	(Th.Tons)	46,481	39,025	51,863	45,826
Crude Petroleum	(th.Tons)	2,629	2,565	2,877	3,720
MANUFACTURING					
Cotton Yarn (2)	(Tons)	54,134	49,916	42,138	44,858
Wool Yarn (2)	(Tons)	4,523	4,338	3,958	4,378
Filtered Cigarette	(Tons)	52,460	55,598	56,450	56,480
Raki & Beer	(Ml.Lts)	293	322	375	432
Newsprint	(Th.Tons)	159	107	135	166
Kraft Paper	(Th.Tons)	112	83	95	103
Sulfuric Acid (2)	(Th.Tons)	586	732	617	716
Nitrogen Based Fertilizers	(Th.Tons)	4,042	4,018	2,806	3,035
Phosphate Based Fertilizers	(Th.Tons)	3,649	3,822	2,796	3,175
Polyethylene	(Tons)	207,722	232,515	234,032	235,599
PVC	(Tons)	108,721	130,829	129,454	136,655
LPG	(Th.Tons)	603	706	684	692
Naphta	(Th.Tons)	1,512	1,830	1,582	1,525
Gasoline	(Th.Tons)	2,607	2,504	2,582	2,855
Motor Oil	(Th.Tons)	6,584	6,559	6,170	6,558
Fuel-Oil (4,5,6)	(Th.Tons)	8,150	8,993	8,007	8,243
Bcttles & Glass Articles	(Th.Tons)	257	312	334	377
Crude Iron	(Th.Tons)	4,100	4,462	3,523	4,827
Steel Ingot	(Th.Tons)	7,044	8,008	7,854	9,413
Blistered Copper	(Tons)	19,445	12,910	21,306	18,840
Alumina	(Tons)	95,236	181,662	200,560	177,915
Cement	(Th.Tons)	21,980	22,675	23,800	24,416
Tractor	(No.)	35,995	31,327	19,602	30,799
Automobile	(No.)	107,185	120,796	118,095	166,222
Truck	(No.)	13,386	12,766	11,581	16,679
Bus and Minibus	(No.)	10,597	8,913	8,846	14,331
ENERGY					
Electrical Energy	(Bil.Kwh)	44.353	48.049	52.043	57.542
VALUE ADDED IN INDUSTRY					
(AT 1968 PRICES)	(Bil.Tl.)	69.218	71.389	73.601	80.231

Sources: SIS-SPO 1-Pithead Production 2-Public sector

Table 2-6 Agricultural Production-Major Crops

(In thousands of tons)

	1987	1988	1989	1990
CEREALS				
Wheat	18,900	20,500	16,200	20,000
Barley	6,900	7,500	4,500	7,300
Maize	2,400	2,000	2,000	2,100
PULSES				
Lentils	925	1,040	520	850
Chick Peas	725	778	683	860
Dry Beans	210	211	193	210
INDUSTRIAL CROPS				
Sugar Beet	12,717	11,534	10,929	13,986
Cotton	558	673	608	635
Tobacco	182	214	270	288
OIL SEEDS				
Cotton Seed	892	1,077	972	1,015
Sunflower	1,100	1,150	1,250	860
Groundnut	80	60	50	63
FRUITS & NUTS				
Grape & Fig	3,655	3,700	3,709	3,800
Citrus Fruits	1,343	1,445	1,443	1,470
Hazelnut	280	403	550	375
Apple	1,680	1,950	1,850	1,900
VALUE ADDED IN AGRICULTURE				
(AT 1968 PRICES, BILLIONS OF TL,)	56.234	60.750	54.188	60.472

Source: SIS 1-1990 Figures are based on third provisional estimate.

Table 2-7 Foreign Trade

	1983	1984	1985	1986	1987	1988	1989	1990
Exports : Total (FOB)	5,728	7,134	7,958	7,457	10,190	11,662	11,625	12,960
Agricultural Product	1,881 (32.84)	1,749 (24.52)	1,719 (21.60)	1,886 (25.29)	1,853 (18.18)	1,270 (10.89)	932 (8.02)	949 (7.32)
Processed and Manufactured Products	3,658 (63.86)	5,145 (72.12)	5,995 (75.33)	5,324 (71.40)	8,065 (79.15)	10,035 (86.05)	10,282 (88.45)	11,683 (90.15)
Mining and Quarrying Products	189 (3.30)	240 (3.36)	244 (3.07)	247 (3.31)	272 (2.67)	357 (3.06)	411 (3.53)	328 (2.53)
Imports : Total (CIF)	9,235	10,757	11,613	11,105	14,163	14,335	15,792	22,302
Agriculture and Livestock	138 (1.49)	417 (3.88)	375 (3.23)	457 (4.12)	782 (5.52)	499 (3.48)	1,041 (6.59)	1,319 (5.91)
Mining and Quarrying	3,864 (41.84)	3,908 (36.33)	3,626 (31.22)	2,146 (19.32)	3,034 (21.42)	2,861 (19.96)	2,902 (18.38)	3,989 (17.89)
Industrial Products	5,117 (56.06)	6,338 (58.92)	7,342 (63.22)	8,502 (76.56)	10,347 (73.06)	10,975 (76.56)	11,849 (75.03)	16,995 (76.20)

Source : The Turkish Economy '91 (TUSIAD)

The main trading partners in 1990 were as follows:

Export

West Germany, USA, Italy, Saudi Arabia, France, United Kingdom

Import

West Germany, U.S.A., Iraq, Italy, France, Japan, United Kingdom

Approximately 63% of both exports and imports are with OECD countries, and almost all of the remainder being barter with the former Soviet Union, West European countries and OPEC countries based on bilateral trade agreements.

The balance of trade is constantly that of a deficit, and in 1990 exports amounted to $\$12,960 \times 10^6$ and imports to $\$22,302 \times 10^6$ recording a deficit of approximately $\$9,342 \times 10^6$.

2.5 Energy Resources

In Turkey, hydroelectric power resources to be developed economically are estimated to be 30,800 MW, of which twenty two (22) percent had already been developed by 1990

Indigenous energy resources in Turkey are petroleum (estimated to be 57 million tons), coal (12,900 million tons), and uranium as well as hydroelectric power resources above mentioned.

As for petroleum, it covers only 10 to 20 percent of domestic demand.

The lignite, the major portion of coal produced in Turkey and with low calorific value is not suitable for industrial use and is mainly used for residential and fuel for coal fired thermal power stations.

The production of primary energy and the situation of its use in Turkey are given in Table 2-8. According to this, the principal energy sources of lignite, water power, wood fuel, and energy from animals and plant life are made up of what are produced indigenously, but for hard coal, natural gas, and petroleum, imports are almost entirely relied on, while although a slight amount, electric power is also being imported. The increase in importation of natural gas has been especially prominent, this being imported for fuel and heating for urban populations, and for gas-fired thermal power generation. And as described in Chapter 5, since gas-fired thermal power stations will increase rapidly in Turkey, it is thought that importation of natural gas will increase. The sources of these imports will probably be Russia and Iran in view of their reserve situations.

The amount of imported coal will increase for use as raw materials and fuel. However, it is thought there will be almost no petroleum imported for the purpose of electric power.

Table 2-8 Primary Energy Production and Consumption

(Unit: Thousand tons)

		1985	1986	1987	1988	1989
Total	Production	23,355	24,847	27,310	28,013	27,769
	Consumption	40,818	43,781	49,310	50,614	52,311
Coal	Production	2,199	2,151	2,111	1,946	1,973
	Consumption	3,839	3,979	4,567	4,885	4,687
Lignite	Production	8,212	8,949	9,827	8,603	10,478
	Consumption	7,933	8,879	9,189	7,932	10,041
Asphaltite	Production	225	261	271	268	175
	Consumption	225	261	271	268	170
Natural Gas	Production	62	416	270	90	158
	Consumption	62	416	669	1,115	2,878
Petroleum	Production	2,216	2,514	2,762	2,692	3,020
	Consumption	18,134	19,623	22,496	21,967	22,522
Hydraulic	Production	2,691	2,652	4,159	6,467	4,005
	Consumption	2,691	2,652	4,159	6,467	4,005
Geothermal	Production	1	10	13	15	14
	Consumption	1	10	13	15	14
Wood	Production	5,210	5,271	5,308	5,313	5,345
	Consumption	5,210	5,271	5,308	5,313	5,345
Animal and Vegetable Waste	Production	2,539	2,622	2,586	2,614	2,580
	Consumption	2,539	2,622	2,586	2,614	2,580
Imports of Electricity	Production	-	-	-	-	-
	Consumption	184	67	49	33	48
Other	Production	-	1	3	5	21
	Consumption	-	1	3	5	21

Source: Ministry of Energy and Natural Resources

The first unit of a nuclear power station seems not to be realized in this century.

Taking all these into consideration, we can easily understand that the electric power industry supported by two major resources of hydroelectric power and lignite coal plays a significant role in promoting the industrialization of Turkey.

The tendency of each resource used for power generation is shown in Table 2-9.

The outstanding figure in this table is that of other fuels, that is that the use of natural gas and geothermal power have increased sharply in recent years and overcame oil fired thermal power in 1989.

Table 2-9 Distribution of Electrical Energy Generation of Turkey over Primary Power Resources

Years	Hard Coal (%)	Lignite (%)	Oil Products (%)	Other (1) Fuels (%)	Hydraulic (%)	Total Gwh
1980	3.9	21.7	25.0	0.6	48.8	23,275
1981	3.6	21.3	23.6	0.4	51.1	24,673
1982	3.4	20.8	22.4	-	53.4	26,552
1983	2.9	28.5	27.1	-	41.5	27,347
1984	2.3	30.7	23.0	0.1	43.9	30,613
1985	2.1	41.8	20.7	0.2	35.2	34,219
1986	1.9	47.0	17.6	3.5	29.9	39,695
1987	1.4	38.4	12.4	5.8	42.0	44,353
1988	0.7	25.3	6.9	6.8	60.3	48,049
1989	0.6	38.3	8.2	18.4	34.5	52,043

1) Generations provided until 1981 through the utilization of fuels such as wood, husk, furnace gas, coke gas etc.
Generation in 1984 was provided only from geothermal resources whereas, from 1985 onwards, it was provided from geothermal and natural gas resources.

Further, according to the long-range plans for electric power generation prepared by TEK in August 1991, the installed

capacities and composition by type of resource used as of the end of 1995 will be as shown in Table 2-10. As shown in this table, the ratio between thermal and hydro in composition of installed capacity in 1995 will be roughly 50:50. However, this composition ratio will be 54:46 in 2000 and 59:41 in 2005, the proportion of thermal becoming higher as the years go by.

According to the abovementioned long-range electric power plan, lignite-burning thermal will continue to be developed in the thermal power generation program, but there are large increases planned for power generation by natural gas and imported coal. Hydroelectric power generation is also planned to be aggressively developed.

Table 2-10 Composition of Generating Facility in 1995

	Capacity (MW)	Percentage (%)	Composition of Thermal and Hydro (%)		Percentage of Imported Fuel (%)	
Hydro-electric	10,881.0	49.65	Hydro	49.65		
Lignite	6,077.3	27.73			Domestic	78.94
Hard Coal	326.4	1.49				
Geothermal	15.0	0.07	Thermal	50.35		
Natural Gas	2,555.4	11.66				
Heavy Oil	1,690.9	7.72			Import	21.06
Diesel	368.1	1.68				
Total	21,914.1	100	100		100	

2.6 Transportation and Telecommunication

Transportation of goods by road, railroad, ship and air are available in Turkey.

The total length of roads including national and provincial roads amounted for approximately 58,915 km in 1987, ninety-two(92) percent of which is paved.

The most useful measure among various transportation facilities is road, which conveyed 88 percent of passengers and 72 percent of goods transported in Turkey in 1987.

The number of vehicles registered in 1987 amounted for 1,973,670 units, of which 60 percent were passengers cars.

The total length of railroad amounts for 10,186 km, of which 8,439 km are trunk lines (of which 479 km are electrified) and 1,747 km are local lines (of which 72 km are electrified).

Turkey is a peninsula, three directions of which are surrounded by the Black Sea, the Aegean Sea and the Mediterranean Sea, and navigation by the sea made remarkable progress in the old days.

There are 10 international trade ports and another 65 major ports, among which Istanbul port is the most important owing to it's blessed location.

Air liners connecting 10 major cities as well as 3 international air ports of Istanbul, Ankara and Izmir are operated frequently.

Telecommunication systems available in Turkey are mail, telegram and telephone.

The number of telephone exchange offices are, the centrals of 986, the local offices of 2,670 and agencies of 24,427.

TV and radio broadcasting is popularized, a broadcasting network covers all areas in Turkey.

Chapter 3 GENERAL DESCRIPTION OF PROJECT AREA AND SURROUNDINGS

Chapter 3

GENERAL DESCRIPTION OF PROJECT AREA AND SURROUNDINGS

Contents

Chapter 3 GENERAL DESCRIPTION OF PROJECT AREA AND SURROUNDINGS

3.1 General Description of Project Area and Surroundings

3.1.1 General Description

This Project is planned on the Oltu River, a tributary of the Çoruh River. The Oltu River is located in the northeast corner of Turkey between 40°58′ north latitude and 41°07′ and 42°38′ east longitude.

The Oltu River Basin is enclosed by mountainland with Horasan Tepe (EL. 2,842 m) at the north side, Topyolu Tepe (EL. 2,727 m) at the south side, Mescit Tepe (EL. 3,239 m) and Dumlu Dag (EL. 3,169 m) at the west side, and Allakuekber Tepe (EL. 3,120 m) at the east side, and a mountain topography with conspicuous relief is presented.

The Oltu River rises at Topyolu Tepe and flows north, is joined by the tributary Penek River in the vicinity of Iriadac, continues to flow north until it merges with the tributary Olur River in the vicinity of Koprubasi where it changes its course west, is joined by the tributary Tortum River which comes up northward on springing at Dunlu Dağ, and after continuing to flow west merges with the Çoruh River in the vicinity of Yusufeli.

The Oltu River Basin is in an area of continental climate and the annual rainfall is from 300 mm to 500 mm. The months when precipitation is comparatively heavy are April to July.

The air temperature of Oltu, a town in the basin, in terms of annual mean, annual maximum, and annual minimum are 9.8°C, 39.0°C, and -24.1°C, respectively. There is considerable difference between hot and cold.

The Çoruh River Basin drains the following three provinces with areas and population as of 1990 listed below.

	Area (km^2)	Population	Capital/km^2
Erzurum	25,066	848,840	34
Kars	18,557	666,167	36
Artvin	7,436	212,226	29

There are the five counties of Tortum, Narman, Senkaya, Oltu, and Olur in the Oltu River Basin, the total population as of 1985 having been 170,833 for a population density per square kilometer of approximately 2.5 persons.

The residents of the river basin are mainly engaged in agriculture and livestock farming. Cultivated fields amount to only 6% of the entire basin area. Several varieties of fruits, wheat, barley, potato, and maize are being grown.

Although not a major industry in the river basin, salt, coal, and chrome have been discovered at Oltu and Tortum, and are being mined.

National Highways No. 950 and No. 060 which are asphalt-paved go through the basin.

National Highway No. 950 is a road which leads from Hopa and goes through Artvin and Yusufeli, heads north along the Tortum River, and passes through Tortum to reach Erzurum. National Highway No. 060 is a road which branches from Route No. 950 at the confluence of the Tortum River and the Oltu River, heads up the Oltu River, and forks at Asahğı into a route heading for Kars and another heading for Tortum.

There are port facilities at Hopa, while air transportation and railway transportation are available to Erzurum.

3.1.2 Water Resources Development Plan and its Present Status

(1) Hydroelectric Power Development Plan

A Master Plan for hydroelectric power development plan for the Çoruh River was prepared by EIE in 1982, while subsequently, up to the present, feasibility studies of various sites have been carried out and these were summarized by TEK in August 1991 as the Long-range Power Generation and Consumption Study of Turkey by a WASP model. According to the Master Plan, the development plan for the basin would consist of construction of 11 dams and power plants with installed capacity of 2,454 MW and annual energy production of 7,921 GWh. The breakdown of the plan is as follows:

Dam and Power Plant	Installed Capacity (MW)	Annual Energy Production (GWh)
1. Laleli	99	204
2. Eegücek	7	20
3. Ispir	54	327
4. Gullbag	84	285
5. Akus	46	144
6. Arkun	207	645
7. Yusufeli	540	1,705
8. Artvin (Inanlı)	332	989
9. Deriner (Artvin)	670	2,118
10. Borcka	300	1,039
11. Muratlı	115	445
Total	2,454	7,921

Numerous development site schemes were planned for the various tributaries. Regarding the Oltu River, which is one of the major tributaries, there were the three development sites of Olur, Ayvalı, and Şakartepe planned in cascade from in the stretch from the midstream vicinity of EL. 1,100 m to near the end of the backwater of Yusufeli Reservoir.

In 1990, EIE newly set up a Master Plan for the Oltu River Basin. In this Master Plan, the two-stepped development plan consisting of the Olur and Ayvalı projects was selected as the hydroelectric power development plan for the Oltu River.

As for Oltu River tributaries, the Çayasan project site has been selected on the Tortum River for a run-of-river project.

Outline of the three projects in the master plan is as follows.

Dam and Power Plant	Installed Capacity (MW)	Annual Energy Production (GWh)
1. Olur	46.0	158.6
2. Ayvalı	170.0	426.5
3. Çayasan	17.0	84.4
Total	233	669.5

With respect to tributaries of the Çoruh River other than the Oltu River, according to development plans of the reconnaissance level, 22 power plants would be constructed having a total installed capacity of 706.4 MW and total annual energy production of 1,875.9 GWh. The approximate breakdown of these is as follows:

	Number of Plants	Total Installed Capacity (MW)	Total Annual Energy Production (GWh)
North Creeks Development Plan	7	144.6	381.0
Altiparmak Development Plan	4	223.0	509.6
Berta Development Plan	7	257.5	770.9
Lower Çoruh Tributary Development Plan	4	81.5	214.4
Total	22	706.4	1,875.9

Other than the abovementioned plans, there is the Tortum No. 1 Hydroelectric Power plant with an installed capacity 26 MW which has been constructed on the Tortum River, a right-bank tributary of the Çoruh River, and this is presently in operation. The power from this plant is connected to Hopa Substation by a transmission line.

(2) Irrigation Plan

Although an investigation of reconnaissance level has been conducted, there is an irrigation development plan for the Bayburt Plain in the upstream area of the Çoruh river, according to which it is planned to irrigate a total area of 27,084 ha.

3.2 General Description of Project Area

3.2.1 Landform and National Environment

(1) Landform

The total catchment area of the Oltu River is 7,000 km^2, the total length is approximately 150 km, with the annual inflow at the Ayvalı site 813 x 10^6 m^3, the Project being situated on the midstream stretch of the Oltu River. The project area generally belongs to a rugged mountainland, but comparatively broad river-bank terraces are spread out upstream of the site for Olur Dam, and there are scattered hamlets where community life is carried on.

The principal mountains in the basin are Horasan Tepe (EL. 2,842 m), Topyolu Tepe (EL. 2,727 m), Mescit Tepe (EL. 3,239 m), Dumlu Dağ (EL. 3,169 m), and Allakuekber Tepe (3,120 m), so that mountains of 3,000 m class surround the basin. As a major tributary of the Oltu River, there is the Tortum River, which is outside the area of the Project, while inside the project area, the Penek River which flows in from the right bank at the end of Olur Reservoir is relatively large, and otherwise, there are the Olur river and Tovusker River of small catchment area flowing into Ayvalı Reservoir.

(2) General Description of Natural Conditions

1) Geology

The Yusufeli Formation, Ayvalı Volcanic Rocks, and Pugey Formation of the Mesozoic Era, and the Oltu Formation of the Tertiary Period are distributed in the Oltu River Basin where this project site is located. The Yusufeli Formation consists of ophiolite, green schist, basic tuff, and slate, while

the Ayvalı Volcanic Rocks consist of acidic and basic lava, rhyolite, volcanic breccia and tuffs. The Pügey Formation mainly consists of fine alternations of marl and limestone. The Oltu Formation is made up of poorly consolidated mudstone, marl, sandstone, and conglomerate.

At the Olur Reservoir in the project area, the Oltu Formation is distributed upstream from around the end of the reservoir, while downstream of this, there are the Yusufeli Formation and Ayvalı Volcanic Rocks. Downstream of the Olur dam, namely, Olur headrace tunnel and powerhouse, and the greater part of the Ayvalı dam tailrace tunnel, consist of the Ayvalı Volcanic Rocks. The Pügey Formation is distributed near the end of the Ayvalı tailrace tunnel.

2) Earthquake

Turkey is located at roughly the middle of the Alpine-Himalayan Orogenic Belt, and is a region where crustal movements have been severe from ancient times. Large fault zones existing in Turkey are the North Anatolian Fault which runs east-west through the northern part of the country and the South-east Anatolian Fault which runs northeast-southwest through the Eastern Region. Although earthquake faults do not necessarily coincide with active faults, active faults often exist in the surroundings. Most of earthquakes of M7 or greater have occurred along the abovementioned two faults. This project area is located at 100 to 150 km north of the point where the two faults intersect, and in the neighborhood of the project site (but not very near), earthquakes of medium scale have been recorded. However, the area of the Project does not belong to a zone of high seismicity, but is located at a so-called peripheral area of an earthquake region. According to

the "Map of Earthquake Regions by the Ministry of Civil Works" published in 1972, this project site belongs to a second degree zone.

3) Meteorology

The Çoruh River Basin may be divided into a downstream part of Black Sea climate having the greatest amount of rainfall and an upstream part of Eastern Region climate which is of continental nature. The Oltu River of the project area is situated at the eastern part of the Çoruh River midstream stretch and the area is of an Eastern Region climate. Therefore, there are extreme differences between hot and cold air temperatures, and according to the records of the nearby Oltu Meteorological Observation Station, the annual mean temperature is 9.8°C, but the average annual maximum temperature in the summer is 39°C, while the average annual minimum temperature in the winter is -24°C. Precipitation is an average annual of 400 mm, the greater part of which falls during the rainy season from April to July. Snowfall occurs from November to April, the greatest amount of snow cover in the history of observations having been 61 cm in February.

3.2.2 Natural and Social Environment

The natural and social environment will be discussed in detail in Chapter 13. "Impact on Environment," and only an outline will be given here.

(1) Natural Environment

1) Scenery

The project area is located in the neighborhood of a ravine zone, having scenic aspects such as the Oltu River with turbid water, flatland stretching along the river, bare mountains with exposed base rock, sporadically-existing small villages, green cultivated land along the river, rows of poplars around lots of cultivated land, meadows with scarce grass, etc. The green ravine contrasts distinctly with brown, magnificent and steep mountains, showing a dry plateau as a whole.

2) Vegetation

The Reservoir Area mostly consists of wasteland and cultivated land, and there is almost no forest. Only poplar planted along the river side are seen as trees. Both banks of the river are steep and are very poor in natural vegetation.

3) Animals

The types of wild animals are rabbits and wild goats, badgers, water sables, wolves, and martens. As for amphibians and reptiles, snakes and water snakes are considered to exist and lizards and frogs are often seen. There are nineteen types of birds and the main types of them are sparrows, crows, etc.

Carps exist in the neighborhood of the Olur Reservoir and the Ayvalı Reservoir. Trout have been reported to exist in the upper reaches of the Cataksu River, a tributary of the Oltu River.

4) Water Quality

According to the results of water quality investigation, the transparency of water is 4 cm or lower, and the concentration of suspended solids (SS) is high, standing at 340 to 820 mg/l. The chemical oxygen demand (COD) is 24 to 32 mg/l. The concentration of total nitrogen (T-N) is 0.24 to 0.58 mg/l, among this, nitrite nitrogen (NO2-N) concentration is 0.14 to 0.019 mg/l, and an ammonia nitrogen (NH4-N) and nitrate nitrogen (NO3-N) concentration are lower than the limit of quantitative analysis (0.01 mg/l and 0.001 mg/l, each of them).

The concentration of total phosphorus (T-P) is high, standing at 0.58 to 2.08 mg/l. The concentration of dissolved oxygen (DO) is 7.2 to 8.7 mg/l. The hydrogen ion concentration (pH) is 8.1 to 8.3.

(2) Social Environment

1) Population

There are villages located inside the Ayvalı Reservoir, such as Taslıköy, Catger, Asağı, Sefkar, Yenibag, Dokens, etc. The population of these villages is estimated at about 3,000. There are also villages located inside the Olur Reservoir such as Kaledibi, Sağlicak, Kecili, Toklu, etc., and the population of these villages is estimated at about 1,200.

2) Public Facilities

There are public facilities in the project area, such as schools, mosques, graveyards, meeting places, post

offices and health centers. Health centers provide medical service.

3) Transportation

As for the main route to the project area, there are the methods of using National Road No. 060 (Yusufeli-Oltu) by way of National Road No. 010 (Trabzon-Hopa) and No. 950 (Hopa-Yusufeli), and of using National Road No. 060 (Tortum-Oltu) by way of National Road No. 950 (Erzurum-Tortum). The volume of traffic on National Road No. 060 is about 50 to 100 vehicles a day consisting of large-sized cars used for transport, automobiles for residents' riding and everyday use, small-sized trucks, etc.

4) Industries

Livestock-farming in the Olur and Ayvali Reservoir Area is mainly conducted by pasturage and cattle, sheep, goats, etc., are pastured. Irrigation agriculture is conducted by growing cucumbers, tomatoes, beans, peppers, pumpkins, watermelons, melons, etc., and tomatoes and cucumbers in large quantity are grown. And as for fruit, peaches, apricots, pears, quince, apples, mulberries, plums, grapes, etc., are grown.

5) Cultural Assets and Recreation

There are hiking courses and camp grounds between mountains in the neighborhood of Olmanagzi Village and Sinnek Forest near Iriagac Village. There are three ruins in the Olur Reservoir Area, and one ruin in Taslkoy Village.

Chapter 4 ELECTRIC POWER IN TURKEY

Chapter 4

ELECTRIC POWER IN TURKEY

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Chapter 4 ELECTRIC POWER IN TURKEY

4.1 Present Situation of Electricity

Installed capacity of generation facilities in Turkey has shown great increase in this ten-year period. The total capacity at the end of 1979 was 5,118.7 MW and the capacity at the end of 1990 became 16,315.1 MW which is about 3 times (See Table 4-1). For annual energy production and annual import energy, as shown in Table 4-2, they are twice in this ten-year period.

Table 4-1 Development of Installed Capacity of Turkey and TEK (MW)

Years	Turkey				TEK			
	Thermal	Hydraulic	Total	Increase (%)	Thermal	Hydraulic	Total	Increase (%)
1979	2,987.9	2,130.8	5,118.7	-	2,178.8	1,872.0	4,050.8	-
1980	2,987.9	2,130.8	5,118.7	0.0	2,178.8	1,872.0	4,050.8	0.0
1981	3,181.3	2,356.3	5,537.6	8.2	2,344.7	2,097.5	4,442.2	9.7
1982	3,556.3	3,082.3	6,638.6	19.9	2,719.7	2,823.5	5,543.2	24.8
1983	3,695.3	3,239.3	6,935.1	4.5	2,937.6	2,998.5	5,936.1	7.1
1984	4,584.3	3,874.8	8,459.1	22.0	3,542.9	3,644.2	7,187.1	21.1
1985	5,244.3	3,874.8	9,119.1	7.8	4,147.9	3,644.2	7,792.1	8.4
1986	6,235.2	3,877.5	10,112.7	10.9	5,141.8	3,644.2	8,786.0	12.8
1987	7,489.3	5,003.3	12,492.6	23.5	6,290.9	4,720.1	11,011.0	25.3
1988	8,299.8	6,218.3	14,518.1	16.2	7,046.4	5,935.4	12,981.5	17.9
1989	9,208.4	6,597.3	15,805.7	8.9	7,939.0	6,298.1	14,237.1	9.7
1990	9,550.8	6,764.3	16,315.1	3.2	8,261.7	6,465.1	14,726.8	3.4

cf: TEK table original

Table 4-2 Turkey's Development of Generation (GWh)

Years	Thermal	Hydraulic	Total	Increase (%)	Import	Gross Supply	Increase (%)
1979	-	-	22,522	-	1,044	23,566	-
1980	11,927	11,348	23,275	3.3	1,341	24,616	4.5
1981	12,057	12,616	24,673	6.0	1,616	26,289	6.8
1982	12,385	14,167	26,552	7.6	1,773	28,325	7.7
1983	16,004	11,343	27,347	3.0	2,221	29,568	4.4
1984	17,187	13,426	30,613	11.9	2,653	33,266	12.5
1985	22,174	120.4	34,219	11.8	2,142	36,361	9.3
1986	27,822	11,873	39,695	16.0	777	40,472	11.3
1987	25,735	18,618	44,353	11.7	572	44,925	11.0
1988	19,099	28,950	48,049	8.3	372	48,430	7.8
1989	34,103	17,940	52,043	8.3	559	52,602	8.6
1990	34,395	23,148	57,543	10.6	176	56,812	8.0

cf: TEK table original

Distribution of Electrical Energy Generation in 1990 over primary power resources is shown in Table 4-3, the ratio of hydro and thermal power generation is 40:60.

Table 4-3 Distribution of Electrical Energy Generation in 1990
Turkey and TEK Over Primary Power Resources (GWh)

Resources	TEK's Generation	Non-TEK Generation	Turkey's Generation	Ratio Over Total Generation (%)
Hard Coal	563.6	57.2	620.8	1.1
Lignite	19,241.1	319.4	19,560.5	34
Oil Products	622.1	3,319.5	3,914.6	6.9
Hydraulic	22,156.1	991.6	23,147.7	40.2
Geothermal	80.1	-	80.1	0.1
Natural Gas	10,191.2	1.1	10,192.3	17.7
Total	52,854.2	4,688.8	57,543	100.0

cf: TEK table original

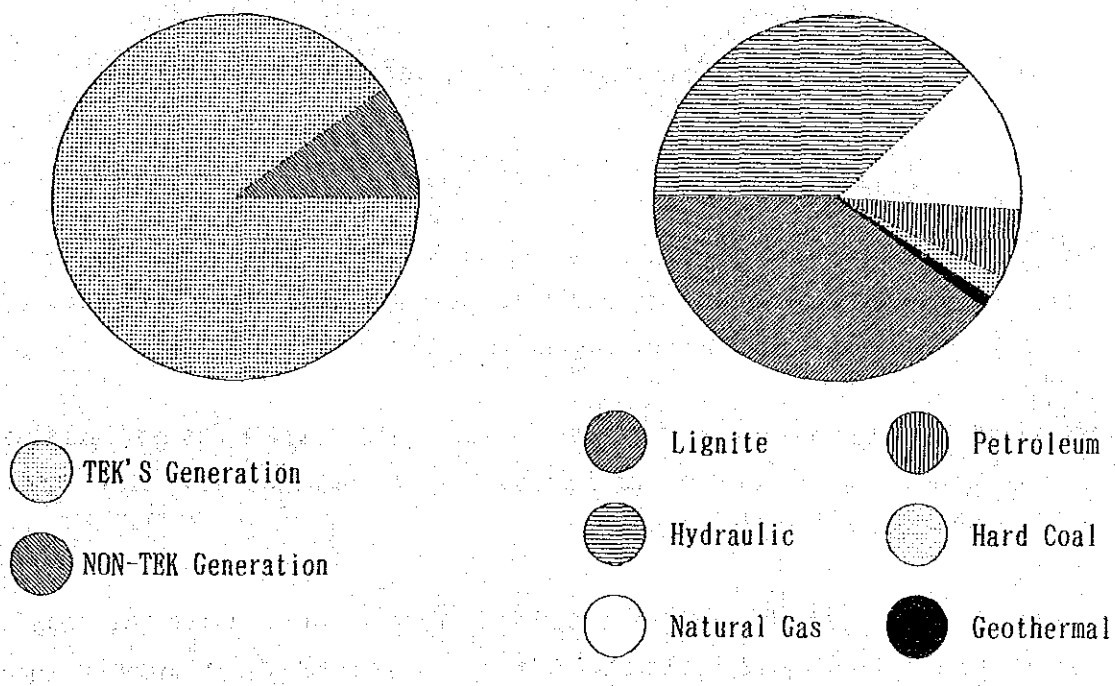

Fig. 4-1 Distribution of Electrical Energy Generation of Turkey and TEK Over Primary Power Resources

4.2 Electric Power Utilities

In Turkey, the following organizations are concerned with electric power, the profiles of which are as shown below;

- Electric Power Development Planning and Survey:

  by Directorate of Electrical Power Resources Survey and Development Administration (EIE)

- Survey, Planning and Construction of Hydropower Stations:

  by General Directorate of Hydraulic Works (DSI)

- Operation and Maintenance of Hydropower Stations,

- Construction, Operation and Maintenance of Thermal Power Stations, and

- Construction and Maintenance of Transmission Lines:

  by Turkish Electricity Authority (TEK)

It should be noted that both EIE and TEK are under the administration of the Ministry of Energy and Natural Resources (MENR), but DSI, the Ministry of Public Works and Resettlement.

Most of Electric Power Utilities are nationally owned, although there are some private utilities, and managed by the Turkish Electricity Authority (TEK).

General Directorate of Electrical Power Resources Survey and Development Administration (EIE) undertakes electric power development planning and survey, which include research and survey of proposed project sites, development scale, scheduling of development, etc.

General Directorate of Hydraulic Works (DSI) has 25 regional administration offices and undertakes flood control, irrigation, dewatering, water works as well as construction of hydraulic power stations.

In some cases, DSI also undertakes engineering works of development of hydropower from the early stage of planning.

Turkish Electricity Authority (TEK) undertakes construction, operation and maintenance of thermal power stations, nuclear power stations and transmission lines, and also operation and maintenance of hydropower stations constructed by DSI.

The generating facilities of 86 percent in Turkey are operated by TEK, and the remaining 14 percent are operated by public or private utilities.

Power distribution to end users is undertaken by three sectors, which are TEK, public utility and power & gas companies owned by community.

As the distribution area of each sector above mentioned overlaps in some parts, it is a public concern to eliminate the overlapped areas by consolidating power distribution enterprises to relieve duplicated public assets.

4.3 Electric Power Facilities

(1) Thermal Power Plant

The installed capacity of thermal power plants over 10 MW in Turkey was 9,390.4 MW at the end of 1990 and 88.4% of which (8,305.4 MW) belongs to TEK. Outline of TEK's thermal power plants is as shown in Table 4-4.

Table 4-4 Outline of TEK's Thermal Power Plants over 10 MW (1990)

Power Plants	Commissioning Date	Installed Capacity (MW) End of 1990	Gross Generation (Million kWh)	
			Actual	Capacity
Afsin-Elbistan (Lignite)	23.5. 1984	1,360.0	4,997	9,520
Çayirhan (Lignite)	1.6. 1987	300.0	1,331	2,100
Seyitömer (Lignite)	6.3. 1973	600.0	2,502	4,200
Soma A (Lignite)	24.7. 1957	44.0	308	320
Soma B (Lignite)	29.9. 1981	660.0	3,279	4,620
Tunçbilek A+B (Lignite)	15.4. 1956	429.0	1,244	3,000
Yatağan (Lignite)	20.10. 1982	630.0	2,927	4,410
Yeniköy (Lignite)	17.9. 1986	420.0	2,135	2,940
Anbarlı (Fuel-Oil)	9.1. 1967	630.0	618	4,400
Hopa (Fuel-Oil)	29.1. 1973	50.0	1	200
Aliağa GT+Com. Cycle (Diesel Oil)	2.9. 1975	180.0	1	-
Digerleri		54.2	-	993
Engil-Van GT (Diesel Oil)	4.2. 1977	15.0	-	-
Seydisehir GT (Diesel Oil)	15.2. 1972	105.0	1	-
Hamitaba + Com. Cycle (Natural Gas)	23.11. 1985	1,200.0	7,453	8,400
ANBARLI (Natural Gas)	9.8. 1988	1,178.2	2,738	8,240
Kangal 1-2 (Lignite)	22.12. 1989	300.0	517	2,100
Y. Çatalagzi B-1 (Hard Coal)	26.7. 1989	150.0	415	1,050
Total		8,305.4	30,698	56,493

cf: TEK table original

(2) Hydropower Plants

Installed capacity of hydropower plants over 10 MW in Turkey was 6,730.3 MW at the end of 1990 and 95.8% of which (6,447.9 MW) belongs to TEK. The outline of TEK's hydropower plants is as shown in Table 4-5.

Table 4-5 Outline of TEK's Hydropower Plants over 10 MW (1990)

Power Plants	Commissioning Date	Installed Capacity (MW) End of 1990	Generation Capacity (Million kWh)	
			Average	Firm
Almus (Dam)	20.9. 1966	27.0	100	30
Altınkaya (Dam)	9.12. 1987	700.0	1,632	1,236
Aslantaş (Dam)	11.5. 1984	138.0	569	360
Demirköprü (Dam)	14.5. 1960	69.0	190	78
Gökçekaya (Dam)	2.11. 1972	278.4	562	460
Hasan Uğurlu (Dam)	2.12. 1979	500.0	1,217	820
Hirfanli (Dam)	8.1. 1959	128.0	400	178
Karakaya (Dam)	6.3. 1987	1,800.0	7,354	6,800
Keban (Dam)	25.2. 1975	1,330.0	6,000	5,820
Kemer (Dam)	25.10. 1958	48.0	135	62
Kesikköprü (Dam)	27.2. 1966	76.0	250	110
Köklüce (Dam)	10.10. 1988	90.0	588	577
Oymapınar (Dam)	16.1. 1984	540.0	1,620	482
H. Polatkan Sariyar (Dam)	24.10. 1956	160.0	400	328
Suaat Uğurlu (Dam)	20.10. 1981	46.0	273	206
Çildir (Natural lake)	14.11. 1975	15.4	30	26
Hazar 1 (Natural lake)	20.10. 1957	20.1	128	16
Hazar 2 (Natural lake)	20.10. 1957	10.0	64	8
Kılıçkaya		124.0	332	277
Kovada 2 (Natural lake)	30.6. 1971	51.2	220	121
Tortum (Natural lake)	14.5. 1960	26.2	85	85
Karacaören		32.0	142	84
Çag-Çag (Rivers)	28.6. 1989	14.4	42	42
Doğankent A+B (Rivers)	24.4. 1971	70.8	314	62
Tercan		15.0	30	18
Göksu (Rivers)	1959	10.8	65	58
Ikizder (Rivers)	11.5. 1961	15.1	100	65
Kapulukaya (Dam)	11.3. 1989	54.0	190	150
Diğerlari		58.5	214.5	179.5
Total		6,447.9	23,246.5	18,738.5

cf: TEK table original

(3) Transmission and Distribution Facilities

Table 4-6 shows the outline of TEK's transmission and distribution facilities.

Table 4-6 Outline of TEK's Transmission and Distribution System (1990)

Tension (kV)	Transformer Centers		Transmission and Distribution Lines	
	Substation Centers	Trans-formers	Capacity (MVA)	Power Line Length(km)
380 kV	20	58	9,060.0	7,737.4
220 kV	2	2	330.0	87.5
154 kV	284	540	19,953.0	19,161.7
66 kV	42	150	1,340.0	1,646.0
Transmission Line Total	348	750	30,683.0	28,632.6
Distribution line Total (34.5 kV and below)		96,157	23,836.5	454,262.4
Grand Total		97,657	85,202.5	482,895.0

Note: Village electrification power line and transformers inclusive.
cf: TEK table original

4.4 Electric Power Supply and Demand

Power demand-supply balance, annual power plant factor and annual load factor in Turkey are as shown in Table 4-7. The annual plant factor in 1989 was only 53.8% in 1989 and the generating capacity still has a big margin. The annual load factors are around 70% which is considered slightly higher than other countries.

Table 4-8 shows the energy balance in 1988 and 1989. TEK's transmission loss in 1989 improved drastically compared to that

in 1988. The distribution loss is about 10% and still has room for improvement.

In the Turkish interconnected power system, a new peak power (8,556 MW) was recorded at 17:25 on November 28, 1989, which is 11.4% higher than the peak in 1988. 93.6% (8,006.4 MW) of the peak was supplied by TEK's power plants and the rest of it by other power utilities. The distribution of power output during peak demand in 1989 is as shown in Table 4-9. As shown in the table, the base load has mainly depended on the thermal power plants and the peak load has mainly depended on the reservoir type hydropower plants.

Table 4-7 Demand/Supply Balance, Plant Factor, Load Factor in Turkish Power System

Year	Gross Energy Production (GWh)	Installed Capacity (MW)	Hourly Peak Load (MW)	Annual Plant Factor (%)	Annual Load Factor (%)
1979	22,521.9	5,118.7	3,543.6	69.2	72.5
1980	23,275.4	5,118.7	3,772.1	73.7	70.4
1981	24,672.8	5,537.6	3,872.6	69.9	72.7
1982	26,551.5	6,638.6	4,308.2	64.9	70.1
1983	27,346.8	6,935.1	4,419.0	63.7	70.6
1984	30,613.5	8,459.1	5,108.3	60.4	68.2
1985	34,218.9	9,119.1	5,409.9	50.3	72.2
1986	39,694.8	10,112.7	6,340.5	62.7	71.5
1987	44,352.9	12,492.6	7,312.0	58.5	69.2
1988	48,048.8	14,518.1	7,613.0	52.4	72.0
1989	52,043.2	15,805.7	8,499.0	53.8	70.0

cf: TEL table original

Table 4-8 TEK's Energy Balance - Sheet and Sales

Energy Balance - Sheet and Sales	1988 (MWh)	1989 (MWh)	Increase (%)
Gross Generation	43,013,565	47,454,083	10.3
Power Plant Internal Consumption	1,972,674	2,824,044	43.2
Net Generation	41,040,891	44,630,039	8.7
Compensator Consumption	44,025	46,977	6.7
Purchased Energy	715,602	768,100	7.3
Gross Generation	41,712,468	45,351,162	8.7
Internal Consumption	50,000	204,936	309.9
Transmission Network Losses	1,966,591	1,339,111	-31.9
Power Sold by the Generation-Transmission Ent.	39,695,877	43,087,115	10.4
1. Sold Directly to the Customer	4,824,377	5,578,305	15.6
2. Sold to Power Distribution Enterprise	34,871,500	38,228,810	9.6
Power Purchased by Dist. Ent. from Non-TEK Utilities	1,544,575	1,697,077	9.9
Total Power Purchased by Distn. Enterprises	36,416,075	39,925,887	9.6
Distribution Network Losses	4,453,455	4,445,813	-0.2
Power Sold by Distribution Enterprises	31,962,620	3,548,074	11.0
Net Consolidated Sales	36,786,997	39,883,683	8.4

* when calculating net consolidated sales, road illumination consumption (1,174,696 MWh) and sales made free of charge were not taken into account.

cf: TEK original table

Table 4-9 Distribution of Power Output During Peak Demand in 1989

	TEK's Power Plants (MW)	Non-TEK Power Plants (MW)	Total (MW)	Input Sources to the Peak (MW)
Power Plants with Dam	4,199.4	29.5	4,228.9	49.4
Natural Lake & River	184.0	110.9	294.9	3.5
Fuel-Oil	0.0	397.5	397.5	4.7
Hard Coal	120.0	9.5	129.5	1.5
Lignite	2,570.0	1.6	2,571.6	30.1
Natural Gas	926.0	-	926.0	10.8
Geothermal	7.0	-	7.0	0.0
Supplied from U.S.S.R.	-	0.0	0.0	0.0
Diesel Oil	0.0	0.9	0.9	0.0
Total	8,006.4	549.9	8,556.3	100.0
Input %	93.6	6.4	-	-
Power Cut & Restriction	-	-	-	-

cf: TEK table original

Chapter 5 LOAD FORECAST AND POWER DEVELOPMENT PROGRAM

Chapter 5

LOAD FORECAST AND POWER DEVELOPMENT PROGRAM

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Chapter 5 LOAD FORECAST AND POWER DEVELOPMENT PROGRAM

5.1 Load Forecast and Power Development Program

5.1.1 Trend in Economic Growth

Turkish economy was not so good in 1979 and 1980 during the second oil shock, but economic growth after 1984 has been improved drastically. After 1984, Turkish annual economic growth rate was more than 5%, especially, the rate in 1986 and 1987 was above the governmental target, 8.2% and 6.8% respectively. In the above circumstance, the electric energy demand is growing steadily and the annual growth rate is more than ten percent after 1986.

GDP Record and Forecast

Periods	Annual GDP Growth (%)
1985 - 1990	6.5
1990 - 1995	6.8
1995 - 2000	6.2
2000 - 2010	6.3

For population growth rate, after late 1970's, the annual growth rate was decreasing from 2.5% level to around 2.0%. However, in 1980's, the rate is increasing upto the previous level since many Turkish people in overseas came back to their home country.

Population Forecast

Year	Million
1990	56.6
1995	63.2
2000	70.4
2010	85.1

5.1.2 Electric Demand Forecast in Turkey

(1) Middle Term Power Development Program (1991 - 1995)

In 1991, TEK has prepared the middle term power development program. In this study, dependable power/energy of hydropower plants has been considered for the dry years case and the average water years, therefore, the power development program has been prepared for these two cases. Tables 5-1 and 5-2 are the demand-supply balance in the power development program.

(2) Long Range Power Development Program (1994 - 2010)

In the TEK's Middle Term Power Development Program Report issued in January 1991, there is a table for the demand-forecast (1990 - 2010) as shown in Table 5-3. This is considered the newest power demand forecast in Turkey. This load forecast is as same as that used for Turkish total energy demand study by Ministry of Energy and Natural Resources.

In the Long Range Power Development Program, annual electric power demand until 2010 is expected to increase at very high rate, 8.5% (Energy: kWh) on an average, and the electric power supply capability in kW is to be increased at the average growth rate of 8.55% per annum. Therefore, the reserve energy of the system which was 39% in 1991 will decrease to 18% in 1995 in average water year case, and then it will increase to and maintain at the level of 20% (See Table 5-2 and Fig. 5-2).

Table 5-1 Middle Term Power Development Program (1)
- Dry Year Case -

		1991	1992	1993	1994	1995
Generation						
Thermal	Power (MW)	9,923	10,463	10,883	10,883	11,033
	Energy (GWh)	62,923	65,418	68,225	70,718	71,556
Hydraulic	Power (MW)	7,159	8,557	9,782	10,777	10,881
	Energy (GWh)	19,754	23,795	27,648	29,084	29,658
Total	Power (MW)	17,082	19,020	20,665	21,660	21,914
	Energy (GWh)	82,677	89,213	95,873	99,802	101,214
Demand	Power (MW)	10,225	11,255	12,390	13,635	15,005
	Energy (GWh)	63,357	69,735	76,754	84,480	92,984
Reserve	Power (MW)	6,857	7,765	8,275	8,025	6,909
	Energy (GWh)	19,320	19,478	19,119	15,322	8,230
Reserve	Power (%)	67	69	67	59	46
	Energy (%)	30	28	25	18	9
Imports	Energy (GWh)	505	1,505	1,600	1,600	1,600
Exports	Energy (GWh)	125	125	100	100	100
Domestic Supply						
	Energy (GWh)	83,057	90,593	97,373	101,302	102,714
Reserve	Energy (GWh)	19,700	20,858	20,619	16,822	9,730
Reserve	Energy (%)	31	30	27	20	10

Table 5-2 Middle Term Power Development Program (2)
- Average Water Year Case -

		1991	1992	1993	1994	1995
Generation						
Thermal	Power (MW)	9,923	10,463	10,883	10,883	11,033
	Energy (GWh)	62,923	65,418	68,225	70,718	71,556
Hydraulic	Power (MW)	7,159	8,557	9,782	10,777	10,881
	Energy (GWh)	25,192	29,826	35,030	37,483	38,534
Total	Power (MW)	17,082	19,020	20,665	21,660	21,914
	Energy (GWh)	88,115	95,224	103,255	108,201	110,090
Demand	Power (MW)	10,225	11,255	12,390	13,635	15,005
	Energy (GWh)	63,357	69,735	76,754	84,480	92,984
Reserve	Power (MW)	6,857	7,765	8,275	8,025	6,909
	Energy (GWh)	24,758	25,509	26,501	23,721	17,106
Reserve	Power (%)	67	69	67	59	46
	Energy (%)	39	37	35	28	18
Imports	Energy (GWh)	505	1,505	1,600	1,600	1,600
Exports	Energy (GWh)	125	125	100	100	100
Domestic Supply						
	Energy (GWh)	88,495	96,624	104,755	109,701	111,590
Reserve	Energy (GWh)	25,138	26,889	28,001	25,221	18,606
Reserve	Energy (%)	40	39	36	30	20

Table 5-3 Load Forecast by TEK

Years	Point Power (MW)	Power Increase (%)	Energy (GWh)	Energy Increase (%)
1990	9,340	-	57,563	-
1991	10,225	9	63,357	10
1992	11,255	10	69,735	10
1993	12,390	10	76,754	10
1994	13,635	10	84,480	10
1995	15,005	10	92,984	10
1996	16,235	8	100,800	8
1997	17,600	8	109,274	8
1998	19,080	8	118,460	8
1999	20,685	8	128,418	8
2000	22,435	8	139,213	8
2001	24,765	10	150,717	8
2002	26,815	8	163,171	8
2003	29,030	8	176,655	8
2004	31,430	8	191,252	8
2005	34,025	8	207,056	8
2006	36,840	8	224,166	8
2007	39,880	8	242,690	8
2008	43,175	8	262,745	8
2009	46,745	8	284,457	8
2010	50,600	8	307,963	8
Average	-	8.55	-	8.5

c.f: TEK table

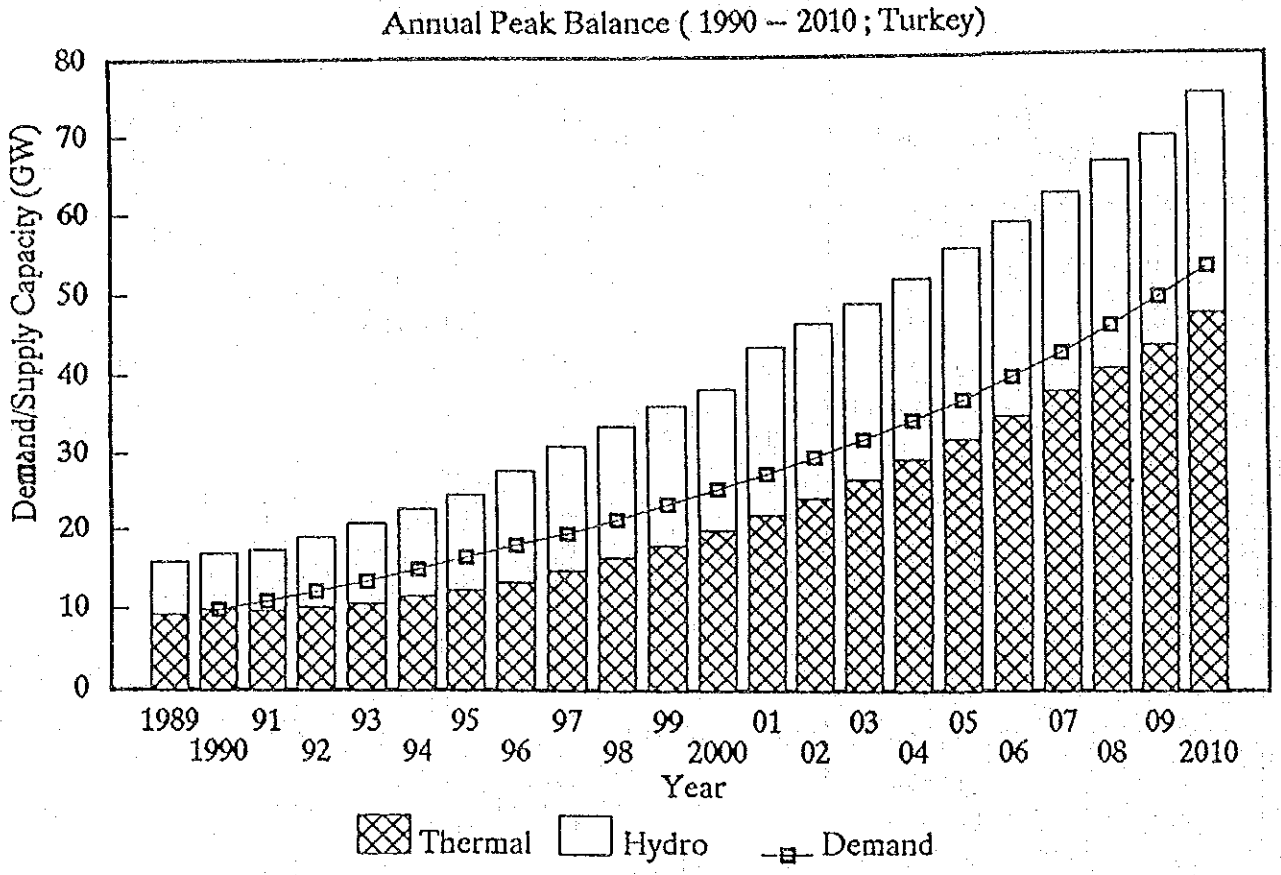

Fig. 5-1 Forecast of Demand/Supply Balance

- Annual Peak -