REPUBLIC OF TURKEY
MINISTRY OF ENERGY AND NATURAL RESOURCES
GENERAL DIRECTORATE OF STATE HYDRAULIC WORKS

YUSUFELI DAM AND HEPP PROJECT

CHAPTER III

PROJECT PURPOSE

ENVIRONMENTAL IMPACT ASSESSMENT

DRAFT FINAL REPORT (Rev F)

ENVIRONMENTAL CONSULTANCY CO.

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LIST OF ABBREVIATIONS

AIGM	General Directorate of Disaster Affairs
ASL	Above Sea Level
B/C	Benefit-cost ratio
Bern Convention	Convention on the Conservation of European Wildlife and Natural Habitats
BOD	Biological Oxygen Demand
BTEP	Thousand Tons of Petroleum Equivalent
CHY	Cable Head Yard
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CR	Critically Endangered
COD	Chemical Oxygen Demand
dB	Decibels
DD	Data Deficient
DIE	State Institute of Statistics
DMI	General Directorate of State Meteorological Institute
DO	Dissolved Oxygen
D/S	Downstream
DPT	State Planning Organization
DSI	General Directorate of State Hydraulic Works
EC	Electrical Conductivity
EDF	Electric de France
EIA	Environmental Impact Assessment
EIE	General Directorate of Electrical Power Resources Survey and Development Administration
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ENCON	ENCON Cevre Danismanlik Ltd. Sti. (Environmental Consultancy Co.)
EN	Endangered
ENE	East-northeast
ENPEP	Energy and Power Evaluation Program
EPDC	Electric Power Development Company
ERL	IUCN (European) Red List
ETL	Electric Transmission Lines
EU	European Union
EUAS	Turkish Electricity Production Corporation
GCCW	Georgian Centre for Wildlife Conservation

GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
GIS	Geographic Information Systems
GNP	Gross National Product
GWh	Giga Watt Hour
HH	Household
HEPP	Hydroelectric Power Plant
HSE	Health, Safety and Environment
HWCR	Hazardous Waste Control Regulation
HWL	High Water Level
IBA	Important Bird Area
ICOLD	International Commission on Large Dams
IPP	Independent Power Producers
IRR	Internal rate of return
IMS	Integrated Management System
IUCN	The World Conservation Union
JICA	Japan International Cooperation Agency
KEP	Kilogram Petroleum Equivalent
KGM	General Directorate of State Highways
KHGM	General Directorate of Rural Affairs
kWh	Kilo Watt Hour
Leq	Noise Level Equivalent
LTL	Long Term Limits
MAED	Model for Analysis of Energy Demand
MAK	Central Hunting Commission
MARA	Ministry of Agriculture and Rural Affairs
MCE	Maximum Credible Earthquake
MoEF	Ministry of Environment and Forestry
MENR	Ministry of Energy and Natural Resources
MOH	Ministry of Health
MPWS	Ministry of Public Works and Settlement
MTA	General Directorate of Mining Exploration and Research
MW	Mega Watt
MWCR	Medical Waste Control Regulation
MWL	Maximum Water Level
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration Environmental Data Service
OECD	Organization for Economic Cooperation and Development
OP	World Bank Operational Policy

PAP	Project Affected Person
PIO	Public Information Office
PM	Particulate Matter
RAP	Resettlement Action Plan
ROW	Right of Way
RS	Remote Sensing
SE	Southeast
SRF	Special Resettlement Fund
SS	Suspended Solids
STL	Short Term Limits
SY	Switch Yard
TCK	General Directorate of State Highways
TDS	Total Dissolved Solids
TEIAS	Turkish Electricity Transmission/Distribution Corporation
TKN	Total Kjeldahl Nitrogen
TKVKK	Trabzon Natural Wealth Preservation Committee
TPAO	Turkish Petroleum Corporation
TPE	Total Petroleum Equivalent
TPP	Thermal Power Plant
TRDB	Turkish Red Data Book
TSWCR	Turkish Solid Waste Control Regulation
TUGEM	General Directorate of Agricultural Production and Improvement
UNDP	United Nations Development Programme
U/S	Upstream
VU	Vulnerable
WB	World Bank
WCD	World Commission on Dams
WEC	World Energy Council
WPCR	Water Pollution Control Regulation
WWF	World Wildlife Foundation

III. PROJECT PURPOSE

Social and economic development of Turkey is going in parallel to the industrial development. Energy is a crucial necessity for social, economic, and industrial development. Turkey needs to exploit domestic energy sources to attain its goals and activities, and has an important potential for hydropower development with its relatively rich surface water resources. Thus, hydroelectric energy is one of the most important domestic energy sources of Turkey (Section I.1.3).

Hydroelectric energy being a renewable energy resource is a very significant source of energy generation in the long run as extensive scientific research on the world's energy resources has shown that fossil sources are rapidly being depleted. Moreover, adverse effects from carbon dioxide emissions from fossil fuel based power generation on global warming are undisputed.

Yusufeli Project will provide for the generation of reliable, inexpensive and renewable energy. The following sections discuss the energy needs of Turkey associated with the development goals of the country.

III.1. Social and Economic Policy

Five Year Development Plans, prepared by the State Planning Organization (DPT), generally govern Turkish social and economic goals and policies. These include policies on the sectors and issues affecting social and economic development, such as energy and industrialization policies. The principal goals of the Eighth Five Year Development Plan (2001), covering the years 2001-2005, are establishing a stable and sustainable development environment by implementing macroeconomic, social, cultural and structural harmonization policies and enhancing its competitiveness and adaptive capability in economy along with the ultimate objective of EU membership. To achieve these objectives, DPT has estimated that growth of Gross Domestic Product (GDP) should be annually around 6.5% for this period, while inflation should be reduced to single digits, and economic annual growth rate should be about five percent (DPT, 2001).

III.2. Present Situation in the Energy Sector

In Turkey, primary energy and electricity consumption have steadily increased since 1950's. While around 800 GWh in 1950's, this amount has increased 190 times today, to 151,000 GWh/year (DSI, 2005). In this period, primary energy consumption has annually increased by an average of 5.2% and electricity consumption by about 11% (DPT, 2001). In Turkey, even though the gross electrical energy consumption per capita reached about 2,100 kWh in 2004, it is seen that this value is lower than the world average, which is 2,500 kWh/capita. The primary energy production was increased to 23,956 thousand tons of petroleum equivalent in 2003 (DPT, 2004).

By the end of 2003, the total installed power in Turkey was 35,587 MW. Among these, 22,990 MW (58.7%) is thermal and 12,597 MW (35,3%) is hydraulic power plants. In 2003 electrical energy production was 140,580 GWh and 105,190 GWh (74,8%) was supplied from thermal and 35,390 GWh (25,1%) from hydroelectric power plants (DPT, 2004). The most significant developments in production were observed in thermal plants using natural gas and oil products, and to an extent hydraulic energy (DPT, 2004). The theoretical hydroelectric potential in Turkey is 433 billion kWh and the potential that can technically and economically be put into use is calculated to be 127 billion kWh (DSI, 2005).

In 1980's, lignite investments were given emphasis in the energy production. Production reached to 51 million tons/year, as of 1994. However, in 1990's Turkish governments gave priority to the hydroelectric power plants in order to use renewable resources in energy production. In addition, health and environmental problems associated with mainly air pollution caused by the power plants based on lignite were also among the reasons of preferring hydropower for energy supply. Total primary energy consumption reached 83,804 thousand tons of petroleum equivalent by the end of 2003 (MENR, 2004).

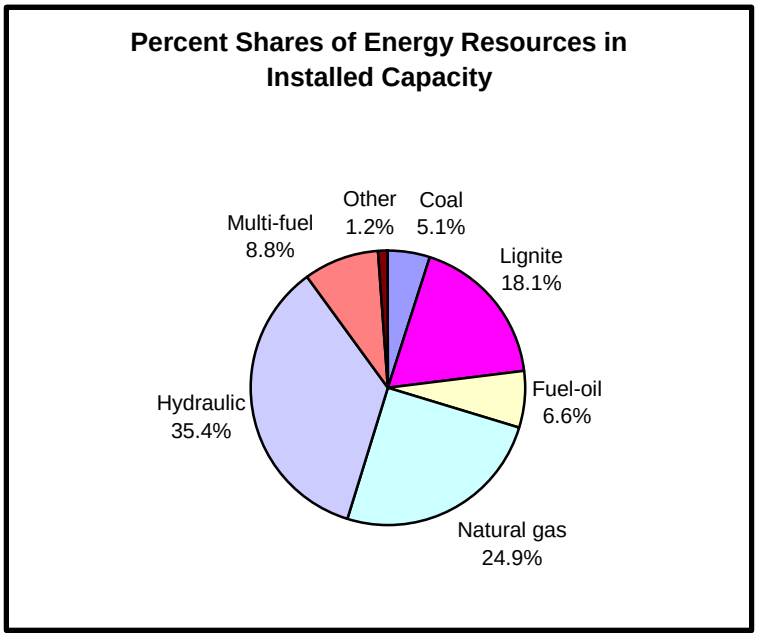
Oil products have 39.1% share and natural gas has 21.8% share in the energy sector, which have approximately 50% and 95% dependency on imported resources, respectively (TPAO, 2002). The share of power plants and industry in consumption increased while the share of residences decreased with time.

The electricity demand of the country is estimated by Ministry of Energy and Natural Resources based on the statistics related to realizations in the consumption in the past years and expectations (future trends) related to the population, economic and industrial growth of the country, by using MAED (Model for Analysis of Energy Demand). This model was developed by International Atomic Energy Agency. In addition, together with the Argonne National Laboratory (USA) they developed Energy and Power Evaluation Program (ENPEP), which has BALANCE (Balance of Energy Supplies and Demands), IMPACTS (Environmental Burdens and Resource Requirements of the Energy Sector) and ELECTRIC (WASP III - Wien Automatic System Planning Package) modules. These models are being used by the Ministry of Energy and Natural Resources to estimate the demand in Turkey and the estimation results are provided to DPT for future planning.

In 1995, installed capacity reached to 21,148 MW and electricity production was 86,300 GWh. In 1997, the installed capacity of electricity power plants reached 21,889 MW and 103,300 GWh of electricity production was realized. In 1998, installed capacity was estimated to be 23,702 MW and electricity production as 111,000 GWh. In 2000, the installed capacity of all electric power plants in Turkey was 27,391 MW and 124,200 GWh of electricity was produced, where the production capacity was 146,400 GWh. In 2003, the installed capacity of all electric power plants in Turkey was 35,587 MW and 140,580 GWh of electricity was produced, where the production capacity was 206,695 GWh.

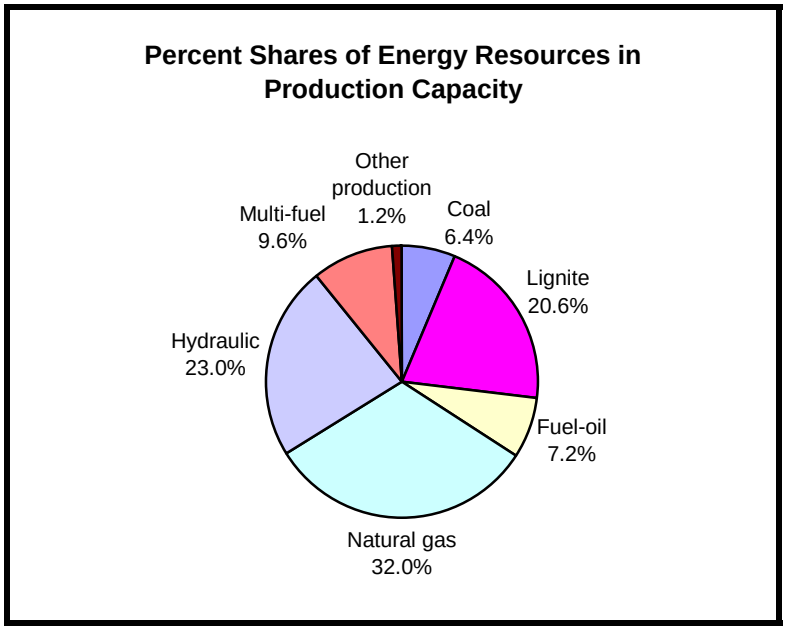
The percent share of energy resources in installed capacity (sum of the nominal capacities of all generators in a power plant, measured in MW) and production capacity (the electrical energy generation capacity of the generators in a power plant in a certain time period, measured as kWh or GWh) in the year 2003 are presented in Figure III.1 and Figure III.2 respectively. In addition, percent share of energy resources in actual production for the same year (2003) is given in Figure III.3. The change of installed capacity (thermal and hydro power plants and total) with years is shown in Figure III.4.

The reserve margin of the total energy production was 23% in 1994, but dropped to 4% in 1996. The demand for electricity was met with the amount of production as of 1997, but energy shortages were faced in late 1999 and in 2000 as the demand was increasing rapidly and energy investments require long planning, development and implementation periods (DPT, 2001). The economic crisis that Turkey lived through 2001 also affected the demand for energy, since consumption was considerably decreased based on the decrease in industrial production levels, and electricity demand was met safely in the second half of 2001 and first half of 2002. In 2003 and 2004 the trend of economic growth was followed with the increasing energy demand, which was met safely with the produced energy, though 71.5% of this production was dependent on imported sources. There have been improvements in the implementation of the Electricity Market Law (No: 4628) in 2003 and 2004, which aims the establishment of a competitive free market for the involvement of private sector in electricity production. However, continuing of planned investments to meet electricity demand safely in the coming years, during the establishment of this free market, is still considered to be very important by DPT (DPT, 2004).



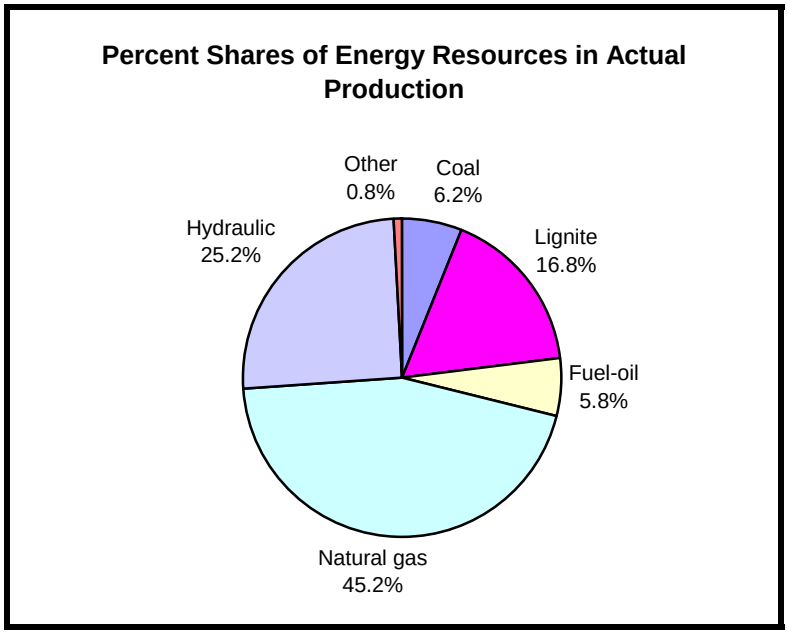
Source: Compiled From DPT, 2004

Figure III.1. Installed Capacities for Electricity Production by Energy Source in 2003



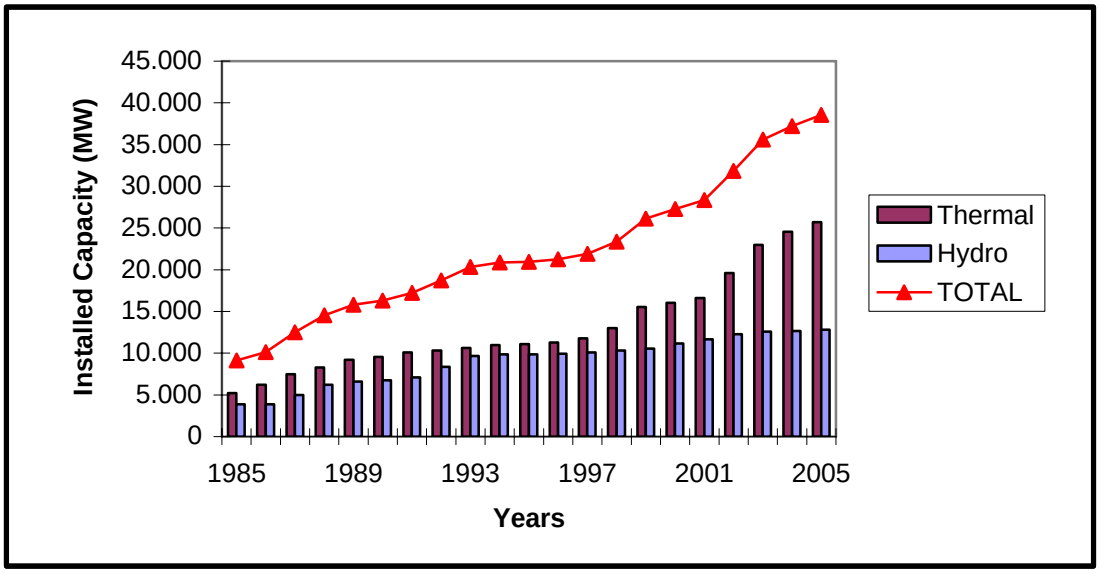
Source: Compiled From DPT, 2004

Figure III.2. Electricity Production Capacities by Energy Source in 2003



Source: Compiled From DPT, 2004

Figure III.3. Actual Production of Electricity by Energy Source in 2003



Source: Compiled From DPT, 2004

Figure III.4. Development in Installed Capacity of Power Plants in Turkey

III.3. Future Energy Sector

In the framework of the expectations of economic growth and population increase aimed in the Eighth Five Year Plan period, it is estimated that total energy demand will increase by an average of 6.2 percent annually and will reach 93.3 MTEP (million tons of petroleum equivalent) in 2005 (DPT, 2004). Projections of long-term electricity demand based on alternative growth scenarios indicate that demand will reach 195,000 GWh in 2005 and 285,000 GWh in 2010 (DPT, 2004). Electricity demand in Turkey since 1995 and forecasted needs for 2005 are given in Table III.1 together with the actual electricity production values and electricity consumption values per capita until 2005.

Electricity production of thermal and hydropower plants is presented in Figure III.5 together with the total production and demand from 1989 to 2005. In addition, primary energy production and associated production capacities are shown in Figure III.6.

It was estimated that installed capacity of power plants should increase to 42,783 MW in order to meet the electricity demand, which is 195,000 GWh, by the end of 2005 with a 20% reserve in the production capacity (DPT, 2004, 2005). With these developments, total energy consumption per capita will reach 1,291 kg oil equivalent and electricity consumption per capita to 2,241 kWh in the year 2005. Developments of primary energy and the production and consumption of electricity are given in Table III.2.

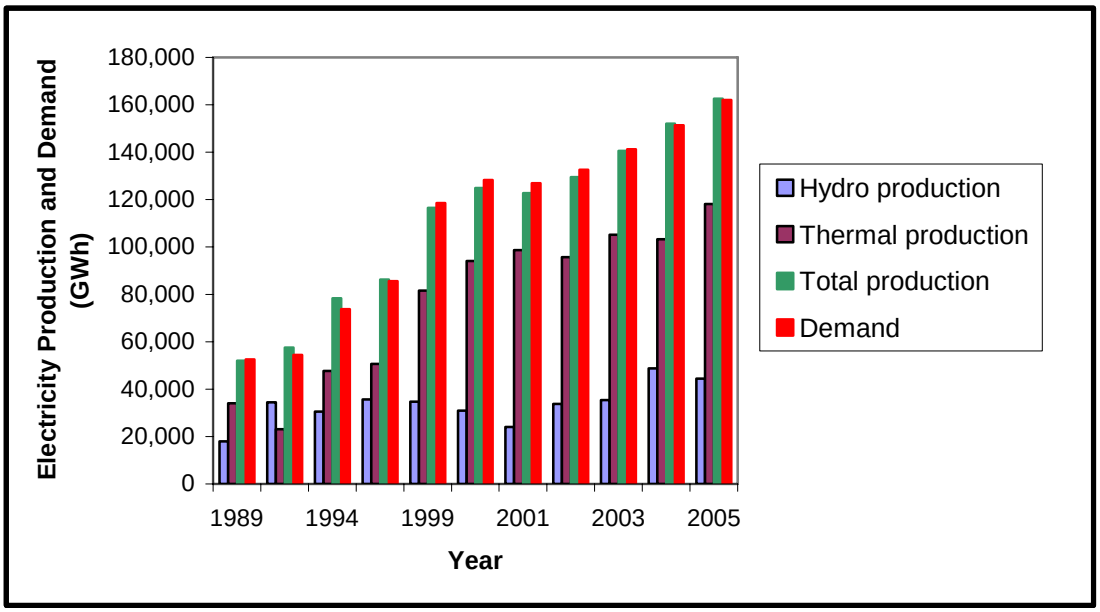
Table III.1. Electricity Demand and Production in Turkey (DPT, 2005; TEIAS, 2005)

Year	Electricity Demand (GWh)	Electricity Production (GWh)
1995	85,551	86,247
2000	128,295	124,922
2001	126,872	122,725
2002	132,553	129,400
2003	141,151	140,580
2004	151,400	152,000
2005	162,000	162,600
2006 (est.'d)	176,400	206,457
2007 (est.'d)	180,248	216,821
2008 (est.'d)	191,677	217,166
2009 (est.'d)	203,827	223,957
2010 (est.'d)	216,747	224,708
2011 (est.'d)	230,399	233,899
2012 (est.'d)	244,951	248,289
2013 (est.'d)	260,401	265,329

Table III.2. Developments of Primary Energy and the Production and Consumption of Electricity (Adapted from Eighth Five Year Development Plan (2001), and 2005 Year Program, DPT)

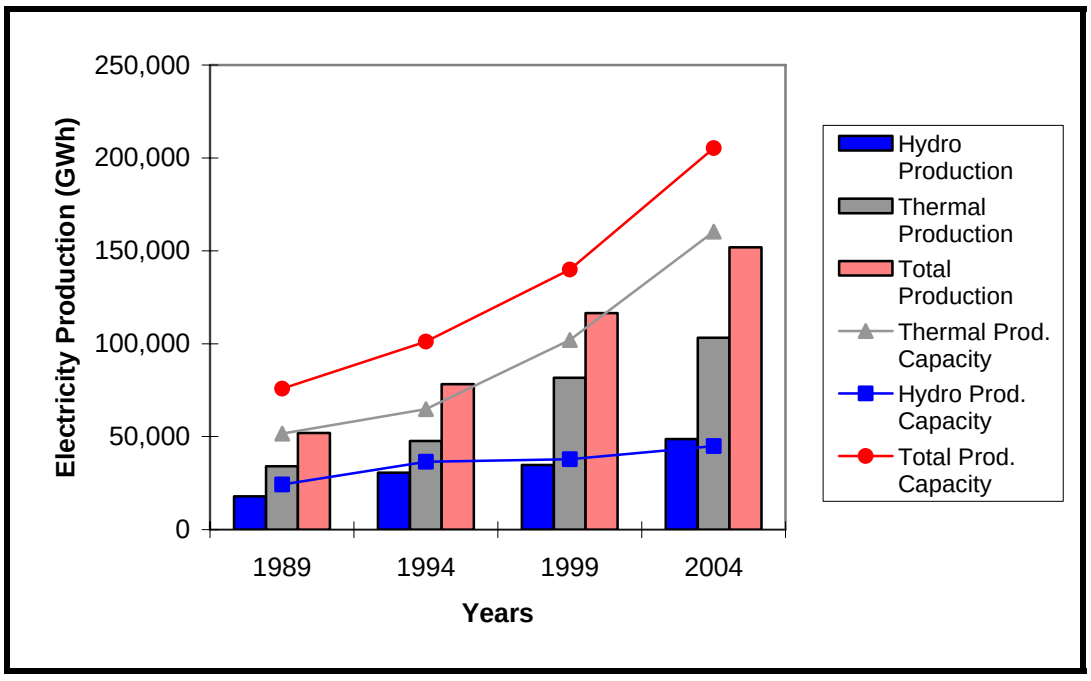
	Year / Unit	2000	2001	2002	2003	2004	2005 (estimated)
Primary Energy							
Production	BTEP	27,621	26,159	24,884	23,956	24,750	26,617
Consumption	BTEP	81,193	75,883	78,322	83,936	87,903	93,335
Consumption Per Capita	KEP	1,204	1,109	1,129	1,193	1,232	1,1,291
Electricity							
Installed Generation Capacity	MW	27,264	28,332	31,846	35,587	37,207	38,552
Thermal	MW	16,070	16,640	19,586	22,990	24,540	25,720
Hydraulic	MW	11,194	11,692	12,260	12,597	12,667	12,832
Production	GWh	124,922	122,725	129,400	140,580	152,000	162,600
Thermal	GWh	94,010	98,653	95,668	105,190	103,240	118,150
Hydraulic	GWh	30,912	24,072	33,732	35,390	48,760	44,450
Import	GWh	3,786	3,588	3,588	1,158	500	500
Export	GWh	413	433	435	587	1,100	1,100
Consumption	GWh	128,295	126,872	132,553	141,151	151,400	162,000
Consumption Per Capita	KWh	1,903	1,855	1,910	2,006	2,122	2,241

BTEP: Thousand tons of petroleum equivalent
KEP : Kilogram petroleum equivalent
GWh : Gigawatt hour



Source: Compiled From DPT, 2004

Figure III.5. Electricity Production and Demand Between 1989 and 2005



Source: Compiled From DPT, 2004

Figure III.6. Electricity Production by Source and Associated Installed Capacities (1989 – 2005)

III.4. Role of Yusufeli Project

The total installed hydro capacity in Turkey was 11,194 MW in 2000 and is expected to be 12,832 MW by 2005. Yusufeli Dam and Hydroelectric Power Plant Project is expected to be contributing to the energy production in Turkey by the year 2013 with its 540 MW installed capacity. Therefore, Yusufeli HEPP, with its relatively large installed capacity and high annual electricity generation (1,705 GWh/year), is expected to meet about 0.6% of the total electricity demand of the country envisaged for 2013 (assuming a yearly increase of 6.4% in the demand). Yusufeli Project will be an important electricity generation facility for achieving Turkish long-term energy goals (TEIAS, 2005). Furthermore, most important domestic and renewable energy sources of Turkey are hydraulic sources. Less than 50% of the feasible hydraulic potential is exploited as of today and meeting the energy demand required for the development of the country by using domestic sources is an important priority. In this context Yusufeli is one of the major projects.

Within the Coruh hydropower cascade, by its high regulating capacity Yusufeli Project will provide benefits to the production capacity of the downstream hydroelectric power plants that are under operation (Muratli Project) and construction (Deriner and Borcka projects). Thus, it is the key project of Coruh River Development Plan, which will be utilized for energy generation of 8,320 GWh/year, when all the proposed projects (10 projects) are taken into operation. Yusufeli and the 4 downstream projects (Artvin, Deriner, Borcka, Muratli) will produce an annual energy of 6,331 GWh with 1,957 MW installed capacity. Both the energy and firm powers of the downstream projects will be increased. It was estimated that Yusufeli Project will increase the firm energy of Deriner, Borcka and Muratli projects by 467 GWh/year and an increase of 160 MW in dependable power of these plants will be realized (DSI, 2001).