CHAPTER 1 INTRODUCTION

1.1 Background

Most of the infrastructures in Iraq have remained in a serious or critical situation due to damages during wars and conflict over a period of 25 years and lack of proper and regular maintenance. For the reconstruction of Iraq, it is essential to restore these infrastructures at the earliest time.

Over a long period of time, the Iraqi people have suffered serious shortage of electricity. Electricity is required not only for humanitarian needs in people's daily lives, hospitals, schools, public services, pumps for municipal water supply and irrigation use, but also for recovering and supporting various commercial and industrial activities.

For the reconstruction of the electricity supply network and facilities in Iraq, the Government of Iraq and some international organizations have implemented rehabilitation works since the Gulf War, and at present the Coalition Provisional Authority (CPA) is undertaking the works after the recent conflict in 2003. In 1990, before the Gulf War, the total installed generating capacity in Iraq was approximately 9,000 MW. However the supply capacity fell to 3,300 MW after the War and has now been recovered to a level of more than 4,000 MW by various urgent rehabilitation works.

Towards the international donor conference at Madrid in October 2003, a Needs Assessment report was prepared by a joint work of the UN and WB groups in which the electricity sector was included with a high priority. In this assessment, the fund requirements for reconstruction of various sectors of Iraq were estimated. Regarding electricity, the report recommended that a master plan be formulated to establish an overall policy for reconstruction of Iraq's electricity sector and to place priority on development plans taking into account the future load demand and system management.

However, the current situation does not permit a master plan study to be conducted. The report pointed out the importance of immediately proceeding with data acquisition and preliminary analyses for the long-term master plan study, which is expected to be carried out immediately after the security issue in Iraq is resolved.

In view of the UNDP's offer to JICA and JBIC to conduct joint operation of the said data acquisition and preliminary analyses, JICA and JBIC dispatched a mission to Jordan in November 2003 to hold discussions with UNDP and MOE (Ministry of Electricity, Iraq) on the possibility of implementation of such preparatory works, and both parties agreed that the preparatory works (hereinafter referred to as "the Study") be carried out at Amman jointly.

A study team comprised of several areas of expertise was organized by JICA and UNDP with a financial contribution by JBIC. The team started the Study at the end of January 2004 and completed it in the middle of July 2004.

1.2 Objectives of the Study

The objective of the Study is to acquire base line information and data for formulating the long-term master plan study to be carried out after the security in Iraq is recovered.

Another objective is to contribute to human resource development in the electricity sector in Iraq through joint preparatory works with the Iraqi staff of MoE during the study period.

1.3 Methodology and Schedule

Since the Gulf War in 1990 and the recent conflict in 2003, various rehabilitation programs and projects have been planned or implemented in order to meet the urgent requirements for electricity. However, this Study has placed more emphasis on the analysis of actual and future electricity demands with due focus on the future supply system required so as to complement on-going exercises.

In accordance with the Minutes of Meeting on December 2, 2003 among JICA, UNDP and JBIC, the Study was conducted at Amman in Jordan by a joint team consisting of the JICA and UNDP experts. Due to security concerns in Iraq, however, the study team was obliged to perform all investigations outside Iraq, that is, at Amman in Jordan. Data and information were mainly collected through two channels. One was through UNDP and the other through MoE.

With a financial contribution by JBIC the UNDP team was composed of several experts who participated in the Electricity Network Rehabilitation Programme (ENRP) implemented in northern Iraq under the Oil-for-Food Programme. Data and information obtained in the ENRP were provided for the Study. UNDP coordinated various discussions at Amman among MoE, CPA, UNDP and JICA, including telephone conferences with CPA.

Data and information were also collected from the MoE staff who visited Amman regularly or occasionally. In January 2004 MoE established a coordinating office in Amman at the offices of NEPCO (National Electric Power Company) of Jordan to liaise with the multi-donor agencies and donor countries for reconstruction of Iraq. In the initial stage of the study in February and March 2004, some discussions were made at the NEPCO Office between the MoE staff and the Team and some basic data on the electricity were provided in response to the Team's questionnaire. However, partly due to the increasing unrest in Iraq after April, discussions with MoE staff at Amman were interrupted. However, in May and June some useful discussions were made with the trainees from MoE who visited Amman under the JICA training program.

Related information was also given by two other JICA study teams which were concurrently working in Amman for reconstruction of Iraq during the months of January to March 2004. One study was a preliminary study for Iraq reconstruction assistance on grant aid of the Government of Japan. The other was a basic study on reconstruction and rehabilitation of infrastructures in Iraq. Another data source was Internet websites. Daily base information of electricity was released on the home page of CPA. Other data was available on the home page of WB, UN, UNDP and other agencies.

The Study was carried out at Amman from February 4 to June 30, 2004, with some interruption during the period due to the contractual arrangement.

As stated in the Minutes of the Meeting between UNDP, JICA and JBIC held on 2nd December 2003, the Study will be conducted on the basis of a so-called "Bottom-up Approach", which focuses more on the distribution network. However, mainly due to the security situation in Iraq, full investigation and study could not be done especially for the distribution network.

1.4 Acknowledgement

The Study was carried by jointly by JICA and UNDP with full assistance and cooperation of JICA Headquarters and JICA Office in Amman. The activities of UNDP related to this study were fully financed by JBIC.

The Team would like to thank the officials and engineers of the Ministry of Electricity who visited Amman for provision of data and information and rendered comments and opinions on the present conditions and future development of the electricity sector in Iraq.

The Team is also grateful to NEPCO who was responsible for coordination between the Team and the MoE trainees.

CHAPTER 2 OVERVIEW OF THE SOCIO-ECONOMY OF IRAQ

2.1 Recent History of Iraq

Formerly Iraq was a part of the Ottoman Empire and during the course of World War I Iraq was occupied by British. In 1920 Iraq was declared a League of Nations UK Administration. Iraq attained its independence as a kingdom in 1932 and a republic was proclaimed in 1958. Thereafter, however, a series of military governments ruled the country, the latest being Saddam Hussein.

Territorial disputes between Iraq and Iran led to the eight year war (1990-88). In August 1990, Iraq seized Kuwait, triggering the Gulf War in January-February 1991. For this invasion, the UN Security Council (UNSC) made a resolution on economic sanctions to Iraq. However, for humanitarian assistance under the sanctions, the Oil-for-Food Programme (OFFP) was introduced. Initially the program was implemented for importing foods and medical items, but later it was extended to other sectors (finally 14 sectors including the electricity sector).

In March 2003, the US-led force attacked Iraq on suspicion of it being in possession of weapons of mass destruction (WMD), and this resulted in the ouster of the Saddam Hussein regime. After the war, the coalition forces remained in Iraq and the Coalition Provisional Authority (CPA) was established on May 6, 2004 to help restore degraded infrastructures and facilitate the establishment of a free elected government until such time as Iraq is politically and socially stable enough to assume sovereignty.

The recent events of Iraq with a focus on international relationships are outlined in Figure 2.1-1, which also includes the status of electricity.

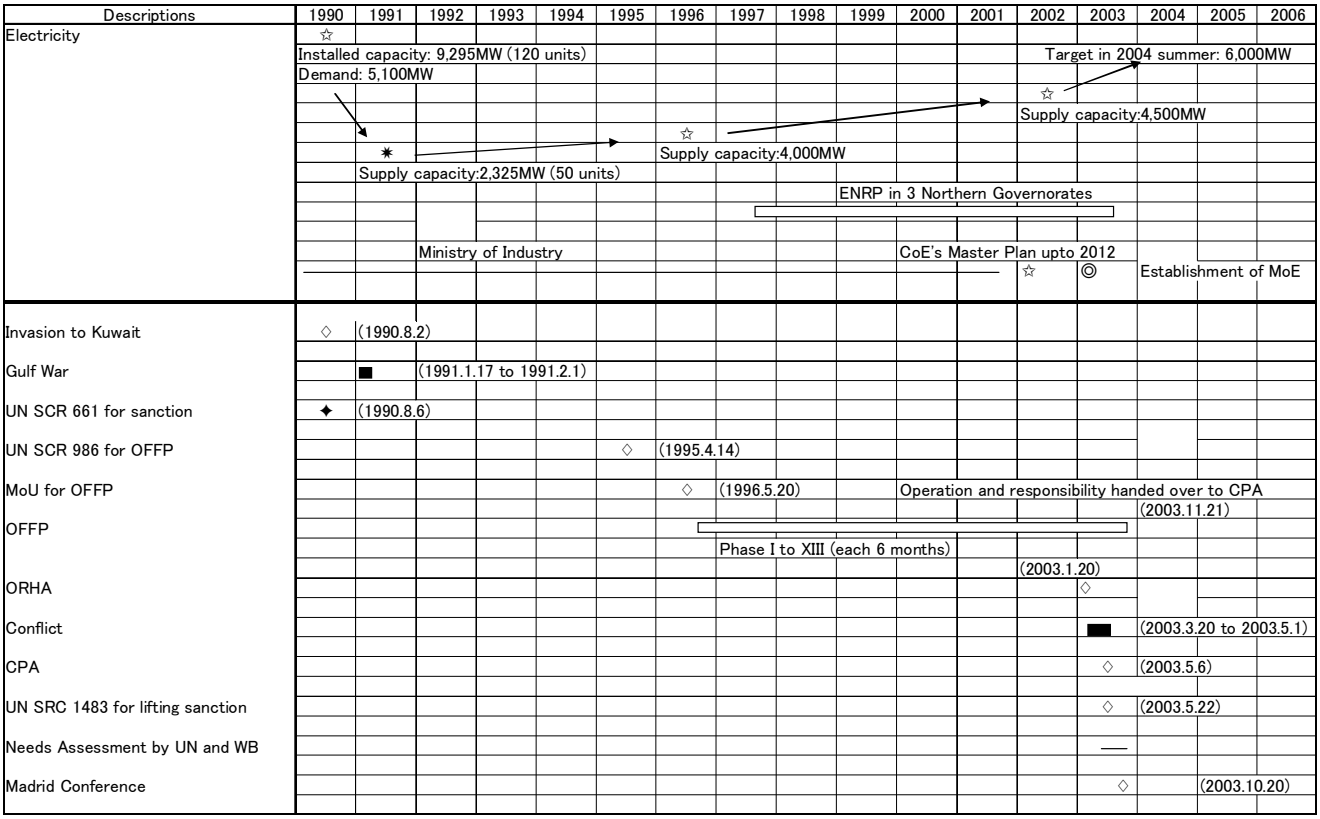


Figure 2.1-1 Recent Events of Iraq

2.2 Government and Administrative Regions

The CPA is a temporary government and has been designated by the UN as the lawful government of Iraq. The CPA was initially only responsible for the administration of Iraq, but sovereignty was transferred to the Iraqi people on June 28, 2004, two days earlier than scheduled in the Agreement on November 15, 2003 between CPA and the Governing Council (GC). The GC is composed of 25 members who were appointed by the CPA on July 13, 2003.

Under the GC, 25 ministries are organized: Agriculture; Communication, Construction & Housing; Culture; Education; Electricity; Environment; Expatriates & Immigrants; Finance; Foreign Affairs; Health; Higher Education; Human Rights; Industry & Minerals; Interior; Irrigation; Justice; Labor & Social Affairs; Oil; Planning; Public Works; Science & Technology; Trade; Transport; and Youth & Sports.

In October 2003, an international donor meeting was held in Madrid on the re-building of Iraq. At this conference, a sum of US$33 billion was committed by the multi-lending agencies and donor countries, and thereafter a number of projects and programs have been discussed and implemented by the parties concerned. At the conference, the Japanese Government committed an amount of US$5 billion in total for re-building Iraq for the year 2004 to 2007.

On June 1, 2004, the Iraqi Interim Government was announced by the UN to take over the sovereignty from the CPA on June 30, 2004 and, the Governing Council was dissolved. The president and two vice presidents were selected, and under the new administration headed by the prime minister, about 30 ministers were announced. While most of the former ministers remain unchanged, some new ministries are established such as for national security, defense, local communities, and female issues.

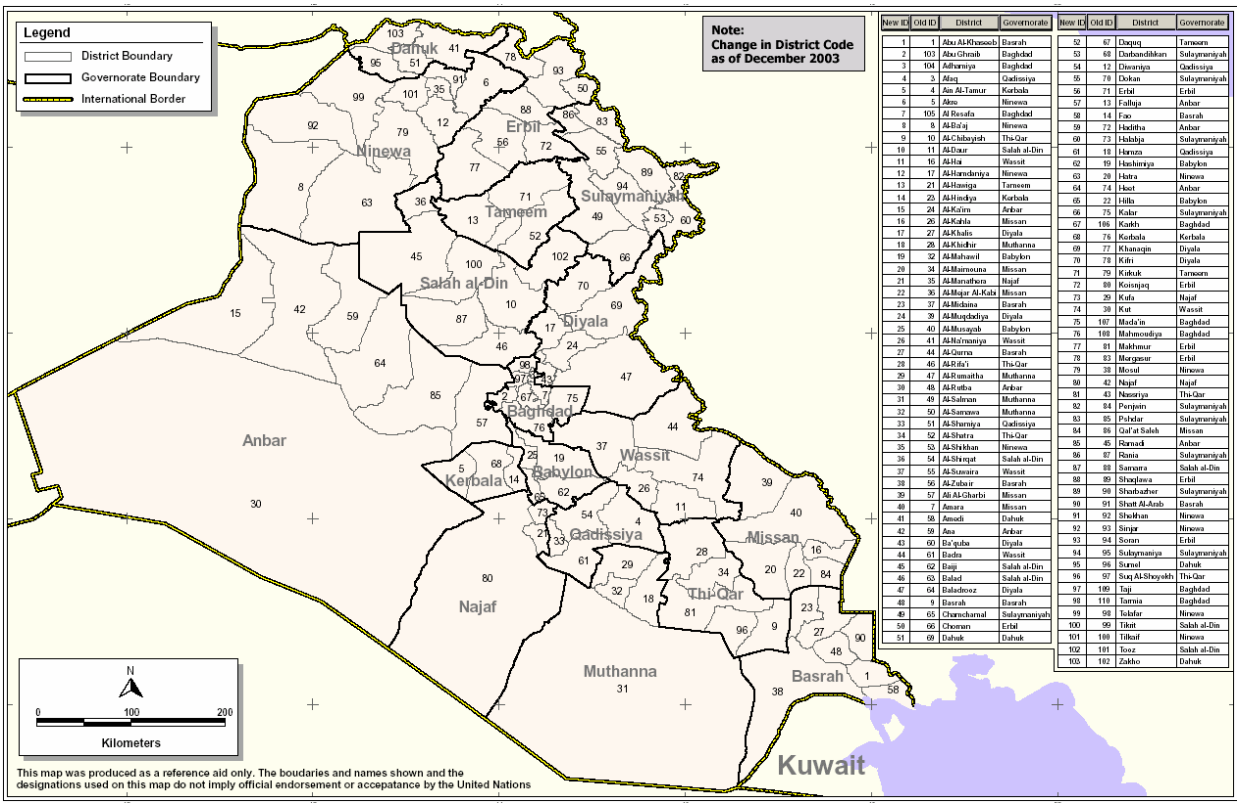
Efforts are underway to begin the drafting of a new constitution and hold elections to establish an internationally recognized representative government for Iraq. The Interim Government will prepare for a new government to be established through the national elections along the following timetable.

- Jan 31, 2005: Election for the National Assembly (NA) completes.
- Early 2005: Iraqi Transient Government takes power.
- August15, 2005: NA completes draft of permanent constitution.
- October15, 2005: Referendum for permanent constitution
- December 15 2005 : Election
- December 31 2005: Elected Government assumes office.

Administratively, Iraq is divided into 18 governorates as shown in Figure 2.2-1. Each governorate belongs to one of the three regions; the north, center or south regions. The governorate and district codes are presented in Figure 2.2-2.

Source: UN HIC (Humanitarian Information Centre for Iraq)

Figure 2.2-1 Governorates in Iraq



Source: UN HIC (Humanitarian Information Centre for Iraq)

Figure 2.2-2 Governorates and Districts Codes

2.3 The Geography and Socio-Economic Conditions

The land of Iraq is 437,062 km^2 and borders six counties including Iran, Turkey, Syria, Jordan, Saudi Arabia and Kuwait. It has a narrow coastline with the Gulf between Iran and Kuwait. The land slopes from mountains over 3,000 meters above sea level along the borders with Iran and Turkey to the remnants of reedy marshes at sea level in the southeast. Most of the land is desert or wasteland. The mountains in the northeast are an extension of the alpine system that runs eastward from the Balkans into southern Turkey, northern Iraq, Iran and Afghanistan, terminating in the Himalayas. The highest point of the land is on the north at elevation of 3,611m above sea level.

Average temperatures range from nearly 40℃ in July and August to below freezing in January. Maximum temperature rises above 50 ℃ in Baghdad and Basrah. Most rainfall occurs from December through April and averages between 100 to 180 mm annually. The mountainous region of northern Iraq along the Turkish and Iranian borders receives appreciably more precipitation than the central or southern desert region. The humidity in Baghdad is 22% in summer time. The land of Iraq mainly consists of desert with dry and hot weather, but the northern mountainous regions experience cold winters with occasional heavy snow.

There are two major rivers in Iraq, the Tigris and Euphrates, which originate in Turkey and flow through the land from north to south. They join northwest of Basrah, forming the Shatt al Arab and pour into the Gulf. Baghdad is situated on the Tigris River, which is at a very low elevation, being 34 m above sea level. The river gradient in the downstream reach is very gentle (1 in 20,000), and reedy marshes extend in the southern part along the Iranian border. The annual discharges of the Tigris and Euphrates Rivers at the border are approximately 28.4 billion m^3 (900 cms) and 20.8 billion m^3 (660 cms) respectively. Both the rivers carry about 70 million cubic meters of silt annually to the delta.

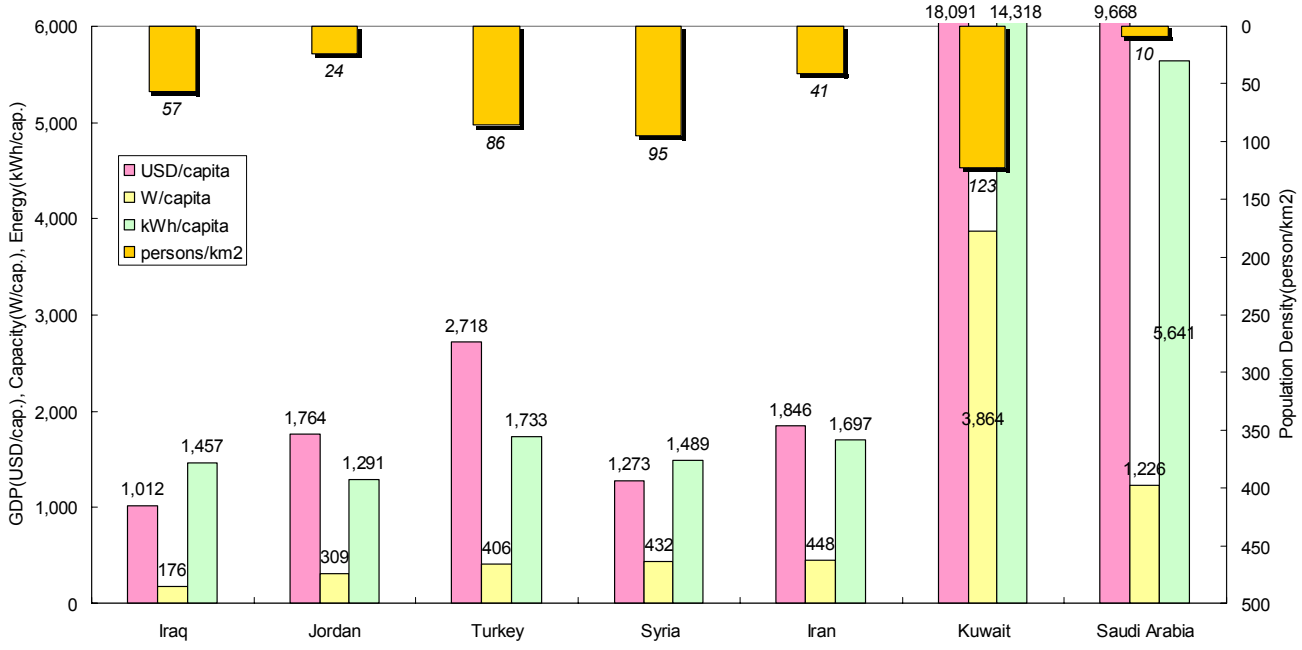
The population of Iraq is approximately 26 million, of which the young generation of 0 to 14 years reportedly represents 41%. The population growth was estimated at 2.78 % in 2003. Ethnically Arab shares 75 to 80% followed by Kurudish 15-20% and Turkuman, Assirian and others 5%. About 97% of people are Muslim, with Shi'a being 60 to 65% and Sunni being 32 to 37%. Christian and others are 3%. About 75% of Iraq's population lives in the flat, alluvial plain stretching southeast toward Baghdad and Basrah to the Persian Gulf.

Iraq's economy is dominated by the oil sector, which has traditionally provided about 95% of the foreign exchange earnings. However, Iraq suffered economic losses from the recent wars and due to the international economic sanctions based on the resolution of UN Security Council (UNSC). Many components of the infrastructure and oil pipelines have been damaged and have further deteriorated due to lack of maintenance and shortage of spare parts, and a considerable amount of foreign debt has remained unpaid (reportedly about US$120 billion). The implementation of the UN Oil-for-Food Programme (OFFP) has helped in improving the basic conditions of the

Iraqi people. In 1999 UNSC authorized Iraq to export under the program as much oil as required to meet the humanitarian needs. As of May 4, 2004, the estimated crude oil export revenue in 2004 reached US$5.7 billion, while that for 2003 (June – December) was US$5.1 billion.

The decline of GDP in 2001 and 2002 was largely the result of the global economic slowdown and lower oil prices. The GDP in 2002 was reportedly US$58 billion, though it may be difficult to estimate with reasonable accuracy. From this value, the per-capita GDP is derived at US$2,000. No detail information is known on the Iraqi industries and the composition of GDP by sector. However, the major industries are petroleum, chemicals, textiles, construction materials, such as cement, and food processing. The share of agriculture in GDP would be as small as 6%.

Electricity production in Iraq was 36 billion kWh in 2002. The per capita GDP, per-capita electricity consumption and population density of the neighboring countries are shown in Figures 2.3-1 for reference.



Data source: Country Analysis Briefs; EIA

Figure 2.3-1 Electricity Consumption per-Capita and Population Density of the Neighboring Countries

At present oil production in Iraq is approximately 2.4 Mbbl/day and the initial goal by the end of 2004 is set at 3.0 Mbbl/day.

In the several years before the conflict the foreign exchange rate had remained almost constant. In 1995 through 2002, one Iraqi Dinar (ID) was equal to US$3.216 to US$3.217 (US$1 = 0.3 ID). However, since January 2004 the New Iraqi Dinar (NID) has been introduced and in May 2004 the average exchange rate was about NID 1,460 per US$ with a few percent of fluctuation.

CHAPTER 3 PAST AND CURRENT STATUS OF ELECTRICITY SECTOR

3.1 Status of Electricity Sector

3.1.1 Overview of the Electricity Sector

Electricity in Iraq has been produced by steam plant, gas turbine plant and hydropower plant and diesel plant. There are 32 existing major power stations as shown in Table 3.1-1.

Table 3.1-1 Existing Generating Facilities in Iraq

Type	Number of Stations (Nos.)	Total Installed Capacity (MW)	Dependable Capacity (MW) *
Steam	8	5,415	1,600
Gas turbine	14	2,181	800
Hydro	7	2,518	650
Diesel	3	87	87
Total	32	10,206	3,137

Note: * reported in NA in 2003, but subject to change from the on-going rehabilitation works.

As seen in Table 3.1-1, however, the actual generating capacity is much lower than the installed capacity, though some of the stations are now being rehabilitated or replaced.

Electricity networks are provided all over the country, which include high voltage lines of 400 kV and 132 kV and low voltage lines of 33 kV and 11kV. The substations are located near the demand centers or at strategic points. Location maps of the 400 kV and 132 kV lines and major power stations and substations are shown in Figure 3.1-1 and Figure 3.1-2. The length of transmission lines and the number of substations are summarized in Table 3.1-2.

Table 3.1-2 Length of Transmission Lines and Number of Substations

Items	Unit	Quantity
400 kV T/L	km	3,541
132 kV T/L	km	13,579
400 kV/132 kV S/S	nos.	19
132 kV/33 or 11kV S/S	nos.	184
Mobile S/S	nos.	83

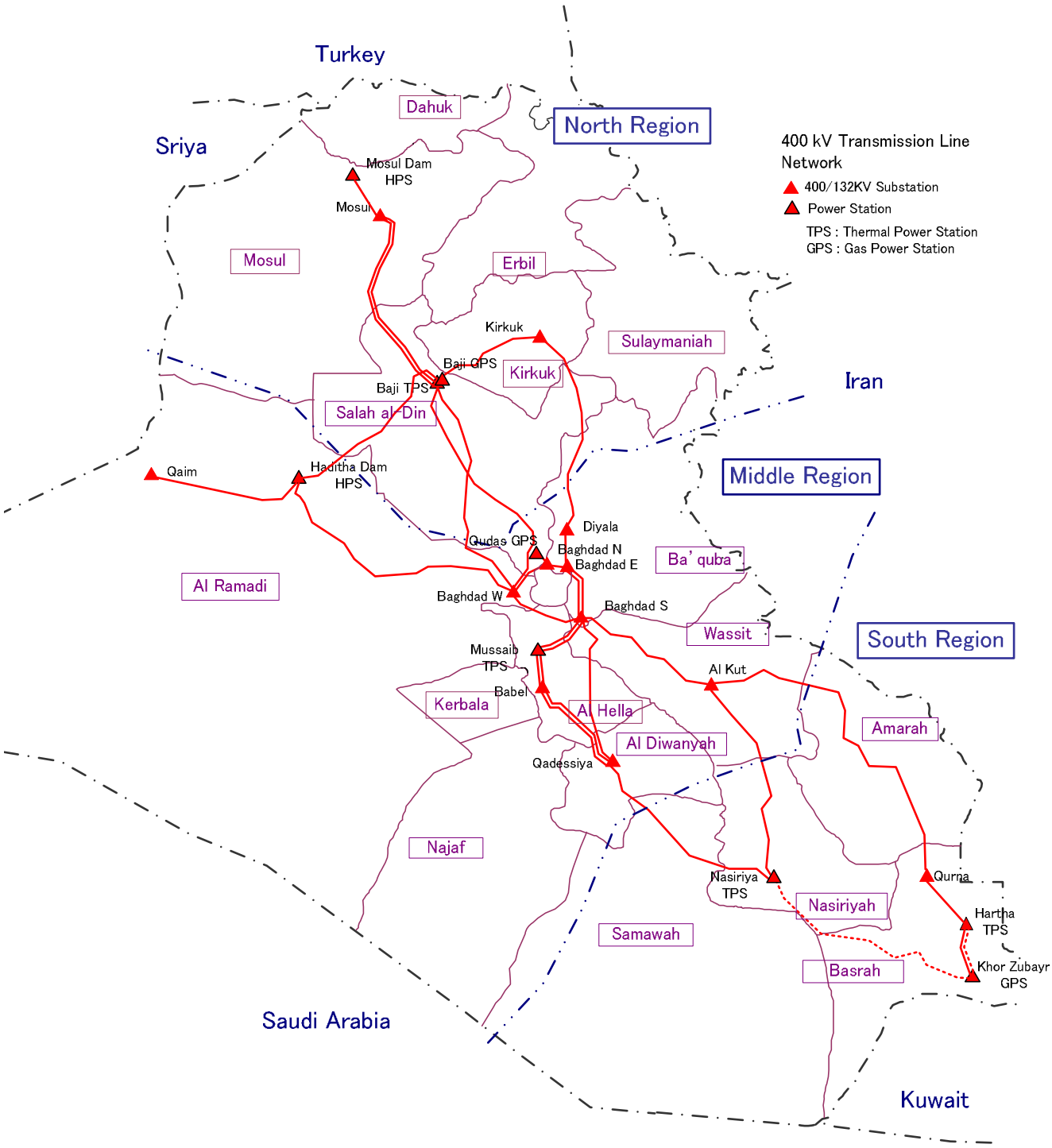


Figure 3.1-1 400 kV Power Transmission Line Network

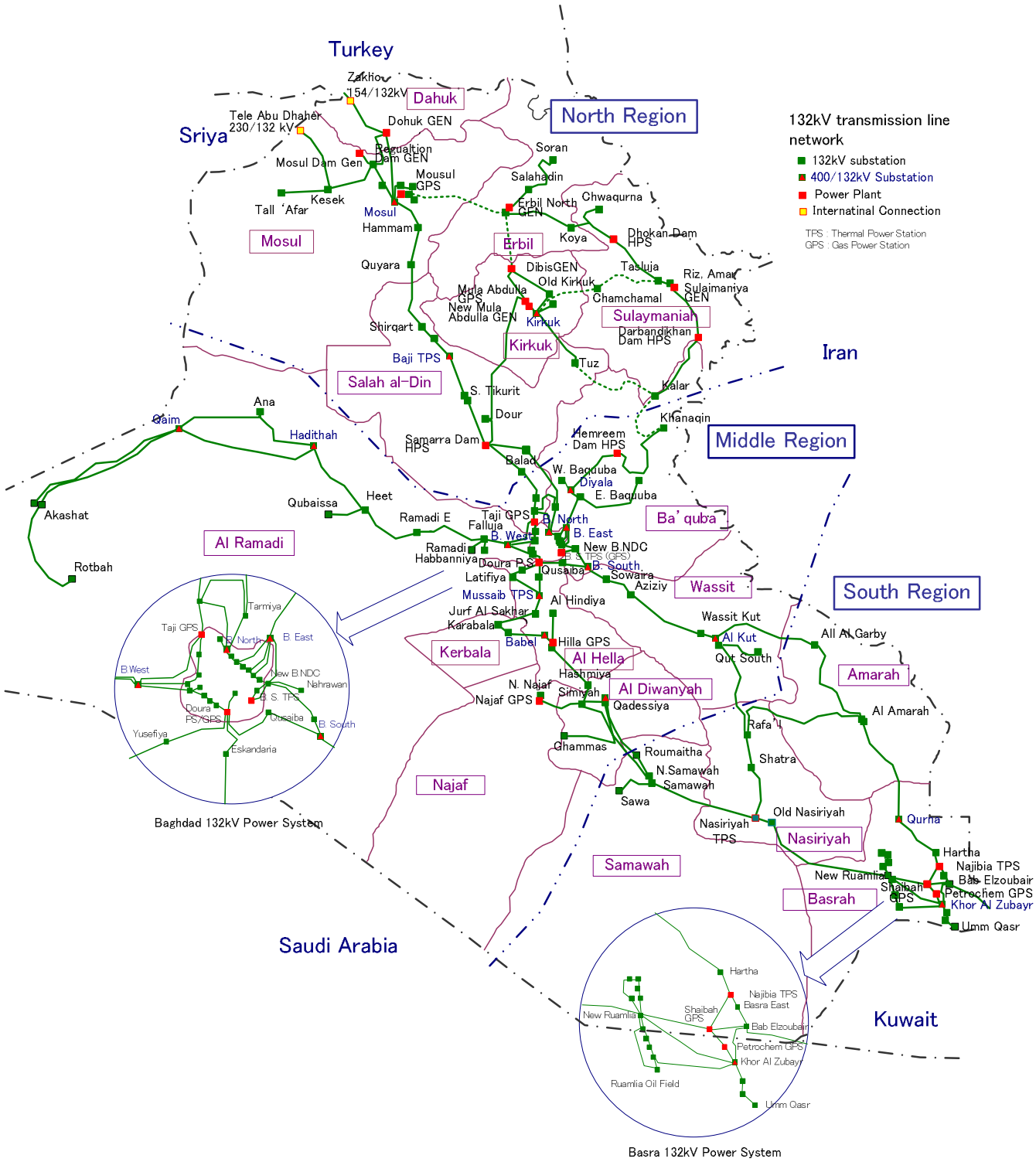


Figure 3.1-2 132 kV Power Transmission Line Network

For overall control and operation of the national power system the national dispatch center (NDC) has been established at Baghdad. In addition, for control of the power system on a regional basis, three regional control centers are operated, that is, North (NRCC) at Kirkuk, Middle (MRCC) at Baghdad and South (SRCC) at Basrah.

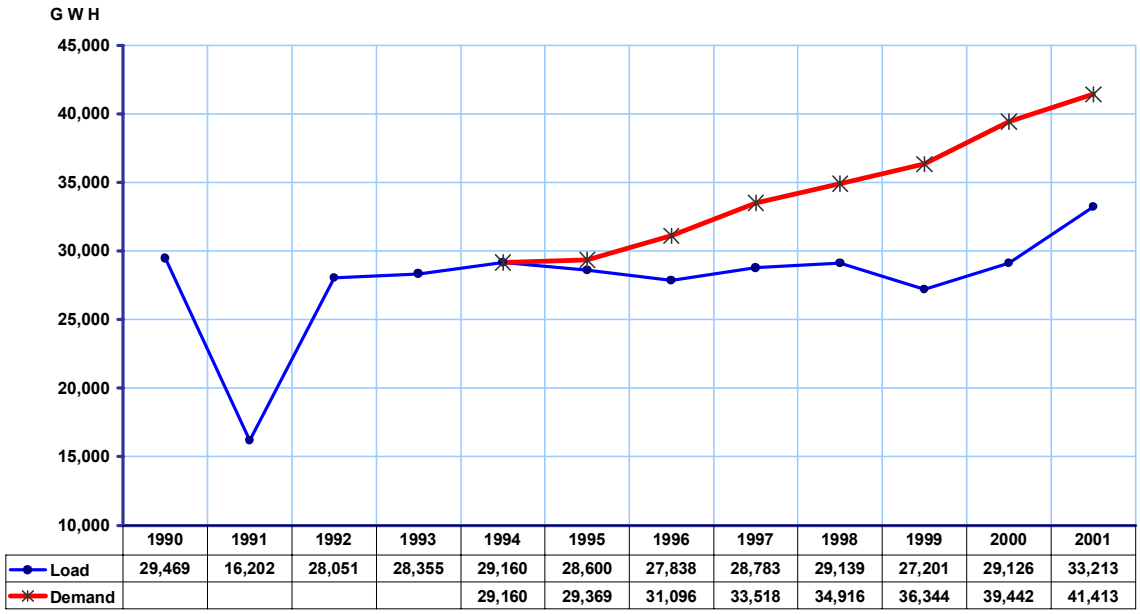
However, for the northern governorates (Erbil and Sulaymaniyah), which are disconnected from the national power grid at present, the local electricity authorities (LEAs) are responsible for supplying electricity by operating their own plants and system.

The electricity system in Iraq is controlled on a regional basis as indicated by the location of the regional control centers, that is, under the northern electric region (NER), the middle electric region (MER) or the southern electric region (SER). Each governorate belongs to one of the electricity regions as shown in Table 3.1-3.

Table 3.1-3 Governorates Classified in Electricity Regions

Region	Governorates
NER	Dahuk, Erbil, Sulaymaniyah, Ninewa, Tameen, Salah al-Din
MER	Baghdad, Anbar, Diyala, Karbala, Babylon, Wassit, Najaf, Qadissiya
SER	Basrah, Missan, Thi-Qar, Muthanna

Electric energy produced from 1990 to 2002 is presented in Figure 3.1-3. Due to the Gulf War in 1990 and for several other reasons, production rates of electric energy have been suppressed as shown in the figure. Over a period of 14 years from the Gulf war to the recent conflict, production increased from 25,000 GWh to 35,000 GWh, which shows an increase of 40 % at an annual rate of about 2.5% on average.

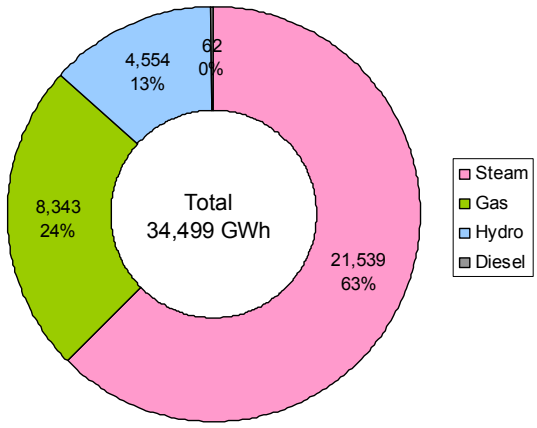


	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Load	29,469	16,202	28,051	28,355	29,160	28,600	27,838	28,783	29,139	27,201	29,126	33,213
Demand					29,160	29,369	31,096	33,518	34,916	36,344	39,442	41,413

Source: Needs Assessment of the Electricity Sector, Annex F: Energy Statistics

Figure 3.1-3 Energy Production 1990 - 2001

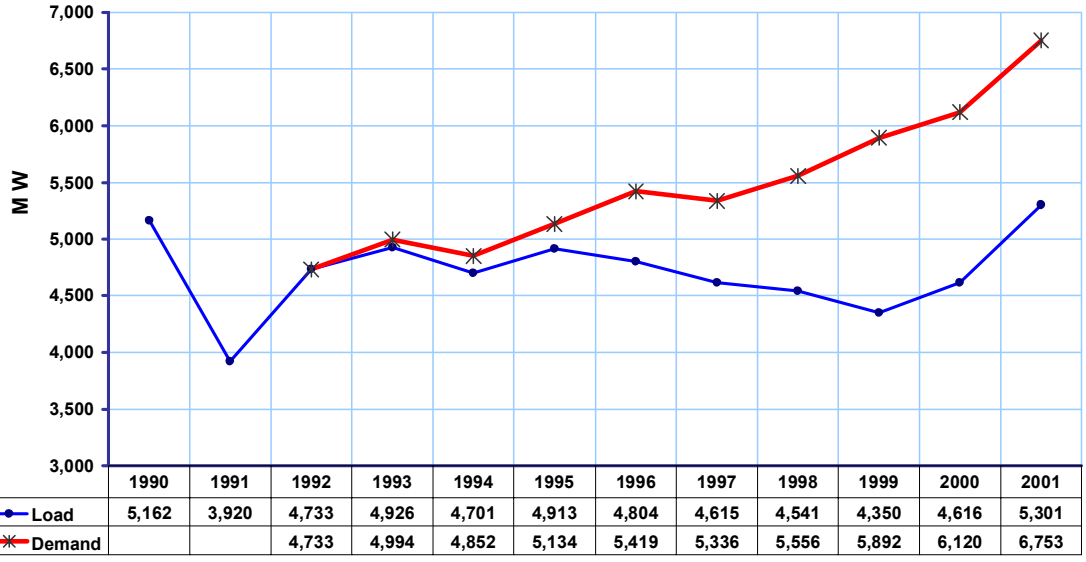
The share of energy production by generating source in 2002 is given in Figure 3.1-4. In 2002 steam plant shared 63 %, being followed by gas turbine (24%) and hydro plant (13%).



Data source: Needs Assessment of the Electricity Sector, Annex F: Energy Statistics
Generation & Energy Balance Report for 2002; MoE

Figure 3.1-4 Energy Production in 2002

The annual peak load on the system is shown in Figure 3.1-5. Available data is limited on the system peak load which usually increases with the energy increase. However, no significant increase is seen in the system load when compared with the energy demand. The load in 2001 remained almost at the same level as in 1990. This indicates a suppressed condition of load due to insufficient supply capacity, which has been caused by deterioration putting existing facilities out of order including parts of the networks, and the absence of addition of new plant. In reality load shedding has been repeated all over the country and power cuts for a few to several hours are quite usual.

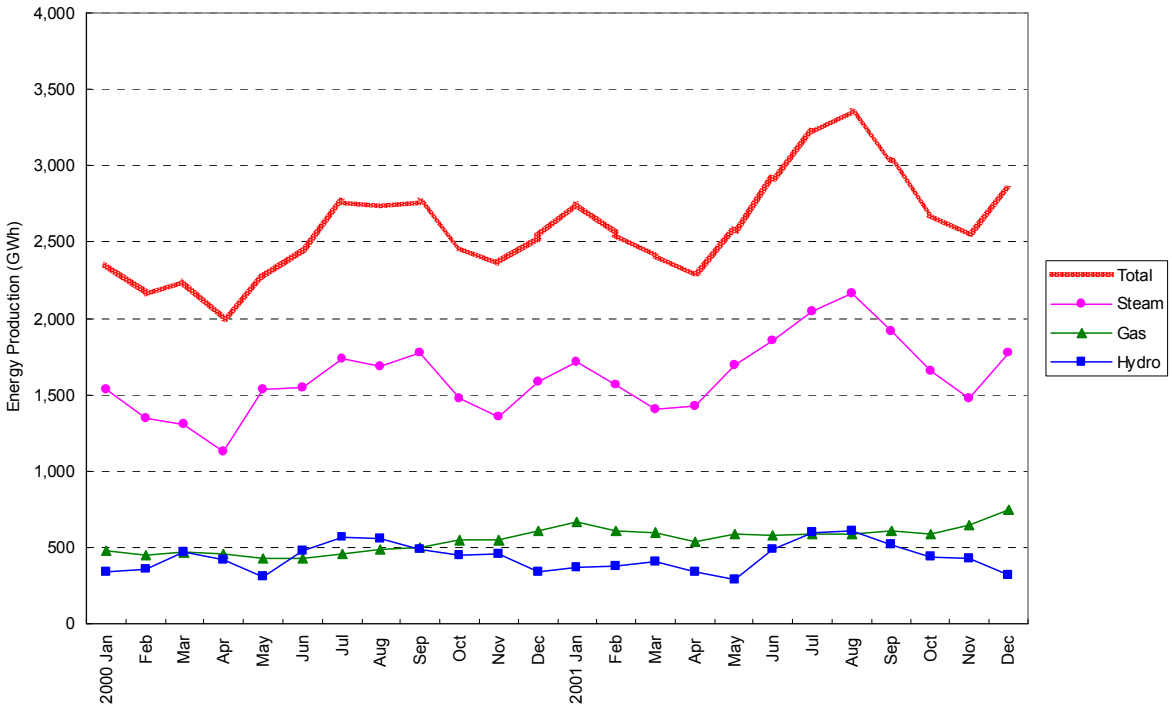


	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Load	5,162	3,920	4,733	4,926	4,701	4,913	4,804	4,615	4,541	4,350	4,616	5,301
Demand			4,733	4,994	4,852	5,134	5,419	5,336	5,556	5,892	6,120	6,753

Source: Needs Assessment of the Electricity Sector, Annex F: Energy Statistics

Figure 3.1-5 Annual Peak Load 1990 - 2001

Seasonal variation of the load demand is evident as shown in Figure 3.1-6. In the months of July, August and September, energy production increases due to high demand in summer time, while it is low in the months of March and April, October and November. The difference is 40 to 50 % in terms of monthly production rate. This seasonal variation coincides with the variation of air temperature. On the other hand, electricity demands of the governorates in the northern region shows a different tendency, where the demand in winter is slightly higher than in summer time.



Data source: Generation & Energy Balance Report for 2001, 2002; MoE

Figure 3.1-6 Monthly Energy Production in 2001 and 2002

No reliable data is available on the loss of energy in the system. In the Needs Assessment by UN and WB in 2003 the total technical loss and non-technical loss were estimated at 20 % to 30 %.

It is noted that most of the electricity data is taken from the current national power network and does not include data for the two governorates: Erbil and Sulaymaniyah that have been disconnected from the national network since the Gulf War in 1990. The population of these two governorates was about 2.7 million in 2000, which is about 12 % of the total population of Iraq. In 2000, the electricity production in these two governorates is approximately 10 % of the total production in Iraq. The electricity data for the two governorates are summarized in Table 3.1-4.

Table 3.1-4 Electricity Status of Northern Governorates (2000)

Governorate	Population (x 1,000)	Energy Demand (GWh)	Peak Power Demand (MVA)	Number of Customers (x 1,000 Nos)	Electrification rate (%)
(1) Erbil	1,221	516	326	127	67
(2) Sulaymania	1,479	1,998	381	181	64
Total: (1) + (2)	2,700	2,514	707	308	-
(3) Dahuk	742	879	169	67	70
Total: (1) + (2) + (3)	3,442	3,393	876	375	-
Total of other 15 governorates in 2002	22,352	25,981	-	2,186	74

Note: Dahuk is connected to the national grid.

As mentioned above the electricity supply in Iraq has not met the potential demand, that is, the load has been suppressed over a long period. For reference the energy production record before the War is shown in Table 3.1-5 in comparison with those in the neighboring countries. It is considered that before the War in 1990 the electricity supply in Iraq increased at a steady rate.

Table 3.1-5 Energy Production before the Gulf War in the Neighboring Countries

Country	Annual energy production in 1980 (GWh)	Annual energy production in 1989 (GWh)	Increasing ratio (1989/1980)
Iraq	10,736	27,196	2.53
Iran	21,256	45,789	2.15
Turkey	23,322	45,879	1.96
Syria	3,729	9,945	2.66
Jordan	1,002	3,229	3.22
Saudi Arabia	20,452	61,568	3.01
Kuwait	8,818	20,204	2.29
(Japan)	(549,107)	(766,152)	(1.39)

Source: Energy Information Administration, International Energy Database, February 2003

The typical power transmission and distribution network systems from the power plant to the consumers are shown in Figure 3.1-7, which includes high voltage transmission lines, substations and distribution lines and step down distribution transformers.

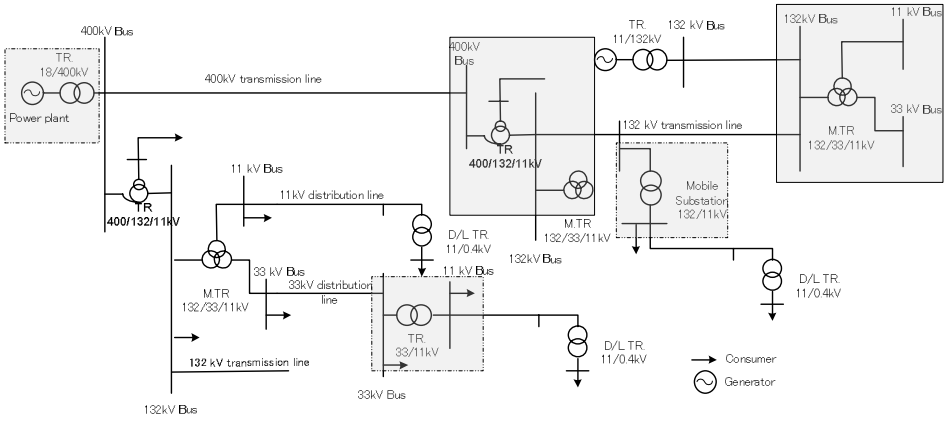


Figure 3.1-7 Typical Power System Diagram

Load shedding has long been conducted to control the power and energy supply within the allowable frequency and voltage level under restricted power supply conditions. Load shedding has been executed by the National Dispatching Centre (NDC) in Baghdad. The load shedding hours for the respective governorates have been determined to share the power supply equally based on the power demand data of the governorates. Further, the NDC has been obliged to operate the power system at the lower system frequency of 49.5 Hz for the rated frequency of 50 Hz, which would affect the operation of utilities and home appliances. For instance, the rotating speed of induction motors becomes lower than the rated speed, which may sometimes have an adverse influence on the quality of factory products.

Under the load shedding condition, the system voltage has fluctuated. In the 132kV substation, it was reported that the operating voltage sometimes fell to 120 kV. It is supposed that the voltage control system does not function properly in the peak time due to lack of reactive power capacity in the system.

3.1.2 Generation

(1) General

Energy production and consumption on a regional basis (north, middle and south) in 2002 is shown in Table 3.1-6. About 40 % of energy is produced in the Middle Region, while it shares 65 % of the total consumption.

Table 3.1-6 Regional Energy Production and Consumption in 2002

Region	Energy Production (GWh)		Energy Consumption (GWh)	
North	12,214	35 %	6,224	18 %
Middle	13,642	40 %	22,536	65 %
South	8,590	25 %	6,098	17 %
Total	34,446	100 %	34,858	100 %

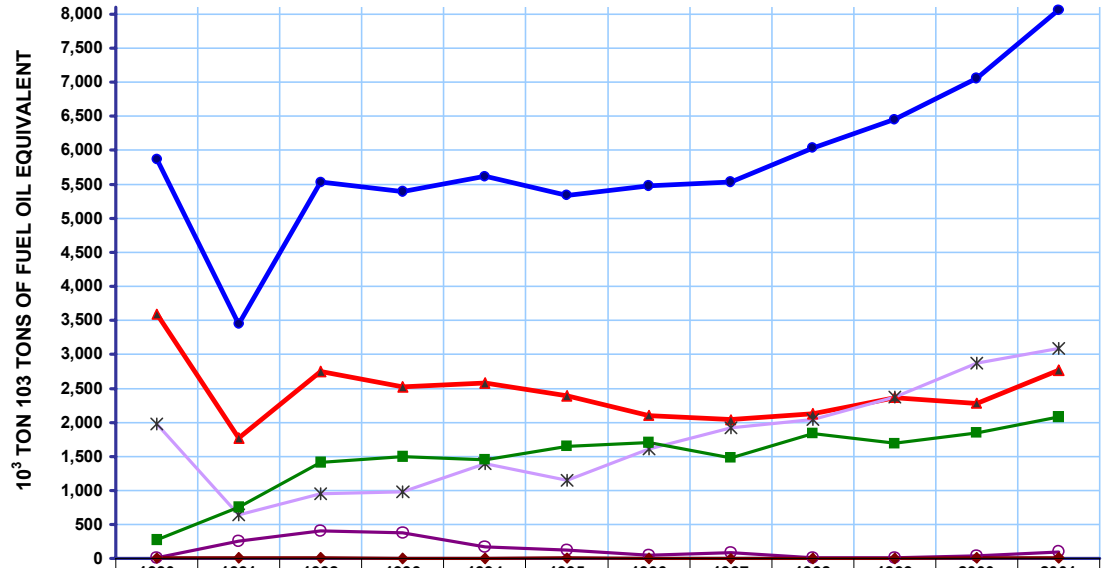
Source: Generation & Energy Balance Report for 2002; MoE

The fuel consumption at each plant is shown in Table 3.1-7. The past trend of fuel consumption in generation is shown in Figure 3.1-8. The recent increase of energy production was mainly born by steam plant, although the rate of gas turbine generation increased, but hydropower plant may have suffered from a decrease of available water.

Table 3.1-7 Fuel Consumption at Each Generation Plant

TYPE	NO	POWER STATION	CRUDE OIL (Liter)	FUEL OIL (Liter)	DIESEL OIL (Liter)	GAS OIL (Liter)	N. GAS (M^3)
STEAM	1	BAGHDAD SOUTH	-	495,792,250	7,855,806	1,391,000	-
	2	DOURA	1,285,715	636,956,999	-	2,763,857	-
	3	MOUSEL	1,495,209,000	64,093,000	4,130,638	-	-
	4	DIBIS	-	-	-	-	49,157,955
	5	BAIJI	10,522,000	1,621,939,000	-	6,794,000	2,828,000
	6	NASSIRYA	1,031,018,000	161,587,000	-	-	-
	7	HARTHA	395,445,167	52,151,211	-	-	287,708,526
	8	NAJIBIA	-	-	-	-	72,562,716
	9	TOTAL STEAM	2,933,479,882	3,032,519,460	11,986,444	10,948,857	412,257,197
GAS	10	BAGHDAD SOUTH	-	-	-	-	-
	11	DOURA	-	-	-	76,276,889	128,824,000
	12	TAJI	-	-	-	70,000	227,165,035
	13	TAJI NORTH	-	-	-	175,750	1,556,960
	14	HILLA	-	-	-	-	137,982,690
	15	NAJAF	-	-	-	79,000	258,224,655
	16	ZAFARANIYA	-	-	-	3,849,972	-
	17	DIBIS	-	-	-	-	123,403,500
	18	DIBIS (Mobile)	-	-	-	18,100	15,839,600
	19	MOUSEL	-	-	-	974,320	467,898,390
	20	MOUSEL EAST	-	-	-	20,679,000	-
	21	TAMMEM	-	-	-	45,000	469,883,700
	22	TAMMEM NORTH	-	-	-	2,964,000	445,383,600
	23	QUDS	-	-	-	174,797,000	-
	24	KHOUR AL ZOUR	-	108,000	-	-	201,817,300
	25	SHUAIBA	-	-	-	-	46,886,180
	26	PETROLEUM	-	-	-	-	56,952,180
	27	G. AL-BAYAA	-	-	-	20,000	-
	28	TOTAL GAS	-	108,000	-	279,949,031	2,581,817,790
	29	D. GEN. 28-April	-	-	4,188,002	-	-
	30	TOTAL SYSTEM	2,933,479,882	3,032,627,460	16,174,446	290,897,888	2,994,074,987

Source: Generation & Energy Balance Report for 2002; MoE



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total	5,870	3,449	5,531	5,392	5,615	5,340	5,476	5,534	6,035	6,451	7,055	8,059
FUEL OIL	3,592	1,771	2,749	2,524	2,578	2,394	2,106	2,040	2,129	2,368	2,284	2,770
N. GAS	1,982	645	952	979	1,400	1,153	1,610	1,920	2,043	2,371	2,871	3,088
CRUDE OIL	278	758	1,413	1,500	1,455	1,655	1,706	1,485	1,841	1,691	1,850	2,085
GAS OIL	9	259	403	382	175	130	51	88	19	18	39	101
DIESEL OIL	9	16	14	7	7	8	3	1	3	3	11	15

Source: Generation & Energy Balance Report for 2002; MoE

Figure 3.1-8 Fuel Consumption by Fuel Type 1990 - 2001

Table 3.1-11 shows the power generation for each type of plant in 2002, including auxiliary consumption and losses, meter error, max./min. power output and load factor. Steam plant has a higher rate for their auxiliary use, which accounts for 6 to 8 percent of the produced energy, being 6.8% on average. Gas turbines use much less for auxiliary use but, on the contrary, the rate of losses and meter error is comparatively high, being 1.16 % on average.

Relatively, auxiliary use of energy in hydro plant is less. On the other hand, it is noted, as a matter of course, that pumped storage plant uses more energy for pumping up water than the produced energy.

The annual load factor expressed as a ratio of average power output to maximum output is 64 % for steam plant, 60 % for gas turbines and 34 % for hydro plant as shown in Table 3.1-8. It is learned from these load factors (or capacity factors expressed by a ratio of average power output to dependable capacity) that steam plant was operated more as mid and base load plant, while hydropower plant shared to meet peak load.

Table 3.1-8 Power Generation for Each Type of Plant in 2002

TYPE	NO	POWER STATION	GENERATION kWh	AUX. CONSUMPTION kWh	%	LOSSES/METER ERROR kWh	%	NET EXPORT kWh	LOAD (MW) MAX	MIN	AVG	LF (%)	CF (%)
STEAM	1	BAGHDAD SOUTH	1,489,957,000	128,234,000	8.61	2,400,000	0.16	1,359,323,000	230	35	170	74	56.7
	2	DOURA	2,060,656,000	141,603,000	6.87	17,965,084	0.87	1,901,087,916	528	75	235	45	36.8
	3	MOUSEL	5,622,020,000	381,298,000	6.78	16,326,000	0.29	5,224,396,000	935	225	642	69	53.5
	4	DIBIS	156,057,000	7,878,000	5.05	4,377,000	2.80	143,802,000	40	15	18	45	40.5
	5	BAIJI	4,644,673,000	329,773,793	7.10	53,473,227	1.15	4,261,425,980	765	160	530	69	40.2
	6	NASSIRYA	4,428,804,000	303,313,000	6.85	54,696,000	1.24	4,070,795,000	755	50	506	67	60.2
	7	HARTHA	2,815,303,000	180,178,000	6.40	23,075,000	0.82	2,612,050,000	400	240	321	80	80.3
	8	NAJIBIA	321,572,408	20,042,586	6.23	2,347,172	0.73	299,182,650	203	0	37	18	18.4
	9	TOTAL STEAM	21,539,042,408	1,492,320,379	6.93	174,659,483	0.81	19,872,062,546	3856	800	2459	64	49.7
GAS	10	BAGHDAD SOUTH	-	-	0.00	-	0.00	-	0	0	0	0	0.0
	11	DOURA	543,191,000	3,485,120	0.64	14,944,796	2.75	524,761,084	113	18	62	55	62.0
	12	TAJI	687,924,000	609,480	0.09	1,219,988	0.18	686,094,532	101	30	79	78	77.0
	13	TAJI NORTH	3,712,000	2,800	0.08	17,258	0.46	3,691,942	18	0	0	2	0.6
	14	HILLA	511,047,000	3,604,800	0.71	2,555,235	0.50	504,886,965	81	30	58	72	85.8
	15	NAJAF	956,488,500	3,664,600	0.38	1,536,900	0.16	951,287,000	160	27	109	68	72.8
	16	ZAFARANIYA	10,844,099	901,821	8.32	108,456	1.00	9,833,822	13	1.8	1	10	3.4
	17	DIBIS	274,230,000	2,739,000	1.00	5,482,200	2.00	266,008,800	50	0	31	63	41.7
	18	DIBIS (Mobile)	39,599,000	321,987	0.81	3	0.00	39,277,010	25	6	5	18	11.3
	19	MOUSEL	1,130,082,000	5,650,410	0.50	16,951,230	1.50	1,107,480,360	156	30	129	83	75.9
	20	MOUSEL EAST	37,536,800	-	0.00	84,420	0.22	37,452,380	38	4	4	11	13.4
	21	TAMMEM	1,050,290,000	5,051,450	0.48	14,954,350	1.42	1,030,284,200	169	95	120	71	64.1
	22	TAMMEM NORTH	1,485,902,000	6,929,510	0.47	20,788,530	1.40	1,458,183,960	222	52	170	76	94.2
	23	QUDS	534,504,300	2,797,950	0.52	15,303,715	2.86	516,402,635	254	0	61	24	30.5
	24	KHOUR AL ZOUR	816,200,000	4,391,000	0.54	757,267	0.09	811,051,733	145	10	93	64	46.6
	25	SHUAIBA	207,048,000	1,542,000	0.74	-	0.00	205,506,000	34	20	24	70	69.5
	26	G. AL-BAYAA	54,470,000	907,833	1.67	1,815,667	3.33	51,746,500	0	0	6		3.9
	27	TOTAL GAS	8,343,068,699	42,599,761	0.51	96,520,015	1.16	8,203,948,923	1579	324	952	60	57.2
	28	D. GEN. 28 - April	9,729,290	-	0	0	0	9,729,290	5	3	1	22	2.8
HYDRO	28	SAMARA	333,340,000	1,847,260	0.55	9,071,540	2.72	322,421,200	60	26	38	63	45.3
	29	HIMRIN	126,311,000	1,083,100	0.86	378,400	0.30	124,849,500	30	9	14	48	28.8
	30	QADISSIA	704,881,000	10,406,500	1.48	13,051,017	1.85	681,423,483	310	32	80	26	12.2
	31	HINDIA	44,378,410	976,954	2.20	608,681	1.37	42,792,775	9.3	1.6	5	54	33.8
	32	KUFA	6,367,950	277,830	4.36	138,504	2.18	5,951,616	2	0.5	1	36	14.5
	33	SADAM DAM (MAIN)	2,713,888,000	12,141,000	0.45	16,153,000	0.60	2,685,594,000	750	240	310	41	41.3
	34	SD (REGULATING)	325,245,000	2,185,000	0.67	2,114,000	0.65	320,946,000	64	24	37	58	61.9
	35	SD (P. STORAGE)	299,963,000	352,662,000	117.57	39,976,000	13.33	92,675,000-	240	120	34	14	14.3
	36	TOTAL HYDRO	4,554,374,360	381,579,644	8.38	81,491,142	1.79	4,091,303,574			520		27.9
	37	TOTAL SYSTEM	34,446,214,757	1,916,499,784	5.56	352,670,640	1.02	32,177,044,333			3932		46.2

Source: Generation & Energy Balance Report for 2002; MoE

The production at each power station in 2001 and 2002 are given in Table 3.1-9. From 2001 to 2002, it increased by 12 %, out of which the increase in hydropower plant is remarkable at 48 %.

Table 3.1-9 Production at Each Power Station in 2001 and 2002

TYPE	POWER STATION	GENERATION 2002 PLANNED (1)	GENERATION 2002 ACTUAL (2)	GENERATION FOR 2001 (3)	Actual/ Planned Ratio 2/1	GROWTH 2/3
STEAM	BAGHDAD SOUTH	1,701,000	1,489,957	1,459,203	0.88	1.02
	DOURA	2,181,000	2,060,656	2,678,150	0.94	0.77
	MOUSEL	4,790,000	5,622,020	4,720,911	1.17	1.19
	DIBIS	174,000	156,057	150,728	0.90	1.04
	BAIJI	5,421,000	4,644,673	4,213,960	0.86	1.10
	NASSIRYA	4,530,000	4,428,804	4,118,247	0.98	1.08
	HARTHA	2,530,000	2,815,303	2,730,157	1.11	1.03
	NAJIBIA	883,000	321,572	612,768	0.36	0.52
	TOTAL STEAM	22,210,000	21,539,042	20,684,124	0.97	1.04
GAS	BAGHDAD SOUTH	60,000	-	-	0.00	0.00
	DOURA	613,000	543,191	587,070	0.89	0.93
	TAJI	645,000	687,924	694,614	1.07	0.99
	TAJI NORTH	174,000	3,712	3,130	0.02	1.19
	HILLA	393,000	511,047	471,307	1.30	1.08
	NAJAF	1,021,000	956,489	671,321	0.94	1.42
	ZAFARANIYA	-	10,844	18,619	0.00	0.58
	DIBIS	316,000	274,230	145,110	0.87	1.89
	DIBIS (Mobile)	46,000	39,599	30,296	0.86	1.31
	MOUSEL	1,223,000	1,130,082	1,078,392	0.92	1.05
	MOUSEL EAST	59,000	37,537	27,569	0.64	1.36
	TAMMEM	1,075,000	1,050,290	1,014,038	0.98	1.04
	TAMMEM NORTH	1,458,000	1,485,902	1,598,889	1.02	0.93
	QUDS	1,459,000	534,504	-	0.37	0.00
	KHOUR AL ZOUR	809,000	816,200	538,740	1.01	1.52
	SHUAIBA	136,000	207,048	164,626	1.52	1.26
	G. AL-BAYAA	1,653,000	54,470	-	0.03	0.00
	TOTAL GAS	9,487,000	8,343,069	7,043,721	0.88	1.18
HYDRO	SAMARA	269,000	333,340	264,750	1.24	1.26
	HIMRIN	53,000	126,311	53,159	2.38	2.38
	QADISSIA	816,000	704,881	728,037	0.86	0.97
	HINDIA	36,000	44,378	35,575	1.23	1.25
	KUFA	-	6,368	2,170	0.00	2.93
	SADAM DAM (MAIN)	1,533,000	2,713,888	1,582,450	1.77	1.71
	SD (REGULATING)	211,000	325,245	222,480	1.54	1.46
	SD (P. STORAGE)	156,000	299,963	183,143	1.92	1.64
	TOTAL HYDRO	3,074,000	4,554,374	3,071,764	1.48	1.48
D. GEN. 28 - April		-	62,083	-	0.00	0.00
TOTAL SYSTEM		34,771,000	34,498,568	30,799,609	0.99	1.12

Source: Generation & Energy Balance Report for 2002; MoE

Table 3.1-10 shows dependable capacity of each power station, of which data were obtained from MoE. It is noted that, as seen in Table 3.1-10, the dependable supply capacity of the generating plant is much lower than the installed capacity. This situation has been caused by absence of regular or proper maintenance or repair during the sanction period. The capacity may vary seasonally or be subject to the progress of rehabilitation and maintenance works.

Table 3.1-10 Power Station Dependable Capacity and Share in 2002

TYPE	NO	POWER STATION	INSTALLED CAP. MW	DEPENDABLE CAP. MW		Commissioning Year	SHARE %
STEAM	1	BAGHDAD SOUTH	355	4x45, 2x60	300	1965, 1983	4
	2	DOURA	640	4x160	640	1983, 1989	8
	3	MOUSEL	1200	4x300	1200	1987	14
	4	DIBIS	60	4x11	44	1959	1
	5	BAIJI	1320	6x220	1320	1983	16
	6	NASSIRYA	840	4x210	840	1975	10
	7	HARTHA	400	2x200	400	1979	5
	8	NAJIBIA	200	2x100	200	1979	2
	9	TOTAL STEAM	5015	4944	4944		58
GAS	10	BAGHDAD SOUTH	27.5	1x15	15	1964	0
	11	DOURA	150	4x25	100	1981	1
	12	TAJI	120	6x17	102	1976	1
	13	TAJI NORTH	76	4x15, 2x8	76	1976, 1978	1
	14	HILLA	80	4x17	68	1973	1
	15	NAJAF	189	3x50	150	1976	2
	16	ZAFARANIYA	36	4x9	36		0
	17	DIBIS	112.5	3x25	75	1982	1
	18	DIBIS (Mobile)	40	5x8	40		0
	19	MOUSEL	200	10x17	170	1976, 1982	2
	20	MOUSEL EAST	40	4x8	32		0
	21	TAMMEM	220	11x17	187	1977, 1988	2
	22	TAMMEM NORTH	222	6x30	180	2000	2
	23	QUDS	246	2x100	200		2
	24	KHOUR AL ZOUR	252	4x50	200		2
	25	SHUAIBA	40	2x17	34	1973	0
	26	G. AL-BAYAA	159	1x159	159	1977	0
	27	TOTAL GAS	2051	1665	1665		20
HYDRO	28	SAMARA	84	3x28	84	1972	1
	29	HIMRIN	50	2x25	50	1981	1
	30	QADISSIA	660	6x110	660	1986	8
	31	HINDIA	15	4x3.75	15	1989	0
	32	KUFA	5	4x1.25	5	1988	0
	33	SADAM DAM (MAIN)	750	4x187.5	750	1986	9
	34	SD (REGULATING)	60	4x15	60	1985	1
	35	SD (P. STORAGE)	240	2x120	240	1989	3
	36	TOTAL HYDRO	1864	1864	1864		22
	37	D. GEN. 28 - April	46	10x2.5, 2x3.5, 1x5, 1x1.9	39		0.5
	38	TOTAL SYSTEM	8976	8512	8512		100

Source: Generation & Energy Balance Report for 2002; MoE

The net energy sold for distribution in 2002 is summarized in Table 3.1-11. It is known that the net energy sent out to the distribution network was about 84 % of the generated energy.

Table 3.1-11 Energy Sold for Distribution in 2002

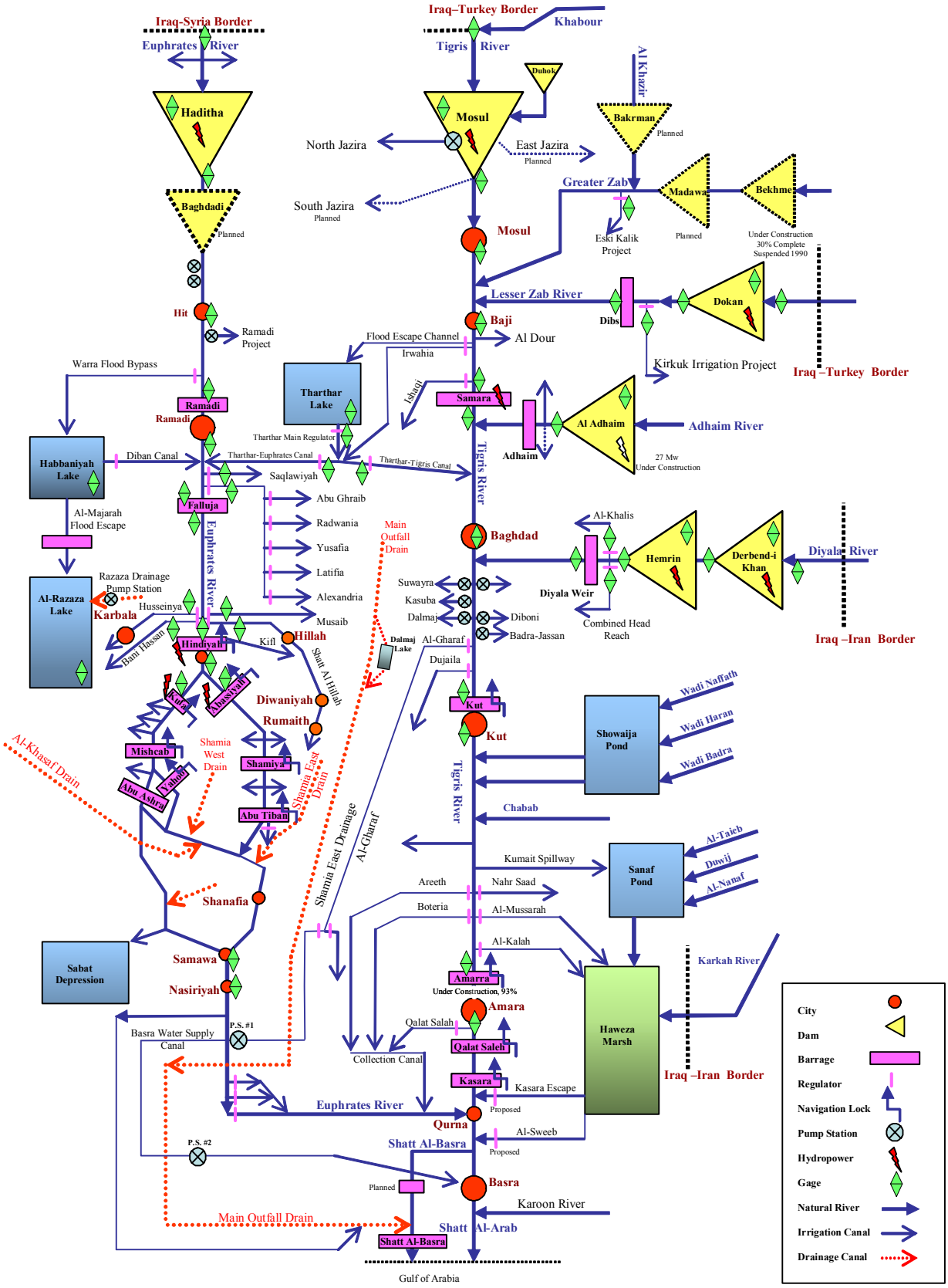
No.	Items	Energy (kWh)	Share (%)
1	Production at Power Station	34,446214,757	100
2	Aux. Consumption in PS	1,916,499,784	6
3	Losses & Meter error in PS	352,670,640	1
4	Sold directly from PS	1,167,087,831	3
5	Export to National Network	31,009,956,502	90
6	Aux. Consumption in Network	66,799,528	0
7	Losses & Meter Error	2,449,616,487	7
8	Import from other source	411,929,537	1
	Sold for Distribution	28,905,470,024	84

After the Gulf War some rehabilitation works for generating plants have been undertaken. After the recent conflict rehabilitation and maintenance works have been continued intensively under the control of the CPA. The relevant information for each plant is summarized as a "Plant Data Sheet" in Appendix A, which includes the present status and plan for the rehabilitation for each plant.

(2) Hydropower

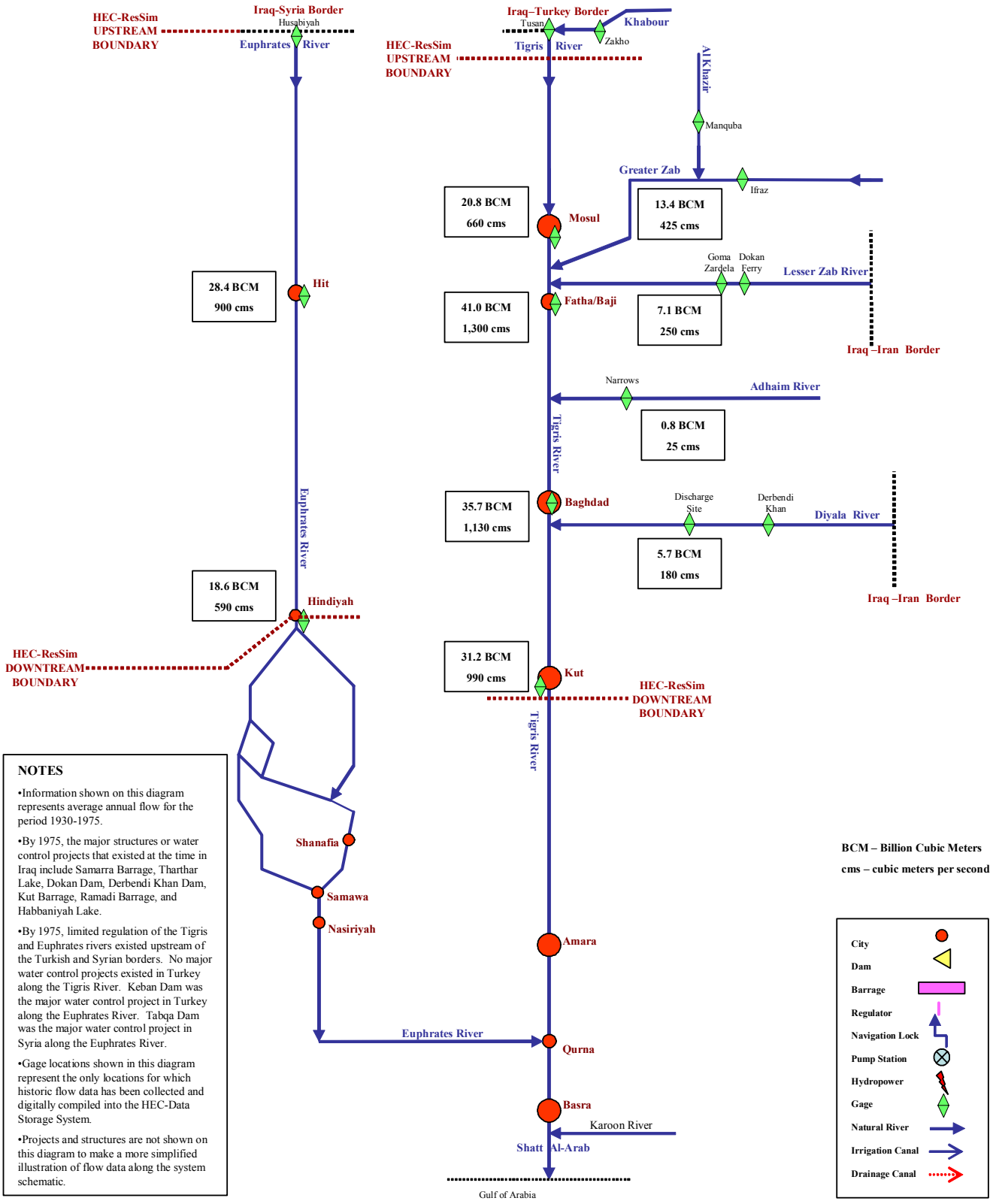
In Iraq two major rivers flow from north to south; one is the Tigris River and the other is the Euphrates River. The Tigris originates in Turkey and has a total catchment area of 471,158 km^2, of which 235,000 km^2 is in Iraq. The Euphrates, also originating in Turkey, has a catchment area of 444,000 km^2, of which 177,000 km^2 is in Iraq. The Euphrates flows in after draining the land of Syria.

A schematic diagram for storage and control of water in Iraq was prepared by USACE as shown in Figure 3.1-9 and the average annual flow of the Tigris and the Euphrates Rivers are shown in Figure 3.1-10. Usually a high flow season occurs for four months from February to May, which accounts for 70 % of the annual total flow.



Source: USACE, Hydrologic Engineering Center (December 1, 2003)

Figure 3.1-9 Schematic Diagram for Storage and Control of Water in Iraq



Source: USACE, Hydrologic Engineering Center (December 1, 2003)

Figure 3.1-10 Historic Period (1930 - 1975) Average Annual Flow Tigris-Euphrates

Blessed with water resources on these rivers and their tributaries, a significant amount of electricity production in Iraq relies on hydropower, while Iraq is a major oil

producing country. Most of the hydro plant is situated in the Tigris basin, while the Haditha dam is located on the Euphrates. Major hydro plants are located at Mosul; Mosul Main of 200 MW, Mosul Regulating Dam of 60 MW and Mosul Pumped Storage Plant of 240 MW. Most of the hydropower plants are integrated in a multipurpose dam scheme, for which priority use of water is given to water supply and irrigation.

Energy production by hydropower plant is given in Table 3.1-12 and 3.1-13, and monthly production is shown in Figure 3.1-6. It is leaned from the figure that production in the summer season from June to September increases, which might have been a result of the greater release of water from the reservoir through turbines for irrigation.

3.1.3 Transmission Lines

The transmission system has been developed with the power demand increase. The transmission line consists of 400 kV national super grid lines and 132 kV trunk lines which interconnect with the northern, middle and southern regions and supply electric power to the major demand centers in the country. The number and lengths of these transmission lines are shown in the following Table 3.1-12.

Table 3.1-12 Circuits Number and Total Length

Region	400 kV Line		132 kV Line	
	No.	km	No.	km
North	7	695	98	4,344
Middle	17	1,859	205	6,353
South	6	987	94	2,882
Total	30	3,541	397	13,579

Source: UNDP/WB Needs Assessment of the Electricity Sector of Iraq

The 400 kV power transmission lines interconnect the whole country so that stability is maintained and disturbance is minimized when transmission line faults occur or power plant outages occur. Usually, the power in 400 kV lines flows into the Baghdad area through four 400 kV substations, Baghdad East, Baghdad West, Baghdad North and Baghdad South, where the line voltage is stepped down to 132 kV and connected to the 132 kV substations. These four substations are linked by 400 kV transmission lines as main ring trunk lines. Major power plants directly connected to 400 kV transmission lines are Baji thermal and gas turbine stations, Mosul dam hydro power station in the north, Qudus gas turbine and Haditha dam hydro power stations in the middle, and Hartha, Nassiryah, Mussaib thermal power stations and Khor Zubair gas

turbine station in the south. The 400 kV power transmission line network is shown in Figure 3.1-1.

The 132 kV transmission lines have been constructed for regional power supply in respective governorates and for oil and gas production and the downstream refining industries. The 132 kV lines generally emanate from the 400/132 kV substations. Some power plants are connected to the 132kV system. Major power plants connected are Shaiba gas turbine and Najibia thermal power stations at Basra in the Southern Region, Najaf, Hilla, Taji gas turbine stations, Doura and Baghdad south thermal/gas turbine stations in the Middle Region, and Mousel, Mula Abudulla gas turbine and Dibis gas/thermal turbine stations, Sammra and Hemreem dam hydro stations in the Northern Region.

Power systems in the Erbil and Sulaymaniyah governorates have been isolated from the national power grid since 1991. In this area, the power system has been extended under the Oil for Food Programme by the UNDP-ENRP. The power source for these areas mainly relies on the Dokan and Darbandikhan hydro power stations and diesel power plants in Erbil and Sulaymaniyah towns. Reconnection to these Governorates is currently underway. The 132 kV power transmission line network is shown in Figure 3.1-2.

The following transmission lines have been seriously affected by looting and vandalism following the recent conflict in 2003.

(1) 400 kV Transmission Line

Table 3.1-13 Status of 400 kV Transmission Line

Region		Line (Substation to Substation)	Length (km)	Condition	Restoration
North	i.	Mousel-Kirkuk	201	Severely damaged by looting. Remaining towers were disassembled by MOE to repair the damaged material in other lines.	No repair/ rehabilitation commenced as yet.
Middle	i	Baghdad -West – Baji GPS	223	32 towers collapsed.	In operation
	ii.	Baghdad -West - Baghdad North	229	6 towers collapsed.	In operation
	iii	Qaudissia dam - Baghdad -West	223	45 towers collapsed.	In operation
	iv	Qaudissia dam - Qaim	128	Out of service	The repair work due to start mid June 2004.
	v.	Qaudissia dam - Baji	159	Out of service	Not yet decided when to start repair.
	vi	Qaudissia - Baghdad -South	142	17 towers collapsed.	In operation

South	i.	Harth - Qurna	56	73 towers collapsed.	In operation
	ii	Kut - Qurna	290	30 towers collapsed.	In operation
	iii	Khour Zubair – Hartha 1	55	Lots of towers collapsed.	Completed
	iv	Khour Zubair – Nassiriya	202	51 towers collapsed.	Was expected to be in operation by 20 June 2004.

(2) 132 kV Transmission Line

Table 3.1-14 Status of 132 kV Transmission Line

Region		Line (Substation to Substation)	Length (km)	Condition	Restoration
North	i.	Tamin –Kirkuk Old	21	32 towers collapsed.	In operation
	ii.	Touz – Azim Dam	55	Complete line collapsed.	Not yet decided when to start repair.
Middle	i	Baghdad -North – Taji (1+2)	12	Some conductor damaged.	Both lines in operation.
	ii.	New Baghdad - Naharman	34	Some conductor damaged.	In operation.
	iii	Baghdad–west – Faluja (1+2)	30	4 towers collapsed.	In operation.
	iv	Diwaniya – Najaf North	55	2 towers collapsed.	In operation.
South	i.	Baz Zubair – Abu Flus Abu Flus - Fao	93	20 towers collapsed.	In operation. Under repair.
	ii	Najibiya - Shuaiba 1 Najibiya - Shuaiba 2	23	14 towers collapsed and all conductors looted.	In operation. Under repair.
	iii	Shuaiba – Petro 1 Shuaiba – Petro 2	17	17 towers collapsed and all conductors looted.	In operation. Under repair.
	iv	Shuaiba – Baz Zubair	20	26 towers collapsed.	In operation.
		Shuaiba - Touba	26	20 towers collapsed.	In operation.
	v	Touba – Rumaila New	55	14 towers collapsed.	In operation.
	vi	Najibiya – Basra East		XLPE Power cable cut and looted.	In operation.

Significant load shedding has been applied to consumers due to the damage to the above lines. Efforts have been made by MoE to restore the most important transmission lines to increase the overall reliability of supply.

Besides the above, most of the transmission lines have severely deteriorated in the 20 years or more since commissioning as very little routine maintenance and repair work has been carried out. A major reason for this has been lack of spare parts and material supply caused by the economic sanctions imposed after the Gulf War. These conditions

have degraded the transmission performance and have resulted in electric hazards to operation and maintenance staffs.

3.1.4 Substations

Some substations were planned and constructed with the increase of power supply and demand. The power system network comprises the 400kV National Grid and 132kV lines and associated substations. The number of substations and relevant capacities are shown below in Table 3.1-18 and Table 3.1-19.

Table 3.1-15 Substations by Regions

Region	400 kV		132 kV	
	No.	Capacity (MVA)	No.	Capacity (MVA)
North	4	2,000	37	4,424
Middle	11	8,750	93	12,125
South	4	2,250	54	3,788
Total	19	13,000	184	20,337

Table 3.1-16 Mobile Substations by Regions

Region	132/33kV		132/11 kV	
	No.	Capacity (MVA)	No.	Capacity (MVA)
North	8	120	11	140
Middle	10	150	29	350
South	8	120	17	245
Total	26	390	57	735

The 400 kV substations are used for injection of power into the regional 132 kV network.

The 400 kV substations usually contain 250 MVA, 400/132/11 kV, auto transformers in single phase banks. Depending on size and location of the substation the number of banks will vary from 2 to 4. The substations consist of both GIS and conventional outdoor types with a one and a half CB bus system.

The 132 kV substations are located at municipalities of governorates and oil extraction and downstream industries, cement factories, steel factories, water pumping stations and some industrial estates. Some of these substations are connected with a local source of power supply and import surplus power into the 132 kV system.

Most of the 132kV substations are provided with standard capacity transformers of 132/33/11 kV, 63/50/25 MVA, and are a three winding type with on load tap changers, of which specifications were introduced in the early 1980's. The substations are also both indoor GIS and conventional outdoor types.

After the recent conflict, some substations suffered seriously from the consequential looting and vandalism. Substations in the southern region were more affected. Some repairs have been carried out, but most of substations still require significant rehabilitation or replacement.

The following tables show the current status of the respective substation.

(1) 400/132 kV substation

Table 3.1-17 Current Status of Substations (400 kV)

Region	Name of Substation	Condition	Remarks
North	Kirkuk (Taza)	Under Rehabilitation	Estimate for the completion of work 15 June 2004.
	Mousel	Extension by ABB	Estimate for the completion of work 15 June 2004.
Middle	Baghdad East Baghdad West	In operation In operation	Rehabilitation work is expected to start soon
Middle (West)	Qaim	In operation	Rehabilitation and extension required to interconnect with Jordan.
South	Al Qurana	Completely destroyed	No decision yet on replacement

(2) 132 kV Substation

Table 3.1-18 Current Status of Substations (132 kV)

Region	Name of Substation	Condition	Remarks
North	Mishraq	The majority of equipment is obsolete.	Rehabilitation has not yet started.
	4 mobile stations	Out of service	Replacement. New order for 27 Mobile S/S is underway.
Middle	Annah	Completely destroyed	25MA mobile S/S is in operation.
	Aurf Al Sakhar	Damaged	Deleted from system

	Iraqi Factory	Damaged	Deleted from system
	Hiteem	Damaged	Deleted from system
South	Al Qurana	In operation, needs rehabilitation	Rehabilitation has not yet started.
	Harbour	Completely destroyed	Rebuilding has not yet started.
	Water pump station	Completely destroyed	Rebuilding has not yet started.
	Steel Mill	Completely destroyed	Rebuilding has not yet started.
	CPS 2, 3,4,5,6,7,8&10	Damaged	Replacement is required but has not yet started.
	New Rumaila	Damaged	Replacement is required but has not yet started.
	Old Nasiriya	Damaged	Mobile S/S is in operation.
	Hammar	Damaged	Replacement is required but has not yet started.
	Merkhazera	Damaged	Replacement is required but has not yet started.
	Fao	Damaged	Replacement is required but has not yet started.

UNDP have estimated the restoration cost for the above substations with US$ 140,800,000 supposing turn-key type contracts over the next 3 years.

All substation equipment has been operated under the economic sanctions, after the two consecutive wars in the 1980's and 1991. Maintenance of the substation equipment has consequently been minimal due to difficulties of obtaining spare parts. Some substations have been cannibalized for parts for use in other substations. The number of substations installed for the last 40 years is shown bellow in Table 3.1-19.

Table 3.1-19 Number of Substation Construction Periods

No.	Voltage	Type	Number of Substations under Construction						Total
			1965-1970	1970-1975	1975-1980	1980-1995	1985-1990	After 1990	
1	400kV	AIS	-	-	6	3	2	2	13
		GIS	-	-	-	2	6	-	8

		Total	-	-	6	5	8	2	21
2	132kV	AIS	10	17	49	39	15	2	132
		GIS	-	-	-	29	23	-	52
		Total	10	17	49	68	38	2	184

As shown in the above table, one third of the substations have been in operation for more than 20 years, which exceeds half of their useful life.

In particular, there are still many minimum oil type circuit breakers installed on 132kV circuits and the 33kV and 11kV distribution feeders. This type of circuit breaker is no longer manufactured and has been replaced with the SF6 gas type. Main transformers, control equipment, protective relays for transmission lines and distribution lines, metering panels, ac-dc power supply equipment and associated equipment are generally old and in poor condition and should be refurbished or replaced.

Under the Oil for Food Programme, parts as well as new substation equipment were procured by MoE in the Middle and Southern regions and by the ENRP in three Northern Governorates. Some substations were repaired or replaced under this programme before cessation of the programme on 21 November 2003 and handover of all ongoing contracts to the CPA. The total value of these contracts was approximately US $ 212,866,000 at the time of handover. The current status of these contracts is unknown but is unlikely to have progressed very well because of the current security situation. If these contracts can be completed the performance of the entire power system and in particular the substations will improve considerably.

3.1.5 Distribution Networks

The distribution network comprises the 33/11kV substations and associated overhead and underground power cable lines, on which 33kV voltage is applied for long distance power supply, and 11kV for other overhead and underground cable lines. The 33kV and 11kV distribution feeders are connected to 132/33/11 kV substations or 33/11 kV distribution substations expanded from 132/33 kV grid substations.

The 11 kV network is a radial configuration for overhead line power supply areas and a ring system for underground cable areas. Distribution transformers are provided for stepping the voltage down from 11 kV to 400/230 V low voltage connecting for the consumers. Distribution network systems in Iraq are divided into four regions; Baghdad, North, Middle and South under the Distribution Dispatching Centre (DDC) by manual control. The Main Distribution Dispatching Centre (MDDC) is in the Baghdad area and it controls three Distribution Dispatching Centers (DDC's) using the SCADA system.

In this study period, actual system data for the distribution network were not collected due to difficulty of access to data sources.

UNDP has conducted a survey of the distribution network in Baghdad and Kirkuk districts as a sample investigation.

According to the Needs Assessment Report, most of the distribution lines network reported on needs immediate rehabilitation or repair due to deterioration of the materials and equipment.

Conditions of the distribution lines are generally as follows:

- Overhead conductors were damaged and repaired by wrapping joints since no proper materials were available.
- Insulators were very dusty and flash over incidents frequently occurred in rainy conditions.
- Many supporting structures were damaged and left unrepaired.
- Little maintenance of distribution lines had been conducted, which reduced the reliability of the system.

In addition, the network system suffered serious damage from vandalism and looting after the recent conflict. On the other hand, the distribution system in the northern governorates has been successfully rehabilitated and developed by the UNDP-ENRP.

3.1.6 Load Dispatching Facilities

The power system comprises the 132 kV transmission network for regional power supply and a 400kV National Grid for integrating the three 132 kV regional networks. The power system in the Northern Governorates is independently operated, but the system will soon be integrated with the National Grid since an interconnecting 132 kV transmission line routed between Dibis and Mousel substations via the Arbil substation is under reconstruction.

At present, there are three regional control centers, Northern Regional Control Centre (NRCC) at Taza in Kirkuk, Middle Regional Control Centre (MRCC) at Al Ameen in Baghdad and Southern Regional Control Centre (SRCC) at Khor Al Zubair in Basrah.

The power demand at substations and generation control in respective regions are managed to provide stable power system operation by these Control Centers. Under the 400 kV national grid there are 21 substations and nine large power plants. Under the 132 kV system, there are 184 substations, 83 mobile substations and 19 power plants.

The control equipment in the three Regional Control Centers was installed by the ASEA Company in 1979 and 1980. These Control Centers have minimal monitoring functions for system and switching operation but no control system for power plant is equipped. The power line carrier communication is used for the SCADA system and Remote Terminal Units (RTUs) at the substations. The protocol for the communication system is the manufacturer's standard, but it is not an international common protocol.

The system is obsolete in the light of current information technology developed with a PC based process control and operating system.

The control system is currently operational but they face difficulty in obtaining spare parts for such old equipment. The system computer in the MRCC was replaced with a normal PC control system to overcome the spare parts problem.

In the SRCC, the control system link was seriously affected by the recent looting and vandalism of the power line carrier communication system.

However, MoE is making an effort to the restore communication links by relocating the equipment and repairing the damaged equipment. Radio communication is being temporarily used for manual control of the substation equipment.

The distribution line networks in the respective regions are supervised in individual substations. The distribution network system in Baghdad is supervised by the Main Distribution Dispatching Centre (MDDC) and three Distribution Dispatching Centers (DDCs) using a SCADA system. However, the MDCC in Baghdad was completely looted and destroyed during and after the recent conflict.

The major functions of the load dispatching centre are as follows:

- Acquisition and recording of generation data and status of the substations and the loading condition of the grid substations.
- Operation command of the power stations based on the energy generation plan
- Operation command for starting and stopping power stations
- Supervision of the power transactions with neighboring countries
- Preparation of the daily energy reports for power system operation
- Restoration coordination and instructions for power system outages.

All other DDCs in 18 governorates are operated manually using VHF radio communication equipment.

National Dispatching Centre (NDC) controls the following items for the whole power system in cooperation with the regional control centers.

(1) Frequency Control

Frequency control is executed by determining the daily load curve for each substation.

The daily load curve for each region is maintained by keeping hot reserve of 10 % and cold reserve of 15 %.

At present, due to shortage of generation, it is necessary to cut the power supply at the substation feeders sequentially. NDC has a plan for the load shedding schedule to minimize the duration of load shedding.

(2) Voltage Control

The system voltage is maintained within allowable voltage levels by operation of a static capacitor bank and reactors as well as by switching power.

(3) Load flow

The load flow is controlled so as not to exceed the allowable current limit.

(4) Stability monitoring

The stability of the system is maintained by monitoring the line load conditions.

(5) Monitoring and control of the imported energy from the neighboring countries

(6) Start and stop control of the generator unit based on the power and energy production schedule

(7) Daily coordination with MoO for fuel supply for power generation

(8) Daily coordination with MoI for seasonal water resources for hydropower generation

(9) Switching operation of 400kV lines for maintenance purposes

(10) Fault analysis and monitoring disturbance due to mal-operation of protective relays

(11) Control and operation of the interconnection with neighboring countries and other systems in the future

3.2 Load Pattern and Load Shedding

From the data available, the annual load factor of the national grid has been calculated as shown in Table 3.2-1. For the period from 1990 to 2001, the annual load factor was in a range between 0.65 and 0.73. However, this figure does not properly represent properly the relationship between the peak load and energy production, probably due to load shedding or unexpected outages. It is noted that if the peak load were over 6,000 MW without being suppressed, as estimated by MoE, the annual load factor would have been lower than 63 % instead of 71 %.

Table 3.2-1 Annual Load factor of the National Grid

Year	Annual Peak* (MW)	Annual Energy* (GWh)	Annual Load Factor
1990	5,162	29,469	0.65
1991	3,920	16,202	0.47
1992	4,733	28,051	0.68
1993	4,926	28,355	0.66
1994	4,701	29,160	0.71
1995	4,913	28,600	0.66

1996	4,804	27,838	0.66
1997	4,615	28,783	0.71
1998	4,541	29,139	0.73
1999	4,350	27,201	0.71
2000	4,616	29,126	0.72
2001	5,301	33,213	0.72

Note *: at P/S Generating Points
Source: The energy production data from MoE

Daily load curves with a reasonable accuracy were not available and the Team assumed them through discussion with the MoE staff who visited Amman during the study period. It is noted that the current load is suppressed, most probably due to insufficient supply capacity, and does not represent a normal condition of electricity demand and supply. For the load pattern, the following are known from the available data and discussions with MoE.

1) The daily peak generally occurs at night, around 21:00 and the load drops at around 18:00.
2) Annual peak load occurs in the summer time from July to September, while loads in the northern governorates are higher in winter than that in summer.

In order to know the load pattern in Iraq, the Team examined the load curves in Iran, Jordan and Japan and assumed that the load pattern in Iraq at present might resemble that in Iran. However, it would be expected to gradually follow the pattern in Jordan and Japan where the daytime peak load grows and may exceed the night time peak load eventually.

It is reported that load shedding occurs usually and frequently all over the country. The Iraqi people are suffering from a serious shortage of electricity supply in various fields from humanitarian needs to industrial use. However, regrettably, no systematic data on the load shedding is available. According to limited information, load shedding occurs relatively more in the middle and northern regions than in the southern region. As shown in Table 3.2-2, frequent and long duration power cuts are usual.

Table 3.2-2 Load Shedding on Governorate Basis

Governorate	Supply hours in a day (*)			
	April 22, 04	May 6, 04	May 26, 04	June 2 ,04
Dahuk	15	17	22	22
Erbil	18	15	11	8
Sulaymaniyah	19	15	11	8
Ninewa	9	11	6	8

Tameen	12	13	8	7
Salah al Din	10	12	8	8
Anbar	13	15	8	8
Diyala	11	12	8	9
Baghdad	12	14	9	10
Karbala	21	16	13	15
Babylon	12	12	9	10
Wassit	18	17	10	10
Qadissiya	11	12	7	7
Najaf	16	10	7	9
Missan	16	16	8	9
Thi-Qar	17	19	14	14
Muthanna	17	15	15	7
Basrah	21	20	10	10

(*) Average hours of electricity available per day over a 7 day period.

Source: CPA's website

3.3 Power Trading with Neighboring Countries

Iraq has country borders with 6 countries. At present power is imported from Turkey and Syria through the 132 kV transmission lines; 80 MW from Turkey and 60 MW from Syria as of May, 2004.

It is reported that construction of a 132 kV transmission line is underway between Kuwait and Iraq to import energy from Kuwait. According to MoE, they are studying interconnection with the neighboring countries as given below.

Table 3.3-1 Power Trading with Neighboring Countries

Country	Amount (MW)	Remarks
Turkey	1,000	80 MW import at present
Syria	600	60 MW import at present
Jordan	300	
Kuwait	800	T/L under construction
Iran	500	

3.4 Fuel Supply System and Quality of Fuel

The present oil and gas supply network in Iraq, including the main refineries and power generating plants, is shown in Figure 3.4-1. There are major oil fields in Kirkuk and Basrah. Most of the natural gas is associated gas, reportedly about 70%, which is produced when oil is extracted, while non-associated gas comes from a field at Al Anfal. Some thermal plants were developed in the proximity of oil fields at Kirkuk and Basrah.

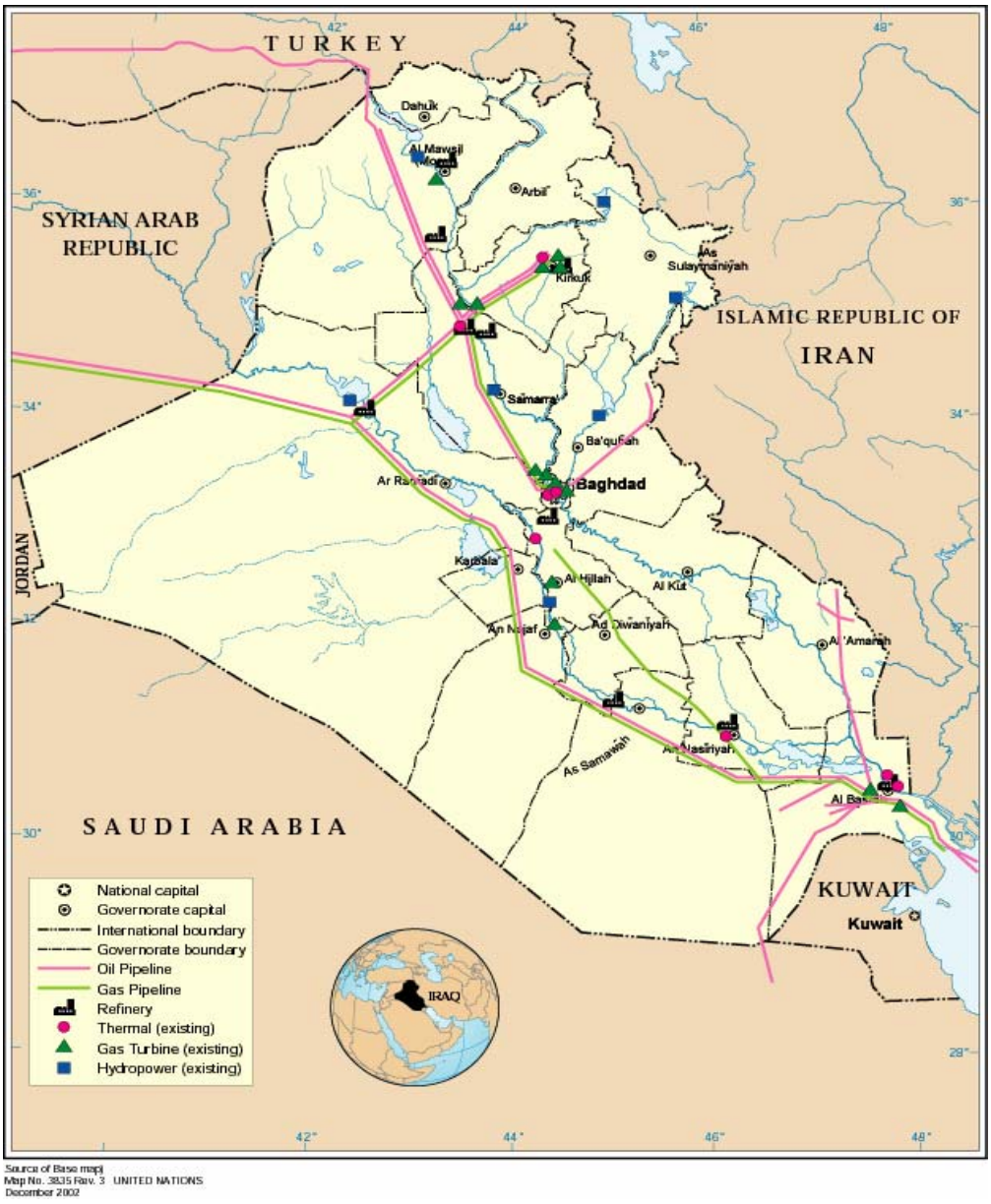


Figure 3.4-1 Oil and Gas Supply Network

Networks of oil and gas pipelines are extended over the country and connected with thermal power plants, except for the Al-Mussaib power station which receives fuel oil via railways and road tankers. These pipelines were not fully maintained under the

sanction regime, but the pipeline networks played an important role in keeping the plants running.

The balance of fuel production and consumption in Iraq is shown in the Figure 3.4-2.

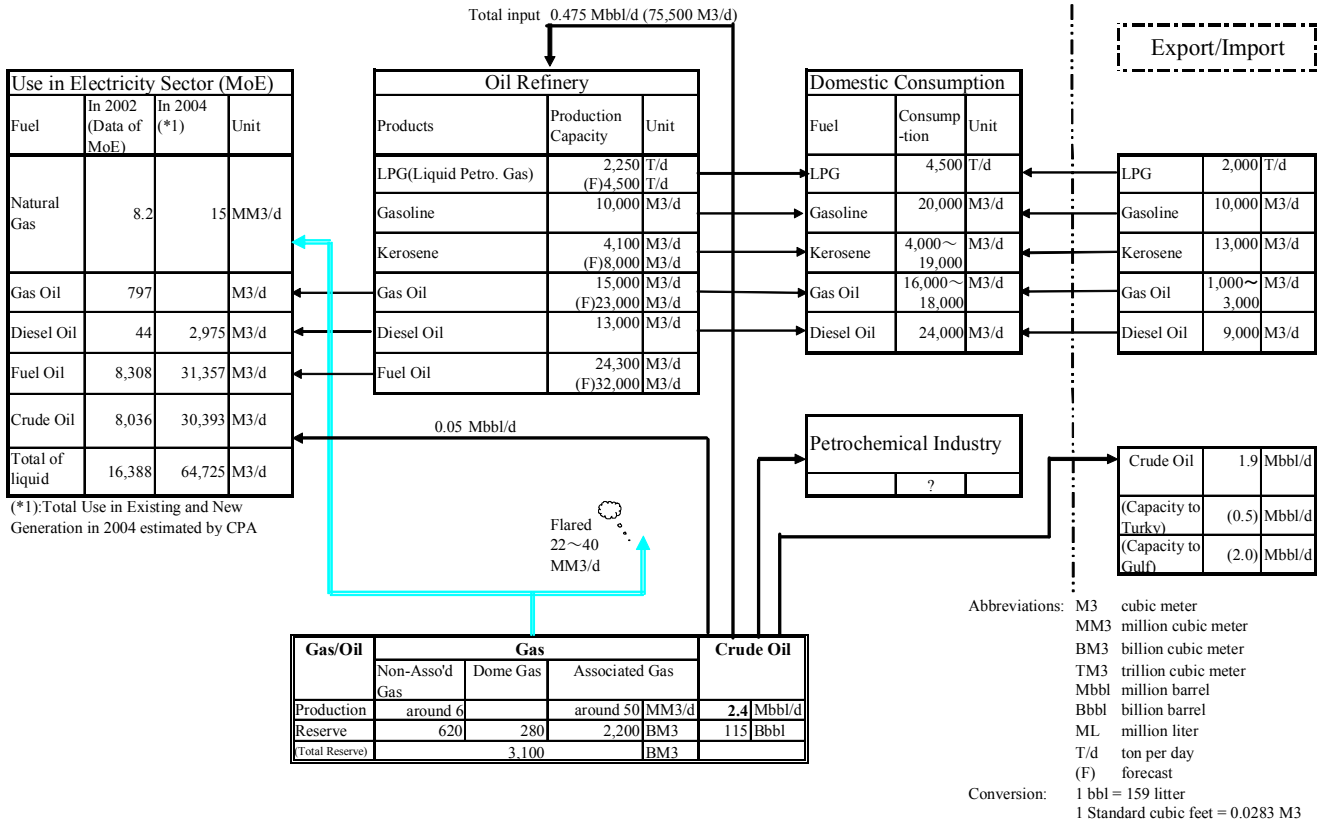


Figure 3.4-2 Balance of Fuel Production and Consumption

These figures were taken from websites and data from MoE, and some figures may not be accurate because no official data is available.

At present about 70 % of the associated gas appears to be flared without effective use and only 30 % is used for power generation and other uses. Therefore, there is a great potential to use more natural gas for power generation. However, development of infrastructures for pipe lines including gas gathering and treatment facilities should be clarified and multipurpose use of the associated gas should be discussed and studied among the parties concerned.

The quality and specification of oil and gas being used for the thermal power plants (gas turbine, steam turbine and diesel engine) is shown in Table 3.4-1. There might have been no other choice for MoE in selecting the fuels that have been used, but the some problems on the quality of fuel are identified as follows.

Table 3.4-1 Quality and Specification of Oil and Gas

Type of Liquid		Crude Oil						Fuel Oil							Gas Oil
Name of Fuel		1.Normal Crude Oil/Basrah	5.Crude Oil /Al-Mishref	9.Crude Oil/Bay hassin	10.Crude Oil /Jambur-Bayhassin	11.Crude Oil /Bagdad East	15.Crude Oil /Kirkuk	2.Fuel Oil	6.FuelOil /Nassryia Refinery	7.Light ,Heavy /Middle Refinery			8.Vacuum Residual Fuel Oil/North Refinery	12.Fuel Oil /Salahh Al-Den Refinery	16.Fuel Oil /Kirkuk	Gas Oil
										No.1	No.2	No.3				
Specific Gravity	15/4℃	0.8572	0.886	0.863	0.852	0.9273	0.85	0.965	0.957	0.9546	0.95	1	1.0389	0.965	0.957	0.85
API specific gravity	60° F	33.6	28.12	35	34.5	21.1	33.6									
Kinematic Viscosity	at 50℃(122F)							410						410	300	
Viscocity	at100F(37.8C)	6.69	14.95	3.4	5.6		6.69									5.6
Kinematic Viscosity	at140F									130	8,000					
Kinematic Viscosity	at185F											500				
Kinematic Viscosity	at210F									29	750	200	900-1000		29	
Pour-point	℃	-26	-36		12	-15	-15	27	25	21	40	45	57	27	25	-9
Sulphur Content	wt%	2.1	3.9	2.66	2.3	4.4	2.1	4.5	4	3.43	4.5	5.5	6,7	4.5	4	1
H2S	ppm				30	-	20									
WaxContent	wt%			2,23	4.2		7.2									
Carbone Resudie	wt%	4	7.5	4.46	4	9.3	4.5	7.5	8.6				26	7.5	8,6	
Asphalt content	wt%		2.2	3.28	2	6	1.5	3	2.8				3.9	3	2.8	
Ash content	wt%		0.09	0.0164	0.0164		0.071	0.1	0.016	0.144	0.32	0.2	0.049	0.1	0.016	0.01
Metals:Vanadium	ppm			25	31	100	30	63	64	38	84	150	100-120	63	54	
Nickel	ppm			12	20	35	12	30	24	12	40	40	78	30	24	
Sodium	ppm			30	30	60	15	35	30	30	40	30	50	35	30	
Iron	ppm				4	15	5	2						2		
Copper	ppm				0.3		0.5									
Water and Sediment	vol%					0.5	0.1	1						1	1	
Heating Value(High)	kcal/kg		10295			10000	10885	10000	10310	10400	10400	10300		10000	10310	10800
Heating Value(Low)	kcal/kg		9640							10000	10000	9800				

Name of Gas		3.Natural Gas		13.Acid Gas/Aji l Field	17.Jambur South Gas
		Max	Min		
C1	%Vol	80	65	82.18	86.783
C2	%Vol	35	12	9.74	7.001
C3	%Vol	5,5	0.5	4	3.125
C4	%Vol	1.8	0.06	1.36	1.486
C5	%Vol	0.45	0.0002	0.41	0.604
C6+	%Vol	0.18	0	1.08	0.728
N2	%Vol	0.7	0.4		
CO2	%Vol	3,3	0		
H2S	ppm Vol	7.5	-	12000	15-28
Total Suphur	ppm	40	-		
Moisture	ppm	140	-		
			-		
Calorific Value	kcal/m3	10000-10500			

(1) Viscosity

Fuel oil, except gas oil, indicates a high value of kinematic viscosity. The liquidity of fuel oil is important for fuel combustion in the boiler and combustion chamber. Depending on the performance of the fuel nozzle, some measures to reduce viscosity, such as oil heating, should be taken.

(2) Sulfur content

The sulfur content increases after the crude oil is processed to fuel oil. The vacuum residual fuel oil shows the highest value (6.7 % by weight) of sulfur content as liquid fuel. The acid gas also shows a high value of hydrogen sulfide which is not desirable for power generating plant.

(3) Carbon residue:

Fuel nozzles that are capable of combusting the residual carbon should be selected to prevent smoke from being produced and carbon from adhering to the combustion chamber.

(4) Metals:

The content of metals, such as vanadium, sodium, etc., is high, which has adverse effects by reacting with other substances in the combustion process and producing erosive compounds. It is especially difficult to remove vanadium in the oil treatment process and usually three times its quantity of magnesium is added to fuel oil to remove vanadium in the form of magnesium compounds.

Great attention should be paid to the quality and specification of fuel used for gas turbines where the combusted gas directly touches the turbine blade and nozzle.

There are five types of fuel which are supplied for power generating plants, i.e. crude oil, fuel oil, diesel oil, gas oil and natural gas. The prices of these fuels remain very cheap as compared with the international market prices. In 2002 MoE paid the prices as given below.

- Crude Oil 0.189 ID/l
- Fuel Oil 1 ID/l
- Diesel Oil 5 ID/l
- Gas Oil 5 ID/l
- Natural Gas 1 ID/m^3

These prices do not represent more than 1 % of the true market price of such fuel. Under the current low price situation for fuel, no incentive may occur for MoE to justify any investment in improving the fuel efficiency of their power plants. Charging the true market price of fuel would have a dramatic impact on the electricity tariffs. Therefore a gradual transition to the true market pricing over a target period can be considered.

3.5 Standards and Regulations

The Iraqi Central Organization for Standardization and Quality Control (ICOSQC), established in 1975, is entrusted with issuing all codes and standards covering all services and commodities related to citizen's requirements. These codes and standards are published periodically in the Iraqi Gazette and take the status of compulsory laws.

The electricity related codes and standards issued by ICOSQC up to year 2002 totalled 80. The standards are categorized under three broad divisions; electrical installation standards, guideline standards, and electrical appliances standards. The electrical

installation standards cover such things as voltage standard, wire/cables size with physical and insulation characteristics, light power switches and sockets, etc. The guideline standards provide guidelines for electrical drawings, symbols, and testing. The electrical appliances standards cover lamps, batteries, and other electrical fittings.

In the later years, the standards started to address the requirements for electrical network equipment such as capacitors. Most of the Iraqi standards are based on international standards (IEC, BS, DIN, ANSI… etc). Appendix G lists all of the standards related to the electricity sector.

Regarding the environment, a number of laws have been issued. One of them is the Environment Protection and Improvement Law No.(3) issued in 1997. These laws can be the bases for environmental legislation to regulate the construction and operation of power plant in Iraq. There are several relevant laws applicable for the electricity sector as described in Chapter 8 (Environment Aspects).

3.6 Organization and Institution of Electricity Sector

3.6.1 History of Electricity Sector

Electricity was first introduced to Iraq by the British troops in 1917, when they entered Baghdad, for their own use and for some neighboring districts near to their camps. In the twenties and thirties, railway and oil companies installed more generators for their use, and some major municipalities established their own networks.

The first steam power station was established in 1933, when the Anglo-Dutch Power & Lighting Company started operating two units of 2.5 MW each in the Al-Sarafiya District of Baghdad. Subsequently, local municipalities in various governorates continued to expand the company's services to many of Iraq's cities and towns.

In 1955, the Anglo-Dutch Lighting Company was nationalized, and all its assets were transferred to the newly established Baghdad Directorate of Electricity. In 1959, the Ministry of Industry's National Electricity Directorate was established, and it took over the role of supplying electricity to governorates outside Baghdad and municipalities turned over all of their electricity departments and assets to the National Electricity Directorate.

In the sixties, Baghdad Directorate of Electricity was dissolved and merged into the National Electricity Directorate. Since then, all management, operational and procurement decisions were made by the Ministry headquarters in Baghdad. In the seventies, the State Enterprise for Generation and Transmission of Electricity was established to give some autonomy to the sector, but it remained a government agency under the Ministry of Industry.

In 1974 generation (and transmission up to 33 kV) and distribution sectors were organized as separate enterprises within the State Enterprise for Generation and Transmission of Electricity. In 1999, Iraq took a step for decentralization of the

electrical sector. Although remaining a government monopoly, the sector became autonomous and decentralized by region and function. On June 21, 1999, a Revolution Command Council (RCC) Decree No. 195 was issued separating the sector from the Ministry of Industry and Minerals and reorganized the sector under the newly formed Commission of Electricity (CoE).

Prior to October 2003 electricity supply was under the control of the CoE and at present MoE is responsible for the electricity sector. However, because an outline framework of CoE appears to remain unchanged, the previous organization under the CoE is mentioned hereinafter for understanding of the present organization.

The Decree No. 195 outlined the aims and duties of CoE which included the supervision, management and follow-up of all the activities related to the electricity system as well as building a stable and reliable electricity system. Under the decree the sector was divided into several companies dealing with generation, distribution, construction, manufacturing, and IT functions.

Three General Companies for Electricity Production (GCEEP) were established; Middle, South and North. Although there were two distribution companies in the middle region, one for Baghdad and the other for the Middle Region, power generation for Baghdad and the Middle Region were dealt with under GCEEP Middle. The power stations were operated and controlled by each GCEEP as follows.

Table 3.6-1 Jurisdiction of GCEEPs for Power Stations

Company name	Power Station	Type	Total Installed Capacity (MW)
GCEEP-Middle	Doura	steam	640
	Al-Musaib	steam	1,200
	Baghdad south	steam	355
	Al-Taji	gas turbine	160
	Al-Hila	gas turbine	80
	Al-Najaf	gas turbine	189
	Himreen	hydro	50
	Al-Hindia	hydro	15
	Al-Qadissia/Haditha	hydro	660
	Al-Zafarraniah	diesel	***
GCEEP-North	Baiji	steam	1.100
	Dibis	steam	60
	Mula Abdullah	gas turbine	***
	Mousel	gas turbine	250

	Saddam dam/Mousul Main	hydro	750
	Mosul, regulating dam	hydro	60
	Mosuel pumped storage	hydro	240
	Dokan	hydro	410
	Debrikahan	hydro	166
	Samara	hydro	84
GCEEP-South	Al-Nassirya	steam	840
	Al-Hartha	steam	800
	Khour Al-Zubair	gas turbine	252
	Petrochemical Complex	gas	-

Each GCEEP company owned the 400 kV and 132 kV transmission lines and associated substations and had its own Regional Dispatch (Control) Center, with full control capability for the whole generation and transmission network within their respective territories. In addition, each regional dispatch center was connected to the CoE administered National Dispatch Center (NDC).

Table 3.6-2 shows the assets for the transmission lines and substations owned by each GCEEP company.

Table 3.6-2 Assets of Transmission Lines and Substations

T/L, S/S	GCEEP-North	GCEEP-Middle	GCEEP-South	Total
400KV T/L	7 nos/695 km	17 nos/ 1,859km	6 nos/987 km	30nos /3,541km
132KV T/L	98 nos/4,344km	205 nos/6,353km	94 nos/ 2,882km	397nos /13,579km
400 kV S/S	4 nos/2,000 MVA	11 nos/ 8,750 MVA	4 nos/2,250MVA	19nos /13,000MVA
132 kV S/S	37 nos/4,424 MVA	93 nos/12,125MVA	54 nos/ 3,788MVA	184nos /20,337MVA
Mobile S/S, 132/33 KV	8 nos/120MVA	10 nos/150MVA	8 nos/120MVA	26nos /390MVA
Mobile S/S, 132/11 KV	11nos/140 MVA	29 nos/350MVA	17 nos/245 MVA	57nos /735MVA

Under the Decree, the following four distribution companies (General Company for Electricity Distribution, GCED) were established, which covered Baghdad, Middle,

South and North and were given autonomous entities under the CoE setup, including pricing of selling energy.

Table 3.6-3 Location of GCEDs

Distribution Companies	Location of Headquarters of Company
GCED-Baghdad	Baghdad
GCED-Middle	Baghdad
GCED-South	Basrah
GCED-North	Mousel

In addition to the above generation and distribution companies, other companies were established under the CoE, which dealt with construction, manufacturing and IT. For construction two companies were established; one is the General Company for Electricity Projects (GCEP) and the other was the General Company for Rehabilitation of Electricity Station (GCEES). The former was responsible for design and construction of power related projects and the latter handled the extensive specialized work for rehabilitating the exiting plant under the Oil-for-Food Program. For manufacturing, the General Company for the Manufacture of Electricity Equipment (GCMEE) was established, aiming at manufacturing boilers, steam turbines, generators, transformers and power plant control systems. For IT, the Rafidain General Company for Information and Technology (RGCIT) was established to develop control and communication systems for generation, transmission, and distribution networks by bringing modern IT capabilities to the CoE companies.

In summary 11 companies in total were established under the CoE. The objective of the previous structure was to decentralize operations and to provide each company with a reasonable level of autonomy and financial accountability.

3.6.2 Present Organization for Electricity Sector

The foregoing section describes the past structure or organization of the electricity sector in Iraq when the CoE was established. However, the CoE was dismissed and transformed into a Ministry of Electricity (MoE) in October 2003, which is one of the 25 current ministries (before the Interim Government was established), while it appears that most of the basic structures and functions remain unchanged.

At present, MoE involves about 43,000 staff, out of which 650 staff are in the headquarters at Baghdad. Approximately 23,000 staff (54 % of the MoE staff) are in the distribution sectors and 14,000 staff (32 %) in the generation and transmission sectors. The remainders are in the construction, manufacturing and IT sectors.

The new organization chart of MoE is shown in Figure 3.6-1. Generation, transmission and distribution sectors have been re-organized under the respective directorate generals and are controlled by the region based jurisdiction as shown in Table 3.6-4.

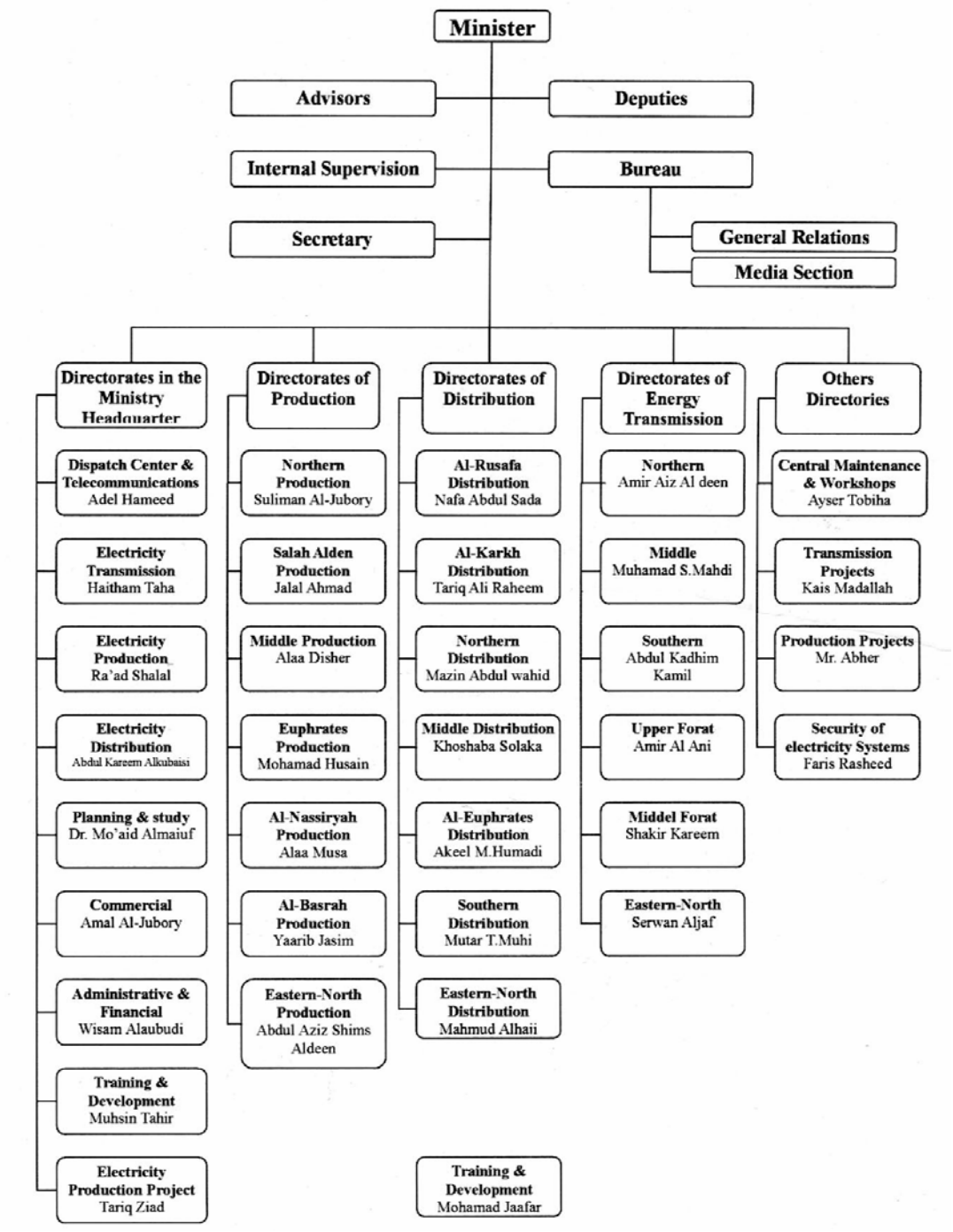


Figure 3.6-1 Organization Chart of MoE

Table 3.6-4 Regional Organization of Generation, Transmission and Distribution Sector

Directorate General of Power Production

G: governate under control

No.	Governorate	(1) Directorate of North Production	(2) Directorate of Salah Aldin Production	(3) Directorate of Middle Production	(4) Directorate of Al Furat Production	(5) Directorate of Nassiria Production	(6) Directorate of Basrah Production	(7) Directorate of North Eastern Production
1	Dahuk	G						
2	Ninewa	G						
3	Tameem	G						
4	Salah al Din		G					
5	Anbar			G				
6	Baghdad			G				
7	Diyala			G				
8	Wassit			G				
9	Babylon				G			
10	Kerbela				G			
11	Najaf				G			
12	Qadissiya				G			
13	Thi-Qar					G		
14	Basrah						G	
15	Missan						G	
16	Muthanna						G	
17	Erbil							G
18	Sulaimaniyah							G

Directorate General of Power Transmission

T: governorate under control

No.	Governorate	(1) Directorate of Power Transmission-North Region	(2) Directorate of Power Transmission-Middle Region	(3) Directorate of Power Transmission- Upper Euphrate	(4) Directorate of Power Transmission - Central Euphrate	(5) Directorate of Power Transmission - South Region	(6) Directorate of Power Transmission -North Eastern
1	Ninewa	T					
2	Tameem	T					
3	Salah al Din	T					
4	Baghdad		T				
5	Anbar			T			
6	Diyala			T			
7	Wassit			T			
8	Babylon				T		
9	Kerbela				T		
10	Najaf				T		
11	Qadissiya				T		
12	Basrah					T	
13	Missan					T	
14	Muthanna					T	
15	Thi-Qar					T	
16	Dahuk						T
17	Erbil						T
18	Sulaimaniyah						T

Directorate General of Power Distribution

D: governorate under control

No.	Governorate	(1) Directorate of North Distribution	(2) Directorate of Al Rusafa Distribution (East Baghdad)	(3) Directorate of Al Karkh Distribution (West Baghdad)	(4) Directorate of Middle Distribution	(5) Directorate of Al Furat Distribution	(6) Directorate of South Distribution	(7) Directorate of North Eastern Distribution
1	Ninewa	D						
2	Tameem	D						
3	Salah al Din	D						
4	Baghdad		D	D				
5	Anbar				D			
6	Diyala				D			
7	Wassit				D			
8	Babylon					D		
9	Kerbela					D		
10	Najaf					D		
11	Qadissiya					D		
12	Basrah						D	
13	Missan						D	
14	Muthanna						D	
15	Thi-Qar						D	
16	Dahuk							D
17	Erbil							D
18	Sulaimaniyah							D

3.6.3 Tariff Structure

After the recent conflict in 2003, billing and collection of electricity charges were suspended. However, billing and collection have reportedly been resumed very recently, though no detail is known.

Resumption of billing and collection of the tariff is quite crucial for sustainable development and proper operation and maintenance of the power system. In particular, needless to say, it would be a very basic and prerequisite condition towards the privatization goal.

Hereinafter, the previous tariff structure is described as it would be helpful to understand the present status and to re-establish the system.

Generally customers were classified into four types; Residential Customers (Type1), Governmental Customers (Type 2), Industrial Customers (Type 3), and Commercial Customers including everything else not under the first three types (Type 4).

The customers were further classified by type, connection voltage and consumption as shown in the following table:

Table 3.6-5 Classification of Customers by Consumption

Phase	Voltage	Consumption and Load by Customer
Single phase	230 V (+4%, -10%)	less than 1,500 kWh/month
Three phase	400 V (+4%, -10%)	from 1,500 up to 12,000 kWh/month
	11 kV (+5%, -10%)	load from 50kW up to 5,000 kW
	33 kV (+/-10%)	load from 5,000 kW up to 31,500 kW
	132 kV (+/-10%)	load over 31,500 kW

In addition to the tariff, service charges were collected by the CoE distribution companies as shown in Table 3.6-6.

Table 3.6-6 Electricity Service Charges

No.	Items	Charges	Remarks
(1)	Inspection Charges:	1,000 ID to 5,000 ID	depending on type of service and location
(2)	Connection Charges:	1,500 ID to 5,000 ID	depending on type and size of facility
(3)	Connection Change:	1,000 ID for disconnect to 30,000ID for moving transformer	
(4)	Disconnect & Reconnect Charges:	1,000 ID to 10,000 ID	depending on type, phase and voltage
(5)	Meter Replacement Charges:	1,500 ID to 5,000 ID	depending on type and phase
(6)	Standby Generator License:	1,000 ID/kVA	
(7)	Temporary Connection:	5,000 ID for single phase, 6,000 ID for 3-phase, plus 2,000 ID/day	
(8)	Disconnect & Connect Charges for Violators of Energy Efficiency Guidelines:	25,000 ID for small commercial and residential, 35,000 ID for others	

Electricity tariffs were broken down according to five customer types; namely household, commercial, industrial, governmental, and agricultural. The electricity tariff in Iraq was probably the lowest in the world, while some efforts were made to increase the electricity tariff in 1996, 2000 and 2002. Table 3.6-7 depicts the evolving tariff over these years.

Table 3.6-7 Electricity Tariffs from 1996 to 2001

Category	Range kWh	Unit Price I.D / kWh		
		1996	2000	2001
Household	1-300	0.010	0.5	1.5
	301-900	0.030	0.6	1.5
	901-1,500	0.08	0.9	1.5
	1,501-2,100	0.525	4	4
	2,101-3,000	0.525	7	7
	3,001-5,100	0.525	15	15

	> 5,100	0.525	30	15
Commercial	1-300	1	2	2
	301-600	1.5	4	4
	601-900	2.0	8	8
	901-1,500	6.25	12	12
	1,501-3,000	13.5	20	20
	> 3000	13.5	25	25
Industrial	0.4 kV	6.35	8.5	8.5
	11 kV	1.5	3.0	3.0
	33 kV	1.25	2.5	2.5
	132 kV	1	2.0	2.0
Governmental	1-10,000	0.2	2.0	2.0
	10,001-20,000	0.2	2.5	2.5
	20,001-40,000	0.2	3.0	3.0
	40,001-100,000	0.2	4.0	4.0
	> 100,000	0.2	5.0	5.0
Agricultural		0.2	5.0	5.0

Notes: Official exchange rate before 2003 was 1 ID = US$3.21 as of April, 2002; US$1 = NID 1,460

It is clear from the above table that unit price for the household category which represents the biggest share of consumption, ranges from 0.103 cent/kWh for low consumption to 1.03 cent/kWh for high consumption levels.

Each company was allowed to retain revenues to cover operational expenses including personnel salaries and each distribution company purchased power from the generating companies at a cost of 1.2 to 1.5 ID/kWh. All companies were required to contribute 3% of the total revenues to the CoE HQ. The total tariffs collected in 2002 were US$ 44 million, compared to almost over a US$ 1 billion true cost of CoE.

Oil-producing countries set power tariffs at a very low level; for example, approximately 0.5 cent per kWh in Iran for electricity for residential use and 1.3 cent per kWh in Saudi Arabia. However, it is noted that the power tariff in Iraq had remained much lower.

Each company prepared its own financial statements and was subject to independent audits.

The electricity sector was the pioneer in introducing mainframe computers in Iraq in the late sixties. The sector developed a sophisticated computerized billing and collection system, which continued to be used until the CoE offices were looted and burned after the conflict in 2003.

Electricity bills were issued periodically once every two months and they were distributed to the customers manually door by door by the COE meter readers, as they recorded the current reading of the electricity meters for the next billing cycle. In an attempt to improve the billing collection rate since the mid-nineties the CoE meter readers were entrusted with the collection of the bills directly from customers.

In spite of the vandalism and looting at the CoE headquarter and most of its companies, the billing and collection system were salvaged by CoE staff, who in spite of the war managed to evacuate both software and hardware to their homes. Currently the various GCED's have embarked on preparing the electricity bills after the reinstallation of the billing system and will soon be in a position to distribute them to the customers as soon as the security situation of the country is improved.

It is reportedly very difficult to obtain estimates of uncollected bills (although some estimated it at 15-25 %). However, in the Needs Assessment by UN and WB in 2003, information was collected on distribution losses and theft, based on metering of total kWh received from the generation companies, versus the kWh actually sold to customers. Table 3.6-x compares the total electric power received and sold for two consecutive year's period 2000 & 2001. The difference between these quantities for each year represents losses of electric energy which might be attributed to both technical distribution losses and theft.

The loss percentages vary from 11 % to 19 % in 2000 and 11 %-15 % in 2001, with GCED-South scoring the lowest values 11% and GCED–Baghdad the highest value 15 %-19 %. In the two years, total distribution losses and theft represented 13% to 16 % of the electricity received from the generating companies. Assuming 16 % losses in the generation side, the total system losses and theft in Iraq is 29 % to 32 %.

Table 3.6.8 Total Electricity Received versus Sold by Region (2000-2001)

GCED	2000			2001		
	Received (MWh)	Sold (MWh)	Loss (%)	Received (MWh)	Sold (MWh)	Loss (%)
Baghdad	9,916,000	8,025,000	19	11,443,000	9,674,000	15
Middle	4,214,451	3,582,223	15	5,037,419	4,388,045	15
North	4,611,530	3,930,147	15	5,379,222	4,756,117	12
South	3,944,553	3,504,007	11	4,448,903	5,052,807	11
Total	22,686,534	19,041,377	16	26,308,544	22,870,969	13

Source: WB Needs Assessment of the Electricity Sector of Iraq, Annex E Customer Services Issues; 2003

CHAPTER 4 REVIEW OF PREVIOUS DEVELOPMENT PLANS

4.1 General

The electricity power system of Iraq has long been in a serious situation because of a large gap between power demand and available generating capacity and also because of a lack of reliability of the system.

In the past and to date, various efforts have been made to restore the facilities which have been damaged by the war and by looting and vandalism which occurred in and after the recent conflict in 2003. Hereinafter, various activities for the electricity sector of Iraq done by the Iraqi Government and other agencies are described.

4.2 Oil-for-Food Program (OFFP)

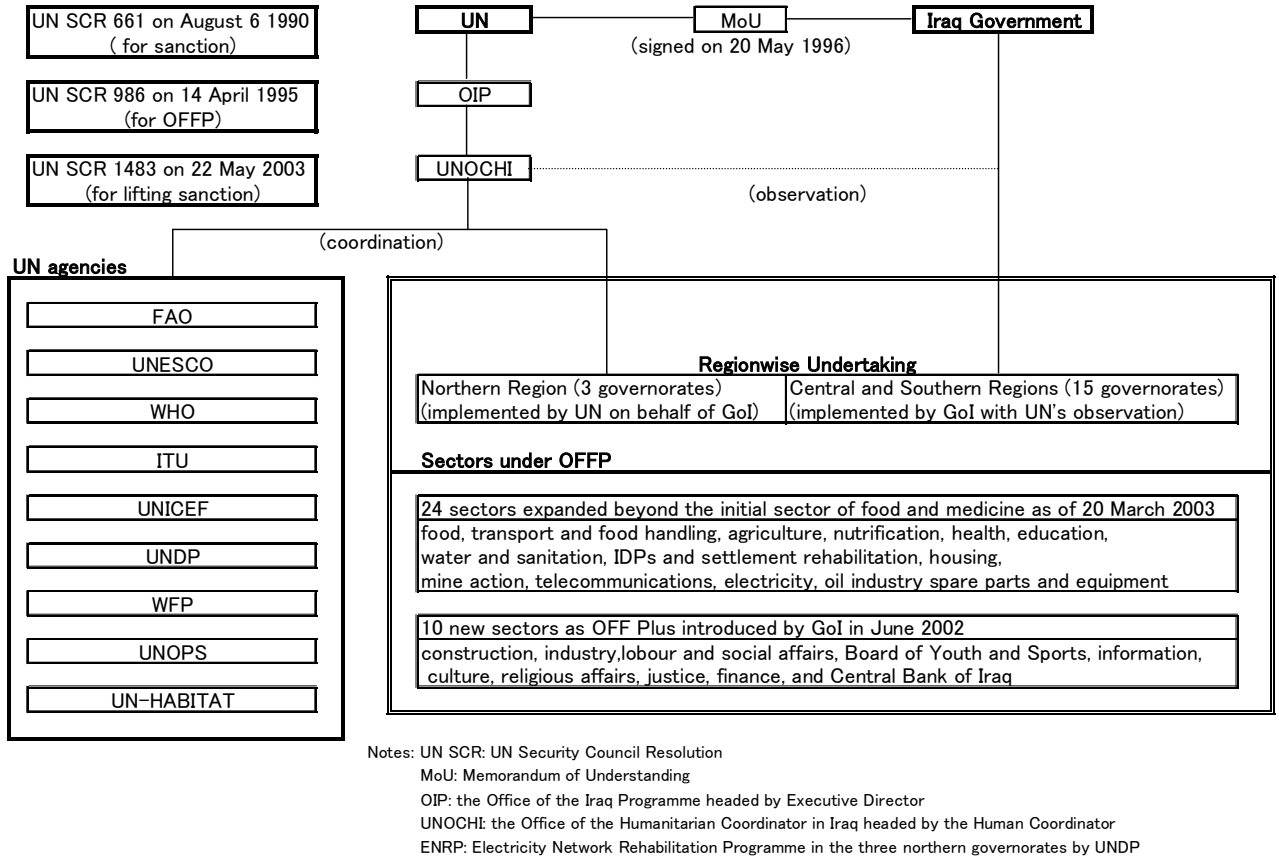
In August 1990 the United Nations Security Council (UNSC) adopted Resolution 661, imposing comprehensive sanctions on Iraq following Iraq's invasion of Kuwait. After the Gulf War, on the other hand, UN dispatched an inter-agency mission to assess the humanitarian needs arising in Iraq and Kuwait. Under the growing concern over the humanitarian situation in Iraq, UN proposed measures to enable Iraq to sell limited quantities of oil to meet the people's needs.

On 14 April 1995, the UNSC passed SCR 986 which enabled the UN to use the proceeds from the sale of Iraqi oil to finance the purchase of humanitarian goods. This established the Oil-for-Food Programme (OFFP). This programme was intended to be a temporary measure to provide for the humanitarian needs of the Iraqi people until SCR 687 was fulfilled by the Iraq Government. On 20 May 1996, UN and the Iraq Government signed the MoU (Memorandum of Understanding) on the details of implementing resolution 986 (1995). After the first Iraq oil export started in December 1996, the first shipment of food arrived in Iraq on March 1997 and the first medicine arrived in May 1997.

The programme was operated in phases of 6 months. It was initially permitted to sell US$2 billion worth of oil with two-third of the amount to be used to meet the humanitarian needs. However, the ceiling amount was raised to $5.265 billion in 1998, and finally removed in 1999. The programme was executed in thirteen (XIII) phases and ended on 3 June 2003. After official termination of the OFFP on 21 November 2003, the responsibility for the implementation of on-going contracts was transferred to CPA.

The programme was administered by the UNOIP (Office of the Iraq Programme). The coordination of works by the various agencies was managed by the UNOCHI (Office of the Humanitarian Coordinator). The implementation of the OFFP was carried out in two ways: (1) the programme for the central and southern regions was undertaken by the GoI with confirmation of deliveries and implementation carried out by UN

observers based in Baghdad, and (2) the programme for the three northern governorates (Dahuk, Erbil and Sulaymaniyah) was directly implemented by the UN on behalf of the GoI. For the programme, nine (9) UN agencies were involved: FAO, UNESCO, WHO, ITU, UNICEF, UNDP, WFP, UNOPS, UN-HABITAT as shown in Figure 4.2-1. The Iraqi oil export proceeds were allocated as shown in Table 4.2-1.



Notes: UN SCR: UN Security Council Resolution
MoU: Memorandum of Understanding
OIP: the Office of the Iraq Programme headed by Executive Director
UNOCHI: the Office of the Humanitarian Coordinator in Iraq headed by the Human Coordinator
ENRP: Electricity Network Rehabilitation Programme in the three northern governorates by UNDP

Figure 4.2-1 UN Agencies involved in the OFFP

Table 4.2-1 Fund Allocation of OFFP

Items	Share	Remarks
Humanitarian use	72 %	Allocated 59 % for the central and south regions, and 13 % for the north region
Compensation fund for war reparation payments	25 %	
UN administration and operation costs	2.2 %	
Weapons inspection program	0.8%	
Total	100 %	

Beyond the initial emphasis on emergency food and medicines, the OFFP was expanded to include infrastructure rehabilitation and 24 other sectors. In June 2002 GoI further introduced 10 new sectors in the program. As of 21 November 2003

US$ 46 billion was approved and allocated for humanitarian needs and US$ 3.8 billion was allocated for spare parts. The programme was seriously affected by oil revenue shortfall from 2000 to 2002. The Security Council lifted sanction on Iraq on 22 May 2003 by SCR 1483.

For the electric facilities spare parts, materials and equipment were procured under the program. It is reported by UNDP that in the 15 central and south governorates available power increased by 900 MW from 2001 to 2002. The number and duration of power cuts declined and there were no planned power cuts in Baghdad City during the 2002 summer peak.

Under the OFFP, more than 2,000 small to medium size generators were provided over the country to deliver emergency energy to essential humanitarian facilities such as water pumping stations and hospitals.

For the three northern governorates, UNDP implemented the Electricity Network Rehabilitation Programme (ENRP) as discussed below.

4.3 Electricity Network Rehabilitation Project (ENRP)

The three northern governorates, Dahuk, Erbil and Sulaymaniyah, were once connected to the national grid through several 132 kV high voltage transmission lines from the Governorates of Mosul and Kirkuk. As a result of the Gulf War in 1991 and the internal conflicts, the electricity supply system in northern Iraq suffered severe damage. Several transmission and distribution lines were put out of use and many substations were destroyed. Control panels at the Derbandikhan power station were damaged.

Under SCR 986, an emergency program had been launched by UNDESA in 1997/98 to assist the Local Electricity Authorities (LEAs) in obtaining urgent requirements for distribution line materials and distribution transformers to carry out the most urgent work to relieve the system from further deterioration/collapse.

UNDP started the Electricity Network Rehabilitation Project (ENRP) in 1999 under the Memorandum of Understanding (MOU) for the OFFP between UNDP and OIP on 11th March 1995 and executed various sub-projects to improve the situation and to carry out suitable development. These projects were designed to improve the generation capacity and viability of power supply, and to rehabilitate/augment and reinforce substations and transmission and distribution networks.

The programme was funded from the 13% account of the OFF Programme and included procurement, installation and commissioning of electrical equipment, and procurement of spare parts necessary for the rehabilitation of the electricity network in these northern governorates.

Under the ENRP the Distribution Network Rehabilitation Master Plan was formulated for the three northern governorates. In this plan, detailed assessment of the network

rehabilitation requirements and proposal for the projects to be implemented was presented. For the recommended rehabilitation and network expansion and reinforcement, the proposed costs were estimated and preliminary economic assessment was carried out to confirm the economic viability for the planned works.

Rehabilitation works were carried out in line with the program and new construction manuals prepared and established. UNDP installed three 29 MW diesel power stations, one in each governorate.

At present the Dahuk Governorate is linked to the national grid but receives limited supply. The Governorates of Erbil and Sulaymaniyah had to rely on electricity from the hydropower stations at Dokan and Derbandikhan, but generating capacity was not always sufficient. Output from the hydro stations suffered greatly from a three-year drought from 1999 to 2001.

4.4 10 Year Plan of Commission of Electricity (CoE)

In 2000 the Iraq Commission of Electricity (CoE) formulated a 10 year plan for the electricity sector for the period from 2001 to 2012, which aimed at improvement of all the electric facilities and development of new projects covering generation, transmission and distribution lines, and load dispatching centers. The plan proposed a target for annual per capita demand to increase from 1,400 kWh to 3,200 kWh over the 10 year period.

In this plan, a demand forecast was made for the period from 2001 to 2012, details of which are described in Chapter 6 (Demand Forecast). For the increasing electricity demand, activities were classified into two categories; the first category for rehabilitation of the existing power generating units and the second category for construction of new power stations.

Under the first category, Dibis GT, Khor Al-Zubair GT, Hartha ST、Najibia ST, Daura ST and Mussaib ST were nominated. Contracts for the rehabilitation of some of these plants were implemented by international companies after the Gulf War. Under the second category, new plants were nominated as shown in Table 4.4-1.

Table 4.4-1 New Generating Plants in the CoE's 10 Year Plan

No.	Name of Power Station	Type	Location	Total Installed Capacity (MW)	Remarks
1	Al Tameen (**) (Mulla Abdulla)	GT	Kirkuk	111	3 x 37MW
2	Al Quds (***)	GT	Baghdad	246 + 246	1st stage (2 x 123MW) in 2002, 2nd stage (2 x 123MW) in 2003
3	Baji (***)	GT	Baghdad	318 + 318	1st stage in 2002, 2nd stage in 2003, 4 x 159MW

4	Najaf (**)	GT	Najaf	330	2 x 165MW
5	Dibis (**)	GT	Kirkuk	300	2 x 150MW
6	Al Rumaila, North(**)	GT	Basrah	500	4 x 125MW
7	Shua'yba (or Khor Al Zubair) (***)	GT	Basrah	126	3 x 42MW
8	Taji (***)	GT	Baghdad	25.8	Two units
9	Floated gas units	GT	Baghdad	50	2 x 25MW
10	Mobile gas units	GT	Baghdad	51	4 x 12.9MW
Total of Gas Turbine Plant				2,596	
1	Yousifiyah (***,**,*)	ST	Baghdad	630 +1,050	8 x 210MW
2	North PS(*) (Al Shimel)	ST	Baghdad	1,400	4 x 350MW
3	Al Anbar(*)	ST	Anbar	300 + 900	4 x 300MW
4	Salah Al Din (**,*)	ST	Salah-Al Din	300 + 900	4 x 300MW
5	Wassit(**)	ST	Wassit	1,320	6 x 220MW
6	Hartha(***)	ST	Basrah	400	Two units
Total of Steam Plant				6,820	
1	Al Odhaim Hydro(***)	HY	Al Khalis	27	2 x 13.5MW
2	Makhool Dam Hydro (*)	HY	Beji	260	4 x 25MW
Total of Hydro Plant				287	
1	Al Haditha DP	DG	Anbar	230	10 x 23MW
Grand Total				9,703	Total of GT, ST, HY and DG

Notes: (***) planned to be installed in 2003, (**) in 2004 and (*) in 2005.

In this plan, construction time required for each type of plant was assumed as follows.

- Gas turbine : 2 years
- Steam turbine : 4 to 5 years
- Hydro : 3 to 5 years

Out of the above new plants, a plan was proposed for manufacturing generators, turbines and boilers, control system and transformers in the Wassit plant by an Iraqi company under the CoE.

The transmission network, in addition to the rehabilitation works in the transmission lines and substations, construction of six 400 kV substations (5,250 MVA in total) and one hundred and twenty 132 kV substations (189 MVA each) were proposed. A new 400 kV transmission line of approximately 2,200 km and a new 132 kV transmission line of 2,700 km were proposed for construction.

Bottlenecks were identified in the distribution network. It was planned to make stepwise improvement of the load dispatch centers, including use of more computers and software and to introduce more advanced communication systems between the power facilities and the dispatching centers. Some institutional issues including the tariff structure were also pointed out.

Though not mentioned in detail, introduction of renewable energy such as solar and wind power was proposed.

4.5 Needs Assessment by UN and WB

In accordance with UNSC Resolution 1483 (May 2003), the UN Development Group and the World Bank jointly undertook a Needs Assessment to inform the International Donor Conference on the Reconstruction of Iraq (Madrid: 23-24 October 2003) of the status and priority reconstruction and rehabilitation needs in fourteen (14) priority sectors. These sectors are education, heath, employment creation, water and sanitation, transport and telecommunications, electricity, housing and land management, urban management, agriculture/water/food security, finance, state-owned enterprises, investment climate, mine action and government institutions. In addition to these 14 sectors, three cross-sector themes of human rights, gender and environment were addressed. Security and the oil sector were not included in the 14 sectors but were dealt with by the CPA.

The electricity sector was one of the 14 sectors and the Needs Assessment for the electricity sector was carried out jointly by UNDP and the World Bank. Field work for the assessment in Iraq was carried out by a UNDP team comprising staff from the previous UNDESA and UNOHCI observation units in Baghdad and the ENRP program in the three northern governorates and World Bank financed consultants. Extensive consultations were held with the Iraqi Commission of Electricity (CoE), the Coalition Provisional Authority (CPA) and USAID.

The present situation and issues to be solved were identified and analyzed and priority reconstruction and rehabilitation needs were identified, focusing on the most urgent requirements for 2004 and indicative reconstruction needs for the period from 2005 to 2007. The report was submitted in October 2003, in which the fund requirement for each sector was estimated except for the security and oil sectors. The estimated fund requirements in the electricity sector are shown in Table 4.5-1.

Table 4.5-1 Year 2004 and 2005-2007 Reconstruction Needs for Electricity Sector

(in US$ millions)

	2004	2005-2007	Total
(A) Rehabilitation & Reconstruction:			
*generation	1,651.2	2,331.0	3,982.2
*transmission	293.7	313.0	606.7
*substation	273.4	241.3	514.7
*distribution	362.0	834.6	1,196.6
*SCADA	54.4	34.0	88.4
*others	1.2	0	1.2
Sub-total	2,635.9	3,753.9	6,389.8
(B) New Investment:			
*generation	197.0	4,443.0	4,640.0
*transmission	133.5	385.0	518.5
*substation	90.0	464.5	554.5
*distribution	112.8	1,075.7	1,188.5
*SCADA	20.3	62.6	82.9
Sub-total	553.6	6,430.8	6,984.4
(C) Funded components through OFFP and identified donor:	-997.0	-473.7	-1,470.7
(D) New Capital Investment Requirements: =(A) + (B) - (C)	2,192.5	9,711.0	11,903.5
(E) Technical Assistance / Capacity Building	31.0	36.0	67.0
(F) Building Renovations / Refurbishment	5.0	0	5.0
(G) Security	153.9	0	153.9
(H) Total Investment and TA Costs: = (D) + (E) + (F) + (G)	2,382.4	9,747.0	12,129.4
(I) Total O&M Costs:	119.2	359.6	478.8
Grand Total, (H) + (I)	2,501.6	10,106.6	12,608.2

The above fund requirements for 2004 include those for the projects being implemented by the OFFP. In the Needs Assessment the total funds required for all 14 sectors were estimated; US$ 9,300 million for the year 2004 and US$ 26,500 million for the years 2005 - 2007. It is noted that the electricity sector requires a large share of the required funds: 26 % for the year 2004 and 38 % for the years 2005 - 2007.

At the Madrid Conference in which 73 countries and 20 international agencies and 13 NGOs participated, a total of US$ 33 billion was committed by the various countries

for re-construction of Iraq. At this conference the Government of Japan committed a total of US$ 5.0 billion, consisting of US$ 1.5 billion to be allocated for grant aid projects and US$ 3.5 billion mainly for loan projects.

4.6 Maintenance Programme by CPA

The Coalition Provisional Authority (CPA) was a temporary government, which was the lawful government of Iraq until the new transitional Iraqi administration took over on June 28 2004. For the reconstruction of Iraq, the CPA placed priority on governance, essential services, economy, security and strategic communication. Great efforts were under way to restore the electric facilities that provide very significant essential services. A summary of the rehabilitation works under the CPA is shown in Table 4.6-1, in which a target to be achieved is described.

Table 4.6-1 CPA's Programme and Targets for Electricity

Phase	Period	Programme/Targets	Remarks
1	August to October 2003	4,400 MW Programme	North :1,700 MW Middle: 2,100 MW South : 600 MW
	October to December 2003	Autumn Maintenance Program	
	February to April 2004	Spring Maintenance Program	
2	October 2003 to May 2004	6,000 MW Program & 120,000MWh/day	North : 2.330 MW Middle: 2,350 MW South : 1,320 MW
3	after April 2004	Continuation to increase capacity	

The maintenance and restoration programs that were undertaken by the CPA number more than 50. The funding and implementation has been undertaken by such agencies as USAID, USACE and TF RIE.

The major generating and transmission / distribution projects under rehabilitation are given in the following tables.

Table 4.6-2 Generation Projects under Rehabilitation

1	Taji	USACE	+70MW
2	Old Mullah GT	USACE	+66MW
3	New Mullah GT	USACE	+30MW
4	Mosul GT	USACE	+21MW
5	Zaferinia ST	USACE	+39MW
6	Haditha Hydoplant	USACE	+105MW

7	Baiji GT	USACE	+30MW
8	Nassiriya water intake cleaning	USACE	+144MW
9	Baghdad South Phase II GT	USAID	+109MW
10	Musaib Thermal Refurbrishment	USAID	+30MW

Table 4.6-3 Transmission and Distribution Projects under Rehabilitation

1	Al Ameen 400 kV S/S with 132 kV T/L	USACE
2	Dibis-Erbil-Quaraquosh 132 KV T/L	USACE
3	Jazair-Yarmook, Samediay-New Baghdad 132 kV T/L	USACE
4	Dibis-Old Kirkuk 132 kV T/L	USACE
5	Burzulgan-Old Amala 132 kV T/L	USACE
6	Baghdad Distribution Network	USACE

4.7 Investigation by the Middle East Cooperation Center, Japan

From June to July 2003, immediately after the recent conflict, the Middle-East Cooperation Center, Japan carried out an investigation of the electric facilities at Basrah in the southern region where several Japanese companies had conducted business operations in the past. In this investigation, basic data and information were collected for reconstruction of the electric facilities necessary for re-building the environment for future investment by the private sector. A report for the investigation (in Japanese) was referred to in the Study.