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JOINT IRAQ NEEDS ASSESSMENT

Electricity

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TABLE OF CONTENTS

1. INTRODUCTION **Page 1**

1.1 Background

1.2 Overall Description of Situation

1.3 Brief Trend Analysis Over Past 15 Years

2. CURRENT STATUS AND ISSUES **Page 2**

2.1 Summary Status of the Power Sector
2.1.1 Summary Status
2.1.2 Issues

2.2 Status of Physical Infrastructure
2.2.1 General
2.2.2 Generation Assets
2.2.3 Transmission System
2.2.4 Substation Assets
2.2.5 Distribution Assets
2.2.6 SCADA and Control Centres
2.2.7 Overview of System Operation

2.3 Current Policy Framework

2.4 Current Institutional Framework

2.5 Human Resources

3. NEEDS & PRIORITIES FOR THE ELECTRICITY SECTOR **Page 12**

3.1 Medium and Long Term Needs and Policy/Institutional Changes

3.1.1 General Infrastructure
3.1.2 Proposed Policy Changes
3.1.3 Proposed Institutional, Legal & Other Requirements

3.2 2004 Needs & Policy/Institutional Changes

3.2.1 Broad Financial Needs During 2004
3.2.2 Proposed Policy Changes During 2004
3.2.3 Proposed Institutional Changes during 2004

3.3 Cross Cutting Issues

3.3.1 Gender Issues
3.3.2 Environmental issues
3.3.3 Human rights
3.3.4 Institutional capacity Gaps & requirements

Table 1: Preliminary 2004 Budget for Sector

1 INTRODUCTION

1.1 Background

1.1 The Needs Assessment for the Electricity sector was carried out jointly by UNDP and World Bank staff and consultants. Field work in Iraq was largely 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.

1.2 Overall Description of Situation

1.2.1 In 1990 prior to the Gulf War, the total installed generating capacity was 9,295MW with a peak demand of about 5100 MW. Approximately 87% of the population had access to electricity. A combination of wars, sanctions, looting and vandalism has however severely affected the entire power system infrastructure in Iraq. During the 1991 Gulf War the electricity system suffered severe damage. Several transmission lines were put out of service and substations were damaged. However, the power generation equipment was the most severely affected. The available capacity was reduced to 2,325MW and power cuts of up to fifteen hours or more were common. In some areas there was no supply at all. Three 132kV interconnections to the three northern Governorates were removed and these Governorates were isolated from the national grid. Erbil and Sulaimaniya had to rely on supply from the hydro power stations at Dokan and Derbandikhan. Dohuk was able to obtain limited power from Mosul.

1.2.2 While some of the damage of the 1991 war was repaired and about 4,500MW of generating capacity was available in 2002, power supply remained unreliable throughout the nineties and load shedding and unplanned power outages were frequent. After the most recent conflict, the situation deteriorated again and currently only 3,300MW of generating capacity is available. Power cuts became more frequent, particularly during the summer of 2003 when demand was at its peak.

1.3 Brief Trend Analysis Over Past 15 years

1.3.1 The 1990 installed capacity of 9,295MW consisted of 120 power-generating units in various thermal, gas turbine and hydro power stations. Approximately 70% of Iraq's installed power generating capacity was partially damaged or destroyed during the 1991 Gulf War. All major power stations were damaged and nearly 80 % of the gas turbines units were affected. After 1991, only about 50 units were available, with a generation capacity of 2,325 MW. The construction work on three new large thermal power stations at Yousifiya, Al-Shemal and Al-Anbar were stopped, because of the ensuing sanctions.

1.3.2 From 1991 to the start of Oil-for-Food Programme, Iraqi engineers were able to repair some of the damaged units, either with available spare parts or by cannibalising other damaged units. The generation level rose from 2,325 MW to about 4,000MW. However, the state of the power generation units remained precarious due to the make shift nature of the repairs and general lack of major maintenance and spares.

1.3.3 To cater for the humanitarian needs of Iraq the Oil for Food Program (OFFP) was established in 1995 under Security Council Resolution (SCR) 986. Under this program 59% of oil revenues were allocated to the Centre - South that comprised the part of Iraq outside the 3 northern Governorates of Dohuk, Erbil and Sulaimaniya. The 59% funds were allocated to the various sectors depending on priorities set by the Government of Iraq and in accordance with the Memorandum of Understanding (MOU). An approval process conducted by the special UNSC sanctions committee ensured that the equipment and materials purchased under the various contracts had no dual military use. The UN's role was limited to observation and verification that equipment was used at the intended locations. Under the OFFP, construction of the three new thermal power stations also continued. While most efforts were initially concentrated on the generation sector, these were soon expanded to include transmission, substation and distribution equipment. With respect to generation the overall situation was stabilised under the OFFP and no further deterioration in available capacity occurred.

1.3.4 The Electricity Network Rehabilitation Programme (ENRP) for the rehabilitation of the electricity system in Erbil, Dohuk and Sulaimaniya was set up under the Memorandum of Understanding (MOU) between UNDP and OIP on 11th March 1995. The program has been funded from the 13% account and entails the procurement, installation and commissioning of electrical equipment, and procurement of spare parts necessary for the rehabilitation of the electricity network in these northern Governorates.

1.3.5 After the 1991 Gulf war, the annual per capita consumption of electricity dropped from about 1,700 kWh to about 900 kWh. By 2002 it was estimated to have increased to about 1400 kWh. It is currently estimated at around 700kWh mainly because of supply shortages.

2. CURRENT STATUS AND ISSUES

2.1 Summary Status of the Power Sector

2.1.1 Summary Status

2.1.1a Over the past 12 years, Iraq's power system has deteriorated from one of the best in the Middle East region to a situation where power supply has become extremely unreliable. The entire power system suffers from a significant backlog of required maintenance, a lack of spares and very little capital investment in new plants over the last 15 years. There are frequent power cuts. The present available generating capacity of around 3,300MW is capable of supplying only approximately half the total potential load, which is estimated to be of the order of 6500 -7000MW.

2.1.1b In 2002, it was estimated that about 2.6 million out of a total of 3 million households in Iraq were connected to the grid. Households represented about 80% of the number of customers, consuming about 48% of the total load. Industry, which represented less than 1% of the number of customers, consumed about 29%. Government (13%), commercial (6%) and agricultural customers (4%) accounted for the balance of electricity consumption. More recent data is not available, but it is expected that actual industrial consumption is lower than in 2002. About 40% of electricity is consumed in the Baghdad area. The remaining industrial and commercial establishments appear to rely on their own standby generators. The present available auto-generation in the country could be well in excess of 1,000MW.

2.1.1c The Commission of Electricity (CoE) and its operating companies were created by decree in 1999 and are responsible for electricity supply throughout the country. Through the innovative work of CoE staff and with assistance provided under the Oil for Food Program, power supply had started to improve after 1996, but generally the quality of supply remained poor. The recent conflict situation has caused a disruption in planned maintenance work and the power supply situation is currently worse than during the summer of 2002.

2.1.1d Although both input and output prices were heavily distorted before the recent conflict, the operating companies were reportedly able to cover their operating costs and enjoyed a reasonable degree of autonomy. However, no revenues are currently collected and the CPA appears to have centralized the management of the power sector throughout the country.

2.1.2 Issues

2.1.2 The main short-term issues identified during the needs assessment are as follows:

- While emergency repairs have been initiated by the CPA, a coherent and well-prioritised and logical rehabilitation strategy and/or plan which takes into account contracts in the pipeline under the Oil for Food Program, has not yet been put in place. Given the age of plant and equipment and war damage incurred, this should include a detailed assessment of whether assets should be repaired or replaced.
- There are currently about $US 1 Bn worth of approved and funded contracts, which have been purchased under the Oil for Food Program. These have been prioritised for delivery to Iraq under UN Resolutions 1472, 1476 and 1483. The mobilization of this equipment into Iraq is urgent but logistical arrangements for transporting and installing equipment already procured and transitional arrangements taking into account the closure of the oil for food program in November 2003 are yet to be finalized.
- Constraints in present absorption capacity will have a direct bearing on the pace of implementation and rate of project disbursement to carry out the works necessary to restore electricity supply. Project management capacity for the extent of the projects required does not appear to be in place. Technical assistance is therefore likely to be required to implement and manage the rehabilitation programs.
- The lack of a secure working environment is presently a major problem in most parts of the country. While a factor has been included in the estimate to cater for this in 2004 it is very difficult to predict the overall effect on the rehabilitation program.
- While levels of CoE staffing have remained largely the same, the loss of main office accommodation, office equipment, computer systems, data and records due to looting and vandalism constitutes major problems. Immediate attention is required to these areas, particularly in view of the need to resume the collection of revenues and to adequately manage rehabilitation programs. Much greater direct involvement of staff from the CoE and the operating companies in the management of the rehabilitation programs appears desirable.
- Ensuring adequate fuel supplies for the power sector, in terms of quantity, quality and type of fuel has proven to be a major challenge. Plans to restore oil and gas production, refining and pipeline capacity remain unclear and may affect available generating capacity even after the completion of rehabilitation works. The negative environmental effects of the power sector would be greatly reduced if more natural gas could be made available to the power sector. Only recently, the inter-ministerial coordinating committee, which decides on fuel allocations, was reinstated.

(This assessment does not cover the restoration of oil and gas production facilities and/or pipeline or refining capacity.)

- Due to drought in northern Iraq and neighbouring countries over the last few years, available hydro generating capacity could not be fully utilized. A reassessment and optimisation of hydropower resources should be carried out, taking into account irrigation and other requirements.
- Under the past and still existent institutional structure, the operating companies had a reasonable degree of autonomy. A decentralized rather than the centralized approach now being adopted by the CPA, is desirable. Priority should be given to provide the operating companies with appropriate autonomy and budgetary resources and to resume metering, billing and collection of accounts even at the current low rates. This assumes the security situation does not compromise the safety of CoE employees.
- Current prices of petroleum products and electricity are distorted and do not reflect real production costs or international market prices. Options for appropriate pricing policies should be reviewed, including a program of phased adjustments of energy prices taking into account the capacity of the consumer to pay for electricity, the need to protect vulnerable groups, the need to conserve energy, government budget revenue requirements and impacts on other sectors of the economy. There is a need to establish creditworthy entities, which have access to local and international capital markets and would be capable of providing efficient and reliable electricity supply at the lowest possible cost.
- The CoE has considerable human resource capacity and could be considered to be over staffed when compared to similar middle-income countries. Technical knowledge needs to be updated and comprehensive training programs in all aspects of utility operations should be initiated as soon as possible.
- Consideration needs to be given to possible interconnections with neighbouring countries. These would include reinstating an existing connection to Turkey once the Iraqi system is stabilized, or supplying "islanded" loads in the North in the meantime. There is also currently a connection to Syria, which is not presently in use. Cost effective interconnections to other countries with excess capacity should be pursued.
- The formulation of a master plan for the power sector, which ensures that short term rehabilitation plans do not compromise a sound long term and least cost development of the sector. This must take into account the development of Iraq's natural resource base (oil, gas, hydro and renewable energy) in an environmentally sustainable and socially acceptable way.

Other issues that need to be addressed as soon as possible include:

- The formulation of a national vision for the long-term development of the sector
- Opportunities for developing renewable energy resources, energy conservation and demand side management have so far hardly been explored and could help to curb demand for energy and investment into the sector.
- While Iraq has already separated policy and regulatory functions from operations and a comprehensive set of by laws and regulations exists, modernization of the current legislation and regulatory framework is probably required in view of the recent decision to open the electricity sector to private investment. This is likely to include the separation of policy making from regulation, the establishment of an independent system operator and the creation of a climate suitable for private sector participation in the sector, including participation through cooperatives and community based schemes and divestiture of shares in the operating companies. Over time, private sector participation in the construction and manufacturing companies, currently under the control of CoE, appears desirable.

2.2 Status of the Physical Infrastructure

2.2.1 General

2.2.1a The physical assessment was carried out using a combination of existing knowledge, feedback from the Commission of Electricity staff and sample site visits.

2.2.1b Since there was a good database of information on the condition of the power stations no site inspections were carried out. Reliance was placed on the previous UN observation team knowledge and inspection reports updated by discussions with CoE staff. Samples of infrastructure were selected in the Transmission, Substation, Distribution and Control Centre areas. In all cases discussions with relevant CoE staff were part of the process. The number and types of sites inspected were influenced by the local security situation. The sample sites selected are considered to be reasonably representative of the different types and conditions found in the system. However in all cases detailed condition assessments will be required to confirm the findings.

2.2.2 Generation Assets

2.2.2a Prior to the recent conflict the available generation capacity was around 4,500MW. Although the power system was not significantly affected by the most recent conflict, capacity has since been reduced to approximately 3,300 MW due to a combination of further breakdowns, lack of spares and major maintenance cycles being interrupted.

The nameplate capacities and the actual available capacity are summarised below:

	No. Of Stations	Name Plate Rating (MW)	Actual Rating (MW)
Thermal	8	5,415	1,600
Gas Turbines	14	2,181	800
Hydro	7	2,518	650
Diesel Plant	3	87	87
Total	**32**	**10,206**	**3,137**

2.2.2b The outputs of the thermal stations are limited by problems associated with the majority of the component systems but in particular has been affected by constraints in boiler and condenser tubes, cooling and treated water systems as well as control and instrumentation systems.

2.2.2c Problems with compressor and turbine blades, air filter efficiencies and control and instrumentation systems as well as variations in fuel gas pressures limit power from the Gas Turbine Generators.

2.2.2d The major limitation for hydro generation is a lack of sufficient water flow. With sufficient water flow these stations are capable of producing close to full capacity.

2.2.2e Generally the thermal generation plant is relatively old by modern standards. The average age is 20 years. The system is presently being operated at a frequency lower than the rated 50 Hz in an attempt to reduce demand. However this has a detrimental affect on thermal plant turbine blades as well as other electrical equipment and consumer appliances.

2.2.2f The general approach has been to optimise increases in power generation by completing those rehabilitation projects in place under the MOU agreement (Hartha TPS, Nassiriya TPS, Dura TPS and Musaiab TPS), and commencing outstanding major overhauls. In addition, major outstanding maintenance will be commenced, but the effects on power production will not be evident until after the summer peak of 2004.

2.2.2g There will also be some generation added in 2004 by completing some new projects, Yousifija TPS and Al Quds TPS, which were commenced under the MOU. It will not be possible to implement any additional major new generation projects because of the lead times required. However detailed planning and the tendering process should be commenced as soon as possible.

2.2.2h The table below summarises the increases in generation required for a load growth of 8% with 5% reserve margin from 2008. This load growth assumes a base demand of 7,050MW in 2004 growing on average by about 8%. Available generation is expected to fall short of potential demand until about 2006 or 2007 taking into account expected and proposed rehabilitation programs, major overhauls and some new plant. This should be reviewed in early 2004 as it does not account for additional emergency, mobile or fixed generation plant. At this stage, the availability of funding remains uncertain.

Year		**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Existing P/S (MW)		3285	4400	4600	4600	4700	4700	4400	4200	4200	4200	4200
MoU	MW*	188	304	1637	1637	1637	1637	1637	1637	1637	1637	1637
Non-MoU	MW*		71	671	1339	2423	4131	5628	6861	7628	8018	8018
Total Gen	MW	3473	4775	6908	7576	8760	10469	11665	12899	13465	13855	13855
Load	MW	6300	7056	7620	8230	8889	9600	10368	11197	12093	13060	13060

* Cumulative MW

2.2.3 Transmission system

2.2.3a The 400kV and 132kV transmission line system was also relatively unaffected by the recent conflict but it has suffered considerably from subsequent looting and vandalism. This has put ten 400kV and ten 132kV lines out of service. Repairs are currently underway, using donor funding. Most are expected to be back in-service by the end of 2003 except for two major 400kV lines connecting Hartha power station / Khor-Al-Zubair substation to the main grid and the line between Kirkuk and Mosul. This latter line has remained out of service due to major vandalism, which occurred following the 1991 conflict. While allowances have been made for the impact of looting it is a very significant problem and further assessments will be required.

2.2.3b Since the early 80's, the application of optimum preventative maintenance practices and the construction of new lines has been severely limited. The most recently constructed line is approximately 15 years old and the average age is between 25 and 30 years old.

2.2.3c It has not been possible to inspect any lines as part of this assignment due to security and time constraints but the present condition and age of each line are generally known from past experience and from data provided by CoE.

The approach adopted is as follows:

- Complete repair of looted lines where possible in 2003.
- Commence construction of new and replacement lines in 2004. The following are average lengths per year:
  - 300km of 400kV and 500km of 132kV for 2004-2005
  - 300km of 400kV and 400km of 132kV for 2006 –2010
- Commence Rehabilitation of Existing lines in 2004:
  - 500km of 400kV and 1500km of 132kV for 2004-2005
  - 500km of 400kV and 1100km of 132kV for 2006 –2010
- Complete a detailed condition assessment in 2004 and commence a program of routine preventative maintenance in 2004. This will be refined and adjusted in accordance with the results of the condition assessment

2.2.3d Detailed load flow and system studies will be required to define construction requirements for lines to new load centres. Similarly detailed condition assessments in conjunction with the load flow studies will determine the priorities for any rehabilitation required. A review of the overall priorities proposed above has been carried out and the proposed priorities have been found to be reasonable, given the average age and reported condition of the existing lines.

2.2.3e After the electrical interconnections to the three northern Governorates of Erbil, Kirkuk and Sulaimaniya were severed in 1991, the northern network deteriorated significantly. Before the advent of the OFFP, equipment was repaired using the ingenuity of the existing local staff and cannibalised spares. As in the remainder of Iraq, new lines are required for new load and to replace existing lines in poor condition. Additionally rehabilitation of the remainder of the system is required. The transmission line component of the ENRP program is presently catering for this in all three governorates.

All of the southern oil fields lines have been completely looted and are to be replaced.

2.2.4 Substation Assets

2.2.4a There are twenty-one 400kV, one hundred and eighty four 132kV substations and a further eighty three 132kV mobile substations in Iraq.

2.2.4b The majority of the 132kV substations are relatively old with the outdoor 132kV sites averaging 24 years. The 132kV G.I.S. and 400kV sites are in the range 15 – 20 years. Maintenance has been limited to defect repairs only for a number of years and has been constrained by a lack of spares. Normal preventative maintenance has not been carried out on a regular basis for many years. Site inspections and substation data obtained from CoE confirmed the above findings.

2.2.4c While the main 400kV and 132kV substations were relatively unaffected by the recent conflict, severe damage was caused by vandalism and looting. The following substations in the Centre-South were either severely damaged or completely destroyed in this way.

Voltage level	Type	Number
400kV	GIS	1
132kV	GIS	1
132kV	Outdoor	19
132kV	Mobile	8
Total		29

2.2.4d Based on the samples inspected a total of twenty 400kV and one hundred sixty four 132kV substations require rehabilitation. In addition, approximately 77 new substations will be required to supply new load centres plus load not presently supplied from existing substations. These requirements are set out in the table below.

	2004	2005	2006	2007	2008	2009	2010
Replacement	9	14	6	--	--	--	--
Rehabilitated	55	55	38	18	18	--	--
Additional - New	10	20	20	9	8	6	4

2.2.4e The above excludes the Governorates of Dohuk, Erbil and Sulaimaniya where the ENRP program under SCR 986 is already catering for requirements up to 2010.

2.2.5 Distribution System

2.2.5a The electricity distribution network in Iraq comprises the following:

- 33/11 kV substations
- 33 kV overhead and underground networks
- 11 kV medium voltage overhead and underground distribution networks
- Distribution transformers
- Low voltage distribution networks and consumer service connections

2.2.5b The distribution system suffered little damage from the recent conflict but has suffered severely from a lack of spares, a lack of preventative maintenance for a number of years and insufficient augmentation to cater for new loads.

2.2.5c Plant and equipment are operating without adequate electrical protection and are being overloaded. The 33/11 kV substations and 33 kV lines are all relatively old. There has been minimal capital investment for a number of years. The design life of the 11KV circuit breaker mechanisms has in most cases been exceeded due to repeated load shedding operations.

2.2.5d The condition assessment surveys on sample schemes have indicated that the majority of the distribution networks are in a highly deteriorated condition. The system needs immediate rehabilitation or replacement. Based on the available information the immediate and long term requirements for rehabilitation have been identified. Long-term rehabilitation requirements are more than 75% for all Governorates except Erbil, Sulaimaniya and Dohuk, where network rehabilitation programmes have been carried out under SCR 986.

2.2.5e In addition to the requirement for rehabilitation of existing networks, the study indicates multiple issues that need to be addressed in the short and medium term. The main issues are inadequate capacity of existing networks to meet present and future demand, low levels of supply reliability, low voltage profiles, high loss levels, energy management issues and the need to expand the networks to provide electricity to non-electrified areas. Also some of the existing overhead lines, in particular Baghdad, need to be converted to underground due to urbanization and other technical reasons. Non-technical losses are also expected to be high.

2.2.6 SCADA and Control Centres

2.2.6a There are three Regional Control Centres (RCCs) in Iraq. These Control Centres are equipped with basic SCADA (Supervisory Control And Data Acquisition) systems for monitoring and switching operations only. All three RCCs were built by ASEA in 1979-1980. This equipment is now obsolete and spare parts are only obtainable by special order at a very high price. Their computing power is very limited by today's standards.

2.2.6b There are Distribution Dispatch Centres (DDCs) in the 18 Governorates of Iraq. Most are operated manually (no SCADA) using VHF radio communication facilities and the public telephone network. In Baghdad there are three DDCs equipped with SCADA systems supplied by NEC in 1982-1984. This equipment is also now obsolete and spares are no longer obtainable. These control centres are in the Maari, Farabi and Jamilah districts. They were monitored and supervised by the Main Distribution Dispatch Centre (MDDC) located in the Baghdad Electricity Distribution Company's Head Office. This latter Dispatch Centre was completely looted.

2.2.6c All the Regional Control Centres were visited but in the case of the substation Remote Terminal Units (RTUs) it was not possible to inspect them all. However a reasonable overview of the condition and needs was obtained from those inspected and feedback from CoE staff. At present 70% of the 400kV and 132kV substations have the required RTU facilities for monitoring. Of these 36% are currently out of service because of a variety of problems in the equipment at either the substation end, in the communications links or at the control centres.

2.2.6d Importing computer, control and communications equipment was particularly difficult under the sanctions regime and this area of the power system was therefore severely affected by a lack of spares and an inability to be upgraded.

2.2.6e The generally acknowledged useful engineering life for this type of equipment is around 10 years and all Control Centres are over 20 years old. Most of the Power Line Carrier (PLC) communications links are 15 to 25 years old. These older units are generally obsolete with parts no longer manufactured.

2.2.6f The approach to rehabilitation has taken into account the following:

- Replacement of obsolete equipment
- Upgrading Communications links using fibre optics
- Implementation of Power Application and Energy Management Software to facilitate efficient system operation.
- Extension of the SCADA coverage.

2.2.7 Overview of System Operation

2.2.7 The present generation system in Iraq is unable to meet the load demand. The demand deficit is maintained through load shedding. In addition the system is currently operated at less than 50 Hz. This has an adverse effect on all electrical equipment. In particular the low pressure blades of turbines are subject to damage and excess vibration. Also, because the system in Iraq is continuously operating at an under frequency, load shedding and under frequency relays have been disabled. This places the system at a greater risk of instability and possible widespread shutdown.

2.3 Current Policy Framework

2.3.1 In 1999, Iraq, as one of the leading countries in the region, reorganized its electricity sector. The electricity sector was separated from the Ministry of Industry and the Commission of Electricity (CoE) was established by the Revolutionary Command Council (RCC) Decree No 195 on 21st June 1999. Under the Decree, the sector remained a Government monopoly with CoE responsible for the supervision and management of all the activities related to electricity. The CoE is now under the control of a new Minister of Electricity who reports to the Governing Council. The CoE was previously under the control of a commissioner who reported to the Council of Ministers. The CoE also provides corporate services and operates the National Dispatch Centre. The CoE comprises three regional generating and transmission (400kV and 132kV) companies and four regional distribution companies, as well as four other companies responsible for power construction, manufacturing of equipment and IT. Key decisions on tariffs and large projects were

taken by the Council of Ministers, but once the annual budgets were approved, there appears to have been a reasonable degree of autonomy.

2.3.2 There is no specific Government policy for the development of the electricity sector, but the existing laws and secondary legislation provide detailed guidelines on how the sector is to be operated. The Iraqi Central Organization for Standardization and Quality Control is entrusted with issuing and enforcing various codes related to the sector. The pre-war legislation did not allow the private sector to participate in the electricity supply industry, but this has recently been changed and private sector participation is now encouraged.

2.3.3 Fuel and electricity prices are determined by the Government. The pricing policies of the previous government combined with the generally low real value of the Iraqi Dinar have led to a situation whereby petroleum product and natural gas prices are less than 1% of their true market value. Similarly, electricity tariffs are low and currently range from US 0.1 cent to US 1 cent per kWh. There have been no electricity accounts issued since the beginning of the recent conflict. This is clearly an unsustainable situation. Although not specifically articulated, before the recent conflict, electricity tariffs were set at such levels that operating costs were fully covered. The latest available accounting data shows that CoE and the companies reporting to it were able to fully cover cash operating costs. However, systems expansion seems to have been almost entirely financed from Government budgetary resources.

2.4 Current Institutional Framework

2.4.1 The CoE is a relatively autonomous institution overseeing 11 companies covering, Generation, Distribution, Construction, Manufacturing and IT. Distribution, transmission and generation functions are further divided on a regional basis. There are 17 Director Generals (DGs) who are responsible for the various companies and/or departments in the CoE.

2.4.2 The objective of the current structure is to decentralize operations and to provide each company with a reasonable level of autonomy and financial accountability. The DG's were able to make their own decisions on issues related to operations and investments once the budget allocation and the development and operational plans were approved. Each distribution company purchases power from the generation companies at a cost of 1.2-1.5 ID/ kWh. All companies are required to contribute 3% of total revenues to CoE headquarters. Each company was allowed to retain revenues to cover operational expenses such as salaries. Each company prepared its own financial statements and was subject to independent audits.

2.4.3 Only limited data is available regarding the operational efficiency of the sector as a whole. However the limited data indicates that there is considerable scope for improving the efficiency of operations when measured against international standards. In 2001, total technical and non-technical losses were estimated to range from 20 to 30%. Electricity is currently not billed and no revenues are collected. Resuming billing and collection, even if the current tariff levels remain in place, will be crucial for rebuilding the power system on a sustainable basis.

2.4.4 Since 1991, most of the network in the three northern Governorates has been separated from the main grid and the operation and development of the power system has been handled independently from CoE. In the three northern Governorates, the implementation of the rehabilitation has been under the overall control of the UNDP with close collaboration with the

2.4.5 Local Electricity Authorities (LEAs) under a common roof arrangement where LEA staff and international staff work closely together. This facilitates skills transfers and capacity building. In the Centre - South materials purchased under the MOU were installed by CoE staff.

2.5 Human Resources

2.5.1 There are approximately 43,000 staff overall in the CoE with 650 of them in head quarters. Most staff are employed by the generation, transmission and distribution companies. The single largest company is the General Company for Electricity Distribution (GCED) Baghdad with approximately 7,000 staff followed by General Company for Electrical Energy Production (GCEEP) Middle Region with 6,600 staff. Approximately 54% of staff are in distribution companies and 32% in generation and transmission companies. The remainder are in the construction, manufacturing and IT companies.

2.5.2 Following the separation from the grid in 1991, Local Electricity Authorities (LEAs) were established in Dohuk, Erbil and Sulaimaniya. The total staff is around 7,300 comprising approximately 1000 in the Dohuk Electricity Authority (DEA), 1,700 in the Erbil Electricity Authority (EEA) and 4600 in the Sulaimaniya Electricity Authority (SEA).

2.5.3 The technical competence and innovative ability of the CoE and LEA staff is evident from the way the system was repaired following 1991, without external assistance and working under a sanctions regime. Most electricity sector staff are relatively well educated and have solid technical skills. However, since most have been forced to operate in a relatively isolated environment since 1991 there is an overall need to update academic qualifications and skills. Dedicated training programs in all aspects of utility operations will be a key element in rebuilding the power sector. To accelerate the rehabilitation process, appropriate use should be made of consulting services and technical assistance.

3.0 NEEDS & PRIORITIES FOR THE ELECTRICITY SECTOR

3.1 Medium and Long Term Needs and Policy/Institutional Changes

3.1.1 General Infrastructure

3.1.1a The recommendations in this report for emergency and longer-term programs and their associated funding requirements are aimed at returning the Iraqi Power System to a reliable and efficiently run system similar to what it was before 1991. These recommendations will not necessarily enhance the power systems reliability beyond these original levels. Further system analysis and investigations will be required in the medium term to ensure system stability criteria and reduce losses to acceptable levels.

3.1.1b The recommendations for rehabilitation works and new programs should be implemented in such a manner that ensures the Iraqi power system is returned to a stable and sustainable system that will provide the short-term needs without prejudicing long-term requirements.

3.1.1c Reasonable milestones for this program are:

- Completion of major maintenance on generation assets.

- Provide a reasonable level of spare parts for the generation assets.
- Commence the rebuilding of the looted and damaged substations.
- Commence the rehabilitation and augmentation program for substations including the purchase of a reasonable level of spares.
- Commence the transmission line rehabilitation program and purchase reasonable spare parts.
- Commence the rehabilitation and augmentation program for the distribution system including the purchase of a reasonable level of spares.
- Improve the safety levels in the entire power system for plant, staff and the public.

3.1.1d The level of investments (Rehabilitation, major overhauls and new investments) required and estimated recurrent expenditures for the period for 2004 to 2007 is shown below. The total investment budget required for the period 2004 to 2010 is estimated at about US$ 20 billion. Rehabilitation and reconstruction expenditures include major overhaul of existing assets and backlog maintenance. Emergency funding by CPA is not included. The recurrent budget estimated by CoE assumes that current (low) fuel prices would remain unchanged and does not include normal maintenance of rehabilitated and new assets. No estimate has been made of revenues, but under normal circumstances it is expected that over time electricity tariffs would be adjusted to be able to cover full recurrent expenditures and that a contribution to the financing of investments would be made from internally generated cash revenues.

	Million US$				
Investment Budget	**2004**	**2005**	**2006**	**2007**	**Total 2004 to 2007**
Rehabilitation/Reconstruction					
Generation	1,651.2	830.0	787.0	714.0	3,982.2
Transmission	293.7	103.5	104.0	105.5	606.7
Substation	273.4	103.9	80.2	57.2	514.7
Distribution	362.0	338.8	308.1	187.7	1,196.6
SCADA	54.4	23.9	10.1		88.4
Others	1.2				1.2
Total Rehabilitation / Reconstruction	**2,635.9**	**1,400.1**	**1,289.4**	**1,064.4**	**6,389.8**
New Investment					
Generation	197.0	911.0	1,474.0	2,058.0	4,640.0
Transmission	133.5	143.5	121.5	120.0	518.5
Substation	90.0	234.2	159.0	71.3	554.5
Distribution	112.8	371.2	376.2	328.3	1,188.5
SCADA	20.3	31.8	13.8	17.0	82.9
Total Investment	**553.6**	**1,691.7**	**2,144.5**	**2,594.6**	**6,984.4**
Institutional/Environment					
Technical Assistance	31.0	14.0	12.0	10.0	67.0
Security	153.9				153.9
Rehabilitation of facilities	5.0				5.0
Total Institutional/Environment	**189.9**	**14.0**	**12.0**	**10.0**	**225.9**

Grand total (investment budget)	**3,379.4**	**3,105.8**	**3,445.9**	**3,669.0**	**13,600.1**
Funding available through OFFP:					
ENRP	126.4	92.4	31.3		250.1
MOU	865.1	250.0	100.0		1,215.1
Others	5.5				5.5
Net Financing Requirements	**2,382.4**	**2,763.4**	**3,314.6**	**3,669.0**	**12,129.4**
Total recurrent expenditures (CoE estimates) *	**119.2**	**120.4**	**119.6**	**119.6**	**478.8**
Total net financing needs	**2,501.6**	**2,883.8**	**3,434.2**	**3,788.6**	**12,608.2**

* This does not include normal and 'catch-up' maintenance costs. These have been included in the rehabilitation category as they are of the order of 400 – 500 $ US M per annum and could not be funded from the present recurrent budget.

3.1.1e The above is not fully consistent with recent proposals by the CPA to raise the current level of generation to 6,000MW by mid 2004. Given the current situation such a target, while desirable, may not be achievable given logistical, security, funding and other constraints. On the other hand, if it is implemented, the effect will be to bring forward the date when generation will match demand from approximately 2007/2008 to 2006.

3.1.2 Proposed Policy Changes

3.1.2a Iraq is well endowed with energy resources (oil, gas and hydro), but there is a need to articulate specific policies for the development of the electricity sector, including pricing. It is recommended that the main objective of such policies would be to provide power at the lowest possible cost to the consumers taking into account the need to develop natural resources in an environmentally sustainable way. For example, given Iraq's known resource base, substantially increasing the use of generation based on natural gas could vastly improve the efficiency of generation and reduce environmental impacts. This would be a major shift from past practices, as the electricity sector focus was very much on meeting quantitative targets to increase supplies.

3.1.2b Another key element recommended to be implemented over time is a pricing policy that reflects true economic cost, provides incentives for conserving energy, minimizes the impact on the environment, is socially responsible (affordability, introduction of life line rates) and ensures at the same time, that entities operating in the sector will be financially viable.

3.1.2c In the electricity sector, policy and regulatory functions are already separated from operations, and a comprehensive set of by laws and regulations exists. However, modernization of the current legislation and regulatory framework is probably required in view of the recent decision to open the electricity sector to private investment. This is likely to include the separation of policy making from regulation, the establishment of an independent system operator and the creation of a climate suitable for private sector investment. Opening up the sector to private sector participation would, in part help meet the vast funding requirements, but equally important would be the potential to improve efficiency of operations. Increased participation of the private sector could take many forms and include contracting out of services, the formation of cooperatives and

community based schemes, the sale of assets, purchasing power from Independent Power Producers (IPPs) and divestiture of shares in operating companies.

3.1.2d Given the close linkages, policy changes in the electricity sector should be carefully coordinated with those proposed for the hydrocarbon sector as well as those related to the investment climate.

3.1.3 Proposed Institutional, Legal & Other Requirements

3.1.3a Experience in many countries shows that establishing an appropriate legal and regulatory framework, combined with a clear articulation of government policies on the use of natural resources, environmental protection and pricing are essential for building an electricity industry capable of providing power at the lowest possible cost. In the case of Iraq, this would involve a modernization of the existing legislative and regulatory framework. Further separation of policy and regulatory functions is recommended and various options for restructuring of the operating companies should be evaluated. Given the size of the country and the power system, a decentralized institutional structure appears desirable. The relationship with the LEA's in the three northern Governorates requires careful attention.

3.1.3b A review of the adequacy of current financial/accounting and procurement systems should be undertaken including an assessment of the current status of the various computerised systems. Improvements in these systems will probably take several years to implement. Capacity building and training programs will have to be part of the reconstruction efforts, possibly with assistance from donor financed consultants.

3.2 2004 Needs & Policy/Institutional Changes

3.2.1 Broad Financial Needs During 2004

3.2.1a The estimated total financial requirement for the electricity sector for 2004 is approximately $US 2,501.6 M with an additional $US 997.0 M provided and funded under the Oil For Food Program. Since the majority of contracts under the Oil for Food Programme (OFFP) for the Centre-South are for the delivery of equipment and materials, the installation cost of this input has been included in the $US 2,501.6 M financial requirement noted above.

3.2.1b The financial requirement for both new works and the rehabilitation of the generation system, to meet a target of approximately 5,000 MW in 2004, is estimated to be approximately $US 1,321M. This is additional to the funded expenditures that will be disbursed out of the original MOU account for the Centre-South and the three northern Governorates (ENRP). This does not include the additional new generation installation currently planned, which would bring the 2004 target up to 6,000MW. The expenditure expected to be disbursed from the ENRP and MOU account is $US 527.2 M. In order to implement all the investments efficiently and smoothly, significant technical assistance will be required.

3.2.1c For the transmission system, because of ongoing looting and vandalism, it is difficult to assess the overall funds that are required. Assuming no further looting/damage occurs the total financial requirements are estimated to be $US 248.3 M while under the MOU, another $US 178.9

M worth of equipment is expected to be delivered.

3.2.1d In the substation area, the total financial requirements are expected to be $US 218.5 M for the commencement of the rehabilitation/replacement of 29 substations, comprising 400kV and 132kV GIS conventional and mobile types. This includes $US 55.8 M for the looted substations and $US 136 M for other rehabilitation and augmentation work and $US 26.7 M for the installation of MOU equipment. Under the OFFP, an additional $US 144.9 M worth of equipment is expected to arrive in the country.

3.2.1e The total financial requirement in 2004 for new works and the commencement of the rehabilitation / replacement of the damaged or destroyed distribution network is $US 337.6 M. Additional equipment worth $US 137.2 M under the OFFP will be available for the distribution sector in 2004.

3.2.1f The financial requirements for the SCADA, control and associated communications systems are expected to be $US 67.1 M for the year 2004. This funding is required for the commencement of the rehabilitation/replacement and upgrading of the above systems and includes installation of the MOU provided equipment. Additionally under the MOU, $US 2.1 M worth of equipment will be available in 2004 and a further $US 5.5 M is available from other donors.

3.2.1g With respect to Institutional Development $US 5 M will be required to cover the rehabilitation and replacement of buildings and business systems while $US 31 M has been included to cover capacity building, institutional strengthening, environmental and consulting services. A master plan and tariff study costs are also included.

3.2.1h The preliminary 2004 recurrent budget provided by the CoE is 119.2 M US$. This is 40% more than the budget for 2003. The background data and assumptions of the budget prepared by CoE include several elements that might require further adjustment such as fuel price, cost of imported materials and goods and the budget of the three northern Governorates. Fuel costs, salaries and other services were estimated at prevailing prices. Any change in such prices will have an impact on the recurrent budget needs. The recurrent budget for 2004 would not be sufficient for financing normal maintenance required and these have been included in the investment budget. The estimated costs for major overhauls and rehabilitation expenditures for 2004 are also included in the investment budget. For subsequent years the recurrent budget will need to be substantially increased to allow for proper normal maintenance of assets. For a system of this size, an annual maintenance budget of 400-500 $ US M would be required.

3.2.1i Due to the security situation and the low level of economic activity, revenue collection is currently not feasible. For this reason revenue has not been included in the total budget for 2004. If a significant improvement in security and associated income levels occurs, adjustments to the budget will be required.

3.2.1j The broad financial needs for 2004 are shown below. A component of funding has been included for 2004 to cater for possible additional security measures. This has been estimated at 7% of project totals and is shown separately.

Broad Financial needs for 2004						
Investment Budget	2004 Total (Includes MOU Installation) (a)	Oil for Food Program			Other Donor Identified	Financing Gap
		ENRP (Funded)	MOU			
			Contracts (Funded)	Unfunded (Installation)		
		(b)	(c)	(d)	(f)	(a)-(b)-(c)-(f)
Rehabilitation/Reconstruction						
Generation	1,651.2	27.2	500.0	170.0		1,124.0
Transmission	293.7	16.2	162.7	16.3		114.8
Substation	273.4	40.6	104.3	26.7		128.5
Distribution	362.0	41.2	96.0	9.6		224.8
SCADA	54.4		2.1	0.2	5.5	46.8
Others	1.2	1.2				0.0
Total Rehabilitation/Reconstruction	**2,635.9**	**126.4**	**865.1**	**222.8**	**5.5**	**1,638.9**
New Investment						
Generation	197.0					197.0
Transmission	133.5					133.5
Substation	90.0					90.0
Distribution	112.8					112.8
SCADA	20.3					20.3
Total Investment	**553.6**	**0.0**	**0.0**	**0.0**	**0.0**	**553.6**
Institutional / Environment						
Technical Assistance	31.0					31.0
Security	153.9					153.9
Rehabilitation of facilities	5.0					5.0
Total Institutional/Environment	**189.9**	**0.0**	**0.0**	**0.0**	**0.0**	**189.9**
Sub total investments	**3,379.4**	**126.4**	**865.1**	**222.8**	**5.5**	**2,382.4**
Recurrent Expenditures	**119.2**					**119.2**
Grand total	**3,498.6**	**126.4**	**865.1**	**222.8**	**5.5**	**2,501.6**

3.2.2 Proposed Policy Changes (During 2004)

3.2.2a The key policy area, which needs to be addressed, is the pricing of electricity in conjunction with the pricing of hydrocarbon products. While vulnerable groups should be protected and affordability is an issue given current salary levels and high unemployment rates, it is recommended to move as quickly as possible towards full cost recovery and a structure of electricity tariffs, which provide incentives for energy conservation.

3.2.2b Although no policy change will be required, resumption of billing and collection is crucial in order to reduce the budgetary impact of the sector on the Government budget and to allow the sector entities to operate at reasonable levels of financial autonomy. Eventually the aim should be for the electricity sector to have access to the capital markets to finance its expansion programs without Government support. Closely related to this will be the Government policy on the pricing of fuels for the electric industry. A comprehensive analysis of the possible price adjustments should be initiated. In parallel it would be necessary to assess the impact of any pricing policy changes on the financial position of CoE and the operating companies.

3.2.2c The policies for allocation of natural gas and the sharing of water between irrigation and power generation have an immediate effect on the operation of the power system in general and on the availability of generating capacity. Supply of natural gas will probably be severely restricted for the immediate future. It is recommended that the adequacy of the current allocation policies be reviewed.

3.2.3 Proposed Institutional Changes (During 2004)

3.2.3a There is no need for immediately changes to the current structure of the CoE as far as the operating companies that were set up under the Revolutionary Command Council (RCC) in 1999 are concerned. However, immediate efforts should be made to provide the operating companies with the same level of financial autonomy and accountability allowed under the 1999 Decree. While the immediate focus should be on the restoration of electricity supply, it is recommended that option analysis to assess the adequacy of the current legal, regulatory and institutional set up be initiated as soon as possible.

3.2.3b Prior to the recent conflict, the CoE had been functioning relatively well using computerized billing, financial, inventory and personnel systems. Considerable damage was inflicted on these during the recent conflict, mainly due to looting. Rebuilding and modernizing the billing, accounting and other administrative systems as well as the rehabilitation of destroyed office buildings should be made a matter of priority as it will facilitate the reconstruction process.

3.2.3c It is important that there is a smooth transition after the present Oil for Food Programme, which ends in November 2003. Under the MOU in the Centre-South, substantial quantities of equipment and materials are likely to be delivered after November. Assistance will be required to manage the implementation of these contracts.

3.2.3d In the three northern Governorates, the situation is different from the Centre-South. Local Electricity Authorities have commenced the process of capacity building through the “common roof” concept, implemented by the ENRP. Any sudden changes to this program would disrupt this

process. The exit strategy must include transitional arrangements to ensure capacity building is continued and the outstanding projects are implemented.

3.3 Cross Cutting Issues

3.3.1 Gender Issues

3.3.1 There have not been any specific gender issues identified during the assessment, although it is well known that access to electricity at reasonable cost would have a positive impact on the well being of the female population. Complete information on female staff in the CoE was not available, but about 14% of the staff of the generating companies are women. There is no female staff in top management positions. Approximately 75% are functioning in administrative positions, with the remaining 25% employed in the highly skilled category.

3.3.2 Environmental Issues

3.3.2a In the present generation system in Iraq, the lack of normal environmental protection schemes poses a serious threat. Uncontrolled power station emissions and thermal pollution of waterways severely affect the local ecosystems and are among the problems that need addressing. Given an expected continued use of small diesel generators as a cheap and reliable source of power in the immediate to short term, an environment management program should be introduced to ensure the safe storage and handling of diesel fuel and lubrication oil. This should also include procedures for the proper storage and disposal of waste lubricating oil and sludges from storage tanks, the containment of transformer oil and fuel oil spills as well as the control and disposal of any remaining polychlorinated biphenyls (PCBs).

3.3.2b An environmental due diligence audit of all thermal and diesel based power plants should be implemented as soon as possible including the existing status of pollution control systems, fuel and oil storage tanks.

3.3.2c It was noted that environmental monitoring is not carried out and there is no evidence that any existing environmental legislation is enforced. A shift towards increasing gas based combined cycle generation and away from thermal types would be an important factor in mitigating the environmental impact of the electricity sector. Also the long term potential of renewable energy, including hydropower should not be under estimated.

3.3.2d Energy conservation programs should be encouraged. The use of energy efficient appliances by all consumers along with the implementation of demand side management programs by large consumers are invaluable methods of reducing the loads in the short to medium time frame. Solar water heating is another effective power usage reduction program that can be implemented.

3.3.2e The recommended least cost approach towards power systems expansion should internalise environmental costs and sufficient funds should be allocated to implement environmental and social impact mitigation plans. All new power projects should undergo an Environmental Impact Assessment (EIA) study as part of all project design and preparation works. The introduction of appropriate pricing policies would do much to provide incentives for improving

the efficiency of operations and conservation of energy as will the introduction of sound operation and maintenance practices.

3.3.3 Human Rights

There have not been any specific human rights issues identified during the assessment.

3.3.4 Institutional Capacity Gaps & Requirements

3.3.4a There are a number of areas, which will be requiring assistance. In the short term, assistance appears to be required in the design, management and implementation of the rehabilitation/reconstruction plan, including supervision of contractors. Equally important are training programs to update skills in modern design, construction operation and maintenance practices.

3.3.4b A number of studies are recommended to be initiated in 2004, including (i) the preparation of a least cost master plan for the sector (ii) an option analysis to review the adequacy of the existing legal, regulatory framework and industry structure, with recommendations for reforms (iii) a comprehensive tariff study which also analyses the impact of tariff revisions on the population as well as other sectors of the economy and the financial viability of the sector entities and (iv) a study to assess human resource development needs.

Table 1 – Preliminary Calendar 2004 Budget for Electricity Sector in $US Million

Calendar Year 2004 and 2005-2007 Reconstruction Needs
(in US$ millions)

	2004	2005-2007	TOTAL
Rehabilitation & Reconstruction:			
-- Generation	1651.2	2331	3982.2
-- Transmission	293.7	313	606.7
-- Substations	273.4	241.3	514.7
-- Distribution	362	834.6	1196.6
-- SCADA	54.4	34	88.4
-- Others	1.2	0	1.2
	2,635.9	**3,753.9**	**6,389.8**
New Investment:			
-- Generation	197	4443	4640
-- Transmission	133.5	385	518.5
-- Substations	90	464.5	554.5
-- Distribution	112.8	1075.7	1188.5
-- SCADA	20.3	62.6	82.9
	553.6	**6,430.8**	**6,984.4**
Funded components through OFFP and identified donor	-997	-473.7	-1470.7
Net Capital Investment Requirements	**2,192.5**	**9,711.0**	**11,903.5**
Technical Assistance/Capacity Building	31	36	67
Building Renovations/Refurbishment	5	0	5
Security	153.9	0	153.9
Total Investment and TA Costs	**2,382.4**	**9,747.0**	**12,129.4**
Total O&M Costs	**119.2**	**359.6**	**478.8**
Grand Total[1]	**2,501.6**	**10,106.6**	**12,608.2**

[1] Difference with grand total in synthesis report due to a) calculation error in funded components through OFFP and b) additional identified TA needs of US$11 mln for 2004 and US$2 mln for 2005-2007