Securing Afghanistan's Future:
Accomplishments and the Strategic Path Forward

POWER SECTOR

Technical Annex

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Executive Summary[1]

(i) **Context**. Afghanistan's power sector is severely constraining the development of the country. Access to power is only about 6%, one of the lowest in the world; only 234,000 customers are connected to the public grid, of which approximately 30% are in Kabul. The other provinces have even less access, with rural areas being virtually unserved. The existing power network is in a dilapidated state and in urgent need of rehabilitation. The provision of an expanded and reliable electric power service is thus critical for future economic growth, social equity, and the political unity of the country. Unless this occurs it will not be possible to meet the country's development goals.

(ii) **Vision and Objectives**. The Government's vision is to expand rapidly the availability of electric power in the main regional areas of the country. To achieve this it needs to (i) invest heavily in rehabilitation of the existing system, (ii) increase supply, in part by relying more on power imports on an interim basis; and (iii) expand the country's transmission and distribution infrastructure. A key economic and social objective is to increase the number of new connections. Historical rates of connections are an inadequate guide to future needs. Currently, Government plans to create an additional 730,000 connections by 2010. This would result in an increase of the access ratio in urban areas from the current estimated 27% to 77% by 2010, and an increase in the access ratio countrywide from the current 6% to almost 25% at the same date. By 2015, the urban access ratio is expected to be almost 90% and overall access 33 percent.

(iii) **Investment Priorities**. An estimated US$2,785 million would have to be committed during the 2004-2010 period in generation, transmission and distribution as well as in capacity building is required to meet the sector objectives targeted for 2015. Approximately 50% of this amount would be needed for new generating capacities. Over the 2004-2006 period, an estimated US$700 million would need to be disbursed, distributed almost evenly between generation, transmission and distribution. Investment in new generating capacity would focus on a small number of priorities such as:

- Rehabilitation of existing hydro-plants and completion of gas turbines in Kabul;
- Construction of new combined cycle capacity in Sheberghan based on natural gas;
- Construction of the Baghdara hydro-plant, possibly followed by Sarobi 2;
- Construction of the Kajakai 2 hydro-plant;
- Import of electric power from Uzbekistan to supplement shortfalls in domestic generation capacities; and
- Installation of small diesel generators in various cities for which no alternatives to electricity are available.

(iv) Major investment in transmission capacity in the northern provinces is needed to enable import of additional power from Uzbekistan to Kabul and neighboring provinces. In the eastern provinces, investment is also needed in transmission capacity to enable import of power from Iran to meet future demand in Herat. An

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intensive investment program in distribution is critical to meet the new connection goals. This investment would focus on the main urban areas and require a well coordinated implementation effort. In particular, large crews of qualified electricians would have to be trained in an extensive and sustained program, in order to render possible the timely installation and maintenance of the enormous quantities of low voltage material that would be funded under the investment program. The increase in new connections in 2005 and 2006 would be about 150,000 in each year, with a 100,000 connections in each of the subsequent years.

(v) An additional US$43 million are required to finance power production in Kabul and import power in the next three years since the existing tariffs are not sufficient to finance such costs. This would include: (i) fuel purchases required to produce additional power in Kabul until the connection with Uzbekistan is completed (estimated amount $27 million); and (ii) funding of a scheme to guarantee the financing of power imports from neighboring countries (estimated amount US$16 million).

(vi) **Financing Requirements**. Most of the estimated US$2,800 million needed for the 2004-2010 period still has to be committed. Aggregate commitments of approximately US$375 million have already been made for the 2004-2006 period (to be compared with investment needs of approximately US$700 million) as follows:

- ADB: US$90 million;
- KfW: unofficial target is EUR10 million (US$12 million) per year for the coming years;
- USAID: US$80 million (estimate only);
- IDA: US$100 million; and
- Government of India: US$70 million (estimate only)
- The unfinanced portion of this critical three-year investment program is approximately US$325 million. As most of the financing requirements for 2004 have been met, the gap applies mostly to investments for 2005 and 2006.

(vii) **Implementation Strategy**. Weak implementation capacity is the single largest constraint to achieving the sector goals of tripling the number of connections and securing increased reliability of supply by 2010. The Government implementation capacity is very limited with an ageing under-paid and technically poorly equipped labor force. A key element of the implementation strategy is to adopt a "program management approach" within the Ministry in charge of Power, that would involve the following elements:

- Establishing strong ownership within the Ministry which would be responsible for the design and implementation of the investment program;
- Setting up a Project Implementation Support Unit (PISU) within the Ministry, staffed with international and national consultants;
- Giving special attention to distribution, through an intensive and carefully prepared implementation plan for Kabul and for other urban centers, involving "dedicated" implementation teams with prior experience working in densely populated urban environments.

(viii) **Institutional Reform**. The main utility, DABM, would have to evolve into an autonomous enterprise providing reliable and affordable electric service to all Afghan citizens in an environmentally responsible manner. A key first step would be its

"corporatization" to enable it to operate more as a commercially and financially viable enterprise; technical assistance and capacity building efforts would focus on this goal. Private sector participation (PSP) should be sought in parallel; however, any private participation that involves even limited financial risk may be deterred by current perceptions of high risks and limited political stability.

(ix) **Cost Recovery and Pricing Reform**. As large differences exist between tariffs applying to the northern and western parts of the country and Kabul exist, one can conclude that an ambitious tariff reform could be embarked upon much earlier than currently envisaged. Customers are apparently prepared to accept significantly higher tariff when production costs are "visible" and based either on power imported from neighbouring countries and paid in US$ (northern part of the country) or on market price of diesel fuel (western part). In addition, the several thousands of small, private petrol-driven gensets running in the country prove that consumers are well aware of the real cost of electricity and prepared to pay for its real cost. The calculation of the full cost calculation of hydro-based electricity distributed in Kabul, even if seemingly depreciated, is a top priority on the political agenda; the minimum objective being to raise electricity tariffs to a level in line with energy carriers competing in the heating sector (e.g., fuel wood, LPG, other liquid fuels). If proper pricing of electricity is neglected, no investment program would be able to cope with the load increase fuelled by under priced and/or non-paid for electricity.

(x) **Main Risks**. The risks to achieving the sector goals are high. Weak implementation capacity is a major concern and requires a fundamental change in approach. Security risks will also deter contractors from bidding and will impede progress in implementation. These are however systemic risks that the Government is coping with to assure an acceptable security environment for sound business.

[NOTE: This technical annex draws heavily from previous documents produced by donors, consultants, and advisors to the government, including the recently produced "Power Sector Master Plan – Draft Final Report" dated October 20, 2003 and which is expected to be finalized in January 2004. In particular, it is noted that the base case demand forecasts in the draft Power Sector Master Plan are not as optimistic as the economic growth projections in the re-costing exercise. However, the authors of this chapter have attempted to reconcile this by frontloading investments to allow for a higher number of connections at a quicker pace and to assume that imports of power will continue in later years when the Master Plan assumes when they will be phased out.]

Background

1. The power sector is one of the least developed ones in Afghanistan, and its inadequate status is preventing the development of the country. The access ratio is one of the lowest in the world (about 6%), with only 234,000 customers connected to the public power grid, of which 76,000 are in the Kabul area[2] (See Annex 1). The other provinces have even less access with rural areas being virtually un-served.

2. The existing facilities provide an unreliable service, and in most places for only a few hours a day. Of the about 450 MW installed generating capacity, only 270 MW are available, and most of the units require overhaul or replacement. Distribution systems in the country are dilapidated or non-existent due to insufficient investment, lack of maintenance, and looting or theft over the past 25 years. The substations and low voltage distribution networks of Kabul and other cities are totally inadequate, overloaded and mostly outdated. Substantial reconstruction and expansion of the distribution systems, based on modern least cost design concepts, will be required. (See Annexes 2 and 3 for a description of the generation, transmission and distribution facilities in Afghanistan by region.)

3. Beside this state of disrepair and network inadequacy, there is another issue which is resulting in high economic losses for Afghanistan. As mentioned above, Kabul's public network currently supplies consumers through about 76,000 electricity meters. These are the meters of those customers, which the electricity authority, DABM, has contracted to supply. However, the actual number of households and commercial properties which are connected to the network is unknown, but it is far in excess of 76,000. The meters are mainly mounted on the pole from which the customer is fed or grouped in metal cubicles placed on the walkways, and each measures the supply of electricity to the officially contracted customer. Besides the contracted customer, the meter also measures the supplies to the several other consumers that the customer has agreed (unofficially) be connected to his meter. The resulting extensive reticulation consists of very small diameter wires, which often run for hundreds of yards to the consumer's premises. The wire is procured and owned by the consumer, and because of

[2] This number reflects the number of official customers, but understates the number of actual consumers as it is not uncommon for a customer to connect several neighboring households to their meter. Therefore, the number of households (official and unofficial) connected to the grid is unknown.

its small diameter and long length, it results in poor voltages and high technical losses, which if saved could be used to supply other consumers. This is especially important under the circumstances which prevail in Kabul because generation supplies are limited and where the marginal cost of production is in the region of 10-12 US cents per kWh. It is known that the same practice of customers connecting additional households to their meter prevails in other cities as well.

Organization of the Public Power Sector

4. The Ministry of Water and Power (MWP) manages, controls, and operates the power sector of Afghanistan through eight departments and four public enterprises, of which the largest is the Da Afghanistan Breshna Moassasa (DABM). (See Annex 4 for the organization chart.)

5. The state utility, DABM, is responsible to MWP for operation and maintenance of the country's generation, transmission, and distribution assets, as well as for the sale of electricity it produces. DABM has no appropriate governance structure, nor the financial resources to improve the country's electricity services. In spite of being defined in Afghanistan's 1986 Usage of Electricity Act as an autonomous enterprise, DABM depends heavily on government support for its operational and investment funds. Until 2003, the salaries of the staff were paid from the MWP budget.

6. The Government established five enterprises for the management of the power sector under the 1980 Enterprises Act, which are theoretically separate and autonomous but in practice are closely controlled by MWP:

- **Da Afghanistan Breshna Moassassa (DABM**), in charge of generation, transmission and distribution of electricity in Afghanistan (5421 employees).
- **Spinghar Construction Unit (SCU),** in charge of civil works for power stations and substations and all civil works relating to the power sector (385 employees).
- **Power Construction Unit (PCU),** in charge of erection of all electrical works like transmission and distribution lines and substations (420 employees).
- **Water And Power Engineering Consultancy Authority (WAPECA),** responsible for design (including field survey) of new generation, transmission and distribution projects (182 employees). WAPECA is now converted into a department of MWP.
- **New and Renewable Energy Research and Development Centre**, responsible for activities relating to development of renewable energy (149 employees).

7. The organization suffers from a lack of training in modern planning and utility management methods, as well as computers and communication facilities. During the conflict period, proper maintenance of the assets (power plants, transmission and distribution lines and stations, office buildings and equipment) was not possible. Spare parts, tools, test equipment, vehicles and consumables were not available. Technical staff were cut off from progress made internationally in power engineering. All these factors

contribute to a generally low productivity of the staff, somewhat compensated by great amounts of good will and an astonishing muddle-through capability.

Current Status and Accomplishments

8. There are four key donors assisting the Ministry of Water and Power: Asian Development Bank (ADB), International Development Association/World Bank (IDA/WB), Germany (through KfW and GTZ), and the US (through USAID). In addition, Iran has financed transmission lines to interconnect the city of Herat, and India is financing the detailed design and construction for the missing transmission link between Pul-e Khumri and Kabul. The following summarizes the current status of donor assistance to the Ministry of Water and Power.

9. Under the Emergency Infrastructure Reconstruction and Rehabilitation Project, **ADB** has committed about $41 million in the power sector to finance: (i) rehabilitation and reconstruction of damaged transmission lines and substations in the northern provinces to enable increased power imports (transmission lines from Hairatan to Khulm, Khulm to Pul-e Khumri, Khulm to Mazar-e Sharif, and substations at Khulm and Pul-e Khumri); (ii) urgently needed rehabilitation and reconstruction of the Kabul distribution system, which was damaged during the conflict period; and (iii) consulting services for project management and on-the-job management support training. The rehabilitation and reconstruction of the Kabul distribution system will complement and integrate the efforts provided by the World Bank, KfW, and the European Commission to bring about a total improvement in electric power supply to Kabul city and surrounding districts, which will reduce system losses, improve security, and provide reliability and quality of electricity supply to users. More specifically, this component will cover (i) rehabilitation of 280 circuit–kilometers (cct–km) of 220 kilovolts (kV) transmission lines; (ii) reconstruction of Khulm and Pul-e Khumri 220/110 kV substations, (iii) rehabilitation of Kabul distribution substations, junctions, transformers, equipment, cables, and material; (iv) electricity service delivery including installation of45,000 meters and utilization of low–voltage aerial bundled conductors, which are insulated to deter illegal connections; (v) load dispatch center for Kabul; (vi) billing, revenue collection, and computerization; and (vii) geographic information, asset management, and customer management systems. Consultants have been mobilized to undertake the detailed design and oversee implementation. The project is expected to be completed by mid 2006.

10. The pipeline projects as provided in the **ADB** Country Strategy and Program Update for CY 2003-2005 is listed below:

- 2004 Loan: Power Transmission and Distribution project ($40 million from ADB; $10 million through cofinancing);
- 2004 PPTA: Feasibility Study for National Power Transmission Grid (ADB $0.75 million);
- 2004 ADTA: Institutional Strengthening of Ministry of Water and Power (ADB $0.75 million); and
- 2005 National Power Transmission Grid Project (ADB $50 million; Government $2 million; cofinancing $13 million although latest

guesstimate indicates a further $25 million of cofinancing may be required giving a total of $38 million of cofinancing to be sought).

11. **IDA/WB** is currently implementing a $15.5 million power component under their Emergency Infrastructure Reconstruction Project which includes: distribution materials for Kabul and six provincial cities, supply of essential tools and equipment, the re-commissioning of the NW Kabul gas turbine plant and fuel, installation of spare parts for the 4x25 MW Naghlu hydropower station, and technical assistance for the Power Sector Master Plan. In January 2003, the 45 MW NW Kabul plant was re-commissioned almost doubling the available capacity for Kabul during the peak winter hours. While much of the essential tools and equipment have been delivered, most of the distribution material remains to be delivered so that installation will not commence before May 2004. Completion is expected by December 2004.

12. **IDA** is currently preparing a new $200 million project (of which IDA funding is $100 million) which would finance investments in distribution and generation in addition to substantial technical assistance to commercialise the operations of DABM. The proposed project will support the overall reform of the sector, but will focus largely on distribution activities. It will help reorganize the utility on a commercial basis while addressing the sector's enormous investment needs. The project will help to finance the rehabilitation and expansion of distribution networks in Kabul and several other cities and will provide support to improve the commercial and management aspects of DABM. It is expected that this project would be approved in the third quarter of 2004.

13. The proposed Power Utility Investment and Technical Assistance project referred to above would tentatively consist of the following components:

A. *Investment* ($190 million of which $90 million from IDA)
- Rehabilitation and Expansion of Distribution Networks in Kabul and other cities. ($180 m)
- Rehabilitation of Hydro Power stations (e.g. Naghlu – 100 MW) ($10m)

B. *Technical assistance* ($10 million of which $10 million from IDA)
- Commercialization of DABM;
- Technical support for rehabilitation and expansion of the distribution networks;
- Technical support to develop a gas-fired power station in Sherbeghan/Mazar using indigenous natural gas with private sector participation in its development and operation; and
- Capacity building and training for MWP and DABM. This work would complement and be coordinated with ongoing assistance from USAID, GTZ and others.

14. **KfW** is currently implementing four projects with funding from **Germany**, the **European Commission**, and the Afghanistan Reconstruction Trust Fund (ARTF) for a total of Euro 46.65 million. The first project is the rehabilitation of Kabul Region

Electric Grid (Phase 1) for Euro 16.1 million. Under this project: (i) the street lighting component was finalized at the end of June 2003, (ii) the rehabilitation of the 110 kV transmission line Sarobi – Breshna Kot started in August 2003 and is expected to be completed by mid 2004, (iii) the 15(20) kV overhead lines (Breshna Kot to Junction I and III) reconstruction works is under progress since August 2003, (iv) the rehabilitation of the Breshna Kot substation began in August 2003 and will be completed in the first quarter of 2004, and (v) the rehabilitation of the medium and low voltage distribution network started in July 2003. The second project is Phase 2 of the rehabilitation of Kabul Region Electric Grid (KfW Mandate from the European Commission) for a total of Euro 9 million. This involves four lots technically very similar to the 1st Phase: street lighting, 110 kV transmission line Breshna Kot – Kabul East, substations Breshna Kot (extension) and East (reconstruction), medium and low voltage distribution network. The contracts were negotiated in September 2003 and installation work is expected during 2004.

15. The third project involves the rehabilitation of hydropower plants Mahipar and Sarobi which serve the Kabul area for a total of Euro 15 million. The supply and erection contract will come into force in December 2003. The works will go on during 2004, with the second Sarobi unit reaching into 2005. The fourth committed project is a KfW Mandate from Afghanistan Reconstruction Trust Fund (ARTF) for Euro 6.55 million (USD 7.4 million) to complete some of the above projects: hydropower plant rehabilitation, city distribution network, and 110 kV transmission lines. On the technical assistance side, KfW has seconded a long term adviser to the Ministry of Water and Power. The assignment started in April 2003 and is expected to extend well into 2005. In addition, GTZ has seconded a long-term advisor build capacity in the power utility, DABM, but more specifically in the Kabul Electricity Department.

16. It is the intention of the German Government to continue co-operation with Afghanistan in the Energy Sector, recognised as a key element of the national reconstruction programme. Subject to availability of funds, appraisal by KfW, and approval of the German Government, the following projects were put on a preliminary agenda for the coming years:

- Rehabilitation of hydropower station Chak-e-Wardak;
- Rehabilitation of 110 kV transmission line Naghlu – Kabul; and
- 110 kV transmission line and substations Kajakai – Kandahar (in parallel with the possibly USAID funded 3rd unit for Kajakai HPP).

17. **USAID** is providing technical assistance to MWP under their Economic Governance Project which covers institutional strengthening and restructuring of MWP, design of a regulatory framework and new sector law and includes the funding of a resident advisor. In addition, the **US Government** is providing approximately $80 million as part of the $1.2 billion funding package for Afghanistan Relief and Reconstruction over the next year. A tentative list of projects to be financed by USAID is provided below, but is subject to the availability of funds and discussions with the Afghan government and other donors. Implementation has already begun on rehabilitating Kajakai hydro power station which is the sole plant serving Kandahar.

USAID Critical Power Sector Interventions	**USD million**
Helmand River Valley Power Supplies	**50.50**
Part 1 – Provision of Emergency Power Supplies	
o Kandahar (10 MW diesel gensets/fuel)	14.85
o Lashkar Gah (3.3 MW diesel gensets/fuel)	4.00
o Qalat (1.88 MW diesel gensets)	2.00
Part 2 – Rehab. of Two Turbine/Gen Sets at Kajakai Hydro Plant	
o Kajakai Hydro (repair of 2 x 16.5 MW units)	10.00
Part 3 – Expansion of Power Supplies	
o Kandahar Soviet diesel gensets (2 x 3.5 MW)	2.50
o Kajakai Hydro (new 3rd 18.5 MW turbine/genset)	15.15
o Kajakai Hydro Phase 2 Study (new 50-100 MW power plant)	2.00
Kabul and Jalalabad Area Fuel and Power Supplies	**17.50**
Part 1 – Winter Fuel Supplies for Kabul NW Plant	
o Kabul NW (2003/4 winter fuel for 45 MW)	10.00
Part 2 – Repair the Darunta Hydro Facility	
o Darunta Hydro (repair 3 x 3.5 MW units)	4.00
Part 3 – Expansion of Power Supplies for the Kabul Area	
o Mazar/Sherbeghan Gas-Fired Power Study (125 MW)	3.50
Economic Reform of the Energy Sector to Support Investment	**12.00**
Part 1 – Energy Sector Reform Roadmap Development and Implementation	
o Policy, legal, regulatory reform; sector restructuring; training needs assessment; privatisation	11.00
Part 2 – Revenue Enhancement and Management	
o Pricing reform; metering, billing, and collection pilots	1.00
TOTAL	**80.00**

18. MWP has begun to address how to ensure that these investments will be sustainable through sector reform. First, they have doubled the hydro-based tariffs which are applicable in Kabul and Kandahar and are aware that cost recovery levels will need to be reached over the next few years in order to meet the Ministry of Finance edict that state-owned enterprises should be self sufficient. While DABM is able to meet its staff costs under the current tariff, they are unable to finance routine maintenance and procure fuel to run the thermal plant during the crucial winter months. As a comparison, the average tariff in 2002 for Kabul was US$0.031; Kandahar, US$0.032; Mazar, US$0.077; and Herat, US$ 0.094. Higher tariffs are charged in Mazar and Herat as they depend on diesel generators and/or imported power which is more expensive than hydro. (See Annex 5 for current tariff structure.)

19. In addition, the Ministry has endorsed a Power Sector Reform Road Map (see Annex 7) and a draft Electricity Policy Statement (see Annex 8) which are to be submitted to Cabinet for endorsement. These policy documents have been developed in close coordination with the four key donors mentioned above. The Ministry has also appointed a Reform Task Force which will assist them in carrying out these reforms. One of the first tasks will be to develop a strategy for separating the public enterprises

from the Ministry. Lastly, the Ministry is in the process of recruiting a firm to lead its Program Implementation Support Unit (PISU) with the aim of drastically increasing its capacity to implement their ambitious investment program (see paras 35-37 for more details.)

Key Issues and Constraints (Including Cross-Cutting Issues)

20. Several combined factors make the development agenda for the power sector a formidable challenge including: (i) an unpredictable security situation that makes it difficult (and more expensive) to attract contractors/consultants and can prohibit work from taking place in certain, high risk areas; (ii) less than rudimentary condition of the physical infrastructure and the utility's operations, (iii) dependence on donor financing for both recurrent and development costs, and (iv) weak implementation capacity of the government overall, organizational and financial weakness of the utility, and lack of qualified people in the labor market due to the "brain drain" caused by over 20 years of conflict when either people fled the country or those that stayed did not have access to higher education. Many of the sector's staff are close to retirement, and because of the conditions prevailing for the last twenty-five years, most have been unable to remain current with modern methods of management, definition and design, implementation and construction, as well as maintenance in the power sector. In addition to a poor quality of service, there are widespread reports of corruption, illicit consumption and non-payment by government and other "notables." As such, the most significant operational concerns are governance and commercialization.

21. There are several cross cutting issues with other ministries: e.g. with Ministry of Mines and Industry (MMI) on coal and gas reserves in order to develop power plants using indigenous fuels; with Ministry of Irrigation, Water Resources and Environment (MIWRE) on developing multi purpose dam projects; and with Ministry of Rural Rehabilitation and Development (MRRD) on expanding rural access to electricity. The most urgent issue with the Ministry of Mines is to arrive at a geological confirmation of the gas reserves in Sherbeghan as work on developing a 100 MW combined cycle plant in this area should begin in 1383 (2004). As reported in the technical annex for oil and gas sector, there may be possibility that an additional 1.0 mmcm per day of gas may be available to generate an additional 100 MW of power. It is expected that confirmation fo reserves will be completed by June 2004 through MMI consultants working on a feasibility study for a gas transmission line from Sherbeghan to Kabul.

22. MWP and the MIRWE have formed a task force to deal with cross cutting issues with respect to multi purpose dams which has met several times to date. It is noted power supply from combined irrigation and hydropower projects cannot be included in a Power Sector Master Plan before firm schedules have been established regarding implementation of the irrigation component of the projects. In general, the combined projects will operate with irrigation needs as priority. In such case, electricity production will not fit the seasonal demand curve and firm power is required from other generating sources for covering peak power demand. However, once it is shown that these projects are feasible, then the power component should be added and the Power Sector Master Plan revised. Lastly, it is expected that the MRRD will be largely responsible for

development of off grid options (e.g. micro hydel schemes) to expand rural access to electricity. It is highlighted that this is ranking as a high priority amongst the communities targeted through the National Solidarity Program.

Strategic Vision, Goals and Key Priorities

23. The **vision of MWP** is that by 2010 DABM will "evolve into autonomous, financially viable enterprises providing reliable, low cost electric service to all Afghan citizens in an environmentally responsible manner, consistent with sound business practices". To accomplish this vision, MWP has planned ambitious projects with the goals of rehabilitating and expanding the country's transmission and distribution infrastructure, increasing its generation capacity, including through private sector participation, increasing the number of consumers it serves, establishing more appropriate tariffs, and increasing its revenue through enhanced and effective billing and collection procedures.

24. The following priority investments have been identified as key priorities by the recently submitted draft final Power Sector Master Plan (October 2003):

- *A 220 kV transmission line from Termez via Pul-i-Khumri to Kabul is of crucial importance for all realistic development scenarios for the central and north-eastern regions. Funding for this has been identified (ADB/India/IDA) and is envisaged to be completed in the first half of 2006.*

- *Import of up to 150 MW from Uzbekistan is recommended in order to provide supply to the interconnected Kabul-Nangarhar-Parwan, Balkh and Ghori Regions in the period 2006 to 2011.*

- *Work on confirming volumes and quality of available gas reserves at Sheberghan should start as soon as possible and be concluded within one year. Verification of available resources is one prerequisite for obtaining financing of a gas fired power plant.*

- *A feasibility study for a gas-fired power plant at Sheberghan should begin immediately. It is estimated that the earliest commissioning date for a 50 MW first stage plant would be November 2007. The plant will reduce Afghanistan's dependency on imports for supply to the interconnected regions in the north-east. The feasibility study for a gas-fired power plant at Sheberghan is estimated to cost about US$ 1.0 million.*

- *A cost estimate and clarification of contractual conditions for completion of the Combined Cycle at Kabul North West Thermal Power Plant should be made. It is noted that MWP has already been in contact with the original equipment manufacturer in this regard, but is prepared to go out for international tender if the OEM is not responsive.*

- *A feasibility study on Baghdara Hydropower Plant on the Panjshir river should start soonest. Earliest possible commissioning date of the first unit of Baghdara HPP is estimated to be late 2011 provided a feasibility study is started by the*

middle of 2004. The Power Sector Master Plan Consultant proposes that the study be undertaken in two phases. The Consultant estimates that the cost would be US$ 2.5 million for the first stage and US$ 3.0 million for the second stage of these studies.

- *A feasibility study of Sarobi 2 Hydropower Plant, on the Kabul River, should be started, but only when the conclusions of the feasibility study on Baghdara HPP are available. The Consultant's cost estimate for a feasibility study for Sarobi 2/Sarkundo is US$ 3.5 million.*

- *The Consultant recommends that the third unit at Kajakai be installed as soon as possible. No new feasibility study is necessary.*

- *It is recommended that investigations and studies regarding the raising of the level of the Kajakai reservoir and development of Kajakai II hydropower plant should be initiated immediately . A feasibility study should start early in 2005. The Consultant estimates that a feasibility study will cost US$ 2 million.*

- *A Memorandum of Understanding between MWP and ADB for a feasibility study for 220 kV double-circuit transmission line from Mazar Sharif to Herat via Sheberghan, Andhoy and Maimana was recently signed. This is part of the backbone of a national transmission grid and at the same time would provide grid supply to the provinces of Jawzjan, Faryab and Badghis. The feasibility study, with an estimated cost of US$0.75 million, will also look into the development of a national load dispatch center in Kabul.*

- *Construction of a number of transmission lines and substations for connection of load centres is recommended. Some major ones are:*

    - *One single circuit 220 kV line from Pul-i-Khumri to Kunduz, and a 220/110 kV substation at Kunduz.*
    - *Looping one of the 220 kV lines from Termez to Mazar-e-Sharif, and constructing a 220/110 kV sub station at Mazar.*
    - *One single circuit 110 kV line from Naghlu to Jalalabad and constructing a 110/20 kV substation at Jalalabad.*

  A detailed list of recommended transmission lines and sub-stations is included in Annex 10.

- *It is essential that sufficient funds be made available for the development of the distribution systems that will be necessary as a consequence of recommendations in the Power Sector Master Plan. Distribution is not a part of the Power Sector Master Plan. The recommended projects and timing for development of generation plants and transmission systems are based on a co-ordinated rehabilitation and development of the distribution system. The estimated cost of distribution over the next 7 years is US$400 million. (See Annex 10 for more details.)*

Outcome/Service Delivery Indicators and Targets

25. The key outcome/service delivery indicator is access to electricity defined as the number of connections divided by the number of households.

26. Based on available data, current access is about 6% overall. Urban access to electricity is about 27 percent[3]. However, these figures underestimate the actual number of households with access to electricity as it does not incorporate private generators and it is known that some metered customers connect their neighbors significantly expanding the number of those connected. It also does not include any rural, off grid access to electricity for which no data is available. Data is only available on metered connections from DABM.

- *Target is to achieve 33% access overall and 89% access in urban areas by 2015.*

27. The Ministry of Water and Power (MWP) aims to correct the poor state of the networks, and to connect an additional 400,000 customers by end 2007, and an additional 800,000 by end 2015. This involves an ambitious 150,000 new connections in 2005 and 2006, and an additional 100,000 connections for each of the following years through 2015. This is consistent with the Reform Road Map (Annex 7).

Costing of Outcome/Service Delivery Targets

28. The recosting exercise for the power sector is based on the "Power Sector Master Plan – Draft Final Report" dated 20 October 2003 which was undertaken by consultants retained by the Ministry of Water and Power under the IDA Emergency Infrastructure Reconstruction Project. The objective of the study was to prepare a power sector master plan for Afghanistan to serve as a basis for investment decisions for development of the generation and transmission system for the period 2004-2019 (SY1383-95). The study was limited to facilities above 1 MW.

29. In this regard, it should be noted that Master Plan is targeting investments to improve the access to the urban and peri-urban population. Large scale expansion of rural access to electricity is expected to be predominantly driven by the Ministry of Rural Rehabilitation and Reconstruction and to involve off-grid solutions and will not be managed by the power utility, DABM.

30. For the purposes of this re-costing exercise, the high case demand scenario in the Master Plan is being used. Under the high forecast, the energy demand is assumed to reach 3,334 GWh in the year 2015 (compared to 750 GWh today). This is 46% higher than the basic forecast and implies an average annual growth rate of 8.2 percent. Investments proposed under the base case are being brought forward in order to accommodate the higher growth rate. In addition, imports of power are expected to continue in the latter years to meet the increased demand. (Under the base case, imports

[3] Assumptions: (i) total number of domestic connections = 203,470; (ii) total population in 1381 = 21.8 million of which 22.8% is urban; (iii) assuming 7 people per household, number of households = 3.1 million, number of urban households is 0.7 million.

of power are assumed to be stopped after about year 7 as indigenous sources are expected to be sufficient to meet demand.) (See Annex 9 which excerpts the chapter on Demand Forecast from the "Power Sector Master Plan – Draft Final Report.")

31. For distribution rehabilitation and expansion in areas currently connected to the network, the following cost assumptions were used:

- Rehabilitation: $300 per existing connection
- Expansion: $500 per new connection

For urban areas currently not connected to the existing network that require additional expansion of sub transmission networks the assumption was $ 1000 per new connection.

32. For recurrent costs, it is assumed that the tariff will be sufficient to cover salaries and basic O&M expenses throughout the recosting period. However, donor support would be required to fund (i) diesel fuel to run the NW Kabul Power Plant during winter months for the next three years (after which it would be recovered through the tariff) and (ii) an escrow account equivalent to one year of imported power (to act as a guarantee facility to backstop the payment obligations of the MWP under a power purchase agreement with importing countries).

33. The summary of investments required to be disbursed (as opposed to committed) over the next 7 years totals US$1.7 billion and breaks down as follows:

Power Sector Seven Year Investment Program
Disbursement Basis (US$ million)
2004-2010 (SY1383-1389)

Program Component	Total	2004	2005	2006	2007	2008	2009	2010
Generation	839.9	39.5	104.0	110.8	139.6	156.0	164.0	126.0
Transmission	385.8	9.5	128.3	106.0	27.9	30.0	47.0	37.1
Distribution	400.0	15.0	55.0	55.0	50.0	75.0	75.0	75.0
Technical Assistance	52.0	13.1	10.9	8.0	5.0	5.0	5.0	5.0
Recurrent Costs	42.7	9.0	9.0	24.7				
Total	**1,720.4**	**86.1**	**307.2**	**304.5**	**222.5**	**266.0**	**291.0**	**243.1**

Implementation Strategy, Institutional, and Financial Arrangements

34. The Islamic Transitional State of Afghanistan is keen to scale up the implementing capacity of key ministries in order to remove one of the main constraints to achieve rapid recovery and development of the country. There is a significant risk that Afghanistan may fail to stabilise and to develop unless a breakthrough is achieved in increasing capacity for preparation and implementation of key development programmes, both in the short and the medium terms. Programme and project implementation will also depend on a number of other factors such as security, political stability, good governance, an appropriate policy environment, a functioning banking system, and availability of donor funds for investment.

35. Therefore, the MWP is in the process of retaining the services of a firm to provide technical staff to form the core of its Programme Implementation Support Unit (PISU). The overall goal of the PISU is to accelerate implementation of Afghanistan's power sector development program. The firm is expected to dispatch four resident professionals to MWP where they shall work on a continuous basis and lead each of the following areas: (i) project preparation, (ii) procurement, (iii) supervision, and (iv) IT and training. In addition, the firm is expected to provide short term specialists which may be required from time to time, such as environmentalist, social scientist, gas turbine and combined cycle plant specialist, hydrologist, geologist, etc.

36. The professionals fielded by the selected firm would be expected to lead in the following fields of activities:

(i) develop projects from ideas into project concept documents;

(ii) prepare terms of reference and lead in the supervision of the implementation of feasibility studies based, inter alia, on the Power Sector Master Plan, providing comments on behalf of the Ministry;

(iii) manage procurement procedures for the employment of consultants (services) and contractors (goods and works);

(iv) monitor performance and supervise directly consultants, and indirectly contractors through consultants (for some works, directly supervise contractors); and

(v) work closely with MPW counterparts, appropriately transfer knowledge, and build the capacity of the ministry through both on-the-job and other training.

37. In addition to the PISU, it is expected that dedicated teams will be retained to implement major projects such as the rehabilitation and expansion of distribution networks and connections, the construction of a combined cycle plant in Sherbeghan/Mazar, etc. However, the PISU as part of the Ministry will be responsible for monitoring their performance. Indeed, all donor programs and their implementation must be closely coordinated through the Ministry for which they are establishing the Program Implementation Support Unit.

38. The other urgent need for institutional improvement is the billing and collection efficiency of DABM. From the total energy produced in Kabul area for SY1381 (358 GWh), only 55% was billed, the remaining was leaked through technical and non-technical losses. The collection ratio is about 58 percent, and cost recovery is estimated to be about 28 percent. It is noted that the vast majority of domestic customers pay their bills on time; however, several large consumers (both official and non-official) and government ministries do not. All major donors are involved in assisting DABM improve their billing and collection, and MWP has recently sent out a memorandum regarding coordination of these efforts. GTZ (German Technical Cooperation) has financed a long term advisor who is working closely with DABM and will assist in the computerization of all customer data. Improvements in billing and collection are essential preconditions for a medium and long term tariff policy and to ensure financial sustainability of the sector.

39. As large differences exist between tariffs applying to the northern and western parts of the country and Kabul exist, one can conclude that an ambitious tariff reform could be embarked upon much earlier than currently envisaged. Customers are apparently prepared to accept significantly higher tariff when production costs are "visible" and based either on power imported from neighbouring countries and paid in US$ (northern part of the country) or on market price of diesel fuel (western part). In addition, the several thousands of small, private petrol-driven gensets running in the country prove that consumers are well aware of the real cost of electricity and prepared to pay for its real cost. The calculation of the full cost calculation of hydro-based electricity distributed in Kabul, even if seemingly depreciated, is a top priority on the political agenda; the minimum objective being to raise electricity tariffs to a level in line with energy carriers competing in the heating sector (e.g., fuel wood, LPG, other liquid fuels). If proper pricing of electricity is neglected, no investment program would be able to cope with the load increase fuelled by under priced and/or non-paid for electricity.

40. In parallel with these ongoing activities, MWP with the assistance of donors, will work on restructuring and commercializing DABM's activities. The detailed steps are yet to be decided, but it has been agreed that Kabul Distribution department, which has the largest number of customers, will be the priority initial focus.

Development Budget Program and Budget

41. The total commitment over the next 7 years is expected to be in the range of $2.8 billion, according to the breakdown shown in the table below. (See Annex 10 for more details.)

Power Sector Seven Year Investment Program
Commitment Basis (US$ million)
2004-2010 (SY1383-1389)

Program Component	Total Commitments	As of 2004*	As of 2007	As of 2010
Generation	1,483	254	586	643
Transmission	423	244	142	37
Distribution	775	125	275	375
Technical Assistance	62	32	20	10
Recurrent costs	43	43		
Total	**2,785**	**698**	**1,023**	**1,065**

* Of this amount, approximately US$ 375 has been committed.

42. The investment program for the various components follows the projects identified in the Power Sector Master Plan for generation and transmission, although the timing of some investments has been brought forward. Investments in generation include the rehabilitation of existing hydro and thermal facilities; the construction of a combine-cycle power station using indigenous natural gas; the development of hydroelectric facilities such as Bagdhara, Sarobi II, and Kajakai II;. In the case of transmission, investments are oriented to rehabilitate existing transmission lines, construct transmission systems such as the interconnection between Uzbekistan and Kabul, and some other lines and substations required to integrate dispersed loads among the regions. The program also considers the funds required to import power from the northern countries.

43. Since the Master Plan does not include distribution analysis, the proposed investment in distribution is developed to meet government goals. Projects are oriented to rehabilitate and expand the distribution networks around the country. Primarily, the investment is oriented to expand the network to improve the service to existing customers, and to provide an official connection to those users currently supplied through an official customer's meter. Additionally, the investment is oriented to connect households without electricity supply in urban areas.

44. The Program considers also the financing of the technical assistance required for capacity building in the Ministry of Water and Power, and to accelerate implementation of Afghanistan's power sector development program.

List of Annexes:

1. Present Number of Customers
2. Status of Generation, Transmission, and Distribution in Afghanistan by Region
3. Afghanistan Installed Generation Capacity
4. MWP Organizational Chart
5. Current Tariff Structure
6. Selected Energy and Power Values for Afghanistan
7. Afghanistan Power Sector Reform Road Map
8. Draft Electricity Policy Statement
9. Demand Forecast (Chapter 4 of Norconsult's Draft Final Power Sector Master Plan)
10. Detailed Investment Program

ANNEX 1

[Source: "Study for Power Interconnection for Regional Trade – Final Report", ADB Report, March 2003]

Present Number of Customers

Item	2nd & 3rd Units of (DABM)	Family	Other Consumers	Governmental	Total
1	Kabul electricity	71,785	4,226	440	76,551
2	Nangarhar presidency	6,127	1,080	120	7,327
3	Ghori presidency (Pul-e-Khumri)	6,719	736	135	7,590
4	Balkh presidency(Mazar-e-Sharif)	39,000	5,500	550	45,050
5	Herat presidency	8,877	1,120	163	10,160
6	Ghazni department	259	208	48	515
7	Andkhoy department	4,611	1,000	19	5,702
8	Farib department (side of Jawzan)	2,495	455	43	3,083
9	Paktia department (S of Khandahar)	144	65	40	249
10	Juzjan presidency (Shebergan)	14,481	826	69	15,376
11	Parwan presidency (Charikar)	4,770	1,500	430	6,700
12	Konar department (east side)	340	60	30	450
13	Kunduz presidency	7,700	1,800	500	10,000
14	Hydro power generation presidency	708	200	12	920
15	Helmand department (Lashkargah)	3,721	700	50	4,471
16	Takhar presidency	292	1,420	10	1,722
17	Badakhshan presidency (East)	1,671	1,200	60	2,231
18	Saripul presidency (South of Jawzjan)	179	400	15	1,134
19	Khandahar presidency	28,000	4,393	350	32,743
20	Farah department (West side)	696	100	4	800
21	Grishk	895	200	30	1,125
Grand Total		203,470	27,189	3,118	233,899
		87%	12%	1%	

ANNEX 2

[Source: "Afghanistan's Power Sector: Short Term Critical Investment Options", February 2003, The World Bank, South Asia Energy and Infrastructure]

STATUS OF GENERATION, TRANSMISSION AND DISTRIBUTION IN AFGHANISTAN BY REGION – FEBRUARY 2003

NORTH EAST REGION

North East Region Generation

Name of hydro plant	Country of origin	Year of commissioning	No. of turbines	Installed capacity kW	Area served
Faizabad	India	1984	3	255	Badakhshan
Baharak	India	1986	2	200	Badakhshan
Pulikhumri-II	USSR	1964	3	9,000	Baghlan
Pulikhumri-I	Germany	1960	3	4800	Baghlan
Khanabad	Germany	1950	3	1,740	Kunduz

Faizabad Micro Hydel station. This plant was built on the Jouzen River with Indian technical and economical co-operation in 1984, having 3 x 0.085 MW turbines. The plant was constructed to provide electricity to Faizabad town. All the three turbines are now non-functional, due to lack of spare parts. The government of India and the supplier *Jyoti* are prepared to provide parts. The plant would require about US$ 400,000 for rehabilitation. It is proposed that three machines (0.085 MW) be replaced by machines each with a capacity of 0.25 MW. Work was to begin several years ago, and was to be helped by Tajikistan government.

Baharak Micro Hydel station. This plant having an installed capacity of 2x100 kW was built on the irrigation canal at Baharak in 1986 with the assistance of Indian technical and economical co-operation to supply electricity to the towns of Baharak and Jurm. The plant is not operational due to lack of spare parts. Ahgha-Khan Network has agreed to reconstruct this scheme.

Pulikhumri I Hydro electric plant. This plant using German equipment of capacity 3 x l.6 MW, is damaged and the cost for rehabilitation is estimated at USS 1.8 million. This plant belongs to the Ministry of Mines and Industry.

Pulikhumri II Hydroelectric plant. This plant was built on the Pulikhumri River in 1964 by USSR at a cost of USS 3.9 million with a capacity of 3 x 3 MW using Kaplan type turbines. The purpose of this plant was to provide power to the towns of Pulikhumri Baghlan and Kunduz. Only one turbine is currently operational. The other 2 turbines require servicing and spare parts, especially turbine oil and carbon brushes. Rehabilitation cost of this plant is about US$ 1.2 million.

Khanabad hydroelectric plant. The Khanabad power plant was built in 1950 on the river Takhar. The plant was constructed to feed electricity to the now defunct Spinzar Company, which produced vegetable oil, cottonseed oil and soap. The plant was destroyed in 1990. At the moment, the plant is not producing electricity. Destruction is total and a new plant should be constructed to replace it. The estimated cost for rehabilitation is US$ 3 Million. This plant belongs to the Ministry of Mines and Industry.

North East Region Sub-stations

Name of Sub-Station	Capacity MVA	Voltage kV
Baghlan Sub-Station	1.8	35/6
Kunduz Old	3.2	35/6
Kunduz New	32	110/35/6
Spinzar	1.6	20/6

Baghlan substation. This sub-station has a capacity of 1.8 MVA and obtains power from Pulikhumri II through the Pulikhumri-Kunduz transmission line, which is at present damaged. The sub-station is no longer operational. Details of damage to the sub-station are un-known. If damage is limited to switch gear, this require US$ 200,000 for rehabilitation.

'Old' Kunduz substation. This sub-station had a capacity of 3.2 MVA, and used step down from 35 kV to 6 kV from Pulikhumri-II. This substation is partly damaged, mainly the protection gear, and requires about US$30,000 for its rehabilitation and updating.

'New' Kunduz substation. This sub-station steps down from 110 kV to 35 kV and 6 kV, and has a capacity of 32 MVA using 2 transformers of 16 MVA. The sub-station was built to utilize imported electricity from Tajikistan. In 1990 the sub-station was damage. The transformers need to be replaced or repaired together with new switchgear, etc. MWP has begun the rehabilitation works of the transmission line and substation with Government funds and the work is expected to be completed in May 2003.

Spinzar substation. This sub-station has capacity of 1.6 MVA and steps down to 6 kV from 20 kV. The substation is functional but cannot be used because of damage to the transmission line from Khanabad to Spinzar (see below). This substation belongs to the Ministry of Mines and Industry.

North East Region Transmission

Line from	To	Distance km	K kV
Tajikistan	Kunduz	60	110
New Sub-station	Old Sub-station	5	35
Pulikhumri	Kunduz	82.4	110

Transmission Line Tajikistan-Kunduz. This 110 kV single circuit line was built on P.C.C. poles. It is badly damaged, needing new insulators and conductor. The cost for rehabilitation is estimated at US$ 1,200,000, which would increase the capacity to import by 32 MW. Work of re-construction is proceeding and MWP expects to re-commission in May 2003.

Transmission line – 'New' substation to 'Old' substation. The single circuit line transmission voltage 35 kV length 5 km is operational, requiring only proper connections and joints to reduce losses. Repair work is proceeding and MWP expects to re-commission this line in May 2003.

Transmission line Pulikhumri to Kunduz. The single circuit line of 82.4 km, with a transmitting voltage designed for 110 kV and used for 35 kV is completely destroyed. Connection of Pulikhumri-II to Kunduz would require US$5 million. This line, if repaired, would also provide electricity to Baghlan rural areas.

Distribution network. The region had a total network of 333 km having various voltages of 20 kV, 6 kV/0.4 kV. The distribution system suffered 60 % damage, with over 32 km of 20 kV line destroyed. The region had two main distribution networks; Baghlan network, and Kunduz network.

Baghlan distribution network. The distribution network of 183 km length comprises 6 kV and 0.4 kV networks. At present 60 % is damaged. The network had 50 transformers, of which 30 are reported to be damaged and require replacement. Cost of rehabilitation of the distribution system is estimated at US$ 2 million.

Kunduz distribution network The distribution network consists of 32 km of 20 kV single circuit line and 118 km of 6 kV/0.4 kV. There were 44 x 6 kV/0.4 kV transformers, of which 18 are damaged. Some of the 20 kV line is destroyed, and 50 % of the distribution/5 kV/0.4 kV has been damaged. Work of rehabilitation has begun, and MWP expect to re-commission the line in May 2003.

NORTH REGION

This region covers the provinces of Balkh, Samangan, Jawzjan and Faryab.

Northern Region Generation

Name of diesel plant	Country of origin	Year	Number of units	Capacity (kW)	Area served
Maimana	UK	??	1	500	3,000 households in Maimana

There is a plan to bring a 10 kV power line from Andkhoi in the north via Sherintageb in Faryab, which would allow power costing 3 cents/kWh to be imported from Turkmenistan. Of the 125 km line, poles have been erected for all but 32 km. More

poles and conductors, etc are needed, and will likely be sourced from the World Bank-funded materials.

Fertilizer Company. This is the major source of electricity production in the region, comprising 4 turbines, with name plate ratings of 4 x l2 MW but down-rated to 3 x 12 MW and l x 9 MW. The plant was constructed for use by the fertilizer factory with the surplus power distributed to Mazar-i-Sharif and Balkh. The plant requires servicing and spare parts to upgrade its production to installed capacity. Upgrading is essential became of its use of gas as an indigenous fuel. The estimated cost of rehabilitation is estimated at US$1 million. This plant belongs to the Ministry of Mines and Industry.

Khoja Gogirdak. This plant has two gas turbines, which supply 2 MW of power, to operate the gas fields of the Ministry of Mines and Industry. The plant lacks spare parts and requires servicing. The estimated cost for rehabilitation is estimated at US$500,000. This plant belongs to the Ministry of Mines and Industry.

Jarqodoq. This thermal electricity production plant has 6 turbines of 2,500 kW. The plant belongs to Ministry of Mines and Industries and produces electricity for use in gas well fields. The plant requires servicing and spare parts. Cost of these is currently unknown.

Northern Region Substations

Name of substations	Capacity (MVA)	Voltage (kV)
Andkhoi	10	110/6
Old sub-station, Mazar-i-Sharif	8	35/6
Sub-station, Balkh	2	35/6
New sub-station, Mazar-i-Sharif	32	110/35/6
Jawzjan	32	110/35/6
Khulm	126	220/110/10

Old Substation Mazar-i-Sharif. An 8 MVA capacity substation is functioning with burnt switchgear and controls. Estimated cost for rehabilitation is US$30,000.

Substation, Balkh. A 2 MVA capacity substation is operating but requires servicing.

New Substation, Mazar-i-Sharif. This 2x16 MVA, 110 kV substation was constructed to utilize imported electricity from Uzbekistan. The station is functioning and requires servicing and spare fuses and relays etc. Cost not yet estimates.

Jawzjan substation. This 2x16 MVA substation supplies the feeder from Mazar-i-Sharif and the distribution system of Jawzjan, i.e. Shiberghan city and rural areas surrounding Shiberghan. The sub-station is functional and only requires servicing.

Andkhoi substation. This substation contains 1 x 10 MVA transformer and was built with Turkmenistan credits. It is operational and supplies power to Andkhoi villages.

Khulm substation. The substation capacity is 2x63 MVA for voltage 220/110/10 kV. This substation would utilize the power imported from Uzbekistan to meet the demands of Mazar-i-Sharif, Jawzjan, Balkh, and Khulm. This substation is completely destroyed and pillaged, and only plinths remain. Estimated cost for rebuild is US$8 million.

Northern Region Transmission

Line from	To	Distance	Voltage (kV)	Length (km in single circuit)
Fertilizer	Balkh	14.2	35	14.2
Fertilizer	Mazar-i-Sharif	17.5	35	17.5
Uzbekistan	Khulm	71	220	142
Khulm	Mazar-i-Sharif	49	110	98
New substation	Old substation	9.3	35	9.3
Mazar-i-Sharif	Jawzjan	142	110	142

Transmission line Fertilizer company – Balkh. This single circuit line voltage 35 kV and 14.2 km in length is presently functioning.
Transmission line Fertilizer company - Mazar-i-Sharif. This single circuit line voltage 35 kV, 70 square mm aluminum conductor 17.5 km is functioning.

Transmission line Uzbekistan-Khulm. This is a 71 km dual circuit on separate poles. Both circuits are damaged. The line has transmission voltage of 220 kV but was operating at 110 kV. Estimated cost for rehabilitating the line is US$2 million.

Transmission line Khulm-Mazar-i-Sharif. 45 km, 110 kV line is damaged and needs rehabilitation at an estimated cost of US$1.5 million.

Transmission line - New substation to Old substation. 9 km line of conductor size 70/11 mm^2 ACSR single circuit on P.C.C. poles, line voltage 35 kV, is operational.

Transmission line Mazar-i-Sharif to Jawzjan. 142 km of single circuit line voltage 110 kV conductor size 95/16 mm^2 ACSR on P.C.C. poles is operational.

Northern Region distribution networks. The 3 distribution networks comprise 375km of 6/0.4 kV. 30 %, or 135 km, of the distribution system, is estimated to be damaged. 15 of 65 transformers are damaged. Repair to the network is estimated at US$1.3 million.

WEST REGION This region covers Herat, Badghis and Farah provinces.

Western region generation

Name of plant	Type of equipment	Country of origin	Year	Installed capacity (kW)	Area served
Chalwarcha	Hydel	Germany	1936	80	District Enjil
Diesel Gen. Sets Herat	Diesel	USA Czech USSR	1964 –1979	3400 not working	Herat city
Diesel Gen. Sets Badghis	Diesel	Czech USSR	1970–1983	530	Badghis
Diesel Gen. Sets Farah	Diesel	Czech USSR	1970 –1981	10,000	Farah

Chalwarcha Micro Hydel Plant. This 80 kW capacity plant was built in 1936 on a canal from Harkod River in Enjil district. The plant supplies electricity to the surrounding areas. Damage has rendered the plant non-operational for the last ten years. US $200,000 is required for rehabilitation.

Herat. 11 Diesel generating sets produce a total capacity of 3400 kW. All generating sets have depreciated due to excessive use and damage and require overhauling. The engines consume oil 5 liters/hr. Parts can be obtained from the suppliers and over-hauling done locally. The estimated cost for over hauling the engines is US$ 500,000.

Diesel Generating Sets – Badghis. Three diesel generating sets were installed to meet the demand of essential services in Badghis. All the sets have deteriorated or been damaged and require replacement. The cost is estimated at USS 100,000.

Diesel generating – Farah. Six diesel generating sets from Czechoslovakia/EX. USSR were installed to meet the demand of essential services. All have depreciated and require spare parts and or replacement. Estimated cost for rehabilitation is USS 300,000.

Partly completed electricity generation plant - Salma Project. This US$ 57 million Saudi Arabia-aided project was started in 1974 to meet the regional electricity demand. The irrigation-based project was to produce 40 MW of electricity to cover 40% of construction work. The housing complex, diversion canal, pen stock canal and excavation were completed. A percentage of work on the earth dam also has been completed. During the war all construction equipment at the site was damaged or destroyed. Rehabilitation of this project is vital for the region. Completion of the project, which is the only hydroelectric project feasible in the region, would require about US$ 55 million. This project belongs to the Ministry of Irrigation.

Sabzak Thermal Power Plant. In the Master Plan of 1980 a 50 MW plant was envisaged using locally available coal from Sabzak coalmine. An incomplete techno-economic study has been carried out by Czechoslovakia.

Western Region transmission lines. Circuits are nonexistent in the region. If electricity, costing 3 cents/kWh, is to be imported from Turkmenistan then 143 km of 220/110 kV single circuit with a 220/110/20 kV substation would be required. The estimated cost of the project is about US$10 million, and it will be completed using Government budget in March 2004.

Western Region Distribution Network - Herat. 50% of the 220kV of distribution network of 6/0.4 kV in Herat is destroyed. A plan for a distribution system for Herat and the Salma project were to be simultaneously completed. Plant, including 50 step-down transformers, worth USS 4.6 million were imported and are available in Herat. The network voltage was to be 20/0.4 kV. Completion of the project is allowed for under the World Bank funding.

EAST CENTRAL REGION The two provinces in this region are Bamyan and Ghor.

East Central region generation

Name of thermal plant	Type of plant	Country of origin	Year	Number of units	Capacity (kW)	Area served
Bamyan	Diesel	Czechoslovakia	1972	4	700	Bamyan
Ghor	Diesel	Czechoslovakia	1980	2	300	Ghor

Bamyan diesel generating sets. To meet essential service needs Bamyan city installed engines as described above. Their total capacity is about 60 kW. All are in need of overhaul, or replacement, at an estimated cost of US$100,000.

Ghor diesel generating sets. Chakhchran, the capital of Ghor, had two units as described above. Neither is functioning and the estimated cost to replace them is about US$200,000.

Bamyan Micro Hydel Project. About 50% of the work to build this station was completed under Indian Economic and Technical Assistance. It will require about US$1.5 million to complete and commission the station.

Eastern Region Transmission. No transmission facilities exist in the Eastern Region.

Eastern Region distribution networks. These are centered on Bamyan and Ghor and about US$60,000 is required for their restoration.

CENTRAL REGION

The provinces included in this region are Kabul, Parwan, Kapisa, Wardak and Logar. The region has a nameplate-installed capacity of 300 MW, which is 66 % of the national installed capacity. Damage to the system is extensive in this region. The region has 387 km of 110 kV transmission lines and 98 km of 44 kV line. 285.25 MW of step down capacity substations also exists.

The distribution system 20/15/6/0.4 kV is 60,410 km, through 800 step-down transformers and provided electricity to 150,000 consumers. Only 90,000 consumers are currently supplied.

Central Region Generation

Name of plant	Type of plant	Country of origin	Year of installation	No. of units	Installed capacity (kW)	Area served
Naghlu	Hydro	USSR.	1967	4	100,000	Kabul
Mahiper	Hydro	Germany	1967	3	66,000	Kabul
Sarobi	Hydro	Germany	1957	2	22,000	Kabul
Kabul East	Gas Turbine	Switzerland	1978	2	43,600	Kabul
Kabul N.W.	Gas Turbine	Switzerland	1985	2	45,000!	Kabul
Charikar	Hydro	China	1973	3	2,400	Charikar
Jabel Seraj	Hydro	US/UK/ Germany	1920	4	2,540	Charikar
Gulbahar	Thermal	Germany	1958	1	2,800	Gulbahar
Gulbahar	Diesel	Germany	1958	3	2,200	Gulbahar
Kabul	Diesel	Czech	1960	20	10,000	Kabul
Logar	Diesel	Czech	1975	2	300	Pul-e-Alam
Chak Wardak	Hydro	Germany	1940	3	3,300	Chak Wardak
Ghorband	Hydro	India	1975	3	300	Ghorband

Naghlu Hydro Electric Plant. This plant was constructed in 1967 with a 4 Frances type vertical turbine on Kabul river at Naghlu under USSR Techno-Economic Assistance. It has a capacity of 100MW, the largest single plant in Afghanistan. At present the plant is producing about 50 MW, mainly due to low water levels. Due to deterioration, non availability of spare parts, and lack of servicing, the plant may stop production at any time. The World Bank has agreed to fund from the on-going Grant spares and replacement parts.

Mahiper Hydro Electric Plant. This plant is constructed on the Kabul and Logar Rivers at Mahiper, with a capacity of 66 MW, 3 x 22 MW vertical Francis turbines from Germany. At the moment the plant is operational but lacks spares. Since its commissioning in 1967, the plant has hardly received any servicing. Strategic spare parts are estimated to cost about US$ 1.2 million. However, the replacement of these may need to be considered an interim step, in advance of a complete replacement of the turbo-generators and control and instrumentation, because the age of the sets, and their condition means that they are uneconomic to continue to repair.

Sarobi Hydro Electric Plant. This plant located at Sarobi on the Kabul River produces 22MW using 2 vertical Francis turbines procured from Germany. The plant design was constructed in 1957. At present the plant is operating at 70% of the installed capacity due to lack of maintenance and spare parts. The control panels are not operational, and are old fashioned and it will be very expensive to obtain spare parts for them. Strategic spare parts are estimated to cost about US$ 1.1 million. However, the replacement of these may need to be considered an interim step, in advance of a complete replacement of the turbo-generators and control and instrumentation, because the age of the sets, and their condition means that they are uneconomic to continue to repair.

Kabul East Thermal Plant. A 43.6 MW plant was built at Utkhel in 1977 by ABB at a cost of SF 28 million. The plant is a package UNIT type GT-9, with 2x 21.SMW capacity turbines which can be operated on crude or diesel oil. The plant was damaged by rockets in 1992, and it has been decided that the plant will not be economic to repair.

Kabul North-West Thermal Plant. This plant was completed at a cost of USS 22.8 million in 1985 by ABB (now Alstom) at Khair Khana with a capacity of 45 MW. The plant has two turbines of 21.8 and 23.2 MW respectively. On full load each turbine consumes 9000 l/hr of diesel. Much of the combined cycle unit has been supplied, but because of war, contractor, ABB, did not remain on site to complete installation. It is likely that the cost to complete the plant would be about US$ 10 million.

Charikar Micro Hydel Plant. The plant at Charikar was built by the Chinese at Parwan irrigation canal in 1973 with a capacity of 3 x 0.8 MW. The plant is operating at 60% of its capacity because of lack of spares. The estimated cost for rehabilitation is USS 80,000.

Jabul Seraj Hydro Electric Plant. This plant has 2 x 0.5 MW and 2 x 0.77 MW capacity turbines at Jabul Seraj. The turbines are horizontal Francis type procured from Siemens, Germany and GEC, USA in 1920. The plant is operating at 30% of its rated output due to depreciation. The antique design of the plant may make rehabilitation unfeasible. Replacement of turbines and generators is recommended, at an estimated cost of US$ 4 million.

Gulbahar Thermal Plant. The plant belongs to the Ministry of Light Industries and Food stuff and was built to Provide power to the textile factory at Gulbahar. The Plant is of German design and is not operational due to war damage and looting. This is the largest coal fired plant in Afghanistan. The exact details of the damage to the plant are not known.

Gulbahar Diesel Electricity Generating Plant. The plant belonged to the Ministry of Light Industries and Food stuff and was built to provide power to the textile factory at Gulbahar. Its condition is unknown.

Kabul Diesel Generating Sets. 42 diesel generating sets were installed in essential departments. Most of the sets were to be used on stand-by, but over the years they have

been working continuously. Most are non-operational. Of varying types and from varying countries, only about 5 of them may be worth overhauling. The rest would require replacement to ensure vital electricity supply to essential services such as hospitals. The estimated cost is about USS 4 million.

Loger Diesel Engines. Both 2x150 kW diesel sets are destroyed and require replacement at an estimated cost of USS 150,000.

Chak-Wardak Hydro Power Plant. This plant was built on the river Wardak in 1940 using German 3 x 1.12 MW turbines with a maximum capacity of 3.3 MW. The reservoir is full of silt. The plant is operating at 500 kW instead of 3.3 MW due to damage.
Repair of the turbines is not possible due to their age. Replacement of the plant is required along with desilting of the reservoir. The cost estimated for replacing this plant is USS 4 million.

Ghorband Micro Hydel Plant. This plant was built in 1975 at Ghorband with 3 x 100 kW Indian turbines on the Kimchak River. The plant is functional, providing power to Ghorband district. The plant requires a small amount of spares, estimated at a cost of USS 20,000.

Central Region Substations

Name of Substation	Capacity (MVA)	Voltage (kV)
Breshna Kot	53	110/15
East	40	110/15
North West	70	110/15
Sarobi	5.6	110/6
North	80	110/15
But Khak	4	110/20
MW. Radio	12.6	110/10
Gulbahar	15	110/6
Bagram	2.6	44/6
Jabul Seraj	2.45	44/6

Breshna Kot Substation. The 53 MVA sub-station was burned to the ground during the fighting in Kabul in the early 1990s. Full reconstruction is estimated at USS 5 million.

East Substation. This sub-station is connected to Breshna Kot sub-station as well as to Naghlu power plant and supplies power to the eastern part of the city. The switchyard of the sub-station has been damaged as well as the switchgear and one power transformer. It will probably prove prudent to install a new 2 x 25 MVA substation here at a cost of US$ 5 million.

North-West Substation. This steps down the voltage 110/15 kVA for distribution to the Kabul North-West area. Its capacity is 70MVA. The sub-station is functional.

Sarobi Substation. A 5.6 MVA transformer steps down 110 kV to 6 kV for the Sarobi region. The sub-station switchyard and switchgear are damaged. The cost for rehabilitation is estimated at USS 700,000.

North Substation. This sub-station is located in the northern part of Kabul Khair Khana with a capacity of 80 MVA; the input/output voltage is 110/15 kVA. The sub-station is functional.

But Khak Substation. A 110/20 kV, 4 MVA sub-station used to provide power to But Khak area. The switchgear and transformer are damaged, requiring US $500,000 for repair. At present the sub-station is not operational.

MW Radio Substation. The sub-station has a capacity 12.6 MVA, 110/10 kVA, and the sub-station is functioning.

Gulbahar Substation. 15MVA, 110/6 kV sub-station is completely destroyed and requires reconstruction at a cost of USS 3 million.

Bagram Sub-Station. This sub-station is not functional. Its capacity was 2.6 MVA, voltage 44/6 kV.

Jabul-Seraj substation. This substation has a capacity of 2.45 MVA, 44/6 kV, and is functional.

Central Region transmission lines

Line No.	From	To	Distance (km)	Voltage (kV)	Length in single circuit km
143 145	East substation	Northwest substation	2 x 35	110	70
141 142	Naghlu plant	East substation	55	110	109
111 112	Sarobi plant	Breshna Kot substation	65	110	131
111 112	Mahiper plant	Late Band	5	110	10
121	Sarobi plant	Naghlu plant	13	110	13
	Naghlu plant	Gulbahar	73	110	73
	Chak Wardak	Kabul	80	44	80
144	East substation	Breshna Kot	16	110	16
	Jabul-Seraj	Bagram	18	44	18

Central region transmission lines which need repairs and reconstruction:

Sarobi to Breshna Kot line. Several towers are damaged. 100% of conductor is missing, alongwith insulators. Estimated cost to rebuild is US$ 2.5 million.

Naghlu to Gulbahar line. 100% of towers are damaged. 100% of conductor is missing. Estimated cost to rebuild is US$ 5 million.

Chak Wardak to Kabul line. About 80 km of line is missing and 40 towers damaged. Estimated cost to rebuild is US$ 2.5 million.

Transmission line from Naghlu to Jalalabad. The cost of constructing this line, which would provide greater flexibility in the operation of the hydro stations, is estimated to be about US$ 6 million.

East substation to Breshna Kot line. 100% of this line is damaged. Estimated cost to rebuild is US$ 0.5 million.

Jabel Seraj to Bagram line. Line totally damaged. Estimated cost to rebuild is US$ 0.25 million.

Central region distribution networks. Largest distribution network in Afghanistan consisting of 800 transformers, 400 km of 15 kV, 10 km of 15 kV underground cable, 35,000 km of 0.4 kV lines and 25,000 km of 0.4 kV underground cables to supply 150,000 (now 90,000) consumers. 300 transformers, and 50% of overhead network and consumer services were damaged.

EASTERN REGION. Konar, Laghman and Nangarhar

Eastern Region Generation

Name of plant	Type of plant	Country of origin	Year commissioned	No. of units	Installed capacity (kW)	Area served
Darunta	Hydro	USSR	1964	3	11,550	Jalalabad
Samer Khel	Diesel	USSR		4	2,400	
Assadabad	Hydro	Germany	1983	2	700	Assadabad

Darunta Hydro-Electric Power Plant. This plant with 3 vertical Francis type turbines was constructed by the USSR in 1964 on the Kabul River. At present 2 turbines are operating. All three turbines require servicing and spare parts. Present production is 4 MW instead of 11.55 MW. Cost of rehabilitation of this plant is estimated to be US$ 0.9 million.

Samer Khel Diesel-Electricity Generation Plant. This plant was constructed by USSR in 1963 to provide power to Jalalabad during peak loads. Its 2.4 MW production capacity was completely destroyed in 1990. The plant needs to be replaced at a cost of USS 2 million.

Assadabad Micro Hydel Plant. This 2x350 kW plant was built on the Konar River to provide power to Assadabad. It was supplied from Germany and commissioned in 1983.

At present one turbine is functioning; the other is awaiting spare parts. The cost for rehabilitating this plant is an estimated USS 300,000.

Eastern Region Substations

Name of Substation	Capacity (MVA)	Voltage (kV)
Ghouchak	5.6	35/6
Ghaziabad	2.5	35/6
Samar Khel	1.8	35/6
Jalalabad	5.8	35/6

Ghouchak substation. One transformer burnt out and work needed in substation. Estimated cost for rehabilitation is US$ 0.6 million.

Ghaziabad substation. This 2.5 MVA sub-station was completely destroyed in 1990 and requires compete reconstruction at an estimated cost of US$ 0.3 million.

Samer Khel substation. This 1.8 MVA sub-station is similar to the one at Ghaziabad and requires US$ 0.2 million for rehabilitation.

Jalalabad substation. 2 x 4.0 MVA sub-station with total capacity of 8 MVA feeds the city of Jalalabad and at present, while requiring servicing, is functional.

Eastern Region transmission lines. The circuit transmission voltage is 35 kV and length is 50.3 km. 4 km to Samer Khel and 9 km to Barikaut have been destroyed, and require rehabilitation at an estimated cost of USS 1 million.

Eastern Region distribution network. Of 22 original distribution transformers 8 are damaged, alongwith 12 km of the 90 km network. Replacements are estimated to cost about US$ 0.3 million.

SOUTHERN REGION Generation is by local diesel sets, and the region has no transmission system. Distribution networks amount to about 68 km with 8 transformers.

Southern Region Generation

Name of plant	Country of origin	Year of commissioning	No. of units	Installed capacity	Area served
Paktika	Czechoslovakia	1990	4	600	Khost and Gardez
Paktika	Czechoslovakia	1963	3	300	Urgon
Ghazni	Czechoslovakia and USSR	1963	16	1,165	Ghazni

All these diesel units are in need of major overhauls or replacement. Estimated cost US$ 1.3 million. The cost to re-build suitable networks is about US$ 1 million.

SOUTH WESTERN REGION This region includes Kandahar, Zabul, Uruzgan, Helmand and Nimroz. It had 46,410 kW of installed capacity of electricity generation, 36.29 MW hydro electric, and 10.2 MW from diesel generators. 219 km of 110 kV line existed in the region with 5 sub-stations and an 80 km distribution network of 22 step down transformers.

South Western Region Generation

Name of plant	Type of plant	Country of origin	Year of commissioning.	No. of Units	Installed capacity kW	Area Served
Filko	Hydel	Germany	1950	2	640	Kandahar
Baba-Wali	Hydel	Germany	1936	1	250	Kandahar
Kajaki	Hydel	USA	1975	2	33,000	Helm and Kandahar
Grishk	Hydel	USA	1945	2	2,400	Grishk
Kandahar	Diesel	USA	1948	14	2,800	Kandahar
Zabul	Diesel	Czech	1980	30	5320	Zabul
Nimroz	Diesel	Czech	1979	4	700	Nimroz
Uruzgan	Diesel	Czech	1982	6	1300	Uruzgan

Filko Hydro Electric Plant. This plant was built in 1950 on the Zahir Shahi canal using German equipment with 2x0.32 MW Kaplan type turbines. One of the turbines is missing, whereas the other is damaged beyond repair. Both turbines with switch gears and control panels would need to be replaced at an estimated cost of US$ 1.6 million.

Babe Wali Mydro Hydel Plant. A l x 250 kW micro hydel plant was built in 1936 on Zahir Shahi canal using German Kaplan turbine. The plant needs to be rebuilt at an estimated cost of US$ 0.75 million.

Kajaki Hydro Electric Plant. The American built plant on the Helmand River was commissioned in 1975. The design capacity of the civil works is 51.6 MW. 2 x 16.5 MW vertical Francis American turbines were installed. The transmission line from this station to the substation has been rehabilitated, and supplies are being provided to Kandahar and Helmand. Since the plant has not been serviced since 1979 and the power transformers need servicing, the estimated cost for rehabilitation is US$ 2 million. If the third turbine were also to be installed, the total cost would be about US$ 6 million.

Grishk Hydro Electric Plant. This plant was commissioned in 1945 on the irrigation canal fed by the Helmand River. It used 2 vertical Francis type turbines supplied by Westinghouse USA at a capacity of 2 x 1.2 MW. The plant is heavily damaged and of antique design. Replacement is required at a cost of about US$ 3 million.

Zabul Diesel Generation Plant. To meet the demands of the region, 30 Czechoslovakian and Russian units of different capacities amounting to a total capacity of 5,320 kW were installed. 10 units function with a capacity of 1,130 kW. Maintenance of these and replacement of the others is estimated to cost about US$ 3 million.

Nimroz Diesel Generating Sets. Four Czech diesel engines with a total capacity of 700 kVA were providing electricity to Nimroz region. All the diesel sets require overhauling and spare parts. Estimated cost for rehabilitation is US$ 120,000.

Uruzgan Diesel Generating Sets. Six diesel sets from Czechoslovakia previously supplied power to Tirin Kot's essential services with a total capacity of 130 kW. The entire system has been destroyed. Estimated cost of rehabilitation is US$ 500,000.

South West Region Substations

Name of Sub-station	Capacity (MVA)	Voltage (kV)
Lashkar Gah	12.50	110/4
Lashkar Gah	5.00	44/32
Kandahar	2 x 25	110/20
Pashmol	1 x 4	110/20
Grishk	1 x 3.45	44/3.3
Sungeen	1 x 4	110/20

Lashkar Gah Sub-Station. The 12.5 MVA capacity sub-station has been damaged but is operational. Rehabilitation would require USS 400,000.

Lashkar Gah substation. The 5.2 MVA capacity sub-station is functional and requires only minor servicing and spare parts.

Kandahar Sub-Station. One transformer of 25 MVA has been commissioned and one more 25 MVA is required. The estimated cost to complete the substation is US$ 2.5 million.

Grishk Sub-Station. A 3.4 MVA 44/3.2 kV transformer is required estimated at USS 500,000

Sungeen substation. A 4 MVA substation has been erected. A town network is required at an estimated cost of US$1.5 million.

South West Region Transmission

From	To	Distance (km)	Voltage (kV)	Length in km (single circuit)
Kajaki	Junction	74	110	74
Junction	Kandahar	97	110	97
Junction	Lashkar Gah	48	110	48
Lashkar Gar	Grishk	58.5	44	58.5

Transmission line Kajaki to Junction. The 74 km, transmission voltage 110 kV using ACSR conductor size 397.5 mm lost 100% of the conductor in 1990 and 27 towers needed to be rehabilitated. The line has been repaired and is operational.

Transmission line Junction to Kandahar. This single circuit line connects Junction to Kandahar using ACSR 397.5 mm conductor over a length of 97 km. The damaged portion length was 97 km. The line has been reconstructed and is operational.

Transmission line Junction to Lashkar Gah. A 48 km single circuit line conveys power from Kajaki to Lashkar Gah. All 48 km of this line were damaged. The line ahs been reconstructed and is operational.

Transmission line Lashkar Gah-Grishk. The 58.5 km, 44 kV transmission line is a total loss and will require about US$ 2.8 million to rebuild.

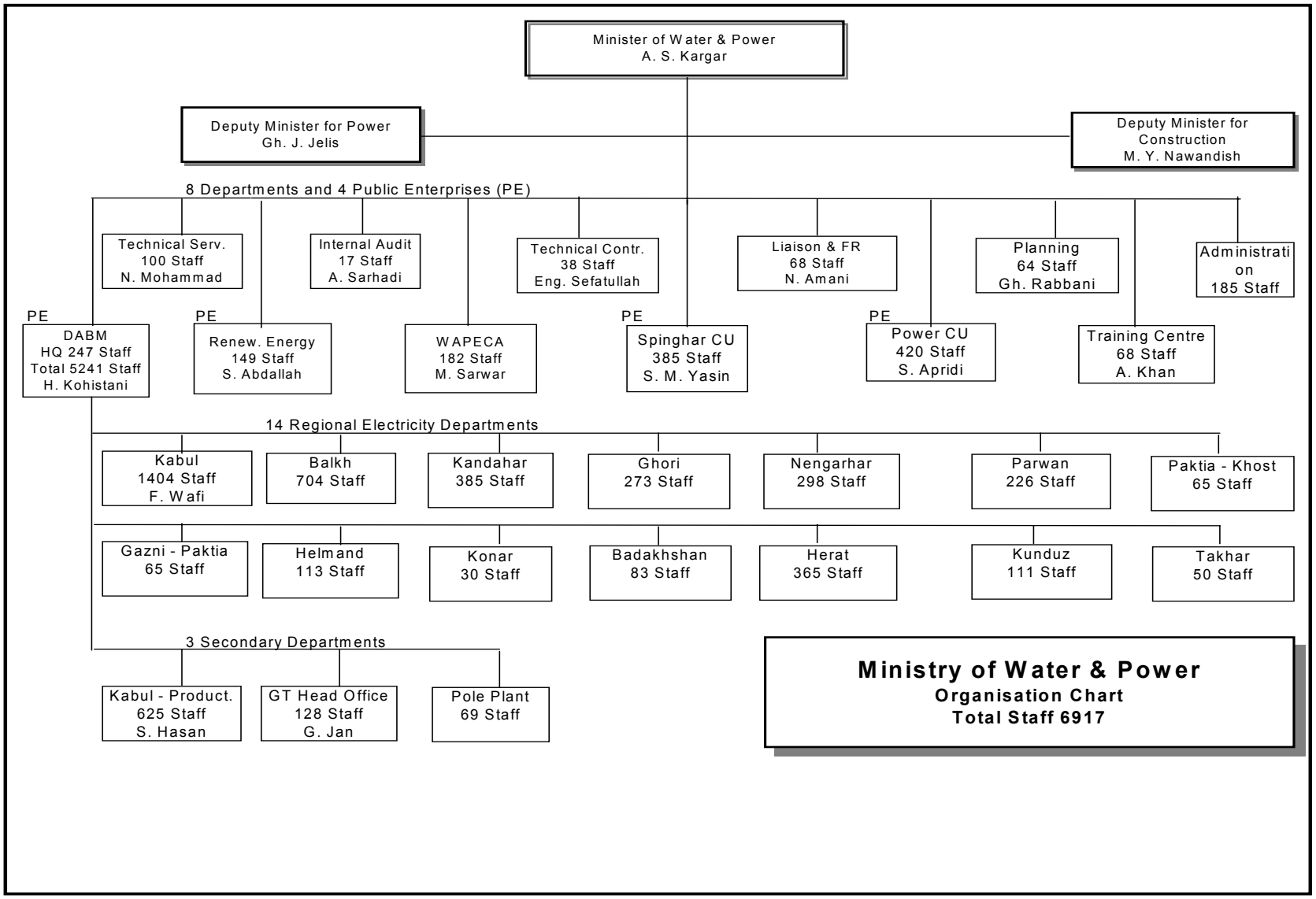
ANNEX 3

Annex 3: Afghanistan Generation Installed Capacity

Name of the plant		Country of origin	Year of commissioning	No. of units	Installed capacity kW	Area served
North East Region Generation					**15,995**	
Faizabad	hydro	India	1,984	3	255	Badakhshan
Baharak	hydro	India	1,986	2	200	Badakhshan
Pulikhumri-II	hydro	USSR	1,964	3	9,000	Baghlan
Pulikhumri-I	hydro	Germany	1,960	3	4,800	Baghlan
Khanabad	hydro	Germany	1,950	3	1,740	Kunduz
Northern Region Generation					**60,000**	
Fertilizer	TG			3x12+1x9	45,000	
Khoja	TG			2	2,000	
Jarqodoq	TG			6	12,500	
Maimana	Diesel	UK	??	1	500	Maimana
Western region generation					**14,010**	
Chalwarcha	Hydel	Germany	1,936		80	District Enjil
Diesel Gen. Sets Herat	Diesel	USA	1964 –1979		3,400	Herat city
		Czech			not working	
		USSR				
Diesel Gen. Sets Badghis	Diesel	Czech	1970 – 1983		530	Badghis
		USSR				
Diesel Gen. Sets Farah	Diesel	Czech	1970 –1981		10,000	Farah
		USSR				
East Central region generation					**1,000**	
Bamyan	Diesel	Czechoslovakia	1,972	4	700	Bamyan
Ghor	Diesel	Czechoslovakia	1,980	2	300	Ghor
Central Region Generation					**256,840**	
Naghlu	Hydro	USSR.	1,967	4	100,000	Kabul
Mahiper	Hydro	Germany	1,967	3	66,000	Kabul
Sarobi	Hydro	Germany	1,957	2	22,000	Kabul
Kabul East	Gas Turbine	Switzerland	1,978	2		Kabul
Kabul N.W.	Gas Turbine	Switzerland	1,985	2	45,000	Kabul
Charikar	Hydro	China	1,973	3	2,400	Charikar
Jabel Seraj	Hydro	US/UK/ Germany	1,920	4	2,540	Charikar
Gulbahar	Thermal	Germany	1,958	1	2,800	Gulbahar
Gulbahar	Diesel	Germany	1,958	3	2,200	Gulbahar
Kabul	Diesel	Czech	1,960	20	10,000	Kabul
Logar	Diesel	Czech	1,975	2	300	Pul-e-Alam
Chak Wardak	Hydro	Germany	1,940	3	3,300	Chak Wardak
Ghorband	Hydro	India	1,975	3	300	Ghorband

Name of the plant		Country of origin	Year of commissioning	No. of units	Installed capacity kW	Area served
Eastern Region Generation					**14,650**	
Darunta	Hydro	USSR	1,964	3	11,550	Jalalabad
Samer Khel	Diesel	USSR		4	2,400	
Assadabad	Hydro	Germany	1,983	2	700	Assadabad
Southern Region Generation					**2,065.00**	
Paktika	Diesel	Czechoslovakia	1,990	4.00	600.00	Khost and Gardez
Paktika		Czechoslovakia	1,963	3.00	300.00	Urgon
Ghazni		Czechoslovakia and USSR	1,963	16.00	1,165.00	Ghazni
South Western Region Generation					**46,410**	
Filko	Hydel	Germany	1,950	2	640	Kandahar
Baba-Wali	Hydel	Germany	1,936	1	250	Kandahar
Kajaki	Hydel	USA	1,975	2	33,000	Helm and Kandahar
Grishk	Hydel	USA	1,945	2	2,400	Grishk
Kandahar	Diesel	USA	1,948	14	2,800	Kandahar
Zabul	Diesel	Czech	1,980	30	5,320	Zabul
Nimroz	Diesel	Czech	1,979	4	700	Nimroz
Uruzgan	Diesel	Czech	1,982	6	1,300	Uruzgan

ANNEX 4


Minister of Water & Power
A. S. Kargar
Deputy Minister for Power
Gh. J. Jelis
Deputy Minister for Construction
M. Y. Nawandish
8 Departments and 4 Public Enterprises (PE)
Technical Serv.
100 Staff
N. Mohammad
Internal Audit
17 Staff
A. Sarhadi
Technical Contr.
38 Staff
Eng. Sefatullah
Liaison & FR
68 Staff
N. Amani
Planning
64 Staff
Gh. Rabbani
Administrati
on
185 Staff
PE
DABM
HQ 247 Staff
Total 5241 Staff
H. Kohistani
PE
Renew. Energy
149 Staff
S. Abdallah
WAPECA
182 Staff
M. Sarwar
PE
Spinghar CU
385 Staff
S. M. Yasin
PE
Power CU
420 Staff
S. Apridi
Training Centre
68 Staff
A. Khan
14 Regional Electricity Departments
Kabul
1404 Staff
F. Wafi
Balkh
704 Staff
Kandahar
385 Staff
Ghori
273 Staff
Nengarhar
298 Staff
Parwan
226 Staff
Paktia - Khost
65 Staff
Gazni - Paktia
65 Staff
Helmand
113 Staff
Konar
30 Staff
Badakhshan
83 Staff
Herat
365 Staff
Kunduz
111 Staff
Takhar
50 Staff
3 Secondary Departments
Kabul - Product.
625 Staff
S. Hasan
GT Head Office
128 Staff
G. Jan
Pole Plant
69 Staff
Ministry of Water & Power
Organisation Chart
Total Staff 6917

ANNEX 5

Electricity tariffs in Afghanistan

The following electricity tariffs are valid for Afghanistan. The price is per kWh and an exchange rate of USD 1 = Afs 48.81 (exchange rate of June 2003) has been used for calculation of the tariff in USc.

Customer group	Kabul [1]		Balkh		Kunduz		Herat	
	Afs	USc	Afs	USc	Afs	USc	Afs	USc
Domestic			2.0	4.1	2.5	5.1	4.0	8.2
up to 600 kWh [2]	0.5	1.0						
601 --- 1200 kWh [2]	1.6	3.3						
above 1200 kWh [2]	2.5	5.1						
Government	5.0	10.2	5.5	11.3	5.0	10.2	7.0	14.3
Other	5.0	10.2	5.5	11.3	5.0	10.2	7.0	14.3
Foreign NGOs etc.	5.0	10.2	6.0	12.3	10.0	20.5	10.0	20.5

[1] Also valid for other hydropower based systems.
[2] Consumption per 2 month period (invoicing period).

The tariff in areas supplied from hydropower generation is considerably lower than the tariff for areas supplied from thermal generation and import. The average consumption for domestic consumers in the Kabul area was around 2,600 kWh in 2002. The average domestic tariff can thus be assumed to be close to the lower tariff group of 0.5 Afs per kWh.

Average tariff: Kabul (USc 2.0 per kWh); Balkh (USc 5.2 per kWh); Kunduz (USc 5.9 per kWh); and Herat (USc 9.1 per kWh).

ANNEX 6

[Source: Summary Appraisal of the Technical and Socio-economic Situation of the Power Sector Kabul Region (including an outlook to the other parts of Afghanistan) Prepared by: Axel Werner, KfW Advisor to MWP, April 30, 2003]

Selected Energy and Power Values for Afghanistan

1 Installed Generation Capacity in MW

	Hydro	GT	Steam	Diesel	Total
Ministry of Water and Power	256.05	88.60	0.00	32.25	376.90
Ministry of Mines and Industries	0.00	65.00	0.00	0.00	65.00
Ministry of Light Industries and Food	4.80	0.00	4.11	2.70	11.61
Total MW (regardless of condition)	**260.85**	**153.60**	**4.11**	**34.95**	**453.51**

2 Overall Production (SY 1380 = 2001/02) in GWh

Supply System	Gross Generat.	Plant Use	Net Generat.	Losses	Net Distribut.	Tr. & Dist. Loss %
Kabul (hydro)	311.809	52.052	259.757	67.160	192.597	25.9
Nangarhar (hydro)	45.446	0.244	45.202	12.527	32.675	27.7
Kandahar (hydro)	94.168	1.886	92.282	21.732	70.550	23.5
Pul-i-Khumri (hydro)	23.286	1.292	21.994	5.316	16.678	24.2
Parwan Region (hydro)	1.450	0.020	1.430	0.459	0.971	32.1
Konar (hydro)	0.030	0.000	0.029	0.008	0.021	27.0
Baba Wali (hydro)	0.065	0.001	0.064	0.019	0.045	30.0
Filko (hydro)	0.298	0.004	0.294	0.082	0.212	27.9
Badukhchan (hydro)	0.098	0.001	0.097	0.031	0.066	32.0
Diesel	1.500	0.021	1.479	0.429	1.050	29.0
Country Total	**478.150**	**55.522**	**422.628**	**107.763**	**314.864**	**25.5**

3 Available Capacity in MW

A gross generation of 311.809 GWh at an estimated load factor (LF) of 30.9 %
is equivalent to an available capacity of about 115.2 MW of the Kabul hydro system.
This means that approximately 25.4 % only of the installed capacity as per 1 were available in 2001/02.
Since January 2003, the GT Kabul North is rehabilitated, adding 45 MW available capacity.
This takes the actually available capacity to 160.2 MW (Kabul peak in Jan./Feb. 2003)
Assuming simmilar conditions in the other power plants, generation outside of Kabul may provide an additional available capacity of about 61.5 MW. The remainder of the country's load is imported from Uzbekistan and Turkmenistan (imports from Tadjikistan and Iran not figured)

4 Summary (Jan./Feb. 2003) in MW

Kabul Hydro	115.2
Kabul Gas Turbines	45.0
Generation outside of Kabul	61.5
Import from Uzbekistan	5.0
Import from Turkmenistan	7.0
TOTAL COUNTRY LOAD	**233.7**

ANNEX 7

Afghanistan Power Sector Reform: Road Map

Phase Activities	Preparatory Phase 2003 to 2004	Intermediate Phase 2005 to 2007	Long-term Phase 2008 to 2010	Results
Legislation	▪ New Constitution is enacted ▪ National economic legislation is completed. ▪ MWP Policy Framework approved ▪ Power sector specific law prepared	▪ Power Sector specific law is enacted ▪ Law and regulations are completed and implemented		▪ Comprehensive Power sector regulation is functional
Regulator	▪ Capacity building in MWP on regulation functions ▪ MWP continues to adjust tariffs in Kabul to cost-recovering levels ▪ Study on future industry structure completed	▪ Independent Regulatory Agency is created	▪ Independent Regulatory Agency is fully operational	▪ The Regulatory Agency is operating independently
Utility Operation	▪ Basic commercialization activities are undertaken ▪ Billing and collection ▪ Accounting systems ▪ Cost of service analysis ▪ Metering and connections ▪ Theft control ▪ New connections	▪ Separate generation and distribution companies established according to the Policy Framework o Kabul Distribution Company (KDC) is created and a management contract (MC) is awarded	▪ Generation and distribution companies are ready for a deeper Private Sector Participation	▪ Distribution and generation companies providing efficient and reliable power to the country with private sector participation ▪ Government has the subsidiary role in the sector
Physical Infrastructure	▪ Master Plan for power sector is completed ▪ Reconstruction projects are completed (ADB, KfW, WB) ▪ Study/Plan for Kabul and major provincial cities distribution network completed ▪ Key feasibility studies initiated ▪ Implementation of urgent priority projects according to Master Plan initiated ▪ Study on options to expand rural access	▪ Hairitan to Kabul transmission line is constructed. ▪ IDA and soft loans finance new projects in KDC (200,000 new customers are connected) ▪ MWP construct new distribution projects around the country (200 000 new customer are connected) ▪ Master Plan priority generation and transmission projects initiated ▪ Rural electrification program implemented.	▪ KDC connected 200,000 new customers ▪ New generation installed on the order of 200 MW ▪ Electricity reaches 75% of all districts ▪ Backbone of national transmission grid constructed.	▪ 40% access has been achieved (from 4-6% today) ▪ Reduction of overall system losses from 40-50% to 20-30%

ANNEX 8

Transitional Islamic State of Afghanistan
Ministry of Water and Power

Electricity Sector Policy

August 2003

1. Policy Vision

Electricity is a vital service in the economy; it is an input in the production of nearly all other goods and services, and it is also an important final good, consumed by households. The Transitional Islamic Government of Afghanistan recognizes that the electric sector is essential to achieve the nation's reconstruction and development goals. Electricity is the backbone of the economic recovery and availability of reliable power will help stimulate economic growth, raise living standards and restore the traditional sense of community and common purpose that unites the Afghan people. A reliable power system is essential to providing basic services, in attracting new industries, retaining existing ones, and bringing back to the country those that have left.

Today, only 4-6 % of the country's population has electricity, and among those 4-6%, the availability is unreliable. Many of the country's residents and businesses rely on diesel generators placed on their premises. Afghanistan has the lowest per capita consumption of electricity in the world. After 23 years of armed conflict that destroyed the country's electrical infrastructure, the total consumption of electricity has declined from 554 GWh per year in 1980 to 394,000 GWh in 2000, reducing the consumption by a third of what it is today. Similarly on the generation side, even though the country's nameplate capacity remains at 454 MW, the actual production is around 240 MW, due to the damage and lack of maintenance of the generation plants.

The vision of the Ministry of Water and Power (MWP) is:

> *By 2010, to evolve into autonomous, financially viable enterprises providing reliable, low cost electric service to all Afghan citizens in an environmentally responsible manner, consistent with sound business practices*

To accomplish the above vision, the MWP has planned, over the next few years, ambitious projects with the goals of rehabilitating its existing infrastructure, increasing its generation capacity through the participation of the private sector, steadily increasing the number of customers it serves, establishing more appropriate tariffs, and increasing its revenue through enhanced and effective billing and collection and loss reduction procedures. The MWP also recognizes the pressing need to develop institutional capacity and tools that would allow it to effectively manage the reconstruction efforts of the electric infrastructure. The purpose and objectives of this policy is to provide the organizational structure and the legal and regulatory framework which would allow the MWP to accomplish its vision, while at the same time transforming the power sector into a commercially viable and stable sector that attracts and retains private investors.

The Government supports the liberalization of the electricity sector, through a combination of competition and regulations, as market forces. The government, where possible, will encourage the joint use of its physical electric infrastructure to provide other services. Where joint use is possible, the MWP intends to competitively price the cost of providing and managing these services.

To encourage and attract private sector involvement, and to provide for the safety of customers and environmental stewardship, the government will develop a regulatory framework and will introduce law that would create an independent electricity regulatory entity.

2. Role of the Government

The Government's chief objective, as articulated and led by the MWP, is to set the overall vision for the electricity sector, to create the organizational structure which would allow the transparent execution of all its policies and vision, and to enable the environment for private investment, competition and rapid industry growth. The Government itself will no longer be the *operator* of the electric sector. The MWP would continue to have the sole responsibility for sector policy, specifically including the drafting of legislation and the development of international competitive tenders for private sector participation. More specifically, the MWP role would be to:

- Provide overall direction for electricity sector development and formulate broad policies and regulations for the benefit of all of Afghanistan that is consistent with other national development plans and laws;
- Initiate the establishment of an independent electric regulatory entity;
- Promote private sector participation and investment in the electricity sector;
- Encourage the expansion of access to underserved and rural communities;
- Stimulate the rational use of new and renewable sources of energy; and
- Represent the government of Afghanistan in electricity matters pertaining to regional interconnections and international organizations.

3. Restructuring of the Electricity Sector

The sector would be restructured by (i) separating the utility functions (generation, transmission and distribution/sale of electricity) from sector policy and planning functions; (ii) strengthening the role of MWP in preparing and implementing sector policies, coordinating donor programs, and improving governance in the sector; (iii) establishing an independent regulatory entity, which would set technical, financial and operational performance standards and regulate the power sector; and (iv) developing feasible options for handling certain non-core functions which are currently being handled by MWP or by government enterprises controlled by MWP.

3.1. The MWP

The MWP comprises nine (9) departments and has de facto responsibility for four (4) public enterprises. These enterprises are:

- Da Afghanistan Breshna Mosssesa (DABM), which is responsible for the operation & maintenance for generation, transmission & distribution, and sales of electricity.
- New & Renewable Research and Development Center, which is responsible for the research and introduction of devices that use new and renewable sources (solar, wind, biomass, micro hydros).
- Spinghar Construction Unit, which is responsible for the civil works for substations, power stations, and other facilities.
- Power Construction Unit, which is responsible for the erection of power stations equipment, transmission and distribution lines, and substations.

The role of MWP will be redefined to cover (i) the preparation and execution of sector policy and planning; (ii) preparation of the legal framework for the electricity sector (in coordination with

other Ministries); and (iii) coordination of donor programs and activities. MWP will no longer be responsible for the day-to-day management and operation of the public enterprises. MWP will seek expert services and advice for strengthening its policy making role, as well as for enhancing staff capabilities through training and other institutional development programs.

3.2. DABM

DABM is responsible for the generation, transmission, distribution of electricity, operation and maintenance of assets, sales of electricity, and revenue collection. As a first step to separate these utility functions from MWP, a new Board of Directors will be constituted. This Board would include representative(s) of the Ministry of Finance, which is the owner of the enterprises, the MWP, and other relevant stakeholders, and will ensure that the public enterprises will operate in accordance with commercial principles.

3.3. Other Enterprises

Presently MWP (and/or DABM) also perform some activities which are normally performed by the private sector, and can be acquired on a competitive basis by the electricity sector entities. These include Power Construction Unit, Spinghar Construction Unit, a Pole Manufacturing Plant, Water and Power Electricity Consultants Authority (WAPECA), and the New & Renewable Research and Development Center – which handles research and pilot programs for promoting new and renewable sources. The Government intends to (ultimately) divest these functions to the private sector.

4. Creation of an Electric Regulatory Entity

Today, no legal and regulatory framework exists in Afghanistan. Tariffs settings, one of the basic functions of a regulatory agency, are done at the MWP. There is no provision for private participation in the power sector.

The government intends to create a legal and regulatory framework by establishing an electric regulatory entity. This regulatory framework would: (i) establish a licensing/ authorization process that would regulate and attract private investments; (ii) create and design electricity tariffs, and (iii) create a process that would ensure consumer safety, protection, and environmental protection.

The scope of the regulatory entity duties will include, but shall not be limited to the following:

- Implement the national policy for the power sector that ensures a fair, transparent and competitive market environment according to international best practices;
- Provide just and reasonable rates and charges for electricity services and promote conservation of energy;
- Create an enabling environment for competition and private sector participation;
- Ensure adequate, reliable, and economical utility service;
- Ensure least cost planning;
- Encourage and promote harmony between utility companies and their customers;

- Set technical standards regarding interconnection between utility companies to ensure open access on a fair and non-discriminatory basis; and
- Ensure consumer protection, safety, and environmental stewardship.

5. Implementation

To implement this policy, the government will:

- Develop an updated electricity law (last revised in 1984) to allow for, among other things, private sector participation in the sector;
- Create a Program Support Unit to ensure the accountable execution of the reconstruction efforts and act as the main implementation interface for donor-funded projects;
- Appoint a Technical Advisory Board to advise the Minister/Deputy Minister when necessary; to advise the Minister/Deputy Minister when necessary; and
- Establish a high-level Reform Task Force to lead the sector restructuring process..

The Reform Task Force, chaired by the Deputy Minister for Power and reporting to the Minister for Water and Power, would be established in MWP. It will engage consultants/experts to: (i) advise on, prepare, and implement the restructuring of DABM into independent entities responsible for the generation, transmission and distribution/sale of electricity; (ii) conduct public relations and information campaigns to develop support for the restructuring and reform program among employees, consumers, and other stakeholders; and (iii) prepare policies and recommendations for enhancing the commercial viability of the new companies/entities.

The Task Force will also identify the legal and other constraints (if any) which preclude the divestiture of non-core functions to private owners/operators, ascertain whether any staff of these entities can or should be accommodated within the MWP or DABM, and develop suitable social programs (early retirement, training, outplacement, etc) for handling the remaining staff of these entities.

ANNEX 9

[Excerpt from Chapter 4 "Demand Forecast" from the "Power Sector Master Plan – Draft Final Report" dated 20 October 2003 by Norconsult/Norplan. The final report is due January 2004.]

Introduction

The demand forecast is aiming at producing forecasts for each of the seven presently separate electricity supply regions: Kabul, Nangarhar, Parwan, Ghori, Balkh, Herat and Kandahar. A forecast for other regions and for the whole of Afghanistan are also given

The latest population census for Afghanistan was carried out in 1979, showing a population of around 14 million. The Central Statistical Office has estimated the population in 2003 based on the 1979 census and an assumption of a population growth of 1.92 % per year, resulting in a total population of 22.2 million. The vast majority of the population, around 80 % is living in rural areas.

The gross national product (GNP) in current market prices decreased by 3.5 % from 2000 to 2001 and increased by more than 50 % from 2001 to 2002. Agriculture plays an important role in the Afghan economy and accounted for more than 50 % of the GNP for the most recent years. Mining, manufacturing and energy is the second largest sector and contributed around 20 % to the GNP. The GNP per capita was USD 122 in 2001 and the preliminary estimate for 2002 is USD 186.

The present Chapter gives brief information on the method and basis used for the demand forecasts, and a summary of the results. Reference is made to Appendix A, in Volume 2 of the present study, for in depth details of the analyses, assumptions and formulas used.

Demand Model

Consumer groups

A model has been developed to project future electricity demand under alternative assumptions. The model includes demand relations for the three customer groups specified in the DABM electricity tariff:

- Domestic customers
- Governmental organisations and institutions and
- Other customers.

The last group includes also non-governmental industrial and commercial activity.

Domestic Customers

The development of domestic electricity consumption is described in an equation with income, price of electricity and the number of new connections as explanatory variables. Demographic trends (population growth and urbanisation) are often used as explanatory variables. However, for Afghanistan where less than 50 % of urban households and only some 5 % of total households have access to electricity, the Consultant is of the opinion that the utility's ability to connect new customers will be a better explanatory variable than the population growth rate.

Governmental Organisations and Institutions

The governmental customers include ministries and other administrative authorities, schools, hospitals, military installations etc. Also some commercial activities owned or controlled in some way by the Government are included by DABM in this customer group. The development of electricity consumption for government customers is described in an equation with budget growth rate and price of electricity as explanatory variables.

Other Customers

Other customers include commercial activity like industry, shops etc. The development of electricity consumption for this customer group is described in an equation with growth in value added and price of electricity as explanatory variables, plus an additive element to take into account any incremental load from new customers.

For other parts of Afghanistan than the seven mentioned regions a more simple methodology has been used. The starting point is the population in 2003 in the provincial centres and Minor Civil Divisions with an urban population and the following assumptions:

- an average of 6 persons per household;
- an initial electrification ratio of 30 % of the urban households and 5 % of the rural households;
- a consumption per household of 3 500 kWh per year;
- a load factor of 0.25;
- a growth rate of 5 % per year for energy demand and load for the Basic Forecast and 7 % per year for the High Forecast.

General Assumptions

The following is a description of assumptions made for Kabul. The description may serve as an example of the method used - similar descriptions are given in Appendix A for the regions investigated.

Some of the assumptions are common for the three forecasts. This is valid for the basis/starting point for the forecasts, the electricity tariff, average consumption for new domestic customers, distribution losses and load factor.

Forecast basis

The starting point for the forecasts is the adjusted 2002 demand (including suppressed demand from existing customers) at 570.9 GWh. Normal losses are deducted to arrive at the demand from the three customer groups (domestic, government and other customers).

Electricity tariff

As mentioned earlier the electricity tariff valid from 21 March 2003 is approximately the double of the tariff for 2002 for all tariff groups. If an average price increase of 25 % from 2002 to 2003 is assumed, the doubling of the tariff means a real tariff increase of 60% from 2002 to 2003. This tariff increase has been introduced in the demand model.

The domestic tariff will have to be increased considerably if the utility shall be able to cover its costs of supplying sufficient energy to meet the future demand. This applies regardless of the additional energy being provided by increased generating capacity or by import from neighbouring countries.

Future increases in the average real tariff for domestic customers have been assumed according to the following schedule:

2004	1.5	2007	1.25
2005	1.3	2008	1.25
2006	1.3		

This tariff increase implies that the real price of electricity will be four times as high in 2008 than in 2003. If the average price for domestic customers can be assumed to be close to Afs 0.5 in 2003 as indicated above, this means a real average domestic tariff in the order of Afs 2 – 2.5 per kWh in 2008. This is the same level as the present tariffs in Kunduz and the Balkh region, but still lower than the tariff in Herat (diesel based supply), and equivalent to around USc 4 – 5 per kWh. No further real tariff increases have been assumed for the domestic customers.

The tariff level for other customers than domestic customers is at a level equivalent to USc 10.2 per kWh after the 2003 increase. This is a relatively high price for electricity in a country like Afghanistan and no further increases have been assumed in the real tariff after 2003 for these customer groups.

Average consumption for new domestic customers

The actual domestic consumption per customer for 2002 was around 2 600 kWh. The average consumption according to the adjusted demand figures is close to 5 400 kWh, while DABM has indicated that the average household need for power is 3 600 kWh per year.

The Consultant has assumed the average consumption for new domestic customers to be connected up to and including the year 2008 to be 4 000 kWh per year. For the next five years this is reduced to 3 500 kWh per year, and thereafter it is further reduced to 3 000 kWh per year.

Distribution losses

The distribution losses for the adjusted 2002 consumption and generation have been assumed to be 20 %. These losses are assumed to be gradually reduced over the forecasting period to reach 12 % in 2020. The reason for this reduction is an assumption of rehabilitation and improvement in the distribution system during the forecast period.

Load factor

The load factor for the adjusted 2002 generation has been calculated to 0.39. The Consultant has assumed a gradual improvement in the load factor, reaching 0.50 in 2011. From this year no changes are assumed.

Basic Forecast

Domestic Consumption

The explanatory variables for development of domestic electricity consumption are real income growth and connection of new customers.

The real income growth for households supplied with electricity is assumed to be 4 % per year up to and including the year 2008 and 3 % thereafter.

The number of new domestic connections has been assumed to be 10 000 per year for the first five years after 2003. The basis for the assumption of a considerable increase in the number of new connections is the extensive ongoing and planned rehabilitation of the transmission and distribution network in the Kabul region, as well as the foreseen rehabilitation of infrastructure, including housing, and influx of returning refugees.

For the next five years of the forecast period (2009 – 2013) the number of new domestic connections has been reduced to 7 500 per year, reflecting possibly a greater share of connections in the outskirts of Kabul requiring more resources. For the last years of the forecast period, from 2014 and thereafter, the number of new connections have been further reduced to 3 000 per year.

Government Consumption

The Consultant has assumed a budget growth of 4 % per year for the years up to and including 2008 and a growth of 3 % per year for the rest of the forecast period.

Other Consumption

The Consultant has assumed a value added growth of 6 % for the year 2003, 8% per year for the period 2004 – 2008, 6% per year for the period 2009 – 2013 and 5 % per year thereafter.

Considerable construction activity is ongoing in Kabul in the summer of 2003. However, the new buildings seem mostly to be for housing and commercial purposes, like shops and offices not requiring heavy load per m^2. It seems to be little ongoing construction work for industrial purposes.

An incremental load of 2 GWh has been added in 2003, increased to 3 GWh per year for the period 2004 – 2008 and thereafter reduced to 2 GWh per year for the rest of the forecast period. The average consumption in 2002 for customers in this tariff group was around 4 300 kWh, and according to the adjusted basis without load shedding for the demand forecast the average is around 9 000 kWh. An incremental load of 2 GWh thus corresponds to the load from around 220 average customers, while 3 GWh corresponds to the load from around 330 average customers.

Low Forecast
In the Low Forecast a slower real income growth for the domestic sector, a lower number of new domestic customers, a lower growth in government budgets, a lower value added growth as well as lower incremental demand for other customers have been assumed compared to the assumptions for the Basic Forecast.

High Forecast
In the High Forecast a higher real income growth for the domestic sector, a higher number of new domestic customers, a higher growth in government budgets, a higher value added growth as well as higher incremental demand for other customers have been assumed compared to the assumptions for the Basic Forecast

Results

Forecast summary - Afghanistan

Table 4.1: Summary Energy Demand Forecasts for Afghanistan (GWh)

Region	Present load	Suppressed demand	Forecast basis	2020 energy demand forecast		
				Basic	Low	High
Kabul	359	212	571	1 373	846	1 879
Nangarhar	49	9	58	209	111	335
Parwan	1	38	39	157	93	256
Ghori	28	75	103	460	287	733
Balkh	149	52	201	730	448	1 060
Herat	1	51	52	291	185	473
Kandahar	141	43	184	442	295	630
Other	22	65	87	199		274
Total	750	545	1 295	3 861		5 640

In the Basic Forecast the energy demand is assumed to reach 3 861 GWh in the year 2020. This gives an average annual growth rate of 6.3 %.

In the High Forecast the energy demand is assumed to reach 5 640 GWh in the year 2020. This is 46 % higher than the Basic Forecast and implies an average annual growth rate of 8.2 %.

Table 4.: Summary Peak Load Forecasts for Afghanistan (MW)

Region	Present load	Suppressed demand	Forecast basis	2020 peak load forecast		
				Basic	Low	High
Kabul	111	55	166	313	193	429
Nangarhar	8	5	13	43	23	70
Parwan	2	8	10	36	21	58
Ghori	14	12	26	103	64	158
Balkh	38	13	51	167	102	242
Herat	2	13	15	66	42	103
Kandahar	30	12	42	92	61	131
Other	10	30	40	91		125
Total	215	138	363	911		1 316

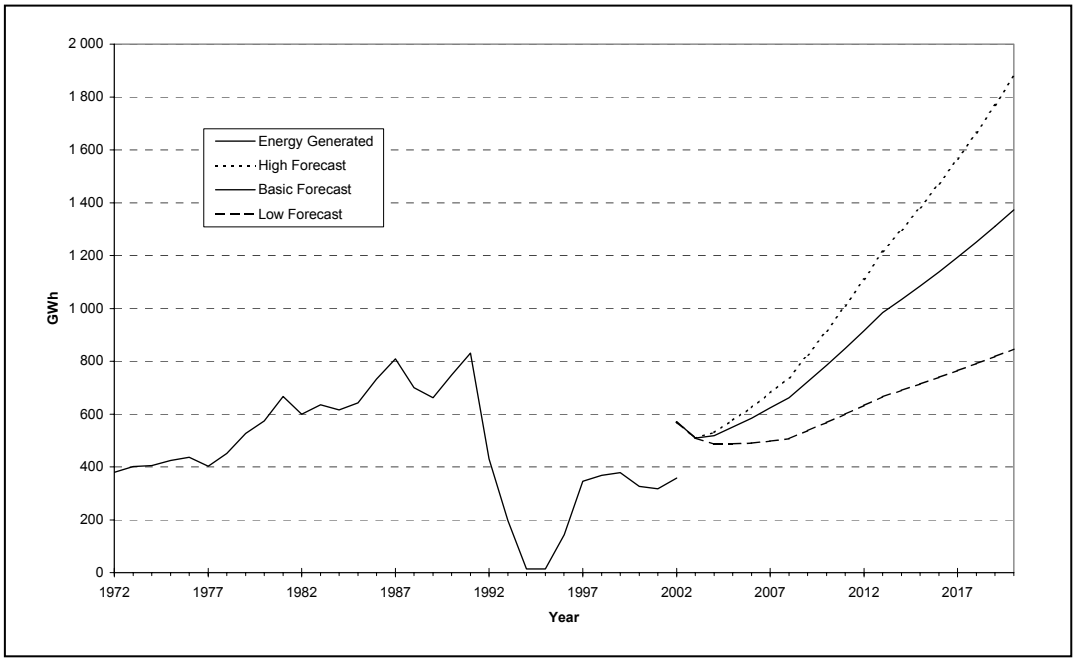
The present peak load is assumed to be around 215 MW for all of Afghanistan. Adding a suppressed demand assumed to be 138 MW the peak load starting point for the forecasts is 363 MW.

In the Basic Forecast the peak load is assumed to increase to 911 MW in 2020. This gives an average annual growth rate of 5.2 %. The growth rate for the peak load is somewhat lower than the growth rate for energy demand since the load factor is assumed to increase during the forecast period.

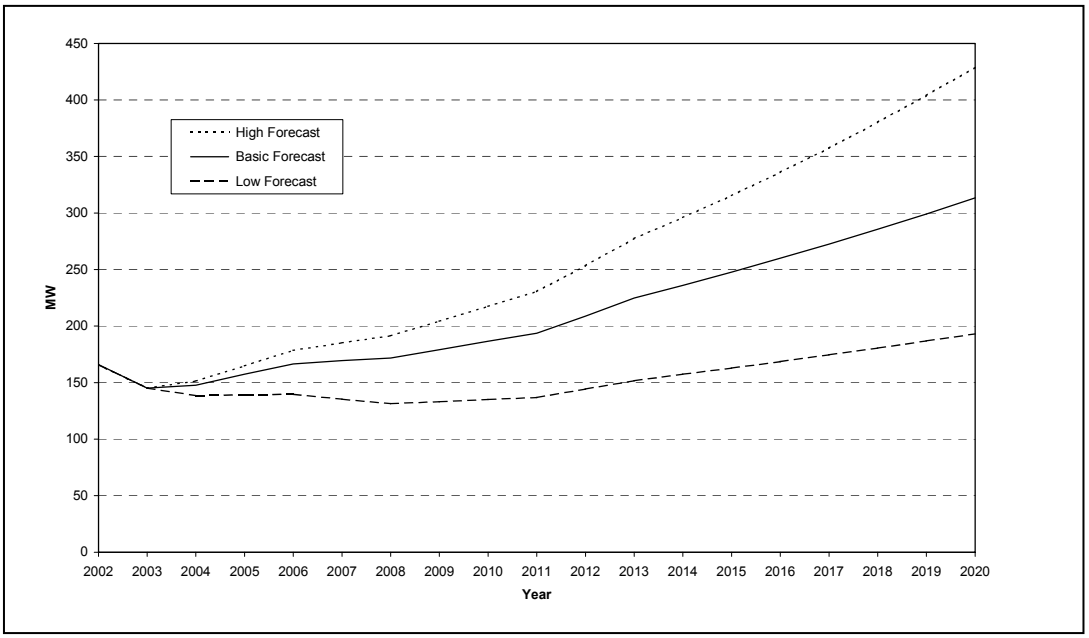
In the High Forecast the peak load is assumed to increase to 1 316 MW in 2020. This gives an average annual growth rate of 7.4 %.

Energy and peak power demand - Kabul region

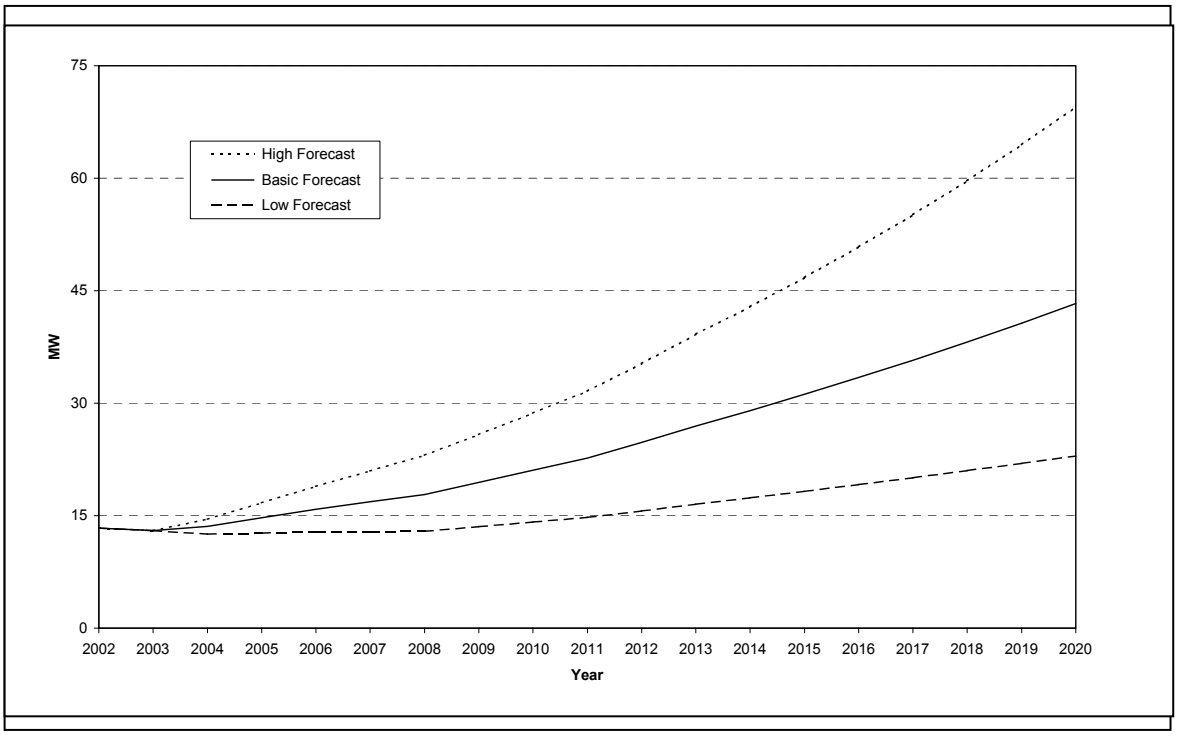
The actual energy consumption for the years 1972 - 2002 and the three forecasts for the period 2002 - 2020 are illustrated in figure below, for the Kabul region. The next figure shows power demand forecast



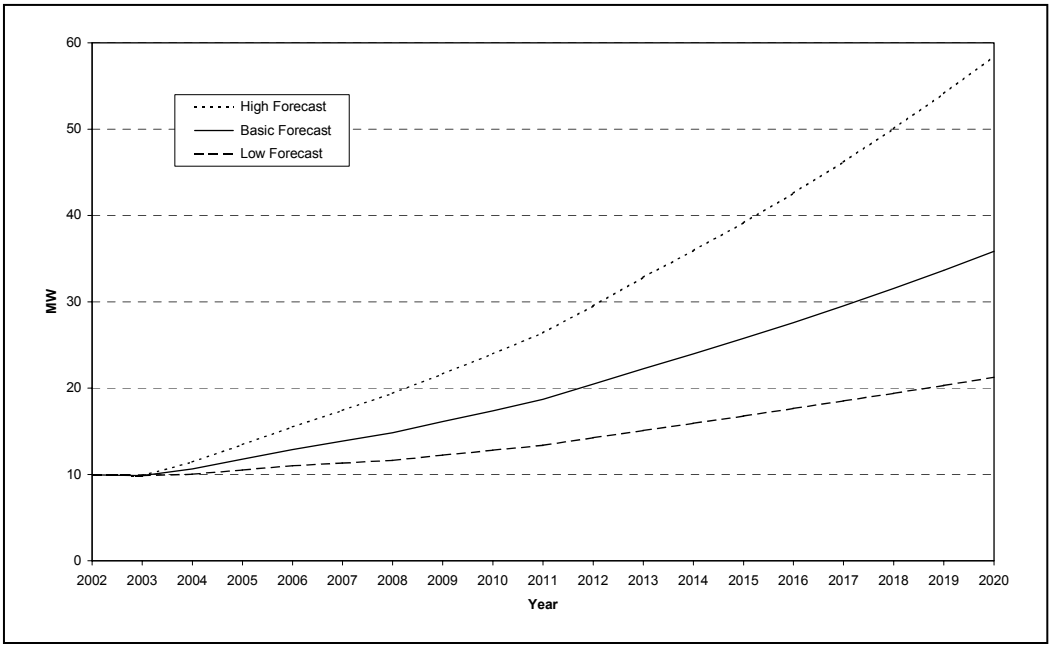
Peak load forecasts, Kabul

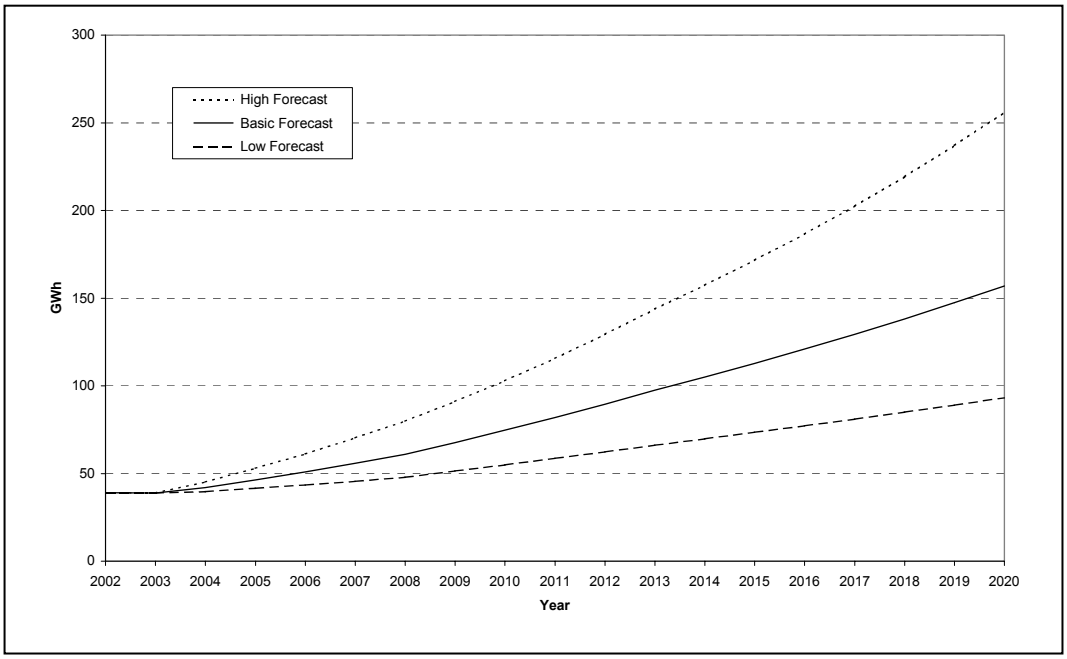


Energy and peak power demand forecast, Nangarhar

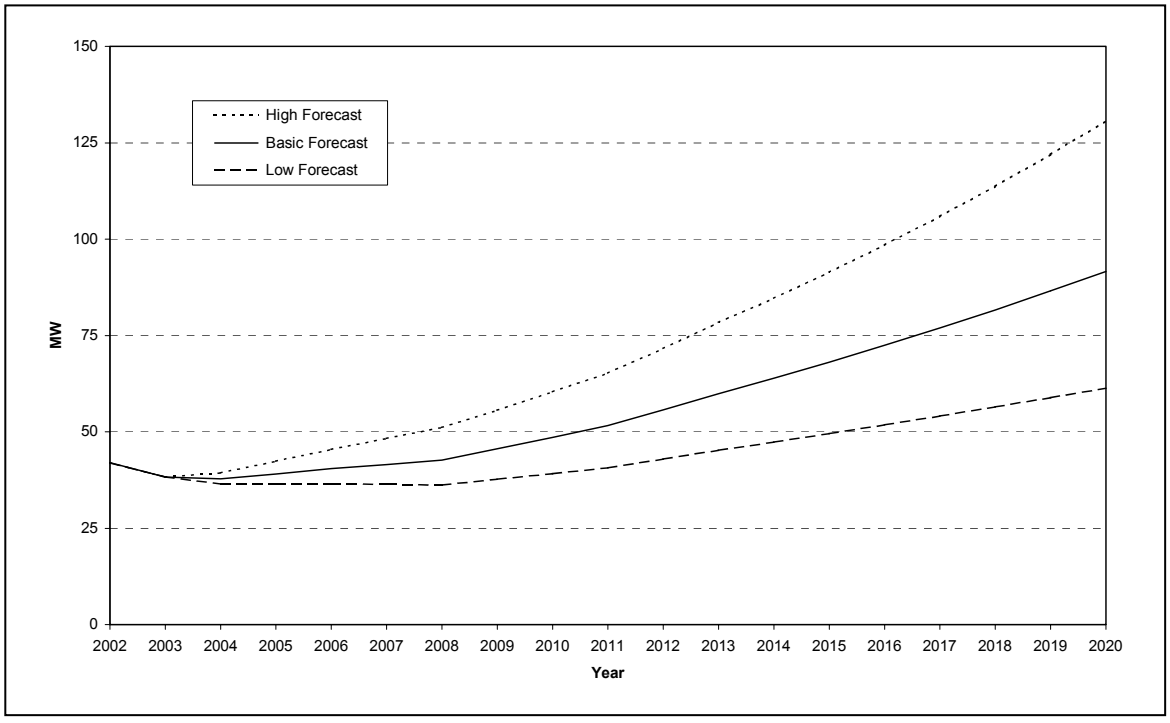


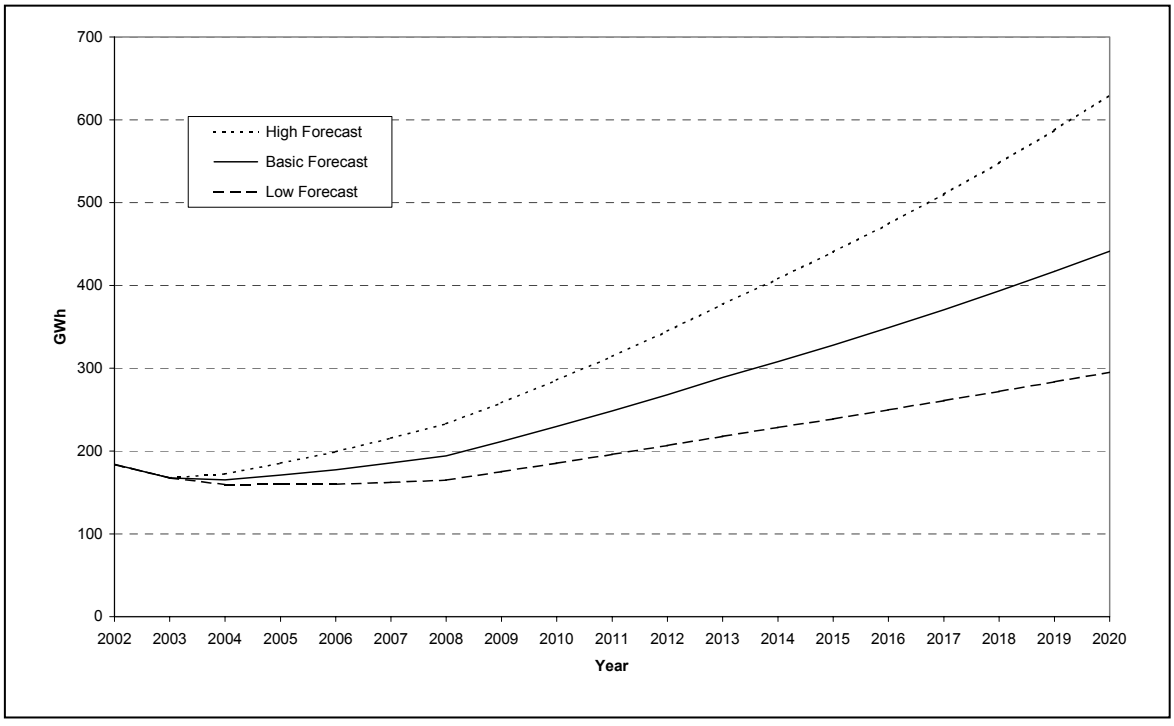
Energy and peak power demand forecast Parwan



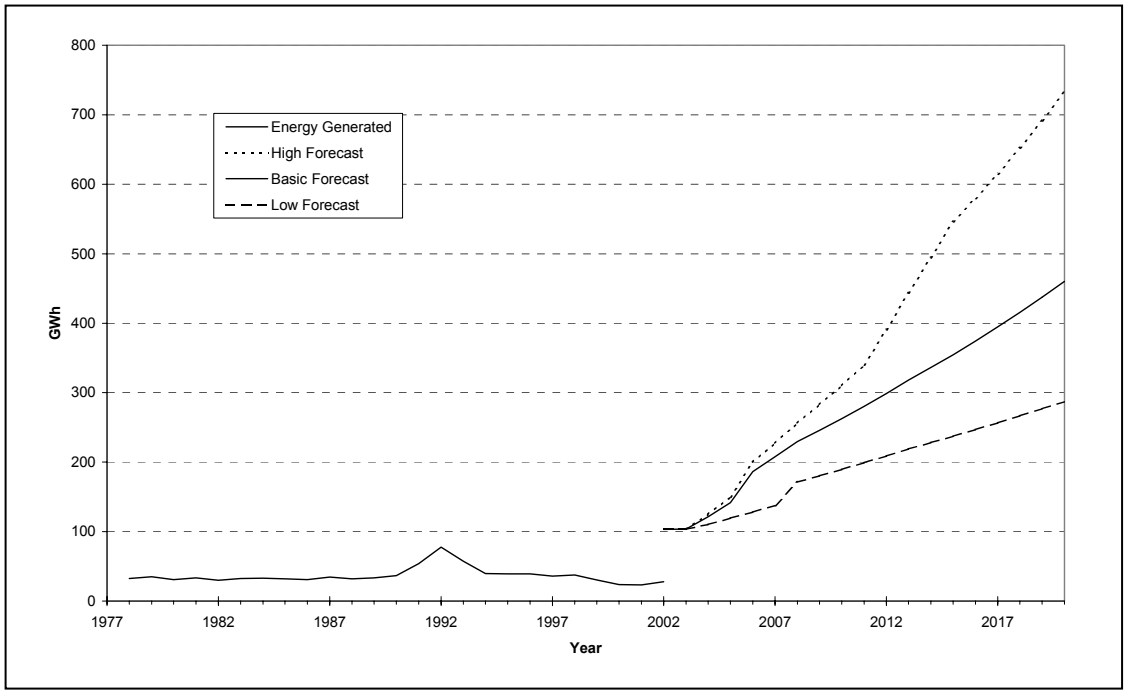


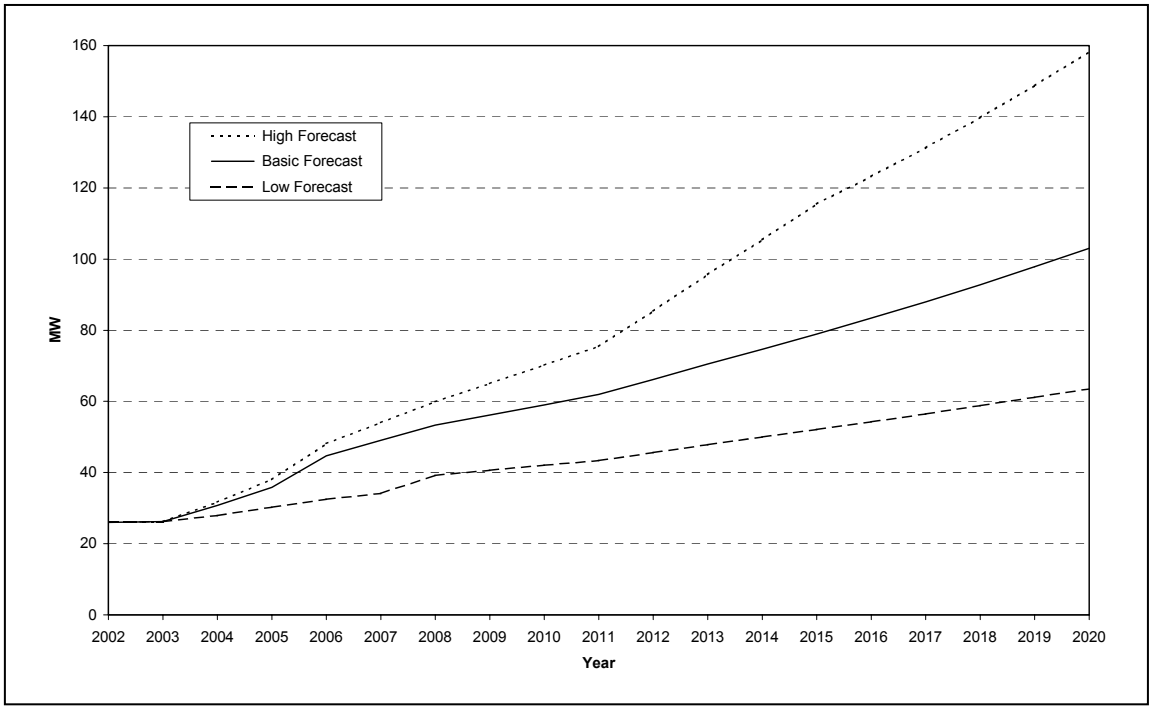
Energy and peak power demand forecast, Kandahar



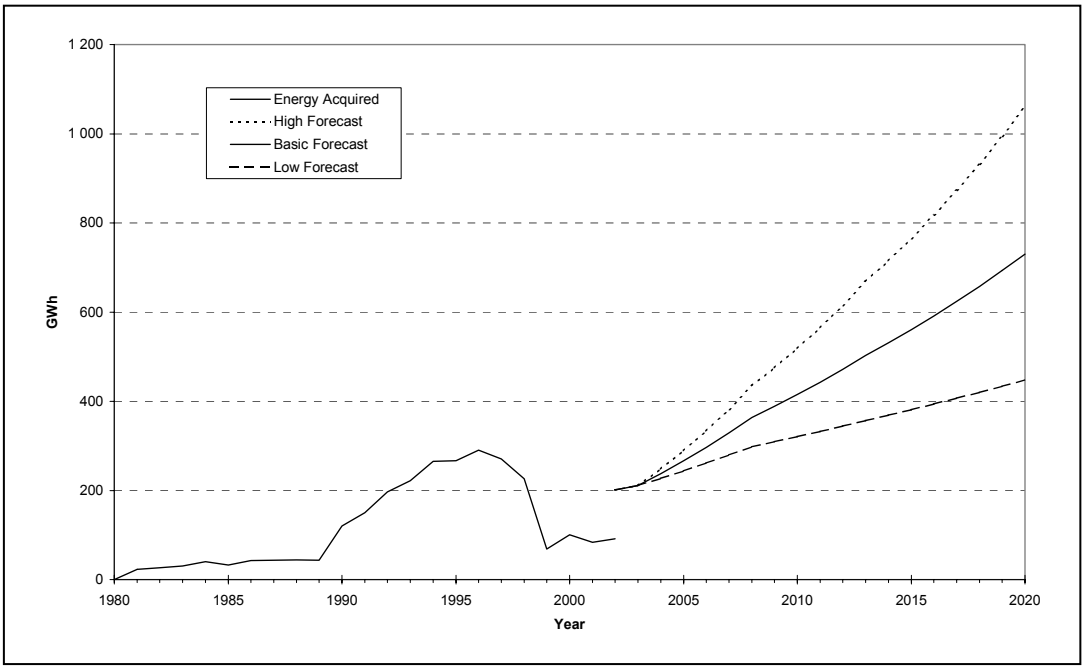


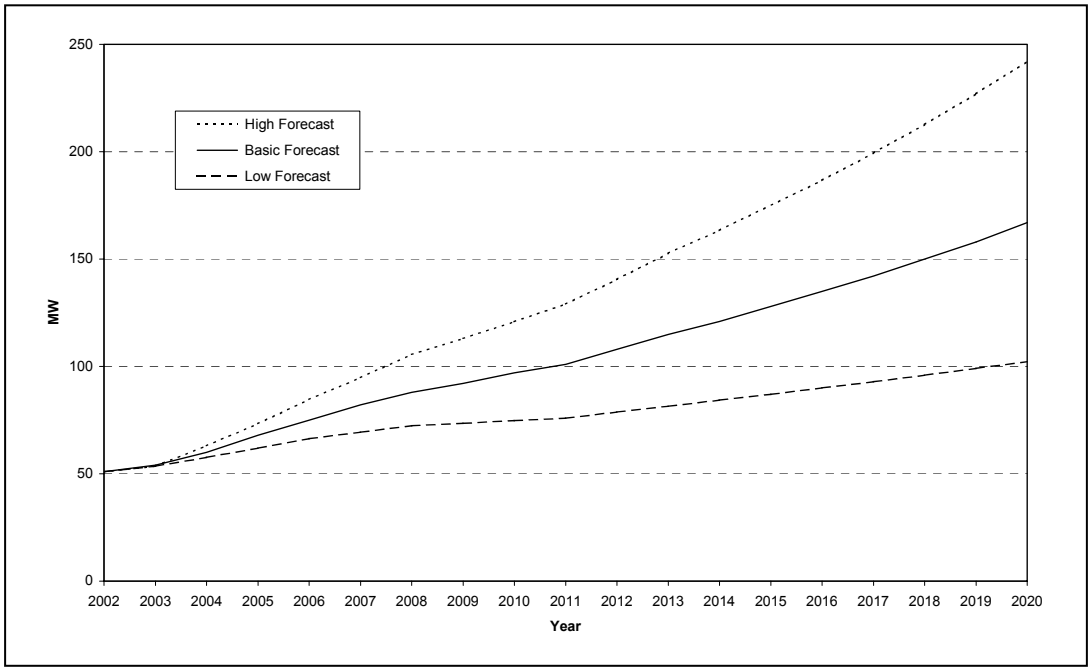
Energy and peak power demand forecast, Ghori





Energy and peak power demand forecast, Balkh





Energy and peak power demand forecast, Herat