IUCN Pakistan Programme

Northern Areas Strategy for Sustainable Development

Background Paper

Energy

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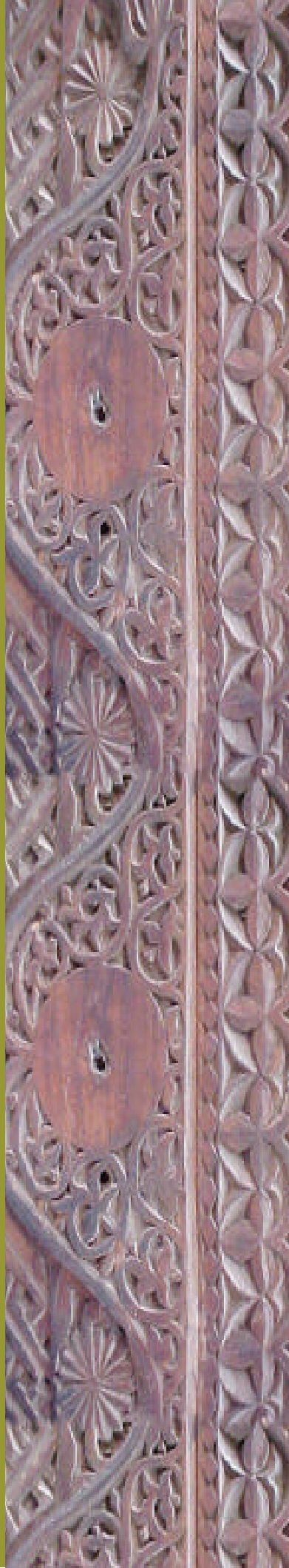
IUCN
The World Conservation Union



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LIST OF ACRONYMS

AKRSP	Aga Khan Rural Support Programme
AKDN	Aga Khan Development Network
AKCSP-P	Aga Khan Cultural Services, Pakistan
AKES	Aga Khan Education Services
AKHS	Aga Khan Health Services
AKU	Aga Khan University
BACIP	Building and Construction Improvement Programme
BAEJ	Baltistan Association of Environmental Journalists
BCF	Baltistan Cultural Foundation
DFID	Department for International Development
FWO	Frontier Works Organisations
GoP	Government of Pakistan
GCIC	Gilgit Information and Conservation Centre
HERP	Hunza Education Resource Project
HWF	Himalayan Wildlife Foundation
KADO	Karakoram Area Development Organisation
MoKANA	Ministry of Kashmir and Northern Areas Affairs
NACS	Northern Areas Conservation Strategy
NA	Northern Areas
NAA	Northern Areas Administration
NCS	National Conservation Strategy
NDO	Nounehal Development Organization
NGO	Non-Governmental Organization
NRM	Natural Resource Management
MACP	Mountain Areas Conservancy Project
PRIF	GEF – Pre-Investment Facility Project
SPCS	Sarhad Provincial Conservation Strategy
SAP	Social Action Programme
VCC	Village Conservation Committee
VC	Village Councils
VO	Village Organisations
WO	Women Organisation
WASEP	Water and Sanitation Extension Programme
WWF-P	World Wide Fund for Nature, Pakistan

FOREWORD

The Northern Areas have a unique and critical role to play in the sustainable development of Pakistan. Although they span a relatively small geographical area, the Northern Areas serve as a vital catchment for the Indus River, upon which a majority of Pakistan's irrigated agriculture and hydroelectricity depends. The Northern Areas also contain the nation's most important natural forests, extensive mineral reserves, and a wealth of biodiversity. Dramatic scenery, some of the world's highest mountains, and a rich cultural and archaeological heritage make the Northern Areas one of the most visited tourist destinations in the country.

Over the last several decades, however, many of the Northern Areas' natural resources have come under increasing pressure, as a result of a growing human population and the opening of the Karakoram Highway. At the same time, it has become increasingly recognised that the isolated nature of many of the region's communities, coupled with the Northern Areas' high-altitude and fragile environment, poses special constraints and challenges to development. Perhaps more so than in any other part of Pakistan, there is a need in the Northern Areas to ensure that social and environmental considerations are fully integrated into the development process.

In response to these concerns, the Northern Areas Administration began the preparation of a Northern Areas Strategy for Sustainable Development in 1999, with the financial assistance of the Swiss Agency for Development and Cooperation, and the Norwegian Agency for Development Cooperation; technical support has been provided by IUCN–The World Conservation Union. The Strategy addresses a broad range of social, economic and environmental issues, and seeks to provide a comprehensive policy framework for the sustainable development of the region. It responds directly to the provisions and recommendations of the National Conservation Strategy, adopted by the Government of Pakistan in 1992.

In parallel, *The State of the Environment and Development in the Northern Areas* summarises in a single volume the key information gathered during the preparation of the NASSD. It is the first report of its kind to be produced for the Northern Areas, which provides a succinct, up-to-date and readily accessible analysis of the status of the most important environment and development sectors in the Northern Areas, including information on major trends and issues, the responses taken by both government and civil society to date, and strategic options for the future. It also provides a baseline against which future change can be measured and establishes the context and foundations for the Northern Areas Strategy for Sustainable Development.

During early consultations at the tehsil level, and with key governmental and non-governmental organizations 16 areas of intervention were identified as being critical for the NASSD. These include sectors like: water; agriculture; forestry; biodiversity; rangelands and livestock; the private sector; energy; urban

environment; and cultural heritage and sustainable tourism. In addition, some crosscutting themes were identified as crucial to each sector, including population, poverty and environment; communication for sustainable development; environmental education; NGOs; gender, environment and development; environmental health; and governance.

To address the needs of each of these areas, basic information was gathered through consultations and literature reviews. This data was analysed through background papers commissioned on each of the sectors and themes identified. The draft of each paper was shared with the larger community of stakeholders of the NASSD as well as experts in the relevant field of knowledge.

The papers follow a similar format: analysis of the current situation; issues; past and present initiatives in the sectors and thematic areas along with the lessons learnt; stakeholders; and recommended policy and action measures. The authors have also addressed cross-sectoral linkages and environmental concerns for the sake of more integration in planning for sustainable development.

There were constraints to developing these Background Papers and in some cases these hurdles were only partially overcome. These included the fragmented and scattered nature of information, the prevalent culture of not sharing information, contradictory and unreliable data, lack of thinking on cross-sectoral linkages and integrated planning, and lack of expertise in developing linkages with the environment.

Parts of the information of the papers were then incorporated into the State of the Environment and Development (SoED) and the main strategy, i.e., NASSD. However, since the Papers contain a wealth of extremely useful information, a decision was taken to produce a series of NASSD Background Papers.

Considering the need and importance of timely sharing information with the stakeholders, these papers are being produced without extensive editing. The authors have sole responsibility for the views expressed and data presented.

EXECUTIVE SUMMARY

The Northern Areas of Pakistan consist of 72,496 sq. km. that is said to be the toughest and most difficult mountainous terrain of the world with a total population of 0.870 million restricted to different valleys. Rugged and lofty mountains of Northern Areas attract many tourists and mountaineering expeditions from all over the world every year. Nature has lavishly endowed the area with high peaks and large glaciers concentrated in a relatively small radius. It has 28 world famous peaks over 6,000 metre height including K-2 (8,611 m), Nanga Parbat (8,128 m) and Raka Poshi (7,788 m). Beautiful valleys of Hunza, Astore, Naltar, Ghizar, Shigar, Sadpara, Khaplu and Deosai plains are also located in the Northern Areas. Mighty Indus enters into this area like a stream and gathers its dimension as it passes by. All types of terrain with varying weather conditions and temperatures ranging from 37∞C to minus 11∞C exist in NA. Administratively the area is divided into five districts namely Gilgit, Ghizar, Diamir, Skardu, and Ghanche. Geo-politically, it is the most sensitive area of Pakistan. It touches Sinkiang in the North East and Afghanistan in North West with new Islamic states of ex-USSR close behind. On Southern side there is a stretch of over 500 km long ceasefire line with occupied Kashmir and Kargil. With the opening of KKH Northern Areas have acquired additional strategic and Political importance. Majority of the population in Northern Areas is associated with agriculture, some with trade and a smaller number with service. The area remained neglected till 1978 but significant development started with the completion of KKH, when the area was linked with rest of the country by a metalled road.

The region due its far location and rugged mountainous terrain is not connected with National Power Grid system. The principal forms of energy consumed in the area are electricity generated from small hydro electric power stations and Diesel generators, Firewood, Kerosene oil, dung cake, candles and batteries. Generally fire wood (including sticks, bushes and grass etc) and dung cake are used for cooking and heating, Kerosine oil, Candles, batteries and electricity from hydel or Diesel generators for lighting. Forests are available on a very small area. The current indiscriminate cutting of these limited forests if allowed to continue for use as firewood for cooking and heating these limited forests too will be eliminated completely in the next few years. Dependency on use of K-2 Oil, diesel oil is more costly because the transportation cost of these importable items to the far located areas adds significantly to the original ever rising heavy purchase cost. The economic conditions of the people living especially in Rural areas is so weak that purchase of costly energy sources is skipping out of their financial reach beside these sources are causing pollution to the atmosphere and dangerous to human health. Eye deceases and respiratory diseases are very common due to excessive use of such sources especially in rural areas where the family lives together in a single smoke filled room from the first day of their birth to death. Experience of solar energy has not been successful in the past for want of spares. Two solar energy stations were established in the year 1984 one each at Hini Hunza and Sandus at Skardu. Both these stations were abandoned for some essential spares within three

months of start. Constant and uniform wind is nowhere available in NA, therefore generation of energy through windmills is also not feasible.

The entire Northern Areas on the other hand is very rich in hydel power potential. People call it a "gold mine" for generation of hydro electricity, the most environmental friendly and cheaper source of energy. The energy strategy for NA therefore has been confined to deal with the socio-economic aspects, present available source of energy, present power demand and demand forecast up to the next fifteen years, i.e., 2016, identification and implementation of the hydel project at the promising sites. Electricity in this area is presently generated through establishment of small hydroelectric power stations on water sources available in the close proximity of the area to be electrified. So for eighty-one power stations are operative and electricity is supplied at a limited scale to 50% of the population for lighting only. Eight hydel projects with an installed capacity of 7.6 MW are at different stages of construction (NA PWD Review Report for the year 2000-2001). WAPDA in association with GTZ, a German Consulting Firm have identified another hundreds of sites for establishment of the hydel power stations on tributaries of river indus in NAs. The total installed capacity of only fifteen most promising sites is 635 MW .The present power demand of the area is 83 MW and projected demand would be 206 MW by the year 2016. The demand includes meeting shortfalls in the already electrified areas, extension of power supply for un-electrified areas for domestic, commercial and industrial consumption. Adding the projected power demand of 355 MW for cooking and heating also, the exhaustive power demand in the next fifteen years may be 561 MW . From this situation, following is concluded for the energy strategy in NA:

1. The energy is essential to economic uplift of the people in general and social development and improved quality of life in the area in particular, the sustainable pattern of its production, efficient transmission and distribution system and efficient use is more essential. The conservation strategy therefore perceives the need to reduce the environmental impact of continued energy sector development and to reduce local health hazards and environmental pollution. This requires significant financial, human, as well as technical resources and broad based energy supply scenario to minimize the possibilities of natural resource degradation like forests which are already at risk in the Northern Areas.

2. NAhas the lowest per capita consumption in Pakistan being as low as 0.05 kW P.C. There is therefore an urgent need for equity and sharp increase in the production of energy from the hydel potential sources already identified to be most promising but have not been implemented due to resource constraints. An adequate, reliable and affordable supply available from the renewable and environmental friendly supply of energy in this backward area will have a beneficial impact on poverty alleviation by generating opportunities of employment, improving health, education, water supply and tourism inflow due to establishment of better hotel facilities and services.

3. The NA Energy Conservation Strategy in line with the national objectives is therefore to be based on indigenous production of entire energy demand from its hydel resources, minimizing dependency on limited forest resources, importing Diesel and K-2 Oil. Increasing efficiency of energy use and optimum

utilization and exploration of renewable energy sources and selecting sites for establishment of hydel power stations at economically viable and technically sound sites.

4. The conservation strategy considers that while pursuing the objective of development, the NA Government should develop indicators of sustainable process to provide a solid base for decision making at all levels and to monitor progress towards self regulating sustainability of integrated environmental and development system for the area. The NA Government should develop an infrastructure to ensure compliance with the National Environment Quality Standards. Environmental management system and environmental audits should be introduced. An environmental cell needs to be created in the NA Planning and Development Department to ensure that every new project prepared is supported with an environmental impact assessment report in true sprit, meeting the requirement of the guidelines established by Pakistan Environmental Protection Agency. This assessment is mandatory for all development projects as per laid down procedure of the Planning Commission.

5. For the development and implementation of an efficient energy programme in NA, there is an urgent need to evolve sound area-specific policies relating to production, distribution and use of energy that are consistent with short term and long-term development perspectives and achieve economic goals of the NA.

6. The institutional structure is neither adequate nor capable by virtue of 'capacity'. Government needs to develop the institutions concerning to development by opening new units in the existing department inducting fully qualified and experienced manpower to catalyse the demonstration, development construction and dissemination of energy efficient technologies. Such institutions should be capable to handle the affairs like market assessment of commercially viable energy projects based on the renewable sources. These institution should also be developed and networked at the national level to serve as centre of excellence in the field of energy. The centre of excellence will establish day-to-day reliable information on new technological development pass it into lower centres, monitor the progress on implementation of the projects and achieving the objectives.

7. Since the NA have abundance of the most environmental friendly and renewable sources of energy generation from its hydel sites not only to meet the energy demand of the area, the surplus energy can also be transmitted to the rest of the country by selecting a few most promising sites and implementing the proposed projects. Detailed ranking survey for identification of such potential sources has been carried out by WAPDA & GTZ. The need is to implement these projects one by one depending on availability of financial resources. Proposed short term and long-term projects for various energy zones are provided with the detailed report on energy strategy.

8. Energy conservation and improved efficiency of the existing facilities are the most cost effective means to improve the accessibility of energy to the people in the area. Energy conservation programmes should be supported by financial incentives, demonstration of projects and regulatory and legislative measures.

9. Government alone cannot implement these hydel projects through its limited resources, there is therefore an urgent need that incentives are given to private sector to come forward to work as joint venture with the Govt, undertake projects either on BOT or BOO basis. For this an area specific power generation policy needs to be evolved on priority.

10. The energy policy for NA should be self-contained providing quick and easy decision making opportunities for attracting the private Investors. For this an independent power infrastructure board to deal with the energy development affairs needs to be constituted on high priority.

11. Energy demand forecast for the Northern Areas was carried out by WAPDAin the year 1996. The entire area was divided into thirteen regions depending on their socio-economic condition energy use pattern and demand. The total demand of the area based on that survey was 52 MW. The projected demand for the year 2001 is worked out to be 83 MW and that projected till the year 2016 is estimated out to 206 MW. Adding 355 MW exclusively for cooking and heating, the total power demand of the area by the year 2016 will be 579 MW . The total power from all the eighty-one currently operative hydel power stations in NAis only 46 MW. There is a short fall of 39 MW to meet the present demand of 83 MW. The energy strategy for NA therefore needs to cover short-term measures to meet the immediate demand and long-term measures to meet the exhaustive demand by the year 2016. Identification of more than hundred hydel potential sites has been already made by WAPDA out of which fifteen most promising potential sites have been selected for an installed capacity of 635 MW. These proposed projects are listed in annexure-v. The most promising sites for implementation to meet the immediate power demand of the area are also listed in annexure-v. These projects need to be implemented on high priority to meet the immediate energy demand of various regions in NA. The proposed order of priority for implementation of these projects to meet the short term and long term energy demand is also given in of annexure-III . Implementation of the rest of the identified projects needs to be considered once the area specific energy policy for the Northern Areas is introduces and institutional reforms for the capacity building of the stockholders like Planning & Development Department and NAPWD are made and an area specific power policy for Northern Areas is introduced.

12. Energy development in NAneeds to be included in social development sectors, so that financial resources for its implementation could be arranged through interest free soft or commercial loans from foreign funding agencies. The NGOs may also come forward to join hands with the Government agencies to undertake development projects in energy sector to meet the increasing demand of NAfor this will have a positive impact on the development of other social sectors like health, education and environment. Supply of adequate energy will add to improvement of economic growth through establishment of small and cottage industries and bringing huge tracts of barren lands under cultivation through lift irrigation.

13. The conservation of heat in building has become more important of recent years because of the great increase in cost of fuels and the improved standards of comfort that people expect. Northern Areas fall in a meteorological region

where mercury falls below 15-20 C. Living cost is thus increasing manifold. Developments in new systems of construction have tended the other ay i.e. to lighter, thinner walls of concrete blocks, roofs of metal decking etc. which without added insulation would lose heat from the building more quickly than traditional constructions. As the normal temperature of Northern Areas during summer and winter are +30 C and ñ20 C respectively. So main problem is the heating rather cooling arrangement. So following pre , during and post construction measures are imperative to imply:

a. Orientation of building.
b. Making use of prevalent wind, cross ventilation
c. Reflecting, absorbing and insulating building materials for roof and walls
d. Provision of cavity walls or hollow blocks.

14. Fuel wood is a critical source of energy throughout the Northern Areas, and in particular, for low-income households. Although the increased development of the NA's hydroelectric resources can be expected to ease the demand, it is likely that fuel wood will continue to be an important energy source in many areas. In order to meet this demand and to reduce the pressure on the NA's natural forests, it is recommended that the supply of cultivated fuelwood be increased. This could be achieved by expanding the area dedicated to fuelwood plantations and by encouraging the adoption of agro-forestry practices. (These options need to be explored in more depth in the chapters dealing with forestry and agriculture.) The use of more efficient woodstoves should also be actively promoted.

1. INTRODUCTION

The Northern Areas, as the name suggests, lies in the extreme north of Pakistan between 34-36.5 degree North latitude and 72.c-78 degree east longitude. The Northern Areas are surrounded by Afghanistan in the North, China in the Northern East, occupied Kashmir in the southeast and Chitral district in the west. Republic of Tajikistan is only a handshake away from the border.

The Northern Areas comprises a territory of some 72469 sq km with low population density and scattered settlement indicating 11 person per sq km. Five districts namely, Gilgit, Ghizar, Diamir, Skardu and Ghanche constitute the entire NA with its administrative centre at Gilgit.

Nature has been very generous to the Northern Areas in its endowments of towering mountain peaks, gigantic glaciers, majestic rivers and splendid green valleys and meadows with abundant fruit trees. Mount Godwin Austin (K-2) 8625 meters high, the second highest peak in the world, is perched in the extreme north, while Nanga Parbat, 8126 meter high, stands sentinel over the southern gateway. It is here that the Himalayas meet the Karakoram and Hindukush Ranges are watched just across the Pamirs and the Kun Lun. The glacier, the longest in the world outside the poles. To complement nature's gifts, man-made Karakoram Highway is an engineering marvel bearing testimony to enviable Pak-China friendship.

1.1. Administrative Set-up

Administratively, the Northern Areas have been divided into five district, namely Gilgit, Ghizar, Ghanche, Diamir and Skardu. The districts are headed by Deputy Commissioners. The area has been further divided into 13 Sub Divisions each headed by Assistant Commissioners. The major policy making body of the area is, the Northern Areas Council headed by the Chief Executive NA. Also, under Local Government Ordinance 1979, three tiers i.e. union councils, elected on the basis of adult franchise for five years as in other parts of Pakistan. The councils/committee identify, prepare and execute micro development schemes at grass-root lave. The judicial set-up consists of five District and Session judges one in each district and is headed by a Judicial Commissioner. A special Court for speedy trial and a Chief Court headed by Chief Judge, are being functioning in the area.

1.2. Local Economy

The local economy is based on irrigation, agriculture and stock breading/daily production. Staple crops are wheat and maize with a number of subsidiary crops including millet and buckwheat, potato, apricots, walnuts and other fruits. In the Southern zone there is considerable extraction of timber. The area is socially and culturally diverted.

1.3. Population

Population concentration in Northern Areas is mostly in valleys around rivers and streams. There are few valleys with large population. Most of the villages are spread over on both sides of rivers/nullahs. Small towns and villages in rural area have schools, mosques and small bazaars whereas the towns have all the basic infrastructure.

1.3.1. Main Population Centres

Some of the main population centres (region wise) are given in Table 27 introduced in the following paragraphs:

1.3.1.1. Chilas

Chilas (Region I) is the administrative centre of Diamir district consists of three sub Divisions. It lies in the upper Indus valley between the Himalayas on the south and Karakoram on the north and included all the villages falling under sub Division Darel/Tangir and Chilas.

1.3.1.2. Astore

Astore (Region 2) is a part of Northern Areas of Pakistan and lies in upper Indus valley between the Himalayas and the Karakoram. The entire region/areas is situated in Diamir district and is spread over from Bunji to Chilim on Astore river. The region consists of 19 villages of Astore Tehsil. The population of different load centre are given in Annexure-A.

1.3.1.3. Gilgit City

The most important place in the area is Gilgit city, which has the largest concentration of population in the region. Gilgit city is located near confluence of Hunza and Gilgit river and Karakoram highway leading to Khunjerab pass through Gilgit.

The city is very important as it is an administrative centre of the whole NA, it has an airport facility and people of the surrounding areas and even tourists travel to Gilgit while on their way to other parts of the country and NA. It is thus a gateway of Northern Areas. Gilgit city is also the biggest commercial centre and has more than three thousand shops and commercial establishments. All the border trade is done via Gilgit.

Gilgit city is part of Region-3 that includes the area of Gilgit and Ghizar districts and is spread over from Singal village on Gilgit river, Juglote Gah on Hunza river and up to Sai nulah on Indus river. The region consists of 9 union councils of Gilgit Sub Division and 7 villages of Ghizar District. The population of the load centre in the region.

1.3.1.4. Hunza

Hunza (Region 4 and 12) lies all along the Hunza river and Karakoram Highway. The region is situated in Gilgit district and is spread over from Skindarabad village up to Khunjerab Pass on Hunza river. The region includes the village of Hunza and Nagar sun division.

Hunza valley is one of the beautiful valleys of NA of Pakistan. Main attractions of these sub-divisions are the scenic beauty of Hunza and Nagar valleys. About 15,000 tourists visit these valleys every year. The local languages are Shina, Brushaski, Wakhi and Urdu. Many people understand more than on language, These who act as mountain guides and porters speak English. Hotel facilities have added more attraction for the tourists.

1.3.1.5. Ishkoman

Region 5 is part of Ghizar District and consists of 5 union councils of Punial/Ishkoman Sub Division and one village of Singal union council.

Ghizar District is a newly constituted district comprising of two sub divisions namely Punial/ Ishkoman and Gupis/Yasin. Headquarter of Ghizar District is located at Gahkuch. So, the main activity of the district is concentrated in Gahkuch. It takes time to build all possible facilities such as proper public offices. Rest houses, hotels/restaurant and other basic facilities for the officials and tourists. The people of the area are very hardworking, main sport is Polo and the local languages, spoken and understood, are Shina, Brushaski, Khawar and Urdu. Many people understand more than one language. Those who serve as mountain guides and porters also speak English.

The Region consists of 12 villages of Punial/Ishkoman Sub Division and Singal union council.

1.3.1.6. Yasin

Region 6 Yasin, is a part of Northern Areas of Pakistan and lies in upper Indus valley-between the Himalayas on the south and Karakoram on the north. The region is situated in Ghizar district and is spread over from Khilti village in Pingal union council to Darmadar in Sumal union council.

The Region consists of 20 villages of Gupis and Yasin tehsils having 7 union councils, 3 in Gupis and 4 in Yasin Tehsil.

1.3.1.7. Skardu

Skardu city is the headquarter of district Skardu and is part of region-7. The area lies in the upper Indus valley between the Himalayas on the south and Karakoram on the north. The region is situated in Skardu district and is spread over from Basho to Gole villages on Indus river and from Shigar to Askoli villages on Shigar river. The Region consists of 25 villages of Skardu and Shigar Tehsils.

1.3.1.8. Ghanche

Khaplu is the headquarter of Ghanche District and the entire district is included in region-8 Shyok. The area lies in the upper Indus valley between Himalayas on the south and Karakoram on the north. The region is spread over from Keris to Frano villages on Shyok river and consists of Mashabrum and Khaplu tehsils.

1.3.1.9. Rondu/Haramosh

Region 9, Rondu/Haramosh is part of Gilgit and Skardu districts and lies in the upper Indus valley between the Himalayas on the south and Karakoram on the

north. The region included 11 villages of Gilgit and Skardu district and is spread over from Farhad Bridge to Tungas village on Indus river.

1.3.1.10. Kharmang

Kharmang (Region 10) is a part of Northern Areas of Pakistan and lies in upper Indus valley between the Himalayas on the south and Karakoram on the north. The region is situated in Skardu district and is spread over from Sermik to Gangani villages including 17 villages on Indus River. The project area consists of Kharmang Tehsil.

1.3.1.11. Ghizar District

Ghizar region-12 comprises Ghizar valley, extending from Shandoor pass on the west to Rawat village on the east. The valleys are hilly area all along, with small tracts of uneven cultivable land on both sides of the river. The region has two union councils, namely, Teru and Phander, falling in Tehsil Gupis of District Ghizar. The region has no town in the true sense of the word.

1.3.2. Population and Growth Rate

The study of population size as well as its growth and distribution in the area is very important as the load forecast for the Northern Areas, is strongly dependent on this parameter. With the objective in view a detailed analysis on the information, contained in 1981 census of Northern Areas was made. To project the population of the area, 1981 census figure and the data obtained from Tehsil office/field survey were considered. On these considerations the population of the area has increased from 586,357 in 1981 to 952,336 in 1996. It increased by 62 percent during the period 1981-1996 at an average growth rate of 3.28%.

Field surveys show that majority of households were inhabited by single families with an average of 7.8 person per household. It is interesting to note that majority of houses is dispersed and located all along the mountains as the people live on farm land. This crucial aspect of the distribution of population in the area has been kept in view for the development of the load centres. An interesting aspect, observed during the study, was that in most of the community in the rural areas, the household has many children, old people and female population. The young male do not remain in the village due to lack of employment opportunities in the area.

1.3.3. Migration

Various forms of migration have been reported. Firstly there is a periodic migration when people go on appointment or transfer to other parts of the state and visit their families occasionally. Secondary a number of students are studying in the other part of the country and come to their villages on vacation or on special occasions. Thirdly there are seasonal migrations that take place during winter from the area of high altitude due to extreme cold. People along with their cattle move to the lower part where pasture fields can be found as the summer approaches these people return to their houses in the upper parts with their cattle. Migration to the area also takes place in the form of employees of Federal Government, traders, tour operators, technically skilled persons and persons engaged in different projects in the area.

1.4. Climate

Due to varied and diverse topography, the climate of the area is characterized by cold winter and warm, dry summer, June, July and August are the hottest months with temperature going to 40 degree while December, January and February are the coldest months with temperature many degrees below freezing. The summer season in the low-lying valleys is hot but at high altitudes, it is very pleasant. Similarly, winter season at high altitudes is extremely cold compared to the valleys. Valleys receive aerographic rainfall that varies from 50 to 175 mm per year. The maximum mean rainfall is during the months of March, April and May.

1.5. Social Services and Infrastructure

1.5.1. Communications

1.5.1.1. Roads

Road system in the NA is generally not good, owing to the difficult topographic condition, frequent landslides and movement of glacier moraine, which greatly hampers the construction of the road and its maintenance.

Karakoram Highway and Gilgit Skardu roads are the most important road systems in the area, which connects major towns of the area with the rest of the country. Chilas Gilgit and Hunza being situated on the Karakoram highway have access to a good road system. But roads in far off valleys like Gupis, Ishkoman, Yasin, Astore, Khaplu, Shigar, Darel/Tangir and Kharmang are un-metalled. The existing un-metalled roads are all rough surfaced, poor grade and have sharp curves. Most of these roads are risky. The network of the metalled roads, in the area is 657 km physical conditions of un-metalled roads are not even satisfactory. Approximate length of existing roads in NA is given as under:

Table 1: Existing Road Network

Existing Road	Condition	Length (km)
Basha Dam site to Gilgit Bridge (KKH)	Metalled	165
Gilgit Bridge to Khunjerab Pass(KKH)	Metalled	266
Gilgit Skardu Road(Alam Bridge to Skardu)	Metalled	170
In different towns/cities of the area	Metalled	58
Jeepable in different parts of NA	Un-metalled	3,231
Pony Tracks	Un-metalled	143

Note: All tables are based on WAPDA's survey and personal contacts with concerned officers of NA.

1.5.1.2. Airway

Gilgit and Skardu is linked to the national capital Islamabad by PIAwhich operates regular Boeing and Foker flights (subject to weather conditions).

1.5.1.3. Transport

Transport facility is generally available in many parts of Northern Areas except a few villages that are still in isolation. Northern Areas Transport Corporation

(NATCO) is an organization that provides the transport and operates buses for the residents of the area. However, even then there is still deficiency of transport facilities. The effort is being shared by the private sector. The general means of small distance and inter regional transport into these areas is, jeeps, wagons and buses. In winter, transportation in many part becomes very difficult and it takes time to have free flow of traffic from one part of the area to the other.

1.5.1.4. Telegraph/Postal Service and other Infrastructure

Telephone and postal facilities are available in major parts of Northern Areas. Special Communication Organization (SCO) provides Telephone and Telegraph services through 65 public Call Offices, 48 telephone exchanges and 122 post offices are also functioning in the area.

Two radio stations with the capacity of 10 kW each and two television boosters each at Skardu and Gilgit provide means of entertainment to the people of the area.

Table 2: Telecommunication and Postal Facilities by District

Infrastructure/ facility	Gilgit	Diamir	Ghizar	Skardu	Ghanche
Radio Station (10 kW)	1	-	-	1	-
Television Booster	1	-	-	1	-
Telephone Exchange	16	9	9	12	2
Public Call Office	25	8	11	18	3
Post Offices	32	17	22	37	15

Also there is no gas supply in Northern Areas except, Gilgit, Hunza, Chilas and Skardu where liquid petroleum gas cylinders are used. Kerosine oil, firewood and animal dung are used for lighting heating and cooking. About 35% people have access to clean (piped water supply being managed by NAPWD. However in the last few years, efforts are being made to provide various social services in the rural areas. A number of schemes for water supply have been sanctioned by Local Bodies and Rural Development Department (LB&RDD), to extend drinking water supply to more villages, it may be pointed out, however, that the location in many villages is such that access to safe water supply may not be possible for long time to come. Some of the people have made their own arrangement to bring piped water from nearby streams.

1.5.2. Health

The health facilities in NA are rather inadequate. Although 23 hospitals and 105 dispensaries besides a number of first aid posts have been established, the qualified doctors are reluctant to serve in remote places of the area. Therefore, no indoor treatment exists in most of the dispensaries. The existing health facilities are being supplemented by the Aga Khan health Services (AKHS) by establishing 23 health centres in the area. Detail of hospitals, Dispensaries and first aid posts district wise and region wise are given in Table 3.

Table 3: Health Facilities				
District	Government		First Aid Post	AK Health Centres
	Hospital	Dispensary		
Gilgit	6 (269 Beds)	23	24	9
Skardu	5 (213 Beds)	36	25	1
Diamir	6 (195 Beds)	15	23	-
Ghanche	3 (40 Beds)	20	19	-
Ghizar	4 (40 Beds)	12	25	13

1.5.3. Education

All the colleges and schools in the NA are under the Board of Secondary and Intermediate Education, Islamabad except, the degree college at Gilgit and Skardu and Education college at Gilgit that are under the university of Punjab. The standard of education is at par with those in down country at similar level and with the same facilities. A heartening aspect of the area is that it has attained a sizeable literacy rate through the concerned efforts of the Govt of Pakistan and the Aga Khan Rural Support Programme (AKRSP) i.e. Gilgit district has got high literacy ratio of 32.5 percent as compared to Pakistan literacy ratio of 26 percent. Almost in each village primary school for boys and Girls have been established (refer Table 4).

Table 4: Number of Educational Institutions					
	Gilgit	Diamir	Skardu	Ghanche	Ghizar
Government					
Mosque School	5	8	8	2	5
Primary School	92	171	171	69	53
Middle School	28	29	29	15	9
High School	29	17	17	11	13
Public School	2	1	1	-	-
Inter College	1	1	1	-	-
Degree College	1	1	1	-	-
AKESP					
Primary School	28	-	-	-	50
Middle School	25	-	-	-	21
High School	3	-	-	-	2

1.5.4. Power

NAPWD have arranged power distribution in the whole Northern Areas from 81 hydel power stations and 15 Thermal stations with total installed capacity 46 kW. At the same times 8 hydel stations with the installed capacity of 7.6 MW are under construction in different regions. The demand for electric power in the whole area, particularly in major cities like Gilgit and Skardu is growing rapidly while the present power generation is inadequate to meet the needs of the area. The short fall is being met from diesel generation that is very expensive as the fuel is being transported from down country. Some of the villages in the area are still without electricity. AKRSP is also supplementing the power generation by installing micro hydel power stations in some parts of Northern Areas.

1.5.5. Occupational Level

The survey of socio-economic conditions in Northern Areas show that most of the people are engaged in agriculture sector but at the same time a farmer has his own commercial establishment or in some areas a restaurant/hotels, tea stall, video shop etc.

1.5.6. Cultivated Area

The cultivated area of Northern Areas is very small. About 57,700 hectare of land is under cultivation of which 46300 hectare are under cereals, 10,000 hectare under fruit and 1400 hectare under vegetable/potato. The total area therefore under cultivation is about 0.8% of the total area and exists in patches along the rivers/streams of various altitude. The people own an average of 124 hectare of agriculture land. Cereal crops are mostly cultivated. Wheat and barley are the main staple food crop in certain parts maize is also used for human consumption in place of wheat. These grain crops are supplemented by sorghum and millet in villages at higher altitudes.

1.5.7. Livestock

Livestock contributes a great deal to the economy in agrarian society. However, physical condition and general health of the animals is not satisfactory in the NA, especially in winter due to the shortage of fodder. Bullocks are the main source of farm power, but they are hardly capable of drawing plough due to poor health. Cow, sheep and goats are also lean and thin. Animal diseases cause considerable losses to the livestock. Productivity of cattle is generally low because of severe winter and lack of proper feed. Meat, milk butter and eggs are the main animal/poultry products but most of them are consumed at the household level. At some place milk, meat animal hides, wool and poultry are sold. Efforts are being made to protect and promote the livestock. Some of the major efforts are given as under:

Table 5: Veterinary Hospital and Dispensaries

	Gilgit	Ghizar	Diamir	Skardu	Ghanche
Veterinary Hospital	2	1			
Dispensary	20	11	25	28	6

The total livestock in the Northern areas are given in Table 6.

Table 6: Number of Livestock in Northern Areas

Detail of Livestock	Number of Livestock
Cattle	408,056
Buffalo/Yaks	579
Goat	938,897
Sheep	642,643
Camel	90
Horses	2,615
Mules	183
Donkey	18,383
Poultry	252,157

1.5.8. Irrigation

The irrigation facilities are of inundation type and consist of small channels off-taking from streams and traversing several kilometres along the hills to supply water to few acres of land situated mostly on river terraces.

The irrigation water used for agriculture is obtained from river/tributary that mostly receive snowmelt water from glaciers and springs. Most of the cultivated are lies in the valleys along the bank so rivers and their tributaries and is generally at much higher than the adjoining river. To command these higher areas, the farmers dig water channels upstream of the area at high altitude and divert water from the river/tributaries to irrigate their holdings. Huge tracts of barren lands can be brought under cultivation comparatively at much economical cost through lift irrigation system, if sufficient hydel power is made available. This will not only reduce the dependency on imported food grains but also have a very positive impact on the overall environments of the area.

There is irrigation in may parts but the water supply is inadequate and untimely due to in-sufficient channels and high effort required to maintain these channels.

1.5.9. Food Grain Production and Consumption

The total food grain production comes to about 103,540 tons, which seems to be on very higher side. However as per information obtained from the commissioner office Gilgit, the total yield of food gain is approximately 87,152 tons, which is insufficient to meet the areas requirement. The Government therefore, supplies 16796 Metric tons of wheat annually on subsidized rate. Another 28712 tons of flour is being met through import from down country through private traders. Fruit produced are locally consumed fresh as well as dry to supplement the staple food of the people. The shortage of food grains is mainly due to high population pressure in comparison with very limited area under food grains. This problems can be overcome by increasing crop production by enhancing the present low crop yields per hectares as well as extending cultivation on cultivable waste.

1.5.10. Agriculture Marketing

Marketing of agriculture produce in the district is in under development stage. There are not market committee and no market mechanism has developed so far. As the agricultural production is expected to rise in future, it would be necessary to promote organized market facilities. The marketing of fruits and vegetable is quite unregulated and down not stimulate price signal to the producers.

1.5.11. Income Distribution

According to the results of the survey the average gross monthly income is approximately Rs. 4069.00 per household. The household income is derived from many farm activities, crops, livestock, fruit etc, but the income from other sources are significant and important. These sources are wages, salaries, pension, trade and industries. Since most of the region has low level of agricultural activity people have to work as labourer or enter into trade. It may be pointed out that the income level differs from area to area. It is high in Hunza and Karimabad and low in far off mountainous area.

1.5.12. Tourism

The Northern Areas are famous in Pakistan and abroad, for its scenic beauty and high mountain. The whole Northern Area is known as a paradise for mountaineers, climbers, trekkers, hikers, painters and photographers. There is a continuous flow of tourist and mountaineers from all parts of Pakistan and all over the world. In view of this, Skardu, Hunza, Karimabad and Gilgit have been developed as important tourist centres. A number of hotels and commercial centres have been built for them, and the tourist industry is developing rapidly in the area. The cultural pattern in these areas are as interesting as its topography. The people with their typical costumers, folk dance and sports provide an interesting study for the visitors and researchers. The tourist season remains in full swing from April to October. It is estimated that the number of tourists visiting Hunza was 12,000 during 1991-92. It is expected that tourist traffic will increase further in future specially when links will be developed with Central Asian Republics.

2. POWER MARKET AND DEMAND FORECAST

To estimate the future demand of power in the Northern Areas, a detailed load survey of NA were carried out by WAPDA in collaboration with GTZ from 1992 to 1996. During this period the entire area was surveyed. Visits were made to each village to collect the necessary data on population, housing, public utilities and commercial establishment. Interviews were held with local peoples of all section including Government offices to ascertain their requirements. In addition, data on other socio-economic factors that would influence the consumption of electric power during the are was estimated and a load forecast for the year 2016, taking 1996 as the base year. The present energy sources like electricity, kerosene oil, wood, diesel oil, LPG, batteries and the pattern of power consumption needs were also studied. The aim was to bring into focus the power need for domestic commercial, industrial, offices and street lighting in the area.

2.1. Context and Rationale

Although the Northern Areas have tremendous potential for hydropower generation, the present system of energy production is unable to meet the NA's rapidly increasing energy demands. As a result, the region currently has the lowest per capita rate of energy consumption in Pakistan.

Energy has a vital role to play in the sustainable development of the Northern Areas. It is critically important that the region's domestic, commercial and industrial sectors be provided with adequate, affordable and reliable supplies of energy - particularly electricity. At the same time, however, environmental and social considerations must not be overlooked in the drive to increase the NA's energy supplies.

This chapter discusses current patterns of energy usage in the Northern Areas, and focuses in particular on the status of the region's electricity infrastructure. The results of a power demand forecast are analysed, and a set of strategic recommendations put forward to help guide the future development of the energy sector.

2.2. Energy Usage in the Northern Areas

The principal forms of energy consumed in the Northern Areas are firewood, kerosene oil, electricity, liquid petroleum gas, diesel oil and batteries.

Table 7 illustrates the prevalence of these different fuel types in the NA's households, based upon field surveys conducted by GTZ and WAPDA. From this table, it can be seen that wood is the most commonly used domestic fuel, and that kerosene is also widely employed for both lighting and cooking. Table 13 provides a summary of mean monthly fuel consumption per household.

Tables 14-16 show fuel usage by commercial establishments, hotels and small industries. Most commercial and industrial users do not rely on electricity alone, but supplement their needs with diesel, kerosene and firewood.

Table 7: Prevalence of Domestic Fuel Types in the Northern Areas

Region	Total No. of Respond-ents	Number of Households Reporting the Usage of Particular Fuel Types					
		Wood	Kerosene		Electricity for Lighting, Cooking and Heating	Candles	LPG
			Cooking	Lighting			
1-Chilas	257	256	178	251	8	0	0
2-Astore	200	200	119	200	25	0	0
3-Gilgit	203	200	159	200	11	0	17
4-Hunza	64	64	19	64	64	44	0
5-Ishkoman	210	210	56	146	109	85	0
6-Yasin	289	289	60	280	25	289	0
7-Skardu	173	169	128	168	9	0	11
8-Shyok	204	204	41	160	38	110	0
9-Haramosh	146	146	99	135	3	0	8
10-Kharmong	153	153	39	153	89	47	0
11-Khunjerab	70	70	13	70	48	50	0
12-Ghizar	122	122	12	122	0	122	0
13-Gultari	Data is not available.						
Total	2,091	2,083	923	1,949	429	747	36
Per cent*	100	99.61	44.14	93.20	20.51	35.72	1.72

Source: Comprehensive Planning of Hydro Power Resources on Tributaries of Indus River in Northern Areas, Volume 1 of 2 (Table 3.1) By WAPDAand GTZ (1992-1996).

2.2.1. Firewood

Firewood is the main source of energy in the household and is used for cooking and heating as given. From field investigations, it was found that 99.6 percent respondents used firewood as fuel for household consumption. The monthly mean domestic consumption of firewood was 755 kg during summer and 1,172 kg in winter. It is also used in winter for heating purposes in commercial establishments and small industrial enterprises and hotels. The establishment, hotel and small industries respectively. Since the whole area consists almost of rural localities, therefore only a few people purchase firewood from local market, because it is scarcely available from there.

Most of the people in the area get wood from the forests to meet their household needs. A number of them have also planted trees in their land to meet their fuel needs.

It is important of note that in larger settlements of where there is not forest nearby, people purchase firewood for their needs. During the field investigators it was observed that availability of wood is small compared with the need of the people. Average price of firewood ranged between Rs. 2.5 to 3 per kg.

2.2.2. Kerosene Oil

Kerosene is currently the second most widely used energy source in the Northern Areas. It is readily available on the market, and is used primarily for lighting and cooking. Even in the NA's electrified regions, kerosene is commonly used because of frequent load shedding and disruptions to the power supply.

Table 8: Kerosene Oil Consumption

	Zone-A Diamir		Zone-B Gilgit		Zone-C Skardu	
	No. of Households	Kerosine oil consumed (litre)	No. of Households	Kerosine oil consumed (litre)	No. of Households	Kerosine Oil Consumed (litre)
Domestic	457	39.43	958	39.42	676	47.00
Commercial	371	27.00	216	25.41	128	16.00
Hotel	-	-	19	9.00	-	-
Small industry	-	-	10	35.50	-	-

2.2.3. Diesel Oil

Diesel oil is primarily used in small industrial units in un-electrified areas. Overall consumption of diesel oil is low, as there are only a small number of these units currently in operation. Usage is greater during the winter. Diesel generation is very expensive, as the fuel must be transported from down country.

2.2.4. Liquid Petroleum Gas

The transportation of LPG is both difficult and costly, and as a result, the use of LPG is very limited. In the field survey carried out by GTZ and WAPDA, less than two percent of domestic households reported the use of LPG.

2.2.5. Batteries

Batteries are used in a range of household electronic items, including radios, cassette recorders and flashlights. As the use of electronic goods becomes more common in the region, the demand for batteries is increasing, particularly in rural areas where people still have no access to electricity.

2.2.6. Candles

Candles are a significant source of energy for lighting. Results from the field survey conducted by GTZ and WAPDA indicated that 35.72 per cent of households use candles for lighting.

Since there is no electricity in many rural parts of the NA and power supply in the urban areas are least reliable, people there fore use other means of lighting such as candles. The survey results show that about 38 percent holds use candle as lighting source and approximately 2.15 dozen candles are being used per month.

2.2.7. Dung Cake

The scarcity of natural forests at higher altitudes has led to the use of animal dung cake as a source of energy for heating and cooking. It is estimated by GTZ/WAPDA

that each household in the high altitude valleys of Ghanche, Ghizar, Ghanche and Baltistan Districts uses 28 kilograms of dung cake per year.

Scarcity of natural forests in the higher altitude valleys of Gilgit, Ghizar, Skardu and Ghanche district, especially in the alpine pastures, has led to adopt dung cake as source of energy for heating and cooking. It is estimated that 28 Kg per house hold per Kg is used for cooking and heating.

2.2.8. Electricity

The Northern Areas are currently served by 81 hydroelectric power stations and 15 thermal stations, with a total generation capacity of 50.74 MW. This is significantly less than the NA's requirements, of 83 MW and the shortfall in power is met through the use of alternative fuels (primarily wood and kerosene) and the use of diesel generators.

Electrical appliances such as irons, heaters, radios, tape recorders, televisions and refrigerators are commonly used in Gilgit and other towns; the radio stations and television boosters located in Gilgit and Skardu also have significant power demands. In the NA's rural areas, there are fewer electrical appliances and electricity is used primarily for lighting and for fans.

Both the demand for electricity and its supply are affected by the seasons. During the winter, the supply of electricity is reduced because of the low volume of water in the rivers; demand, however, is high, because of the need for heating. Summers in the low-lying valleys of the Northern Areas are hot, and the use of air conditioners increases the demand for energy.

Seasonal population movements also affect the overall demand for energy. During the winter, there is a movement of people from the high altitude areas to the lower valleys. During the summer, there is a significant influx of tourists to the region.

2.2.9. Other Sources of Energy

Small amounts of low-quality coal are used in some parts of the Northern Areas, particularly Ghizar. The coal is imported from China, and has a very high sulphur content.

Isolated attempts to harness solar energy have been made. For example, two solar energy stations were established in 1984 at Hindi (Hunza) and Sandus (Skardu). However, both stations were abandoned after several months, because of the lack of essential spare parts.

The use of wind energy is believed to be unfeasible in the Northern Areas, because there are no readily accessible locations with sufficiently strong and uniform breezes.

The monthly energy consumption of pattern of energy sources of different consumer types is indicated in tables 14 to 16.

2.3. Electrical Power Infrastructure

2.3.1. Coverage

It has been estimated that approximately 42 per cent of the NA's houses have access to electricity. Power has also been made available to approximately 85 per cent of the commercial establishments in Gilgit, and 75 percent of the commercial establishments in Skardu. (Power Sector Review By NAPWD, June 2001) Most of the industrial units located in the urban areas are also electrified. In all cases, however, unreliability in supply is a major problem.

Table 9: Hydel Power Generation

	Gilgit	Skardu	Diamir	Ghizar	Ghanche	Total
Operative						
No. of Stations	27	22	16	9	7	81
Installed Capacity (MW)	18.63	10.22	8.83	5.0	4.0	44.0
Population Benefited (%)	50	45	60	55	40	
Ongoing						
No. of Stations	5	2	0	0	1	8
Installed Capacity (MW)	5.2	2.2	3	0	3.2	14.6
Population Benefited (%)	5	5			20	
Active Planning						
No. of Stations	4	5	1	2	1	12
Installed Capacity (MW)	53.5	60.8	425	88	3	630.3
Population Benefited (%)	45	50	40	45	50	

Source: Power sector development program review report 2002-3

2.3.2. Power Supply and Transmission System

The power system in the NAat present is independent of national grid. The area, in the very near future is not likely to be connected to the national grid due to its remote location from the national grid provided, a major power station is constructed. The existing electric power generation, transmission and distribution system is being operated and maintained by NA Public Works Department (NAPWD). The current installed capacity of 46 MW consists of 81 Hydel and 15 thermal power stations. The power generated from small hydel and limited thermal power stations, are transmitted over short distances through 11 kV transmission lines and distributed for domestic, commercial and industrial use.

Gilgit being the major commercial city of NA for instance is fed from a number of Hydel and Thermal power stations through 11 kV lines/feeders. Each feeder is supplied independently by a group of hydel power plants. The transmission and distribution system in Gilgit (for example) has tremendous operational difficulties in terms of selective protection and load management. The situation is even more critical in terms of transmission and distribution losses. All faults are cleared by tripping of individual feeders of hydel power plants. Voltage drop and technical losses in the above feeder are given in Table 10.

Table 10: Transmission Losses in Electricity Supply to Gilgit			
Name of Feeder	**Length (km)**	**Voltage Drop %**	**Losses (kW)**
Konodas	49.29	1.240	1,154.0
VIP	9.35	0.338	189.0
Ph-I	7.30	0.260	1.0
Ph-II	21.81	0.940	167.93
Total			1,512.93

Source: NAPWD Water and Power Division Gilgit (Power Generation & Distribution Log Books)

2.3.3. Future Power Needs

The demand for electricity power in the whole area, particularly in major cities like Gilgit and Skardu is growing rapidly while the present power generation is inadequate to meet the needs of the area.

There appears to be a great shortage of power in this region and efforts are being made to meet this demand. In Gilgit city it is estimated that only 50 percent of the households are getting power. But pending applications are reported to be 1,200. In other towns and villages the coverage of electrification is even less. There is a great pressure to made power available to these areas. The supplies in any case are uncertain and in most of the cases there are available for a restricted period only. Gilgit is the region for the development of social and physical infrastructure. The demand would thus increase further when the planned development takes place. The commercial activities are increasing and new commercial centres are opening. If the trade with the Central Asian Republic and China increase, the commercial activities would expand further in this region. With these developments the number of industries would also increase-particularly medium and small scale.

Table 11: No. of Households Using Cooking/Heating Fuel							
Regions	**No of Respondents**	**Wood (kg)**	**Kerosene (litre)**		**Electricity for Lighting/cooking /heating (kw)**	**Candles (Dozen)**	**LPG (kg)**
			Cooking	**Lighting**			
Chilas	257	256	178	2251	8	0	0
Astore	200	200	119	200	25	0	0
Gilgit	203	200	159	200	11	0	17
Hunza	64	64	19	64	64	44	0
Ishkoman	210	210	56	146	109	85	0
Yasin	289	289	60	280	25	289	0
Skardu	173	169	128	168	9	0	11
Shyok	204	204	41	160	26	110	0
Haramosh	146	146	99	135	3	0	8
Kharmang	153	153	39	153	89	47	0
Khunjerab	70	70	13	70	48	50	0
Ghizar	122	122	12	122	0	122	0
Total	2,091	2,083	923	1,949	591	747	36
Percent	100	44.61	44.14	93.20	28.26	35.72	1.72

Source: Table –3 of Comprehensive Planning of Hydro Power Resources on Tributaries of Indus River in Northern Areas produced WAPDA/GTZ in 1992-96

The most prominent sector that would lead to a great demand of power is the tourist industry. The number of foreign and local tourists visiting NAis substantial and it is expected that a grater number of them would be visiting this region in the future.

Table 12: Number of Rooms Heated

Regions	No. of Households Surveyed	Average Rooms per House	Average Rooms Heated	Heating Month	No. of Households		
					Heating only One Room	Heating Two Rooms	Heating Three Rooms & More
Chilas	257	3.25	2	4	257	96	9
Astore	200	3.5	2	5	200	59	17
Gilgit	203	3.25	2.0	4	203	76	20
Hunza	203	3.25	2	4	203	76	20
Ishkoman	210	2	1.5	5	210	108	47
Yasin	289	3	1	6	189	71	26
Skardu	173	3.5	2	5	173	72	16
Shyok	204	3.5	1	6	204	55	8
Haramosh	146	4.5	1.5	5	146	55	9
Kharmang	153	3.5	1	6	153	31	11
Khunjerab	70	3.5	1	7	70	13	7
Ghizar	122	3.25	1	5	122	38	16
Total	2091	3.35	1.46	525	2091	699	198

Source: GTZ-WAPDASurvey

Table 13: Fuel Consumption Per Household

Regions	No. of Respondents	Firewood (kg)		Kerosene (litre)		Candles (Doz.)	Electricity (kWh)	Batteries (Doz.)	LPG (Cylinders)	Dung Cake
		Summer	Winter	Cooking	Heating					
Chilas	257	995	995	35	11	1.50	0	1.80	0	78
Astore	200	925	1,375	24	7	0	0	2.60	0	0
Gilgit	203	556	1,122	41	11	0	0	2.70	0.77	0
Hunza	64	930	1,861	9	25	2.40	214	1.08	0	0
Ishkoman	210	675	1,080	10	3	4.00	29	0.50	0	0
Yasin	289	600	1,000	22	9	0	0	2.50	0	255
Skardu	173	879	1,500	52	11	0	0	1.80	1.00	0
Shyok	204		1,000	30	13	1.25	48	2.00	0	0
Haramosh	148		1,616	29	8	0	0	1.30	0	0
Kharmang	153	940	1,390	31	13	1.75	40	3.00	0	0
Khunjerab	70		1,400	13	40	1.50	36	2.00	0	0
Ghizar	122		402	1	78	2.50	0	0	0	0
Total	2,093		14,741	297	229	14.90	367	21.30	1.77	333

Source: GTZ-WAPDASurvey. Vol.1 of 2 Table 3.3 of Comprehensive Planning of Hydro Power Resources on Tributaries of Indus River in Northern Areas produced in 1992-96

Table 14: Monthly Energy Consumption in Commercial Establishments

Region	No. of Establishments Surveyed	Per Commercial Establishment		
		Electricity (kW)	Kerosene (litre)	Firewood (kg)
Chilas	27	80	9	130
Astore	344	290	28.5	396
Gilgit	99	139	36.5	385
Hunza	64	20	9	140
Ishkoman	25	95	25	-
Yasin	70	185	35	330
Skardu	26	170	28.5	281
Shyok	43	23	9	80
Haramosh	26	178	23.5	225
Kharmang	33	33	9	90
Khunjerab	18	20	9	140
Ghizar	30	-	5	258
Total	715	1,233	267	2,455

Source: GTZ-WAPDASurvey (1992-96)

Table 15: Monthly Energy Consumption in Hotels

Region	No. of Establishments Surveyed	Per Commercial Establishment		
		Electricity (kW)	Kerosene (litre)	Fire Wood (kg)
Hunza	4	210	20	205
Ishkoman	9	200	64	500
Khunjerab	6	85	80	280
Total	19	495	164	985

Source: GTZ-WAPDASurvey (1992-96)

Table 16: Monthly Energy Consumption Small Industries

Region	No. of Units Surveyed	Diesel (gal)	Electricity (kWh)	Wood in Winter (kg)	Kerosene (litre)	Coal (kg)
Chilas	6	225	700	180	-	-
Astore	32	715	1,800	690	-	-
Gilgit	6	275	850	420	-	-
Hunza	1	-	12,000	500	-	-
Ishkoman	3	84	445	35	50	-
Yasin	4	400	590	350	-	-
Skardu	6	305	1,000	290	-	-
Shyok	19	-	1,600	200	-	-
Haramosh	7	100	1,593	415	-	-
Kharmang	18	-	1,460	160	-	-
Khunjerab	1	-	7,462	500	-	-
Ghizar	7	-	-	880	305	100
Gultari	0	0	0	0	0	0
Total	110	2,104	29,500	4,620	355	100

Source: GTZ-WAPDASurvey. Vol.1 of 2 Table 3.3 of Comprehensive Planning of Hydro Power Resources on Tributaries of Indus River in Northern Areas produced in 1992-96

2.3.4. Existing Power Stations

The present power demand of the Northern Areas is largely met from small hydel power stations, with capacities ranging from 50 kW to 4,000 kW. As summarised in Table 9, there are currently 81 hydel stations in operation in the region, with an installed capacity of 46.44 MW. A further eleven hydel stations are at different stages of construction, and these are expected to provide an additional capacity of 9.280 MW when the stations come on line. An additional 12 stations are at the planning stage; if all of these schemes are constructed, they would represent an additional 635 MW of generation capacity.

Hydroelectric power is supplemented by 15 diesel powered thermal stations, with an aggregate capacity of 4.3 MW.

3. KEY INSTITUTIONS AND INITIATIVES

3.1. Government Institutions

3.1.1. Northern Areas Public Works Department

The Northern Areas Public Works Department (NAPWD) is responsible for power distribution and maintenance. NAPWD also maintains the most up-to-date records on electricity usage in the Northern Areas.

At present, according to the Annual Development Plan (ADP) 2002-2003, NAPWD is major executing department of developmental activities in the sectors of energy, transportation, communication, physical housing and planning, irrigation, and public health engineering with total annual budget (2002-2003) at the tune of Rs. 1.484 billion to execute the 238 schemes of all above mentioned sectors. Where as, recent figures (ADP, 2002-2003) in the sector of energy show that eleven hydel projects are under construction to exploit the installed capacity of 14.6 MW and to benefit the 12% additional average population of five districts of Northern Areas. Further that, twelve hydel projects with 630.3 MW installed capacity to benefit the 46% additional average population of NAhave been planned.

The NAPWD is headed by Chief Engineer (CE) having Basic Pay Scale (BPS)-20 (but recently redesigned as Secretary, Works NA) and supported by more than 1000 personals ranging from BPS-1 to BPS-19 of management, professional, skilled, non-skilled, and support nature posted at Head Quarter and in the offices as well as field power stations of five districts. At NAPWD HQ Gilgit, two Super-in-tending Engineers having BPS-19, four Executive Engineers having BPS-18, three Assistant Executive Engineers having BPS-17, one Administrative Officer having BPS-17, and thirty support staff having BPS-1 to BPS-16 are working. The strength of the manpower in five districts varies as per volume of the work and corresponding budget. However, in each district one Superintending Engineer assisted by two Executive Engineers (except in Gilgit having four Executive Engineers and Chilas having three Executive Engineers), three Assistant Executive Engineers and six Sub-Engineers attached to each Executive Engineer, and 20-24 support staff on average basis are working to discharge the duties according to the mandate of NAPWD.

3.1.2. Water and Power Development Authority

Water and Power Development Authority (WAPDA) remained the sole organization responsible for:

- Supervise, plan and monitor the development of energy and water sectors across the country;
- Design, survey, and prepare the feasibility reports of mega hydro and thermal power projects as well as irrigational head works and dams like Mangla, Tarbela, and Ghazibrotha; and
- Generation, distribution, and billing of electricity connected with a national grid system.

But recently, after the privatisation and reorganization reforms, these mandatory functions have been split and assigned to other newly created organizations. Still WAPDA is the prime organization dealing with power, energy and water sectors because of its huge network throughout the country and significant role to be played in policy and decision making based on gross root level factors.

In fact, WAPDA is enjoying special autonomous status of body corporate in nature empowered through national legislation in the form of ordinance/laws/acts and time-to-time amendments made therein. With its HQ named WAPDA House at Lahore, this organization is run by its Chairman supported by Executive Members responsible for various divisions like Power, Water, Administration, Finance, Planning etc.

Special projects like "Rehabilitation of Watershed Areas in the High Mountainous Catchments" to reduce the sediment load and enhance the water quality as well as quantity leading to big reservoirs of the country like Mangla and Tarbela are also being planned and executed by the WAPDA. Highly valuable extensive survey for the sake of "Comprehensive Planning of Hydropower Resources on the Tributaries of Indus River in Northern Areas" is another conspicuous example of special project, which has been accomplished with the assistance of GTZ.

In conjunction with GTZ, WAPDAwas instrumental in carrying out a detailed load survey of the Northern Areas between 1992 and 1996. Other agencies involved in the survey included the Northern Areas Planning and Development Department and AKRSP.

The entire area was surveyed during the course of the study. Visits were made to each village to collect the necessary data on population size and distribution, housing, public utilities, and commercial establishments. Interviews were held with local communities and Government officers in order to ascertain their energy needs. Data on other socio-economic factors that influence the consumption of electrical power were gathered. Patterns of power consumption and the use of alternative energy sources (e.g., kerosene and wood) were also assessed.

The aim of the project was to bring into focus the electrical power needs of the NA's domestic, commercial, industrial and public service sectors. In 1998, in response to the findings of the project, WAPDA's Hydroelectric Planning Organisation completed a ranking exercise that assessed the potential of hundreds of hydel sites on the tributaries of the Indus River.

3.2. NGOs

3.2.1. Aga Khan Rural Support Programme

The Aga Khan Rural Support Programme has supported the development of micro hydel power stations in several parts of the Northern Areas.

During the last ten years, AKRSP established five micro-hydel projects/stations with the capacity ranging from10 to 15 kW at Pari (Gilgit), Bagheecha (Skardu), Bunyal (Gultari), Ahmedabad and Chapurson Ziarat (Hunza). Out of these two at Ahmedabad and Chapurson can be termed as successes, where as rest of the three

are extreme failures and have become environmental hazards. These successes and failures may be because of certain socio-cultural factors prevailing in the relevant areas. Specifically it can be concluded that village organizations might not be responded up to the marks of sustainability. The total investment figures are although not available but thumb rule of investment ratio by the stakeholders is known. According to which, the participating community has to invest the 30% of the total cost and AKRSP has to invest the 70% of the total cost. The 30% by the community include provision of land, labour, and locally available material such as stones and wood. Independent from micro-hydel projects, AKRSP has also provided technical input as well as saplings of the fast growing tree species to the villagers to establish the wood-lots for fire-wood and fodder.

Building and Sanitation Improvement Program (BACIP) of AKDN (Aga Khan Development Network), World Wildlife Fund Pakistan (WWF-P), and Mountain Areas Conservancies Project (MACP) are worth mentioning, who are working for the promotion of fuel wood efficient stoves, other forms of renewable energy such as biogas, and improved building designs.

Pakistan Council for Scientific and Industrial Research (PCSIR) in collaboration with Pakistan Council for Appropriate Technology (PCAT) is working for the promotion of solar energy in Northern Areas and has established some units under the control of security establishments and private sector. But their success and sustainability along with environmental impacts are still to be determined.

4. ISSUES AND TRENDS

4.1. Issues

4.1.1. Inadequate Electricity Infrastructure

The NA's power supply network is overloaded and ageing. Conductors and transformers erected over two decades ago have not yet been upgraded or improved to cope with the increased number of consumers or the substantial growth in energy demand. As a result, electricity losses and voltage drops are significant; the electricity network in Gilgit town, for example, is estimated to lose in excess of 1,500 kW. Cumulative transmission and distribution losses in the NA's power supply system are currently estimated to be on the order of 30 per cent. NAPWD Water and Power Division Gilgit (Power Generation Log Books).

Table 17: Transmission Losses and Voltage Drops Experience by Gilgit Electricity Network

Name of Feeder	Length (km)	Voltage Drop (%)	Losses (kW)
Konodas	49.29	1.240	1,154.0
VIP	9.35	0.338	189.0
Ph-1	7.30	0.260	1.0
Ph-II	21.81	0.940	167.93
TOTAL			1,511.93

Source: NAPWD Water and Power Division Gilgit (Power Generation Log Books).

4.1.2. Inadequate Electricity Coverage

Less than 50 per cent of the NA's households currently have access to electricity supplies. There are, for example, nearly 3,000 pending applications for domestic electricity connections in the two urban centres of Gilgit and Skardu alone (Power Sector Review By NAPWD, June 2001). Even though the existing power network is unable to cope, there is great pressure to make power available to the urban and commercial areas, and for power coverage to expand in order to keep pace with domestic and commercial development.

In the rural areas, the expansion of electricity coverage is constrained by the NA's difficult terrain and the widely dispersed nature of many communities.

4.1.3. Insufficient and Unreliable Electricity Supplies

As indicated by Table 18, the present supply of electricity is insufficient to meet the demand. It is estimated that the current shortfall is in excess of 39 MW and is growing rapidly. The situation is exacerbated by the unreliability of power supplies: load shedding and power black outs are common occurrences throughout the region.

In an effort to meet their needs for an adequate and reliable source of energy, many small and medium enterprises in the Northern Areas have turned to the use of diesel generators. This, however, considerably increases the price of energy production, and means that manufacturing and processing costs in the Northern Areas are significantly higher than in other parts of the country.

4.1.4. Insufficient Investment in the Energy Sector

Despite the Northern Areas outstanding potential for the development of hydroelectricity, investment in the energy sector has generally been low; although hundreds of potential hydel sites have been identified, only a small proportion has been developed to date. Private sector investment has been constrained by the lack of enabling policies, incentives and mechanisms, and the fact that the Northern Areas are not connected to the national grid.

Table 18: The Current Demand for Electricity in the NA versus Supply

Region	Power Demand (MW)	Energy Available From Hydel & Thermal (MW)		Shortfall (MW)
	2001	2001		2001
		Hydel	Thermal	
Chilas	7.528	5.82	0.4	-1.308
Astore	5.925	3.01	0	-2.915
Gilgit	21.930	11.09	2.5	-8.340
Hunza	7.920	6.94	0.2	-0.780
Ishkoman	2.568	2.76	0	+0.192
Yasin	3.087	1.00	0	-2.087
Skardu	15.731	6.12	0.6	-9.011
Shayok	8.075	4.00	0.4	-3.675
Rondu/Haramosh	2.038	2.22	0	+0.182
Kharmang	5.988	1.88	0	-4.108
Khunjerab	0.611	0	0	-0.611
Ghizar	0.904	1.60	0.2	+ 0.896
Gultari	1.000	0	0	-1.000
Total	83.305	46.44	4.3	-32.565

Source: Power Sector Review (NAPWD) June 2001

4.1.5. The Environmental Impacts of Fuelwood and Other Alternative Energy Sources

In the absence of sufficient electricity supplies, the great majority of the NA's population makes use of alternative energy sources to meet their needs. There are, however, a number of important environmental impacts associated with this pattern.

For example, the continued felling of trees and bushes for firewood, coupled with rapid population growth, is contributing to deforestation in many parts of the region (see the chapter on forests and forestry for more details). There is also a range of social and economic impacts arising from wood collection and use, many of which fall disproportionately on women and children. These include the

increasing amount of time that must be spent searching for and gathering fuel wood as supplies diminish, and the health effects associated with the indoor air pollution that results from wood smoke.

Other alternative energy sources also have negative environmental impacts. The use of dung for fuel instead of for fertilizer is believed to be reducing the fertility of the NA's agricultural soils. The growing use of batteries also poses environmental concerns, as incorrect disposal can lead to heavy metal contamination of water supplies. The use of coal - particularly the high-sulphur coal that is typically burned in the Northern Areas - can lead to both air pollution and acidic precipitation.

4.1.6. Insufficient Use of Environmental Assessment Procedures

Although a number of the NA's more recent energy projects have been the subject of EIAs, the majority of hydel and thermal power stations in the region have been constructed without a thorough assessment of their potential environmental and social impacts. Hydropower is a relatively clean, renewable source of energy, but poorly planned hydel schemes can have serious negative environmental and social impacts (Box 1). Other large-scale sources of energy, such as thermal power stations, can contribute to air pollution and acid precipitation.

Box 1: Potential Negative Impacts of Hydroelectric Projects

Poorly planned hydroelectric schemes can have a range of negative social and environmental impacts, including the following:

Direct Impacts

- Negative environmental effects of construction (e.g., air and water pollution, soil erosion, vegetation destruction, sanitary and health problems caused by construction camps);
- Dislocation of communities living in the inundation zone;
- Loss of land (agricultural land, forests, rangelands, wetlands) by inundation;
- Loss of archaeological, cultural, historic and aesthetic features by inundation;
- Loss of wildlife habitat;
- Deterioration of water quality in the reservoir;
- Sedimentation of the reservoir and loss of storage capacity;
- Scouring of the riverbed below the dam;
- Disruption of riverine fisheries because of changes in river flow, blockages to fish migration, and changes in water quality.

Indirect Impacts

- Uncontrolled migration of people into the area, made possible by access roads and transmission lines;
- Environmental problems arising from new development made possible by the dam (irrigated agriculture, industries, municipal growth.)

Source: The World Bank, 1991.

An additional concern is the absence of a strategic environmental assessment for the NA's energy sector as a whole. At present, for example, there is no mechanism in place to assess the likely cumulative impacts of the region's many different hydel schemes; although each project on its own may be relatively benign, the combined impacts of multiple initiatives may be severe.

4.2. Trends

4.2.1. The Growing Demand for Energy

Using the data collected by the GTZ/WAPDA load survey, a power demand forecast for the Northern Areas was prepared for the year 2016, using 1996 as the base year. The results are summarised in Table 19. They suggest that the Northern Areas' demand for energy will continue to grow significantly, and that the shortfall between demand and supply will continue to increase unless new energy schemes are brought into operation. If promoted load (i.e., the sale of electricity for heating, air conditioning and cooking) is included in the forecast, the projected demand is even greater.

It should be emphasised, however, that forecasting is a complex exercise. The forecast model used to generate the figures in Table 19 requires that assumptions be made about a wide range of issues, including: estimated population growth rates; potential new load centres; income levels; commercial growth rates; and system losses. These issues, in turn, are affected by factors such as economic growth and development aspirations. Thus, although the overall trend is clear, the exact scale of future demand is difficult to predict with certainty.

The forecasting model used to develop the estimate of future demand is described in greater detail in Annex IV of this report.

Table 19: Power Demand Forecast for the Year 2016, under an "Intermediate Growth" Scenario

Region	Projected Demand Without Promoted Load (MW)	Projected Demand for Promoted Load (Heating and Cooking) (MW)	Total Projected Demand Including Promoted Load (MW)
	2016	2016	2016
Chilas	18.112	33.405	51.517
Astore	15.600	26.413	42.013
Gilgit	51.422	102.8	154.222
Hunza	17.794	37.880	55.674
Ishkoman	6.325	3.682	10.007
Yasin	7.044	13.638	20.682
Skardu	41.128	44.269	85.397
Shayok	18.284	42.027	60.311
Rondu/Haramosh	2.545	15.382	17.927
Kharmang	16.840	41.410	58.250
Khunjerab	1.390	2.327	3.717
Ghizar	2.114	3.682	5.796
Gultari	5.572	8.050	13.622
Total	204.170	374.965	579.135

Source: Comprehensive Planning of Hydro Power Resources on Tributaries of Indus River in Northern Areas, Volume 1 of 2 By WAPDAand GTZ (1992-1996).

5. THE WAY AHEAD

5.1. Develop and Implement a Northern Areas Energy Policy

To guide the future development of the energy sector in the Northern Areas, it is recommended that a comprehensive energy policy be developed, through a consultative process involving all the principal stakeholders. The central aims of the policy should be to promote energy self-sufficiency for the Northern Areas through the careful expansion of hydroelectricity, and to minimise the dependence on fuelwood harvested from the NA's natural forests. In particular, it is suggested that the policy:

- Promote institutional development and capacity building within NAPWD and WAPDA;
- Introduce new financial and cost recovery mechanisms, including differential rate structures for the sale of electricity, and the use of incentives/disincentives to encourage desirable patterns of energy supply and use;
- Encourage private sector investment in the energy sector, as well as the active involvement of NGOs and local communities;
- Promote the planned expansion of hydropower, and provide guidance (e.g., in the form of criteria) on the selection of priority sites and projects;
- Emphasise the need for a strategic environmental assessment of the energy sector as a whole, as well as environmental impact assessments of individual projects;
- Actively promote the development and implementation of an aggressive energy conservation programme;
- Promote an increase in the supply of cultivated fuelwood;
- Encourage the use of other renewable sources of energy, such as solar power.

These recommendations are discussed in greater detail below. To oversee the development and implementation of the policy, an independent power board for the Northern Areas should be constituted as a matter of priority, with representation from all the major stakeholder groups.

5.2. Promote Institutional Development and Capacity Building

NAPWD is the only organization, which plans, surveys, designs, estimates, and supervises the execution of all the development projects in the sectors of transport, communication, physical planning housing, public health, irrigation and energy in Northern Areas. The organization is also responsible for maintenance and operation of all the assets built so far in the above-mentioned sectors. This organization with its total number of only 45 qualified engineers is badly over loaded. Actually, the present strength/number of engineers was created back in

early eighties when the number of projects, their magnitudes and allocated budget was much smaller. The number of the projects have been increased manifold as the ongoing projects during the financial year 2002-2003 are 233 and allocated budget is plus Rs. 1.5 billion. In addition, the maintenance load over the last 20 years has also increased due to completion of more projects. This department needs, therefore, reorganization and reinforcement by inducting sufficient number of qualified engineers in order to increase its efficiency.

Training facilities are rarely available both for engineers as well as for the staff engaged for the maintenance and operation of vital installations. The installations of energy sector built wroth million of rupees are run at almost zero budget at the mercy of raw hand operators engaged on casual basis at Rs. 2,000 per month. This situation results in fast deterioration of valuable machinery and equipments. As a result, we have to face the reduction in efficiency and antiquation of valuable equipments before the estimated useful economic life. Therefore, training facilities both for the engineers and other staff responsible for operation of vital installations is highly essential beside provision of adequate funds for carrying out the maintenance of such assets as per laid down engineering principles.

NAPWD is principally responsible to prepare the project feasibility and documents like PC-1 of all development projects. Currently this department does not have any economist, social scientist, and geologist in its existing set-up. Economic, financial, and environmental impact studies in addition to geological studies are mandatory in project preparation. Inducting qualified personnel in the above said fields can enhance the efficiency of the department.

The staff being engaged for maintenance and operation of vital installations of energy sector on casual basis needs to be discouraged and instead staff with basic qualification in the relevant field be engaged on permanent basis at appropriate level of salaries, so that they may work with full satisfaction, responsibility and efficiency.

It appears to be useless to invest more and more on creating new assets ignoring the maintenance requirements of already built assets. It will therefore to appropriate to provide adequate funds for maintenance and upkeep of the vital installations of energy sector already built so as to increase both efficiency and life.

5.3. Introduce New Financial and Cost Recovery Mechanisms

Currently, the responsibilities of power generation, transmission, distribution, and billing rest with the Executive Engineers, Water & Power Divisions of NAPWD (One such division is located in each district). In its existing state, the system is quite vulnerable to theft, pilferage, and undue connections. The billing system against sale of energy needs to be reviewed. Realizing this fact, a case has been taken up by the NAPWD with the local administration to create an independent set up exclusively for billing and recovery against sale of electricity in NA. An Executive Engineer assisted by two Assistant Executive Engineers in each district with full autonomy to perform the function independently should head the new set up. This arrangement, if materialized based on cost recovery mechanism, will

increase the collection of revenue through increased efficiency and checked theft and pilferage of electricity. It will also ensure the availability of more funds to energy sector.

There is a wide gap between the demand and supply of power in NA and before filling up this gap by executing new projects, a strong need to discourage the misuse and excessive use of electricity warrants a special tariff structure (given as under) in addition to already suggested recovery mechanism.

Table 20: Special Tariffs from 2001-2002 to 2004-2005 for Northern Areas

S.No.	Range of Units (kWh)	Year-wise Unit Cost in Rupees			
		2001-2002	2002-2003	2003-2004	2004-2005
Consumer Category-I (Domestic)					
01	0-50	0.90	1.08	1.40	1.82
02	51-150				
1.34	1.61	2.09	2.72		
03	151-300	1.79	2.15	2.80	3.64
04	Above 300	2.23	2.08	3.48	4.52
Consumer Category-II (Commercial)					
01	0-100	2.40	2.88	3.74	4.86
02	Above 100	3.30	4.03	5.24	6.81
Consumer Category-III (Industrial)					
01	For all units	1.50	1.80	2.34	3.04

The above structure for tariff indicates that domestic and commercial consumers have to pay more, if use excess energy beyond specific limits. Where as, uniform rates of sale are introduced for industrial consumers. This differential profile of tariff is already in practice and has quite successful in the area to bring the following results:

- Misuse of electricity and excessive consumption has been reduced.
- A substantial annual increase in the receipt of revenue amount has been possible to cover the cost of generation.
- The demand has reduced and power supply management has become easy.
- The increasing trend of electricity sale rates may be step forward to encourage private investor to undertake energy projects in NA.

5.4. Carefully Expand the Supply of Hydroelectricity

In order to increase the NA's supply of hydroelectricity, it is recommended that:

- The priority hydel projects identified in Table 21 be implemented. In total, it is estimated that these projects have the potential to increase the Northern Areas' supply of energy by some 632 MW;
- AKRSP's successful micro-hydel programme be expanded into other localities and villages, and replicated by other NGOs and organisations.
- In developing new hydel projects, however, it is critically important that adequate attention be paid to the prevention and mitigation of social and environmental impacts (see below). It is also important that hydel development be seen as only one component of a comprehensive energy programme for the

Northern Areas, and that the other elements of the programme (as described in this chapter) also be accorded attention.

Table 21: Priority Hydel Projects in the Northern Areas

Priority Ranking	Project Location	Status	Capacity (MW)
SHORT-TERM			
1.	Naltar-V, Gilgit	Approved	18.0
2.	Naltar-III, Gilgit	Feasibility completed in Dec 2000.	22.0
3.	Basho-II, Skardu	Feasibility completed.	23.0
4.	Mehdiabad Sermik, Skardu	Feasibility completed (Physical work commenced)	1.0
5.	Thore (Chilas), Diamir	Feasibility completed and work started.	1.2
6.	Darmandar, Ghizar	Feasibility completed	1.5
7.	Thaley, Ghanche	Feasibility completed and work started.	2.0
LONG-TERM			
1.	Sai Juglot, Gilgit	Feasibility completed	10.5
2.	Nomal, Gilgit	Feasibility completed & PC-1 approved.	3.0
3.	Harpo (Rondu), Skardu	Feasibility likely to be completed by June 2001	24.0
4.	Kachura-IV, Skardu	Feasibility completed & work started.	1.00
5.	Multi-purpose Sadpara Dam Project, Skardu	Project approved and work started.	10.0
6.	Doyan (Astore), Diamir	Feasibility likely to be completed by Dec. 2003.	425.0
7.	Phander, Ghizar	Feasibility likely to be completed by Dec. 2003.	87.0
8.	Ghawari, Ghanche	Feasibility completed and PC-I approved.	3.0
Total			632.2

5.5. Encourage Private Sector Investment

In order to create an enabling environment that will encourage private sector investment in energy initiatives, it is recommended that:

- Mechanisms and incentives be put in place to generate private sector confidence and attract investors. Law & Order Improvement, Security Provision, Financial Rebates, Loan Facilities etc.
- A capacity building programme be initiated to raise the technical capacity of the Northern Areas Government in the management, regulation and monitoring of joint venture hydel projects;
- The Northern Areas be linked to the national grid. This would not only make investment in hydel projects more attractive, but also, would enable the purchase of surplus power from the Central Asian State of Tajikistan and other areas.

5.6. Strengthen Environmental and Social Safeguards

The urgency of developing the NA's energy supplies should not overshadow the important need to address the potential environmental and social impacts of energy projects; it is crucial that future energy development in the Northern Areas be coupled with rigorous environmental and social safeguards. In this regard, it is recommended that:

- a strategic environmental assessment of the entire energy sector be undertaken;
- detailed environmental impact assessments be undertaken of all projects;
- capacity building programmes in SEA/EIA be offered to the staff of the Planning and Development Department, NAPWD, WAPDA and other organisations involved in the energy sector;
- public consultation processes be fully integrated into all stages of the energy planning and development process.

5.7. Develop and Implement an Energy Conservation Strategy

Energy conservation offers the most cost-effective means for bridging the gap between demand and supply. In effect, energy conservation can be regarded as another way of adding to the total supply of available energy. Other benefits include savings on fuel costs and positive environmental impacts.

A comprehensive Northern Areas energy conservation programme has the potential to increase available energy supplies by 20 to 25 per cent over a relatively short timeframe (Survey by WAPDA/GTZ); the costs of such a programme would also be considerably less than those required to produce the same amount of energy from conventional sources. It is recommended that:

- Losses in the distribution network be minimised by making better use of transformers and conductors. These need to be of an appropriate capacity and correctly positioned at load centres within the network;
- Power generating equipment be maintained on a regular basis, in order to improve efficiency;
- An energy conservation campaign targeted at users be developed and implemented. A wide variety of approaches should be explored, including the use of insulation in homes and workplaces and the promotion of energy-efficient electrical appliances. The elements of the campaign should include:
  - Awareness raising and information provision;
  - The implementation of training programmes;
  - The provision of technical assistance with the development of energy conservation measures for all sectors of the economy;
  - The design and implementation of pilot and demonstration projects;
  - The publication of guidelines on good energy conservation practice.
- Efforts be made to meet the energy demand for heating, cooking and cooling through the use of environmentally-friendly alternatives to electricity. This demand represents over 60 percent of the total projected electricity demand in 2016. Options that might be explored include: the incorporation of passive heating and cooling designs into building construction; the use of solar water

heating; and the increased use of LPG for cooking;

- Existing initiatives dealing with load management and energy conservation be coordinated, in order to maximise their impact;
- Appropriate policies and supporting legislation be developed to encourage energy conservation.

5.8. Increase the Supply of Cultivated Fuelwood

Fuel wood is a critical source of energy throughout the Northern Areas, and in particular, for low-income households. Although the increased development of the NA's hydroelectric resources can be expected to ease the demand, it is likely that fuel wood will continue to be an important energy source in many areas. In order to meet this demand and to reduce the pressure on the NA's natural forests, it is recommended that the supply of cultivated fuelwood be increased. This could be achieved by expanding the area dedicated to fuelwood plantations and by encouraging the adoption of agro-forestry practices. (These options are explored in more depth in the chapters dealing with forestry and agriculture.) The use of more efficient woodstoves should also be actively promoted.

5.9. Promote other Forms of Renewable Energy

In addition to hydel, other forms of renewable energy should also be explored and promoted where appropriate. There may, for example, be potential for the production of biogas in some areas. Solar power may also be feasible in some situations, particularly if the supply of spare parts and the provision of technical back-up can be improved.

Table 22: Existing and Under Construction Power Stations

Region	Existing Power Stations				Under Construction Power stations (Hydel)	
	No. of Stations		Capacity (kW)		No. of Stations	Capacity (kW)
	Hydel	Diesel	Hydel	Diesel		
Chilas	7.8	1	5,820	2000	1	1000
Astore	8	0	3,010	0	0	
Gilgit	14	8	11,000	4,400	2	4,160
Hunza	13	1	6,940	200	1	400
Ishkoman	3	0	2,660	0	0	0
Yasin	1	0	1,000	0	0	0
Skardu	10	4	6,120	1,200	2	1,200
Shyok	7	1	4,000	200	1	1,500
Haramosh	5	0	2,220	0	1	500
Kharmang	7	0	1,880	0	0	0
Khunjerab	2	0	985	0	1	100
Ghizar	4	0	660	0	0	0
Gultari	2	0	110	0	0	0
Total	81	15	44,000	8,000	9	8,800

Source: GTZ-WAPDASurvey 1992-93 (updated)

6. DEMAND FORECAST

Before developing the power supplies for a region, it is necessary to estimate the expected power demand of different load centres in the region. This helps particularly in locating the hydro electric source in various parts of the region. In this chapter the estimate of power demand for the entire area, has been made up to the year 2016.

These estimates have been made for domestic, commercial, crafts, industries, public services and public lights separately and then added up to calculate the total demand for various proposed load centres in the region.

6.1. Basis of Power Demand

The demand forecast includes the identification of load centre, population growth rate, number of domestic, commercial, public service and industrial establishments with respect to energy consumption and load factor.

6.1.1. Load Centres

Basic unit for estimating the power demand is the "load centre". This is a unit spread out in small or large geographical areas covering population. It can be a city, a number of villages or a concentration of population that is economically integrated.

6.1.1.1. Identification of Load Centres

A number of load centres have been identified on the basis of available information that includes GT Sheet, population census reports of NAvarious reports on the area prepared by HEPO WAPDA and P&DD NA and by under-taking survey in the field.

The report prepared by WAPDA and Aga Khan Foundation provided the knowledge on physical characteristic of the area, population distribution, land use and general economic activity. In addition the following information being necessary to identify the load centres was also considered to determine the load centres in various regions of the Northern Areas:

- Access to safe water supply, education, sanitation and medical service.
- Number and type of commercial centres and service establishments.
- Number and types of industrial units.
- Government offices and NGO's establishments.
- Number of public institutions in each union councils.
- Social infrastructures
- General socio-economic situation.

6.1.1.2. Field Investigation

Information was collected on the number of persons in each household, their income, occupation, land holding, migration, availability of social services, use of different kinds of energy etc. This helped is great deal in assessing the economic status and quality of life in various load centres.

Visit were made to different offices in Gilgit to get more details on agriculture, industry, minerals, forests, irrigation system, education, health, social welfare, roads, water supply and electricity in the region. Meetings were held with the AKRSP staff and many socio-economic aspects of the region were discussed.

- Data related to electricity supply system, its operation and sale was collected as under:
- Sale of electricity in Gilgit and Skardu city.
- Number of electricity users and consumption for different categories.
- Use of electrical appliances in the households.
- Monthly load and energy.

6.1.2. Autonomous Load

For estimating the power demand, the autonomous load for power and energy has been considered. It has three basic characteristics.

- Normal demand of the people that increases with the growth of population, with more people in a locality more power would be consumed.
- The demands automatically increases due to the development in agriculture industry, health facilities, educational opportunities, communication system.
- The industrial load. This is the load of small and medium scale industries established mainly in important cities and towns of the region.

These developmental activities lead to a change in income level and people begin to use new products and appliances.

This increase the power demand in general. The autonomous load, thus, consists of the following categories of demand.

6.1.2.1. Domestic

It covers the demand of the household for lighting, fans, irons, air conditions and other household appliances.

6.1.2.2. Commercial

It mainly comprises the demand of commercial centres, shops, hotels restaurants and power stations etc.

6.1.2.3. Industrial

It refers to the demand of small craft centres i.e. handicraft establishments, cottage industry, grinding mills, saw machines, workshops and other mini units spread out in the area. These village industries essentially meet the demand of the community.

The industrial load. This is the load of small and medium scale industries established mainly in important cities and towns of the region.

6.1.2.4. Public Services

Electricity is also needed for schools, hospitals, police stations, administration offices, nation building departments, community services, military establishment and NGO's.

It may be pointed out that a considerable amount of demand for heating in winter may be included in these categories.

Generally, there is a difference in consumption pattern of different households in the same load centre. So the demand of energy for various categories of income groups has been considered differently.

6.1.2.5. Street Lighting

In Gilgit city and other load centres, power is also needed for street lights and adequate provision has to be made for it.

6.2. Determination of Parameters

Following information being necessary for determination of demand forecast were obtained from WAPDA reports and other offices located at Gilgit.

- Number of persons per family
- Number of persons per house (family and relation)
- Number of rooms per house
- Occupation
- Income of the household
- Land holding
- Livestock
- Monthly domestic energy consumption (firewood, Kerosene , LPG, batteries, electrify etc.
- Electric appliances being used.
- Migration to other cites and countries.
- Monthly consumption of electricity for small commercial establishment.
- Monthly consumption of electricity or diesel oil for small industrial establishment.

Data was also collected from the log-books of some hydel stations.

6.2.1. Analysis

Data obtained from the field and elaborated in the office have been utilized to determine the parameters as under:

6.2.1.1. Population In (Year of Survey of Respective Regions)

To make a projection of population for 2001 estimates made in 1981 census have been taken as the basis. Thus the population of the city, town and villages in different load centres are based on 1981 population (Table 27).

For making a projection up to 2016 the inter-censal growth rates for 1972-81 have been evaluated it was found that the rate of growth was 6.5 percent per annum while the rural growth rates was 4.8 percent during this period. It was considered that this growth rate is on the higher side. Therefore, various documents and report

relating to NA were consulted. Population growth rates used in various reports by WAPDA in connection with the planning of hydro-electric resources in the area were looked into. Discussion were held with the Planning and Development Department of Northern Areas and NAPWD officials. All investigations confirmed that growth rate to be adopted after 1981 census was on a lower side-compared to the inter-censal growth rate. Therefore, annual growth rates of 4.5 percent was used for A-1 load centres 3.5 percent for A, 3.2 percent for B and 2.8 percent for C category load centres.

6.2.1.2. Annual Population Growth Rate

The population growth rate is the main determining factor for future load development. As autonomous load is essentially the demand of power of the people in a locality, it is necessary to give the basis of growth rate to be adopted to estimate population over the planning horizon, which in this case comprises 16 years.

Taking into consideration the Government policies, it is likely that in medium and long-range (10-20 years). The growth rate will decline. But future rates of growth can't be defined exactly and assumptions have to be made in order to make sensitivity analysis three alternative scenarios have to be considered.

6.2.1.3. Persons Per Household (P)

A household survey was carried out in the area. The result show that 34 percent of the household have per family with 7 to 8 persons. The remaining 56 percent of the houses are shared with other relatives with 9 to 11 persons per house. This seems to be different from the results of 1981 Census where 8 persons per household have been estimated for Gilgit district. As expected, households with one family were more common in the city. For sensitivity analysis population size per household has been determined for three scenarios as follows:

Table 23: Income Distribution

Monthly Income (Rs)	Category (%)		
	A	B	C
Below 1500 (Low)	28	40	56
2500 – 3000 (Medium)	50	45	37
Above 3000 (High)	22	15	74

Source: WAPDA& GTZ Report 1998.

6.2.1.4. Number of Household Per Commercial Centre

The number of shops and other commercial centres, have been counted during the field survey in selected load centres and verified from the information collected. Based on these results a ratio between households and commercial centres has been established for different load centres. This ratio has been taken as constant over the planning period 2001 to 2016.

6.2.1.5. Number of Households Per Public Unit

The offices of local administration - Sub Division and district administration, NGOs, Northern Areas Organizations and public sector agencies, as well as the union councils have been counted.

Similarly public service units i.e. schools, dispensaries, police station, utility offices have been counted and verified. On the basis of these counting and survey, a ratio between the households and public service units has been established for different load centres.

Street lighting has also been considered as a public service. Since the annual energy demand of street lights correspond to the average demand of one public service unit, it is considered additional as a public service unit.

6.2.2. Electrification Co-Efficient

To determine the electrification co-efficient for various load centres, development of the number of domestic, commercial and industrial consumers in the region has been collected and analyse. Growth in the number of consumers for different categories in other regions was also evaluated.

Power supply system has been operating for a considerable period in Gilgit city. Progress of electrification in the city and in other parts of the region has thus been taken as a basis for determining the electrification coefficient for different categories of consumers. The number of pending applications in some of the load centres have been taken into consideration.

Development in the power supply system in the adjoining areas was also considered. Electrification coefficient in the rural areas of Battagram and Mansehra tehsils ranged between 17 to 49 percent. In Chitral town, the electricity co-efficient for all consumers has developed from approximately 40 percent in 1976 to 84 percent in 1988-within a period of approximately 12 years. The process of electrification considered for high, medium and low income groups and for commercial and public cerci unit is as follows (WAPDA & GTZ report 1998).

For households the electrification coefficients for different categories are given below:

Year	Households (%)					
	High Income			Low & Medium Income		
	A	B	C	A	B	C
1993	100	100	85	75	70	60
2003	100	100	95	90	85	75
2013	100	100	100	100	95	90

For commercial, the electrification coefficient are given below:

Year	Electrification Co-Efficient %		
	A	B	C
1993	85	85	85
2003	100	100	95
2013	100	100	100

For public services, electrification coefficient are same as that of domestic high income.

6.2.3. Annual Consumption Per Consumer

To determine the basis of consumption per customer for different categories of consumers, details were obtained from three sources.

- Trend in the adjoining areas.
- Experience of the power supply system in the region.
- Field survey

Information from various mountainous district of the NWFP, Azad Jammu and Kashmir and other regions of NA were obtained. Historical developments in consumption for various regions were analysed.

Power consumption and generation of power stations for different categories of consumers in Gilgit city and other hydel centres have provided the basis for consideration of unit demand.

6.2.4. Unit Consumption of Domestic Customers

From the record and field survey, it was found that average yearly household consumption in various load centres is as follows:

Load Centre	A1	A	B	C
Consumption Household (kWh Year)	1,184	998	850	708

Due to the fact that there is frequent load shedding and break downs of the system it is considered that these levels of consumption are on the lower side. Therefore, it is assumed that the consumption would increase when a more reliable system is established.

Taking the level of income in the region, the unit demand has been calculated on weighted average basis. It may also be pointed out that the unit demand in case of each category of load centre has been different with regard to high, medium and low income groups as follows.

Table 24: Per Customer Annual Energy Consumption – Domestic Sector (kWh)

Income Level	Year	Category of Load Centre			
		A1	A	B	C
High Income	1993	2,000	1,900	1,800	1,750
	2003	2,800	2,700	2,550	2,450
	2016	3,700	3,600	3,500	3,400
Medium Income	1993	1,250	1,100	1,000	900
	2003	1,700	1,500	1,400	1,300
	2016	2,400	2,200	2,000	1,800
Low Income	1993	950	900	800	700
	2003	1,250	1,250	1,100	1,000
	2016	1,600	1,600	1,000	1,300

6.2.5. Unit Demand of Commercial Consumers

The consumption per commercial unit for in the urban areas of Gilgit was around 712 kWh in 1991. considering that the consumption was lower due to load shedding

shut downs and other constraints in the supply, a 25 percent increase in consumption has been assumed and demand growth is worked out for the planning period.

Table 25: Per Customer Annual Energy Consumption – Commercial Service (kWh)

Year	Category of Load Centres			
	A1	A	B	C
1993	1,200	1,100	1,000	900
2003	1,700	1,500	1,400	1,300
2016	2,350	2,200	2,000	1,800

6.2.6. Unit Demand for Public Services

The demand of electricity for public services relates to administration offices, military, NGOs, community centres, schools, hospitals, police stations and other administration centres. Based on the consumption experienced in Gilgit city and other load centres, the unit consumption of Public services is given below:

Table 26: Per Customer Annual Energy Consumption – Public Service (kWh)

Year	Category of Load Centres			
	A1	A	B	C
1993	4,000	2,000	1,500	1,500
2003	5,300	2,800	2,000	2,000
2016	6,900	3,750	2,700	2,700

6.2.7. Unit Consumption of Industrial Units

Unit consumption of industrial establishments has been determined by two ways (a) through a survey of craft consumers in the region (b) from the records made available by NAPWD of established industries (small and medium) using power in Gilgit city and other areas.

The consumption of craft units e.g. handcrafts establishment, cottage industries, grinding mills, saw mills and workshops etc. has been obtained from the region. The available information shows that (a) monthly consumption of diesel for 3 small industrial units is 275 gallons. In energy terms, this is equivalent to 3.38 MWh of average monthly consumption (b) monthly use of electricity by 3 small establishment was 0.81 MWh.

Average annual consumption for industrial units investigated in this region, thus comes to 16.76 MWh. A figure of 8 MWh has been used for estimating the demand for an industrial unit. The unit electricity consumption of various industrial units in Gilgit city during the recent years was evaluated.

6.2.7.1. Number of Industrial Establishments

The number of industrial units existing in 2000 in the region has been found from various sources as follows:

A list of industrial establishments using electricity was obtained from NAPWD. The departments of industries, local government and rural development, union councils have been the other sources of information. The hotels, tourists industry operating on diesel in the area are expected to use electricity when more reliable supplied are available. These are included in the total number of industries in the region. Similarly new hotels and other tourist industries to be established would meet their requirements provided under the annual increase projected for the two decades separately in the non-electrified areas.

Detail information about the small industrial establishment during the survey of the region. Any craft unit meeting the demand of the local community was identified and listed.

Estimates of the likely number of industrial units in some of the centres have been made taking into consideration the resource position on the area i.e. agriculture, livestock, forestry and minerals.

6.2.7.2. Growth of the Industrial Consumption

The record of consumption of industrial establishment was studied. It appears that growth in consumption in centres of category A1 and 'A' would be 12% to 10% in the first decade (2000-2010) and 10% and 8% respectively in the second decade (2003-2013). For centres of category 'B' the consumption is expected to grow annually 8% in the first decade and 7% in the second decade.

6.2.8. System Losses

Line losses are more in this area as the load is generally scattered. Efforts are being made to minimize the losses by improving the system. Some progress has been achieved due to these efforts. It is assumed that energy loss reduction activities would result in losses as follows:

Year	Category A1	Category A, B and C
1993	25%	20%
2003	20%	18%
2016	18%	15%

This is the target for losses from generation to consumption under normal circumstances.

6.2.9. Annual Load Factor and Hours of Utilization

Detailed calculation of the load factors in various power stations at Gilgit had been worked out. Load factor in Gilgit Danyor, Juglote and Nomal has been studied. The results show that the load factor was 81 percent in Gilgit, 53 percent in Juglote and 47.7 percent in Nomal under the conditions of significant load shedding resorted to in the system.

Based on this analysis following hours of utilization have been projected for the load centres.

Gilgit is designated as 'A1' load centre. It is the seat of NA and Gilgit district and the largest city of the region. It is also important for tourist traffic and commercial relations with the adjoining countries. There is an airport, large number of medium and small industries and thus is a major load centre. Hours of utilization assumed for the station would be 3210 (37%) in 2000 and would go up to 4338 (50%) by the year 2016. The same hours of utilization have been assumed for the other 'A1' load centres.

In the centre of 'A' category the hours of utilization have been adopted as 3210 (37%) in 2000 and would go up to 4000 (46%) by 2016.

For the load centre of 'B' category the hours of utilization have been taking as 2650 (30%) in 2000 and would go up to 3230 (37%) by the year 2016.

In 'C' category load centres the hours of utilization have been taken as 2450 (20%) that would increase to 3000 (34%) by the year 2016.

All values in parenthesis above indicate the corresponding load factors).

6.3. Models Used and Their Technical Operation

6.3.1. Model for Elaboration of Autonomous Load

The parameters elaborated in earlier paragraphs of the study are processed for three alternative scenarios as under:

- Optimistic (high)
- Intermediate (Medium)
- Conservative (Low)

Based on three alternative parameters annual population growth rate persons per households and taking the following factors in to account, the exhaustive demand has been worked out.

- Population in years 2000 to 2016. Number of households served.
- In low income class
- In medium income class
- in high income class
- Number of commercial centres served.
- Number of public service units served annual energy consumed by

6.3.2. Promoted Load

Projected load may develop if the consumer in the region also uses electricity for heating, cooking baking and cooling or when the sale is promoted for these purposes as a policy with some subsides provided.

Table 27: Population in Northern Areas

Geographic Zone	Regions Included	Population 1981	Projected Population			Zones'Projected Population		
			1996	2006	2016	1996	2006	2016
Diamir	Chilas	75,981	119,977	163,263	222,831	194,592	271,871	371,600
	Astore	42,589	74,615	108,608	148,769			
Gilgit	Gilgit	88,763	151,975	236,093	318,583	350,336	505,529	663,933
	Hunza	64,180	95,419	132,387	168,586			
	Ishkoman	24,716	38,339	51,398	68,943			
	Yasin	30,030	45,841	60,449	75,256			
	Khunjerab	4,164	6,611	9,008	12,290			
	Ghizar	8,150	12,351	16,294	20,275			
Baltistan	Skardu	91,605	152,583	215,797	288,949	380,562	527,407	695,261
	Shayok	73,322	115,248	156,945	204,592			
	Haramosh	30,409	47,004	63,127	80,616			
	Kharmang	40,874	65,727	91,538	121,104			
Independent	Minimarg	11,719	20,531	29,884	40,934	20,531	29,884	40,934

Table 28: Number of Households Per Commercial Centre, Public Service Unit and Public Lighting

Load Centre	Households per Commercial Centre	Households per Public Service Unit	Households per Public Lighting
Chilas	621	1,122	583
Astore	349	560	590
Gilgit	398	1,295	595
Hunza	454	1,340	545
Ishkoman	177	570	290
Yasin	234	830	405
Skardu	407	1,320	636
Shayok	364	930	510
Rondo/Haramosh	318	575	323
Kharmang	362	702	410
Khunjerab	126	358	216
Ghizar	63	360	90
Gultari	119	192	152

7. OPTIONS FOR ACTION

The energy sector has to play its role by providing the productive sectors of Northern Areas economy with reliable and competitively priced energy. Northern Areas has the lowest per capita energy consumption in the country. The area is not connected with the national grid. Electric energy is generated through locally constructed hydro electric power stations on various potential sites. Hundreds of hydel potential sites have been identified on various tributaries of River Indus in a ranking study completed in the year 1998 by WAPDA. A logical policy initiative to facilitate implementation of the most promising projects needs to be evolved. Implementation of hydel projects despite the fact that the energy is urgently needed, has not been satisfactory due to low investment in energy sector in the past. Due to limited availability of resources in public sector Development programme, implementation of these urgently needed hydel projects can be assigned to private investors. The Northern Areas Government/ administration is not adequately equipped to effectively manage and monitor joint venture programmes in energy sector. There is therefore a serious needy to raise its technical capacity.

More attractive policies must be developed for effective and encouraging investment in energy sector development in Northern Areas. These policies should give appropriate legislative cover to generate private investors confidence. More attractive policy packages should be devised for implementation of the most attractive potential projects needs to bridge the gap between supply and demand of energy as short term measure.

Early implementation of these urgently needed most environmental friendly and most promising projects shall provide sufficient energy for lighting, heating and cooking. Thus the dependency of people on use of wood for heating and cooking shall be reduced thereby minimizing cutting of forests in this already forests deficit area. In the rural areas most of the time of woman folk is consumed in collection of wood and extracting scanty bushes on hills, this practice in addition causes bad health effect due to extra ordinary physical exertion. The time thus saved by the women folk shall be consumed in other productive activities. Use of K-2 oil for lighting and heating and cooking besides being costly is also dangerous to human health. There is therefore an urgent need to take immediate steps for conservation of all existing energy resources of NA and also augment the shortfall in energy supply by implementing some of the most promising and urgently needed projects.

7.1. Renewable Sources of Energy

Biomass is the main non-commercial renewable resource of energy supply for the low income household in Northern Areas. The unbridled cutting of trees and extraction of scanty bushes from farms, forests and hills coupled with rapid population growth may pose serious environmental threat due to their extinction. In order to conserve biomass resources, a number of steps need to be taken on priority basis as under:-

"Generate sufficient energy by establishing new hydro electric power stations on the most promising sites identified in the ranking study on the tributaries of River Indus. The exhaustive energy demand of energy of the entire population projected till the year 2016 can be met by implementation of the projects listed in Table 21. The dependency on biomass resources shall thus be minimized. At the same time other steps like promoting plantation, improved farm management and community training, establishment of wood based industries and provision of alternate energy like hydro electricity particularly in areas in close proximity of top soil erosion".

7.2. Energy Conservation Strategy

Energy conservation offers the most cost effective supply option to bridge the demand and supply gap. Conservation is a form of use of available energy more efficiently and thereby minimizing the waste component and reducing the losses to maximum possible extent. The same level of output can be achieved with less energy or output can be increased with no corresponding increase in energy consumption. If the wastage and losses of the energy available from the existing resources are reduced. The energy thus saved can be made available to a greater number of consumers. It is therefore another way of adding to the total supply of available energy. In this respect, energy conservation is similar to increasing energy supplied through increased levels of domestic production.

Energy conservation also has several advantages over other supply options. It has short gestation periods. It has specific advantages in terms of scarce foreign exchange and above all it has positive environmental consequences. It is estimated that a comprehensive Northern Areas level energy conservation programme may increase available energy supplies by 20-25% over a relatively short time frame and at much lesser cost than production of the same amount of energy by conventional sources of energy. Losses can be minimized by using adequate size of conductors, transformers of appropriate capacity and positioning them at the load centres in the existing network. Adequate repairs of power generating, equipment and timely overhauling may improve the efficiency. This will enhance the plant factor thereby supply comparatively more energy in a specific time spell. Significant saving of energy can be achieved by introducing the use of efficient house-hold appliances for lighting, heating and cooking etc by domestic and commercial consumers. Significant amount of energy can be saved by industrial consumers by avoiding idle running of their equipment and introducing efficient equipment.

A large part of energy savings can be captured in a relatively short time, as compared to the longer development time needed for meeting other energy supply options. A number of energy saving steps can be implemented in a comparatively short period of time (within a few months) while developing and construction of a new power station and distribution network requires 4-5 years normally.

Energy conservation can be targeted at all sectors of economy including, industries, residential buildings, commercial buildings like hotels and shops, hospitals and educational institution and agriculture sector.

The cumulative power transmission and distribution losses in the existing power supply system of NAare in the order of 30%. This high order of losses is due to over loaded power supply network. The conductors and transformers erected twenty

years back for a limited number of consumers have been completely over loaded due to increased number of consumers and enhanced amount of power input in the same old network without corresponding improvement of the system. The measures likely to occur savings may include improved use of cooking heating equipment and use of more efficient appliances, replacement of incandescent lamps with energy efficient lamps. Improved architect of buildings and opted specifications with required degree of insulation may help add in energy saving protect the natural forests and increase the planted forests.

Specific energy conservation steps required for inclusion in Northern Areas conservation strategy include:-

- Conducting energy conservation awareness campaigns, information and out reach services.
- Demonstrate early result in order to provide visible impact and support for energy conservation.
- Use total energy management approach, which combines engineering management and financial aspects of energy conservation into a single, logically connected unified process.
- Planning of programmes including conducting of special policy studies and development legislative initiatives to support implementations.
- Developing and presenting training courses and curriculum for educational and capacity building of the stock holders.
- Conducting technical assistance projects, including demonstrations energy audits, feasibility projects/studies and applied research projects.
- Monitoring evaluating and reporting on the progress of energy conservation programmes for each sector of economy and institutional strengthening to promote and implement energy conservation.
- Integrating load management plans and energy conservation activities being carried out by various government Organizations and NGOs to minimize redundancy of efforts and maximize results achievements.
- Comprehensive planning of hydro power, resources on tributaries of Indus river in the Northern Areas.

Table 29: Intermediate Demand Forecast (kW)

Region	Increase @	Year			
		1995	2005	2015	2016
Chilas	6.5%	4,705	10,321	17,007	18,112
Astore	90%	3,527	7,529	14,312	15,600
Gilgit	7.5%	14,058	27,262	47,834	51,422
Hunza	7%	5,045	9,808	16,630	17,794
Ishkoman	7%	1,771	3,396	5,890	6,325
Yasin	7%	1,942	3,846	6,583	7,044
Skardu	9%	9,832	19,613	37,698	41,128
Shayok	7%	5,047	10,107	17,088	18,284
Rondo/Haramosh	2%	1,568	2,119	2,515	2,545
Kharmang	9.8%	3,327	7,739	15,337	16,840
Khunjerab	6.5%	399	754	1,276	1,390
Ghizar	7%	576	1,128	1,938	2,114
Gultari	6.5%	-	-	-	5,572
Total		51,797	103,622	184,608	206,000

ANNEX I:

HYDEL POWER GENERATION

1. State of Hydel Power Generation

Region	Location of Hydel Station	Installed Capacity (kW)	Year of Commissioning
1. Chilas	Chilas Ph-I	160	1978
	Chilas Ph-II (Thack)	2,000	1997
	Bunner (Chilas)	1,000	1998
	Tore (Chilas)	100	1985
	Tangir Ph-I	160	1982
	Tangir Ph-II	1,200	1995
	Darel Ph-I	200	1984
	Darel Ph-II	1,000	1993
	Total	5,820	
2. Astore	Astore Ph-I&II	250	1984
	Lous (Astore)	1,000	1986
	Parishing (Astore)	160	1986
	Rattu (Astore)	160	1987
	Gorikote (Astore)	200	1986
	Darley (Astore)	200	1993
	Harcho (Astore)	400	1994
	Gudai (Astore)	640	1994
	Total	3,010	
3. Gilgit	Kargah Phase-I	320	1965/1987
	Kargah Phase-Ii	450	1977
	Kargah Phase-Iii	640	1989
	Kargah Phase-Iv	640	1989
	Kargah Phase-V-A	200	1983
	Kargah Phase-V-B	1,200	1993
	Kargah Phase-Vi	4,000	1994
	Kargah Phase-Vii	1,000	1990
	Juglote Phase-I	120	1977
	Juglote Phase-Ii	1,000	1997
	Nomal	120	1980
	Naltar	80	1965
	Danyore	320	1987
	Jalalabad	1,000	1993
	Total	11,090	
4. Hunza	Chalt Phase-I (Nagar)	40	1966
	Chalt Phase-Ii (Nagar)	1,000	1997
	Budalus (Nagar)	600	1987

Region	Location of Hydel Station	Installed Capacity (kW)	Year of Commissioning
	Sumayar (Nagar)	100	1980
	Minpin (Nagar)	100	1979
	Nagar	1,000	1995
	Hassanabad Ph-I (Hunza)	160	1965
	Hassanabad Ph-IIa(Hunza)	200	1979
	Hassanabad Ph-IIb (Hunza)	400	1986
	Hassanabad Ph-IIc (Hunza)	1,200	1994
	Khyber Ph-I (Hunza)	400	1987
	Khyber Ph-Ii (Hunza)	500	1998
	Misgar (Hunza)	240	1996
	Total	5,940	
5. Ishkoman	Chatorkhand (Ishkoman)	160	1980
	Ishkoman	1,500	1996
	Gupis	600	1987
	Total	2,260	
6. Yasin	Phander (Gupis)	1,000	1996
	Nazbar (Yasin)	1,000	1999
	Total	2,000	
7. Skardu	Skardu Ph-I	320	1973
	Skardu Ph-Ii	640	1987
	Kachura Ph-I (Skardu)	200	1982
	Kachura Ph-Ii (Skardu)	200	1987
	Kachura Ph-Iii (Skardu)	3,000	1996
	Gole (Skardu)	400	1996
	Shigar Ph-I	120	1986
	Shigar Ph-Ii	1,000	1999
	Hshopi (Shigar)	80	1986
	Niaslo (Shigar)	160	1986
	Total	6,120	
8. Ghanche	Khaplu	120	1978
	Garbochung (Khaplu)	200	1991
	Kharkoo	800	1994
	Pion	800	1998
	Dumsum	1,200	1998
	Thally	160	1988
	Kiris	160	1988
	Total	3,440	
9. Rondu / Haramosh	Mendi (Rondu)	160	1987
	Stak (Rondu)	160	1987
	Harpo (Rondu)	400	1996
	Basho (Rondu)	1,000	1994
	Turmik (Rondu)	500	1994
	Total	2,220	

Region	Location of Hydel Station	Installed Capacity (kW)	Year of Commissioning
10. Kharmang	Mehdiabad (Kharmang)	120	1987
	Tolti (Kharmang)	200	1986
	Olding (Kharmang)	100	1987
	Sermik (Kharmang)	100	1980
	Monthoka (Kharmang)	200	1991
	Gandus (Kharmang)	160	1988
	Shiriting (Kharmang)	1,000	2000
	Total	1,880	
12. Ghizar	Sherqillah Ph-I	120	1980
	Sherqillah Ph-II	240	1996
	Singul Ph-I	100	1978
	Singul Ph-II (Gulmuti)	200	1989
	Total	660	
UNDER EXECUTION PROJECTS (kW)			
Gilgit District	Juglote Gah	4,000	
	Bargo	160	
	Haramosh	1,000	
	Hassanabad Ph-III (Hunza)	400	
	Khyber Ph-III (Hunza)	160	
	Total	5,720	
Skardu District	Skardu Ph-III	1,000	
	Kayo (Shigar)	240	
	Total	1,240	
Ghanche District	Balagound	1,200	

2. Proposed Hydel Projects for Meeting the Immediate and Projected Demand by 2016 (MW)

Region	Power Available	Power Shortfall	Proposed Projects	Power Demand by 2016	Proposed Projects for Implementation
Chilas	5.820	1.708	a. Batogah (0.5)	18.112	a. Darel Ph-III 1.823 MW
			b. Thore (1.2)		b. TangirPh-III 3.769 MW
Astore	3.010	2.915	a. Parishing Dichil (4.19)	15.600	a. Parishing Ph-III (5.58)
			b. Gudai (2.0)		b. Parishing Ph-IV (3.15)
Gilgit	11.090	10.840	a. Naltar (18.0)	51.422	Nalter-III (22.0)
Hunza	6.940	0.980	a. Dainter (4.23)	17.709	Connected the area to Region 3 for Naltar-III
Ishkoman	2.760			6.325	
Yasin	1.000			7.044	To be connected to Phander in Ghizar (80.0)

Region	Power Available	Power Shortfall	Proposed Projects	Power Demand by 2016	Proposed Projects for Implementation
Skardu	6.120	9.611	a. Skardu Ph-III (1.0)	41.128	a. Harpo (23.0)
			b. Basho Ph-II (22.0)		b. Skardu-III (12)
			c. Shigar Ph-III (1.0)		
Shayok	4.000	4.075	a. Balagond (1.0)	18.284	a. Balghar (2.0)
			b. Gowari (1.0)		b. Thagus (0.5)
Rondu/ Haramosh	2.220	0.318	a. Haramosh (0.5)	2.545	Harpo-II (23.0)
Kharmang	1.880	4.108	a. Sermik (2.0)	16.840	To be connected to Skarduwhen Basho and Harpo are completed
			b. Mehdiabad (1.0)		
Khunjerab		0.611	a. KDFord (1.5)		
Ghizar	1.600			2.114	Phander-II (80.0)
Gultari	--	1.000	a. Karabosh, Fultux Nero& Thand connected with Astore for balance (2.969)	5.572	To be extended to entire Ghizar

3. Hydro Power Projects in order of Priority for Implementation

S. No.	Project location	Status	Capacity (MW)
SHORT TERM PLAN			
1.	Naltar-V Gilgit	Approved	18.0
2.	Naltar-III Gilgit	Feasibility likely to be completed by Dec 2000.	22.0
3.	Basho-II Skardu	Feasibility likely to be completed by Jun 2001	23.0
4.	Mehdiabad Sermik Skardu	Feasibility completed	1.0
5.	Thore (Chilas) Diamir	Feasibility completed	3.0
6.	Darmandar Ghizar	Feasibility completed	1.5
7.	Thaley Ghanche	Feasibility completed	2.0
LONG TERM PLAN			
1.	Sai Juglote Gilgit	Feasibility completed	10.5
2.	Nomal Gilgit	Feasibility completed	3.0
3.	Harpo (Rondu) Skardu	Feasibility likely to be completed by Jun 2001	24.0
4.	Kachura-IV Skardu	Feasibility completed	2.8
5.	Multipurpose Sadpara Dam Project Skardu	Feasibility likely to be completed within two years	10.0
6.	Doyan (Astore) Diamir	Feasibility likely to be completed within two years	425.0
7.	Phander Ghizar	Feasibility likely to be completed within two years	87.0
8.	Ghawari Ghanche	Feasibility completed and PC-I approved.	3.0
Total			635.8

ANNEX II:

POWER SUPPLY AND DEMAND (MW)

Region	Power Demand	Energy Available	Shortfall	Projected Demand
	2001	2001		2016
Chilas	7.528	5.82	1.708	18.112
Astore	5.925	3.01	2.915	15.600
Gilgit	21.930	11.09	10.840	51.422
Hunza	7.920	6.94	0.980	17.794
Ishkoman	2.568	2.76	0.192	6.325
Yasin	3.087	1.00	0.087	7.044
Skardu	15.731	6.12	9.611	41.128
Shayok	8.075	4.00	4.075	18.284
Rondu/ Haramosh	2.038	2.22	0.318	2.545
Kharmang	5.988	1.88	4.108	16.840
Khunjerab	0.611	-	0.611	1.390
Ghizar	0.904	1.60	0.696	2.114
Gultari	1.000	-	1.000	5.572
Total	83.274	46.44	36.834	206.000

ANNEX III:

INTERMEDIATE DEMANDS FORECAST (MW)

Region	YEAR				
	1995	2001	2005	2015	2016
	WAPDA	Projected	WAPDA	WAPDA	Projected
Chilas	4.705	7.528	10.321	17.007	18.112
Astore	3.527	5.925	7.529	14.312	15.600
Gilgit	14.058	21.93	27.262	47.834	51.422
Hunza	5.045	7.920	9.808	16.630	17.794
Ishkoman	1.771	2.568	3.396	5.890	6.325
Yasin	1.942	3.087	3.846	6.583	7.044
Skardu	9.832	15.731	19.613	37.698	41.128
Shayok	5.047	8.075	10.107	17.088	18.284
Rondu/Haramosh	1.568	2.038	2.119	2.515	2.545
Kharmang	3.327	5.988	7.739	15.337	16.840
Khunjerab	0.399	0.611	0.754	1.276	1.390
Ghizar	0.576	0.904	1.128	1.938	2.114
Gultari	-	1.000	-	-	5.572
Total	51.797	83.274	103.622	184.108	206.000

ANNEX IV:

REGIONAL POWER DEMAND FORECASTS (MW)

1. Overall Power Demand Forecast

Region	Present Status		Intermediate	Projected demand 2016	
	Demand	Avail-ability		Heating & Cooking	Total
Chilas	7.528	5.82	18.112	33.405	51.517
Astore	5.925	3.01	15.600	26.413	42.013
Gilgit	21.930	11.09	51.422	102.800	154.400
Hunza	7.920	6.94	17.794	37.880	55.674
Ishkoman	2.568	2.76	6.325	3.682	10.007
Yasin	3.087	1.00	7.044	13.638	20.682
Skardu	15.731	6.12	41.128	44.269	83.155
Shayok	8.075	4.00	18.284	42.027	60.311
Rondu/Haramosh	2.038	2.22	2.545	15.382	17.927
Kharmang	5.988	1.88	16.840	41.410	38.250
Khunjerab	0.611	-	1.390	2.327	3.717
Ghizar	0.904	1.60	2.114	3.682	5.796
Gultari	1.000	-	5.572	8.050	13.622
Total	83.274	46.44	206.000	354.965	560.965

2. Demand Forecast For Region 1 – Chilas (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1996	2006	2016	1996	2006	2016	1996	2006	2016
Lasnote	244	463	804	218	412	681	195	354	558
GaisBala	230	415	687	204	369	583	184	317	479
Guner Farm	303	498	748	270	446	641	245	385	530
Thak	270	473	756	242	423	646	218	367	536
Niat	250	491	883	224	443	759	205	386	633
Thalpan	126	224	370	112	202	317	102	176	264
Dusi	134	240	391	120	213	331	108	183	271
Chilas Town	1,586	2,836	5,017	1,418	2,551	4,356	1,287	2,242	3,720
Chakar	128	251	452	114	225	386	105	196	320
Balugish	91	160	257	82	142	219	74	124	182
Hamachach	83	155	258	75	137	221	68	118	181
Gamar	276	477	749	248	428	645	225	374	539
Guber	196	384	688	175	344	590	160	298	488
Thilkush	250	508	946	222	452	801	200	387	655
Dodashall	108	197	329	97	175	278	87	150	228

Gayal	237	440	752	212	393	641	192	340	528
Gummari	510	1,032	1,709	513	928	1,471	466	809	1,227
Manikal	317	606	1060	283	539	899	255	463	736
Gabar	160	301	523	142	269	443	129	231	361
Juglote	787	1,446	2,430	707	1,298	2,083	641	1,128	1,734
Kami	296	572	1,017	264	510	864	238	439	708
Pharpuri	242	453	782	216	405	665	196	349	549
Total	6,884	12,622	21,508	6,158	11,304	18,520	5,381	9,817	15,426

3. Demand Forecast For Region 2 – Astore (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1996	2006	2016	1996	2006	2016	1996	2006	2016
Bunji	391	761	1,438	347	679	1,219	313	585	999
Doyan	165	341	688	148	301	583	134	280	477
Dashkin	132	266	531	116	236	449	106	202	368
Harcho	146	294	577	131	262	489	118	226	400
Astore	180	326	571	161	292	485	146	251	399
Chungra	296	528	911	264	471	771	237	404	632
Gorikote	218	480	957	195	410	813	175	363	665
Louse	358	680	1,246	319	606	1,056	285	519	865
Parishing	437	862	1,632	390	768	1,385	350	657	1,132
Rupal	233	463	908	207	413	769	185	354	629
Churit	292	805	1,215	261	535	1,030	234	459	841
Ratu	399	795	1,525	355	705	1,293	319	607	1,058
Mirmalik	131	254	489	115	226	414	105	195	341
Gumai	243	481	935	216	427	792	195	367	649
Gudai	269	530	1,010	238	471	856	214	405	699
Nowgam	243	511	1,052	217	454	893	195	389	730
Khiridas	130	241	446	115	216	375	104	184	308
Chilim	90	177	340	80	156	287	72	136	236
Total	4,353	8,570	16,471	3,875	7,628	13,959	3,488	6,553	11,428

4. Demand Forecast For Region 3 – Gilgit (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1993	2003	2013	1993	2003	2013	1993	2003	2013
Gilgit City	8,986	17,353	31,858	8,091	15,663	27,860	7,395	13,857	23,995
Danyore	1,421	2,672	4,944	1,263	2,377	4,238	1,140	2,069	3,562
Sultanabad	103	213	352	270	446	641	245	385	530
Skawar	40	107	205	242	423	646	218	367	536
Minawar	57	491	883	224	443	759	205	386	633
Pari	496	224	370	112	202	317	102	176	264
JaglotSai	365	240	391	120	213	331	108	183	271
Damote	243	2,836	5,017	1,418	2,551	4,356	1,287	2,242	3,720
Chakarkot	236	251	452	114	225	386	105	196	320

Ghasho	28	160	257	82	142	219	74	124	182
Batkor	31	155	258	75	137	221	68	118	181
Taisot	44	477	749	248	428	645	225	374	539
Bagrote	229	384	688	175	344	590	160	298	488
Jutal	43	508	946	222	452	801	200	387	655
Nomal	309	197	329	97	175	278	87	150	228
Rahimabad	64	440	752	212	393	641	192	340	528
Jaglot	35	1,032	1,709	513	928	1,471	466	809	1,227
Naltar	177	606	1,060	283	539	899	255	463	736
Henzal	35	301	523	142	269	443	129	231	361
Kargah	71	1,446	2,430	707	1,298	2,083	641	1,128	1,734
Gulapur	310	572	1,017	264	510	864	238	439	708
Sherqilla	257	453	782	216	405	665	196	349	549
Hamuchal	124	237	411	111	212	351	100	183	289
Singui	126	244	430	114	222	374	106	195	317
Total	13,837	26,795	48,698	12,438	24,120	42,321	11,341	21,221	36,096

5. Demand Forecast For Region 4 – Hunza (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1993	2003	2013	1993	2003	2013	1993	2003	2013
Chalt	187	338	549	170	304	471	154	263	388
Chaprote	141	225	415	128	230	356	117	198	295
Budalas	59	105	167	52	94	144	48	81	120
Bar	115	203	329	103	183	284	95	159	232
Skindarabad	90	175	316	80	157	267	72	136	221
Nilt	213	421	755	189	375	640	171	321	522
Gulmit	121	216	351	106	189	294	94	160	237
Minapin	124	224	365	109	196	304	96	166	245
Fakar	296	615	1,116	260	539	931	230	457	751
Sumayar	523	942	1,539	450	808	1256	394	674	998
Nagar	481	998	1,817	421	502	912	374	740	1,222
Hoper	268	583	1,114	230	188	354	201	417	724
Nasirabad	93	207	408	83	144	244	77	165	296
Khanabad	82	158	282	73	122	205	67	126	203
Hussainabad	69	133	238	63	329	560	58	106	173
Murtazabad	189	371	662	169	641	1152	152	282	457
Aliabad	368	721	1,357	328	391	667	296	551	944
Hyderabad	224	440	787	200	308	527	180	337	546
Ganish	495	359	642	157	832	1494	137	257	418
Karimabad	211	963	1,731	425	374	670	372	694	1,190
Altit	74	436	821	182	129	230	159	313	533
Ahmadabad	84	151	283	63	150	265	56	108	184
Attabad	93	172	325	73	150	265	63	125	212
Ayunabad	26	165	269	80	143	219	70	120	174
Gulkin	206	350	571	177	300	467	154	252	374

Passu	69	122	157	59	105	163	52	88	129
Shamshall	57	114	203	47	98	168	42	43	134
Total	5,115	9,937	17,609	4,478	8,705	14,760	3,981	7,379	11,922

6. Demand Forecast For Region 5 – Ishkoman (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1993	2003	2013	1993	2003	2013	1993	2003	2013
Gulmuti	81	147	245	68	123	1959	58	100	152
Bubar	310	553	910	272	484	761	243	409	614
Gahkuch	313	554	970	283	499	834	257	434	692
Damas	172	363	723	150	318	602	135	270	487
Hatoon	113	227	434	98	200	363	88	170	293
Hasis	77	158	302	68	138	251	61	117	203
Chatorkhand	271	503	880	243	454	755	222	394	624
Dain	90	170	298	81	154	257	75	133	210
Barjungal	41	85	166	37	78	143	35	67	119
Immit	105	219	435	93	196	369	84	168	302
Ishkoman	154	324	642	138	288	544	125	248	446
Burt	45	91	175	39	81	49	35	69	121
Total	1,772	3,394	6,180	1,570	3,011	5,223	1,418	2,579	4,263

7. Demand Forecast For Region 6 – Yasin (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1994	2004	2014	1994	2004	2014	1994	2004	2014
Darmadar	72	147	270	66	134	231	59	116	191
Sumal	140	283	516	126	254	244	114	221	365
Gupis	131	247	428	119	223	367	108	194	305
Dorot	70	138	251	63	124	215	57	108	177
Khalti	46	93	168	41	84	144	38	73	118
Dahimal	38	77	137	34	68	118	30	59	97
Rahimabad	77	153	276	69	137	237	63	120	196
Pingal	64	128	229	57	115	196	53	99	162
Gandi	57	108	188	52	98	162	46	85	133
Noh	86	163	285	77	146	244	70	126	201
Yasin	249	471	818	225	425	702	206	268	583
Taus	234	443	768	213	401	662	195	349	552
Sandi	130	265	483	116	238	416	106	207	344
Sultanabad	99	204	375	90	184	321	81	158	267
Barkolti	113	234	431	102	210	370	94	183	304
Hundur	78	160	294	70	145	253	65	125	209
Darkot	117	241	444	105	217	380	96	188	315
Kono	62	128	235	56	115	202	51	100	166
Harf	105	216	398	94	194	342	86	168	282
Nalti	58	119	216	52	106	187	47	93	155
Total	2,025	4,018	7,218	1,827	3,618	6,193	1,665	3,140	5,122

8. Demand Forecast For Region 7 – Skardu (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1994	2004	2014	1994	2004	2014	1994	2004	2014
Basho	109	207	364	101	189	316	94	165	268
Kachura	277	508	863	256	467	762	236	415	659
Bigardo	31	56	98	28	51	86	26	46	72
Hoto	116	214	372	105	196	322	97	172	272
Chunda	90	167	288	82	152	250	76	134	213
Gamba	148	278	476	137	257	428	129	234	375
Shigribala	169	311	540	153	283	471	141	248	397
Shigri Khord	253	468	814	231	425	706	211	372	596
Kamrah	117	214	375	106	195	325	97	171	274
Kowardu	125	288	399	113	208	346	103	182	291
Satpara	87	164	281	81	153	253	76	139	224
Skardu City	6,656	12,419	23,951	6,132	11,470	21,465	5,713	10,293	19,057
Hussainabad	160	300	515	148	279	463	138	253	408
Thorgo	45	81	141	39	75	124	37	66	105
Total	8,383	15,675	29,477	7,712	14,400	26,317	7,174	12,890	23,211

9. Demand Forecast For Region 8 – Shyok (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1996	2006	2016	1996	2006	2016	1996	2006	2016
Bara	411	700	1174	366	623	997	331	536	817
Gowari	330	614	1062	126	254	244	114	221	365
Kiris	681	1202	2092	119	223	367	108	194	305
Kuro	330	570	970	63	124	215	57	108	177
Doghoni	442	732	1201	41	84	144	38	73	118
Thalay	290	432	691	34	68	118	30	59	97
Machulo	275	500	859	69	137	237	63	120	196
Husay	100	167	276	57	115	196	53	99	162
Kharkoo	457	806	1399	52	98	162	366	85	133
Frano	206	307	449	77	146	244	166	126	201
Karmanding	4,594	4,924	5,635	4,092	4,375	4,764	3,683	268	583
Gursay	268	388	554	213	401	662	216	349	552
Farwa	120	177	262	116	238	416	96	207	344
Sehat	137	201	288	90	184	321	110	158	267
Siksa	281	418	617	102	210	370	224	183	304
Kuwas	177	265	387	70	145	253	143	125	209
Thagus	270	400	584	105	217	380	217	188	315
Khaplu	1,795	3,129	5,314	56	115	202	1,414	100	166
Total	11,164	15,952	23,814	9,934	14,180	20,202	8,943	12,191	16,592

10. Demand Forecast For Region 9 – Haramosh (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1995	2005	2015	1995	2005	2015	1995	2005	2015
Hanuchall	109	181	320	96	161	271	87	139	222
Dasso	94	157	279	83	139	237	76	119	194
Sassi	107	179	318	94	159	271	86	137	220
Yalbo	120	221	435	107	196	369	96	169	302
Stak	157	302	615	141	259	522	127	231	428
Talu Broo	115	215	424	103	191	360	93	164	295
Harop	118	196	348	104	175	296	93	149	240
Dambodas	541	983	1,631	475	853	1,363	423	733	1,102
Mendi	124	208	373	110	186	316	100	160	258
Turmik	205	392	796	182	349	675	164	300	553
Baghicha	67	126	255	60	113	217	53	973	178
Total	1,757	3,160	5,794	1,555	2,801	4,897	1,398	2,398	3,992

11. Demand Forecast For Region 10 – Kharmang (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1995	2005	2015	1995	2005	2015	1995	2005	2015
Sermik	242	243	721	214	391	615	193	337	501
Mehdiabad	299	603	1,062	126	254	244	114	221	746
Manthoka	280	551	1,009	119	223	367	108	194	702
Katishu	240	521	970	63	124	215	57	108	722
Tolti	417	722	1,201	41	84	144	38	73	763
Saindu	101	205	691	34	68	118	30	59	269
Kharmang	156	305	859	69	137	237	63	120	393
Bagicha	249	457	276	57	115	196	53	99	547
Pari	142	282	1399	52	98	162	366	85	359
Kandarik	121	259	449	77	146	244	166	126	361
Hamizigond	203	429	5,635	4,092	4,375	4,764	3,683	268	590
Moral	110	194	554	213	401	662	216	349	225
Olding	1,346	2,259	3,757	1,201	2,008	3,184	1,080	1,727	2,607
Torghan	281	631	1326	90	184	321	110	158	924
Bresil	244	483	890	102	210	370	224	183	623
Margosal	98	221	456	70	145	253	143	125	317
Ghandus	115	254	522	105	217	380	217	188	368
Total	4,644	8,819	15,848	4,140	7,856	13,427	3,731	6,752	11,017

12. Demand Forecast For Region 11 – Khunjerab (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1995	2005	2015	1995	2005	2015	1995	2005	2015
Khyber	116	186	264	114	181	253	112	176	241
Murkoon	29	62	120	27	56	101	25	48	64
Gircha	23	47	90	20	42	76	18	36	62
Misgar	46	95	187	42	85	158	37	75	130
Chupurson-I	34	70	135	29	62	114	28	53	94
Chupurson-II	54	90	178	40	82	152	35	70	124
Sust	57	115	206	52	102	178	48	91	147
Khudabad	57	112	203	52	101	174	47	88	144
Total	406	777	2,038	376	711	1,204	350	637	1,026

13. Demand Forecast For Region 12 – Ghizar (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1994	2004	2014	1994	2004	2014	1994	2004	2014
Shamaran	57	115	208	54	104	179	69	90	149
Chhashi	80	157	185	72	142	245	66	122	203
Phandar	54	105	188	49	96	163	45	84	135
Dalomal	75	148	268	68	133	231	62	116	190
Serval	29	55	98	25	49	84	22	44	68
Terch	96	190	344	87	172	295	79	148	245
Handrap	87	174	312	79	157	268	72	136	223
Teru	91	179	323	83	161	278	75	141	229
Barsat	26	53	94	25	48	81	21	41	57
Total	595	1,176	2,120	842	1,082	1,824	491	922	1,509

14. Demand Forecast For Region 13 – Gultari (kW)

Load Centre	Optimistic			Intermediate			Conservative		
	1997	2007	2017	1997	2007	2017	1997	2007	2017
Gultari	677	1,188	2,055	600	1,057	1,739	539	903	1422
Buniyal	451	688	1,068	395	603	896	350	512	725
Thanut	229	435	789	201	380	179	179	323	533
Matiyal	109	242	479	98	213	88	88	185	333
Minimarg	755	1,258	2,135	664	1,103	591	591	936	1,441
Qammari	122	267	527	107	236	96	96	203	365
Total	2,343	4,078	7,053	2,065	3,592	1,843	1,843	3,062	4,819

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