Power Sector Situation in Pakistan

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Alternative Energy Development Board

Deutsche Gesellschaft für
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in collaboration with

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Contents

1 National Power Sector at a Glance

Pakistan has two integrated public sector power utilities, the Water and Power Development Authority (WAPDA) and the Karachi Electric Supply Corporation (KESC). WAPDA supplies power to the whole of Pakistan except the metropolitan city of Karachi, which is supplied by KESC. The system of WAPDA and KESC are interconnected through 220 kV double circuit transmission lines. The country has a total installed generating capacity of about 19522 MW. The installed capacities owned by various agencies operating in the country. These are:

- Water & Power Development Authority (WAPDA): 11327 MW
- Karachi Electric Supply Corporation (KESC): 1756 MW
- Pakistan Atomic Energy Commission (PAEC): 462 MW
- Independent Power Producers (IPPs): 5977 MW

WAPDA was established in 1958 and entrusted with a massive agenda, which included generation, transmission and distribution of power along with irrigation, drainage and flood control etc. It owns about 58% of the country's total power generation capacity and serves about 88% of all the electricity customers in the country. It serves over 13 million customers.

The privatization of WAPDA is underway. Its distribution network has been divided into eight electric supply companies, which are successors of former Area Electricity Boards (AEBs). The AEBs were departments within WAPDA to administer the supply and distribution, construction, expansion and operation of the distribution system. These AEBs have been re-structured in eight independent power companies, i.e. eight distribution companies (DISCOs). Side by side three generation companies (GENCOs) and a national transmission and dispatch company (NTDC) have been created. Presently these entities are incorporated under the management of Pakistan Electric Power Company (PEPCO). So far Kot Addu has been privatized. DISCO at Faisalabad (FESCO) are next on line for privatization.

KESC was incorporated in 1913 and is responsible for the generation, transmission and distribution of electricity in Karachi and its adjoining areas. It has nearly 1.5 million customers, predominantly urban consumers.

In order to promote fair competition in the electricity industry and to protect the rights of consumers as well as producers and sellers of electricity, the Government of Pakistan has enacted act the Regulation of Generation, Transmission and Distribution of Electric Power regulation Act, 1997. Under this act the National Electric Power Regulatory Authority (NEPRA) performs three main regulatory functions i.e., licensing of generation, transmission and distribution of electric power, tariff determination and prescription of standards and rules for conduct of business.

1.1 Generation Capacity

Between 1984/85 and 2004/05, Pakistan's total installed power generating capacity increased nearly fourfold, from 5229 MW to 19,522 MW, for details see Annex-1. Thermal power plants contributed 64% of that total, while hydroelectric power plants accounted for 33%, and Pakistan's two nuclear power plants produced 3% of the total[1].

1.2 Power generation

The electricity market in Pakistan has been characterised in recent years by marked changes in the primary energy sources used for producing electricity. In the fiscal year 1990/91, hydropower still accounted for nearly 45% of all electricity generated in the country, but by 2001/2002 that share had dropped to only 26%. Simultaneously, the share of thermally generated electricity increased from 54% to 71%, for details please refer to Annex-2. Most of that increase is the result of capacity expansion since the early 1990s in response to power shortages and the resultant frequent power outages.

Pakistan has little commercially exploitable oil of its own. Consequently, more than 55% of the country's oil needs were met by imports in the fiscal year 2001/02. The imports were used for such purposes as firing thermal power plants.

[1] The nuclear power plant has been in service since 1971, and a second NPP located in Chashma was commissioned in 2001.

Plants fuelled with natural gas, however, operate almost exclusively on domestic resources. This also applies to most of Pakistan's few coal fired power plants[2].

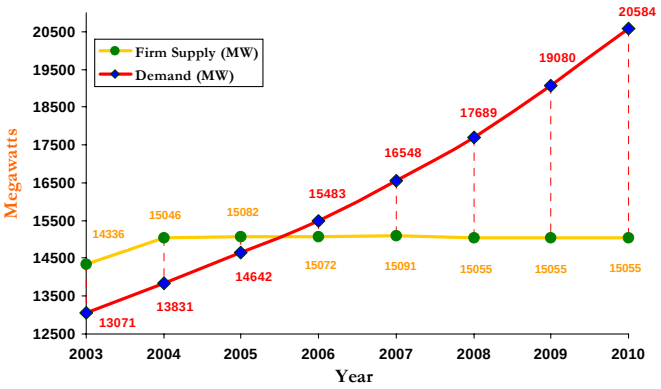
1.3 Power transmission losses

The safe and reliable transmission and distribution of electricity remains a major problem in Pakistan. Due to weak grid infrastructure and substantial theft of electricity, losses from the transmission and distribution network totalled some 30% in 2003/04.

1.4 Power consumption

With the sole exception of fiscal year 1998/99, power consumption has grown steadily in recent years. Between 1990/91 and 2003/04, total consumption increased by more than 84%, from 31 TWh to 57 TWh. Again, with a single exception - fiscal year 1990/91 – the domestic sector was the consumer group with the largest proportion of consumption, followed by industry and agriculture, for details see Annex-3.

The demand for electricity will continue to rise in the years to come. An average annual increase of 7% has been postulated. The generation capacity and demand forecast is shown in the graph.



Source: PPIB, Ministry of Water and Power

[2] Pakistan's commercially exploitable reserves were estimated at approximately 28.3 billion cubic feet I April 2003. Additional resources are expected in the province of Balochistan and in the coastal waters. At the same time the demand for natural gas is expected to double by 2006. Since some substantial new deposits of brown coal (lignite) in the Thar Desert in the Province of Sindh, Pakistan is planning to increase the share of coal used for generating electricity.

1.5 Expansion of generating capacities

By reason of the projected increase in the demand for electricity by some 10,000 MW by the year 2010, the Government of Pakistan has launched a large-scale expansion programme. Nevertheless, power shortages are anticipated, beginning in 2006. To keep that from happening, or at least to minimise future supply deficits, Pakistan has adopted a systematic development plan called 'Vision 2025' that targets a long-term capacity increase of around 35,000 MW by the year 2025. That would be nearly twice as much power as was available at the end of 2002. Around two thirds of the additional power (22,563 MW) is slated to come from hydroelectric power plants. New gas-fired power plants are supposed to contribute 13% (4,680 MW), the same percentage as that to be generated by coal-fired power plants (4,350 MW). New nuclear power plants with a total installed capacity of 1,800 MW (5%) are planned[3]. Finally, renewable sources of energy are supposed to account for more than 4% (1,500 MW) of the overall newly installed capacity. The planned expansion will cost approximately US$ 30 billion. In view of Pakistan's high national debt and persistent budget deficit, the government is intensifying its efforts to attract private investors.

2 Market Actors

The main public-sector actors in Pakistan's electricity sector are WAPDA (Water and Power Development Authority), KESC (Karachi Electric Supply Corporation) and the operators of the two nuclear power plants KANUPP (Karachi Nuclear Power Plant) and CHANUPP (Chashma Nuclear Power Plant). Beyond these, a number of independent power producers (IPPs) have become established in the power generating sector since 1994.

2.1 Vertical unbundling of WAPDA

The vertical disintegration of WAPDA was begun in the year 2000 as part of the country's new

[3] In early December 2003 the Government of Pakistan announce plans to purchase a new nuclear power plant from China. With a rating of 600 MW, the facility will house the second nuclear reactor at Chashma site, some 225 km north of the capital Islamabad.

electricity market restructuring and liberalisation programme. WAPDA was broken down into twelve separate units: three generating companies, eight distribution companies, and the national transmission and distribution company NTDC. However, the envisaged privatisation of these independent generating and distributing companies is proving difficult, because they often operate at a loss due to unpaid bills and submarginal electricity tariffs. For the time being, hydropower will continue to be excluded from the privatisation process and will therefore remain in WAPDA's possession.

WAPDA, as Pakistan's largest power producer by far, held more than 55% of the country's power generating capacities in March 2003. Those capacities were split almost evenly between hydroelectric and thermal power plants. At the same time, the government-owned KESC controlled somewhat more than 10% of overall capacity (almost exclusively thermal), while the two nuclear power plants contributed 3% and the independent power producers already owned 33% of the electricity generating capacities.

2.2 Independent power producers

The 17 largest independent power producers in Pakistan all operate thermal generating plants only[4]. The two largest privately owned power producers are the HUB Company (HUBCO) and the Kot Addu Power Company (KAPCO). HUBCO belongs to a consortium formed by National Power (Great Britain), Xenal (Saudi Arabia) and Mitsui Corporation (Japan) and possesses just under 1,300 MW of generating capacity. KAPCO, with more than 1,600 MW of power generating capacity, was privatised in 1996 and now belongs to the British enterprise National Power. Between 1994 and 1997, 19 IPP projects amounting to an overall capacity of 3,158 MW and a total investment volume of some US$ 4 billion were awarded competitive-bidding contracts. By the end of March 2003, 2,728 MW of the total had already been installed. The power-producing volume was so large that the Pakistani electricity market began to exhibit intermittent overcapacities. The city of Karachi receives all its electricity from KESC, while WAPDA serves the rest of the country. In the medium to long term, though, the sale of electricity is also supposed to be liberalised.

3 Legal Framework

The Ministry of Water and Power (MoW&P) is responsible for formulating Pakistani energy policy. Due mainly to the shortage of electricity in the 1980s and early 1990s, a strategy plan geared to restructuring the Pakistani electricity sector was adopted in 1992.

3.1 Private-sector power law of 1994

Full implementation of the strategy plan has suffered multiple delays already – for example, it has not yet been possible to establish a wholesale market – but that goal is still being pursued. A new energy law adopted in 1994 (Policy Framework and Package of Incentives for Private Sector Power Generation Projects in Pakistan) aims primarily to attract private capital to the Pakistani power sector and to standardise the conditions of investment for independent power producers. It covers the following measures in particular:

- Standardisation of contracts with regard to implementation agreements, contracts of supply for
- primary sources of energy and power consumption contracts.
- Remuneration for all electricity amounting to 5.7 US cents/kWh, coupled to the exchange rate between the Pakistani rupee and the US dollar, including allowance for the US inflation rate and potential fluctuations in raw-material prices[5]
- Surrender of decision-making powers to the project's implementing institution with regard to size, technology, energy source and siting of the power plant

[4] In addition to the 17 major IPPs, numerous small IPPs with total installed capacity of 100 MW or less each have been active in Pakistan since 1994. By mid-2002, 15 small IPPs had received operating lincences from NEPRA for capacities totalling approximately 240 MW (NEPRA 2002).

[5] In addition a bonus of 0.25 US cents/kWh was offered for power plant projects commissioned by the end of 1997

- Power-grid connection and supply guarantee for the required primary energy sources
- exemption of independent power producers from numerous forms of taxation (capital-gains tax, income tax and turnover tax) and duties
- guaranteed acceptance of supplied power and delivery of required primary energy sources

3.2 Creation of Private Power and Infrastructure Board (PPIB)

Also, with a view to improving investment incentives in the Pakistani power sector, a new state-owned consulting institution was established in 1994 – the Private Power and Infrastructure Board (PPIB). This instrumentality is primarily dedicated to serving as a one window facility to investors in Pakistan's private power sector. Acting in the name of the Pakistani Government, PPIB provides advice and guidance for the implementation of power plant projects. Its main task is to negotiate the implementation agreement and provide support in negotiating fuel supply agreements and power purchase agreements. PPIB also provides guarantees to private investors for the performance of government entities (WAPDA, KESC, etc.), monitors litigation and international arbitration for and on behalf of the Government of Pakistan, and, finally, assists the regulatory authority in determining and approving tariffs for new private power projects.

3.3 National Power Regulatory Authority (NEPRA)

The sectoral National Electric Power Regulatory Authority (NEPRA) was created under the NEPRA Act in 1997. NEPRA's main purpose is to ensure fair competition and consumer protection. NEPRA's primary responsibilities include the issue of licences for power production, transmission and distribution (including the stipulation of licensing fees), specification of electricity tariffs, both with regard to remuneration of producers (NTDC purchase price) and in terms of consumer-side pricing. With respect to tariffing, NEPRA is also responsible for approving the tariffs negotiated in connection with bilateral agreements between individual power producers and the NTDC, distribution companies and major customers. NEPRA also defines the licensing requirements and can impose fines for non-compliance with the relevant regulations.

In the summer of 2003, all restructured power companies and twelve of the 17 largest IPPs received their requisite operating licences from NEPRA, and the latter was poised to issue licences to three additional existing IPPs.

3.4 Vertical unbundling of WAPDA in 2000

Another step taken in the restructuring of Pakistan's power sector was the formal disintegration of WAPDA, which was completed in 2000. The medium- to long-term objective is to privatise the public power producing and distributing companies.

3.5 Power Law of 2002

A new power law was enacted in 2002, it closely resembles its predecessor dating from 1994, but it has a broader range of application. Entitled "Policy for Power Generation Projects – Year 2002", the new power law applies both to private investment projects and to public-private partnerships and public-sector power plant projects. The law also makes it possible for investors not only to participate in public tendering, but also to propose power plant projects on their own. Now, the respective provincial governments are responsible for approving plants with ratings below 50 MW. A two-component system of remuneration has been defined for power providers: part of the remuneration depends on the output of the respective plant (capacity purchase price, CPP), and the rest is a function of the sources of energy employed for producing the electricity (energy purchase price, EPP). The latter is supposed to account for at least 34 to 40% of the total remuneration. The new provisions from 2002 give preference to projects involving the use of domestic energy resources, i.e. mainly water, coal and natural gas. This manifests itself primarily in the exemption of all such power plant projects from income taxes, turnover taxes and capital gains taxes on imports (with oil-fired power plants constituting an exception). Moreover, import duties on plant components have been reduced to a mere 5% of the standard rate.

3.6 Wholesale market

Regarding the creation of a wholesale market, a so-called 'single buyer plus' model was established in July 2002. In that model, the NTDC functions as the sole purchaser of all electricity generated by all producers together. Beginning in mid-2009, major consumers are to be allowed to purchase electricity from producers of their own choice by way of bilateral supply agreements. The introduction of a wholesale market is envisaged for mid-2012.

3.7 Clean Development Mechanism

As a signatory to the United Nations' Framework Convention on Climate Change, which Pakistan ratified in June 1994, and as a member of the World Bank, Pakistan is entitled to participate in Global Environment Facility (GEF) projects. Since Pakistan has recognised the Koyoto Protocol in January 2005, a variety of projects is available for the implementation under the Clean Development Mechanism (CDM), but not one yet implemented or initiated.

4 Policy for Promoting Electricity Generation from Renewable Energy Sources

Pakistan's first promotion measures for renewable energy sources were implemented in the early 1980s. For example, the sixth Pakistani energy plan (1983–1988) devoted approximately € 14 million to the areas of renewable energy crops, biogas and a feasibility study for the commercial exploitation of solar energy.

4.1 First activity between 1975 and 1992

The Pakistan Council of Appropriate Technology (PCAT, established in 1975) and the National Institute of Silicon Technology (NIST, established 1981) were jointly responsible for implementing the measures.

While PCAT focused its attention primarily on the areas of mini-hydropower, biogas plants, solar cookers and small wind energy conversion systems for driving water pumps, NIST was more involved in the research, development and commercialisation of solar energy with focus on photovoltaic. For lack of precise promotion instruments, the output of all solar and wind energy systems plus mini-hydropower plants together amounted to less than 5 MW at the end of the 1980s.

The 1990s also saw some isolated instances of promotion measures for renewable energy sources in Pakistan, but they were all very limited in their financial scope. In this connection, mention could be made of the 1992 National Pakistan Conservation Strategy (PNCS) which was subsequently integrated into the ninth Pakistani energy plan (1993-1998). Altogether, PNCS spent some 63 million rupees (€ 900,000) on introducing biogas, wind power and mini-hydropower facilities.

4.2 Pakistan Council for Renewable Energy Technology (PCRET)

The latest alternative energy promotion activities in Pakistan again encompass institutional measures and define target objectives. In May 2001, the two separate research institutions NIST and PCAT merged to become the Pakistan Council for Renewable Energy Technology (PCRET), the main goal being to better coordinate research activities and avoid overlaps.

4.3 National Environment Action Plan – Support Programme (NEAP-SP)

The Support Programme (NEAP-SP) for implementing the National Environment Action Plan (NEAP) of 1997 was signed by the Government of Pakistan and UNDP in October 2001. The NEAP-SP includes six different subprogrammes, one of which concerns the field of energy conservation and renewable energy sources, and concrete projects are to be implemented over the next five years.

4.4 Alternative Energy Development Board (AEDB)

The Alternative Energy Development Board (AEDB) was founded in May 2003 for supplying wind- solar and mini/small hydropower generated electricity in remote regions of Pakistan. AEDB is also responsible for developing the country's medium- and long-term promotion

policy for renewable energy sources. In addition, its functions include the coordination of joint ventures with the aim of having foreign technologies in the field of alternative energies fabricated in Pakistan. The AEDB is located in Prime Minister Secretariat and answers directly the cabinet division and the Prime Minister. The AEDB has a mandate of !0% of the total installed capacity in the country from Renewable Energy sources by 2015.

4.4.1 AEDB Ordinance

The President of Islamic Republic of Pakistan, on 30th April 2005, promulgated an Ordinance to provide for the establishment of Alternative Energy Development Board as an autonomous body for the purpose of implementation of various policies, programs and projects in the field of Alternative or Renewable Energy Technologies.

The objective of AEDB as stated in the Ordinance, is to assist and facilitate development and generation of Alternative or renewable Energy in order to achieve sustainable economic growth with transfer of technology for development of an indigenous technological base through a diversified energy generation.

4.4.2 Renewable Energy Policy

Policy for Promotion of Alternative Renewable Energy in Pakistan has been prepared by AEDB and submitted to the Cabinet Division after incorporating the inputs of all the involved stakeholders. The Policy will soon be submitted to the Cabinet for approval.

4.4.3 100 MW Wind Power Generation Project at Gharo – Keti Bandar, Sindh

On commercial grid connected electricity generation programme, the Government of Pakistan has decided to install 100 MW Wind Power Farm during the year 2005. This programme initiated by the AEDB involves financing through private sector, land from Government of Sindh and power purchase by NTDC for HESCO/KESC. The Government of Pakistan guarantees are backed through NEPRA. The Board has issued LOIs to 22 national and international companies for generation of 1100 MW power through wind energy.

A wind corridor at Gharo-Keti Bandar, Sindh has been identified with an actual potential of 50,000 MW. The pre-feasibility study of the site has been done by AEDB. AEDB drafted the Power Purchase Agreement and the Implementation Agreement and submitted to NTDC for review on 22nd March 2005. AEDB has submitted the 4th Draft of PPA to NTDC for further review. Views of both NTDC and the private investors have been incorporated in the revised draft. NTDC has forwarded this revised draft to their Finance, Planning & Technical Sections for further comments.

- 8 companies with financial and technical viability have been short-listed.
- Three companies have submitted applications to NEPRA for obtaining Generation License.
- OEMs / Suppliers like GE, VESTAS and GAMESA have been short-listed for the project.
- HESCO has agreed to purchase the initial 100 MW Wind Power generated through this project.
- Private investors have entered the PPA negotiations with NTDC / WAPDA.
- Sindh Government has leased out 3460 Acres of land for the project. Land for balance of 13 investors has also been sanctioned by the Sindh Chief Minister.
- New Transmission Network from Mirpur Sakro to Thatta is to be constructed by NTDC in order to sustain the load generated by 100 MW Wind Power.
- Wind Turbine Manufacturing Consortium (WTMC) has been formed for the indigenous production of various components of wind turbines in Pakistan.
- Once the initial target of generating 100 Mega Watt through Wind Energy is achieved, it will be upgraded to 700 MW by the year 2010 and 9700 MW by the year 2030.

4.4.4 Resource Mobilization

AEDB has mobilized different sources of funds from the international donor organizations i.e., ADB, GEF, USAID, GTZ and UNDP for the promotion, execution and implementation of Alternative Renewable Energy Projects in

Pakistan. The Federal Government provided Rs. 100 Million during 2004-05 to meet the cost of the projects undertaken by AEDB. Case for approval of funding of U.S. $ 3.82 Million from GEF-UNDP is with the EAD of the Government of Pakistan for the project of "Sustainable Development of Utility Scale Wind Power Production". The amount of U.S. $ 3.1 Million will be provided by the donor agency, while the remaining amount of U.S. $ 0.72 will be funded by the GoP. A Pak-German Technical Cooperation Programme (GTZ) for Euro 3.5 Million is being implemented over a two year period.

Khushali Bank and Zarai Taraqiyati Bank Limited (ZTBL) have been approached by AEDB to offer micro-credit schemes for the promotion of Alternative Renewable Energy technologies, especially in the remote areas. These schemes have been designed to suit the needs of the common man living in far-flung villages, enabling the villagers to easily afford the basic amenities of electricity and clean water.

4.4.5 Capacity Building

The Asian Development Bank offered a Technical Assistance (TA) project in 2004 for the development of Renewable Energy in Pakistan. The objective of the proposed Project Preparatory Technical Assistance (PPTA) was to assist GoP in designing a loan for financing investment in Renewable Energy. U.S. $ 550,000 were made available for the PPTA with U.S. $ 137,500 to be provided to each of the four provinces, while another U.S. $ 150,000 were made available for the Small Scale Technical Assistance (SSTA) for capacity building for carrying out Renewable Energy projects of all the four provinces involved with the TA.

4.4.5 International Representation

The efforts of AEDB for the promotion, execution and implementation of Alternative Renewable Energy Projects were recognized internationally as well when AEDB was made the coopted member of the Board of Directors of the World Wind Energy Association (WWEA) and the International Solar Energy Society (ISES) presented the chair of the Pakistan Section to AEDB.

4.4.6 Environmental Benefits

AEDB is also playing its part in abatement of Greenhouse gases and improving the Environment of the country by promoting environment-friendly Renewable Energy projects. One such example is the 100 MW Wind Farm project at Gharo-Keti Bandar, which will avoid around 135,000 tons of Carbon Dioxide. As a result of the ratification of Kyoto Protocol, Pakistan can now achieve Carbon trading benefits of 1 – 1.5 U.S. Cents / Kilo Watt Hour.

4.4.7 AEDB Targets

In addition to the targets outlined in the Energy Security Action Plan, the Alternative Energy Development Board has been set forth the following targets for the future:

1. Electrification of 40,000 Villages / Remote Areas that are without Electricity, through Alternative Renewable Energy technologies.
2. Designing of laws and taxes to promote and encourage ARE projects and products in the country.
3. Indigenous Development of Wind Turbines.
4. Indigenous Development of Solar PV Panels.
5. Establishment of Solar Thermal Power Plants in the country.

4.6 GTZ and KfW projects

In addition to the World Bank/GEF, various German and other development organisations are contributing financial and technical assistance to the Pakistani power sector. For example, the Kreditanstalt für Wiederaufbau (KfW) and GTZ are sponsoring projects in the hydropower sector. The purpose of the GTZ projects is to expand the use of renewable energy sources, hydropower in particular. The latter, it is hoped, will eventually constitute a significant, macro economically efficient contribution to Pakistan's future supply of electricity. Social and ecological problems are to be minimised in the process. Under the newly started Renewable Energy and Energy Efficiency (REEE) project in collaboration with AEDB and ENERCON to provide technical assistance and support to these organizations at policy level, capacity building and promotion of REEE through effective media

coverage and seminars. GTZ does see Renewable Energy and Energy Efficiency as an integrated approach.

5 Status of Renewable Energy Sources

5.1 Hydropower

Pakistan's total hydropower potential has been estimated over 40,000 MW, some 24,000 MW of which could be beasily harnessed, and approximately 6400 MW of which is actually being exploited. More than 1000 MW micro/mini hydropower potential is available in northern mountainous region of the country, of which less than 1% is being developed. Due to anticipated growth in demand and of the fact that only about 20% of the available hydropower potential is being utilised, the 'Vision 2025' development plan provides first and foremost for the vigorous, multi-stage development of hydroelectric power.

5.1.1 Run-of-river Ghazi-Barotha power plant

Ghazi-Barotha Power Plant, a run-of-river plant that is presently being commissioned in successive stages, constitutes an initial large-scale project in this sector. Located on the upper reaches of the Indus and built for a total output of 1,450 MW, its first stage (290 MW) went into service last July. The power station was fully commissioned in mid-2004. The project is being implemented under the auspices of state-owned WAPDA. The total cost of the project stands at roughly US$ 2.1 billion. The project is being financed by the World Bank, the Asian Development Bank, the Japan Bank for International Cooperation (JBIC), the European Investment Bank, the Islamic Development Bank, and resources from German Financial Cooperation (KfW). WAPDA is contributing approximately US$ 1 billion, or nearly half of the overall cost. Fully utilised, the power plant is supposed to lower CO_2 emissions by approximately 5.5 million tons annually.

5.1.2 GTZ assistance for medium-size hydropower projects

In addition to the aforementioned large-scale project, three additional hydroelectric power plants of medium size – the high-pressure plants Allai Khwar (121 MW), Khan Khwar (72 MW) and Duber Khwar (130 MW) – have been prepared with GTZ assistance in recent years. The GTZ conducted the feasibility studies and generated the tendering documents for all three projects. The Abu Dhabi Development Fund is providing credit to the amount of US$ 150 million for implementing the projects. Pakistan itself is raised additional funds and all the projects are under construction.

5.1.3 Micro hydropower potential

In northern Pakistan alone there is an estimated potential of 300 MW for micro hydropower plants with installed capacities below 100 kW each. As of today, only about 10 MW of that potential had been tapped by a total of some more than 300 projects co-financed by Aga Khan Rural Supprt Programme (AKRSP) PCRET, European Union (EU) and private developers. Now, with the assistance of the Asian Development Bank and within the scope of Malakand Rural Development Project, 100 micro hydropower plants with ratings ranging from 5 to 50 kW are under implementation with in and around Malakand Division of the North-West Frontier province (NWFP).

5.2 Wind Energy

By the end of 2003 not a single wind energy conversion system with a generating capacity above 500 W had been installed in Pakistan. There are only a small number of micro-plants (300–500 W) for generating electricity, and roughly 30 wind power installations are in use for pumping water in the coastal regions of Balochistan and Sindh provinces [6]. Most notably along its 900 km coastline and in a number of North-West Frontier valleys, Pakistan possesses about 50,000 MW of economically exploitable wind-power potential. On commercial grid connected electricity generation programme, the Government of Pakistan has decided to install 100 MW Wind Power Farm during the year

[6] The installation of initially, 100 small wind turbines in Pakistan's coastal regions by mid 2004 is envisaged as the next step as the form of cooperation project between PCRET and the Chinese Academy of Agriculture Science. With exception of generators, which are to be imported from China, all plant components were supposed to manufactured in Pakistan.

2005. This programme initiated by the AEDB involves financing through private sector, land from Government of Sindh and power purchase by NTDC for HESCO/KESC. The Government of Pakistan guarantees are backed through NEPRA. The Board has issued LOIs to 22 national and international companies for generation of 1100 MW power through wind energy. With the help of AEDB Pakistan also plans to install an additional 300 micro-wind turbiness with a high domestic content by 2003/2004.

5.2.1 Unimplemented wind farms

There have been numerous past attempts to harness wind power on a large scale: In response to investment incentives provided by the 1994 Electricity Act, two American investors planned to build two large wind farms in cooperation with Pakistani contractors. However, those two projects – the 100MW Kenetech wind power project in Balochistan Province and the 150MW Omega-Zond wind farm in Sindh province – have not yet been implemented.

5.2.2 UNDP/GEF project 'Commercialization of Wind Power Potential in Pakistan

The first official initiative to stimulate the use of wind power in Pakistan was launched in November 2002.

With the financial support of UNDP and GEF, the Pakistani Environment Ministry initiated a project entitled 'Commercialization of Wind Power Potential in Pakistan'. That project included a study aiming to identify the existing impediments to the use of renewable energy sources in Pakistan, probing suggestions on how to overcome them[7] and conducting the requisite planning for an initial demonstration project.

[7] The most important recommendations covered a technology-specific system of remuneration, assumption of the grid connection costs by the responsible power utility in each case, the creation of coherent political framework conditions at the national level for the projects involving renewable energy sources on a scale upto 50 MW, consideration of the environmental benefits of renewable energy sources in the planning of additional wind farms, and streamlining of the licensing procedures for projects based on renewable energy sources.

5.2.3 Phase-1 of UNDP/GEF 'Commercialization of Wind Power Potential in Pakistan'

1. The Phase-1 of the Project stems from a detailed set of background and site specific studies carried out in PDF 'B', initiated in April, 2001 under the GEF Operational Programme OP6, with co-financing from UNDP and the Nordic Trust. The detailed studies included an assessment of the regional power supply and demand situation detailed wind measurements and analysis at the initially proposed wind farm site near Pasni, complete environmental impact assessment of the proposed plant site, technical specification of plant equipment, as well as detailed financial and economic analysis, including calculation of costs of wind power generation, avoided diesel generation, and incremental project activities.

2. The project aims to reduce GHG emission through the facilitation of commercial scale exploitation of renewable wind energy for power production in Pakistan. It focuses on establishing a wind power industry in the country based on internationally proven technology as an economically viable and sustainable option by removing policy, institutional, regulatory, fiscal and technical barriers to private investments in wind farms and their integration in the power grid.

3. The project will be implemented using a phased approach where phase 1 (2 years) will focus on removing barriers linked to a currently weak or non existent enabling environment for on grid renewable energy and specifically for wind energy, together with creating government, private sector and academic awareness and capabilities so as to facilitate its effective commercial deployment throughout the country. Towards the end of phase 1 the project will also start the required steps of a procurement process (expression of interest) related to piloting the first commercial on grid wind energy installation in Pakistan. This barrier removing exercise will then create the necessary conditions for phase 2 (3 years) to be presented to the GEF for final approval with adjusted and confirmed estimates of funding from different sources and the conditions attached. Phase 2 will then consist of the initial implementation of the specific enabling environment including contractual and financial conditions to sustain the first commercial on grid wind energy operations on a continued basis (currently the assumption and the costing for

this phase was based upon the PDF 'B' defined 15 MV, however this will change as a result of the implementation of phase 1 of this project and it will be resubmitted for GEF approval).

5.3 Biomass

In Pakistan, where, according to the last census from 1998, approximately two out of three people live in rural areas, the rural residents in particular rely almost exclusively on biomass in the form of fuel wood or charcoal for cooking and heating. Indeed, the majority of Pakistan's urban population (58%) also takes recourse to those traditional sources of energy. According to official data, the country's total wooded area expanded from 34,600 km^2 to 38,100 km^2 (i.e. by about 10%) between 1990/91 and 2001/02, but each year local residents remove some 1.2 million m^2 of wood from the country's forests for use as fuel. In Balochistan, this practice has reduced the total area of standing forest by 70%.

5.4 Solar Energy

Pakistan has a very good overall solar-energy potential. The average daily insolation rate amounts to approximately 5.3 kWh/m^2. Especially the south-western province of Balochistan offers excellent conditions for harnessing solar energy. There, the sun shines between 8 and 8.5 hours daily, or approximately 3,000 hours per annum.

Despite these favourable prerequisites, the use of solar energy for generating electricity or for heating is still in its beginnings. Photovoltaic systems are used primarily for producing electricity in rural areas. As far back as the early 1980s, the Government of Pakistan had 18 PV systems with a composite output of 440 kW installed in various parts of the country. Due to the lack of technical know-how about their operation and maintenance, though, no further systems were installed. For the same reason, seven other PV systems with a total output of 234 kW, which were installed in the Pakistani part of the Hindu Kush in the late 1980s, are no longer in operation. However, with the establishment of AEDB, this time round will ensure sustainability of such projects by providing a workable model on commercial lines.

5.4.1 AEDB Programme of 100 Solar Homes per Province

Aim of the Project

Presently a large number of households in remote/rural areas do not have access to basic amenities like electricity, gas, potable water etc. Therefore these households are forced to use kerosene oil and firewood for lighting and cooking. This solar energy demonstration project aims to change the current status quo by providing local communities with comforts of lighting, cooking and clean drinking water. This demonstration project will assist in the alleviation of poverty, social uplift and rural development. Moreover, it will also aim at mitigating greenhouse gas emissions.

Furthermore, the project will serve the following purposes:

a) To increase awareness in the use of renewable energy.
b) To provide basic necessities of lighting to remote locations.
c) To establish a model project in order to ascertain maintainability and sustainability parameters.
d) To develop a commercial model to encourage the private sector for replication.
e) To develop a solar technological base.

Results Achieved

The project was executed and implemented in the following villages:

1. Allah Baksh Bazar Dandar, District Kech, Balochistan
2. Bharo Mal, District Thar, Sindh
3. Janak, District Kohat, N.W.F.P.
4. Lakhi Bher, Distrcit D.G. Khan, Punjab

Each of the 100 households in each village has been provided with 88 Watt Solar Panels, 4 LED lights, a 12 Volt DC fan and a TV socket. In addition, a Solar Disinfecting Unit and a Solar Cooker have also been provided to each household.

Two solar-powered seawater desalination facilities with a daily throughput of 22,710 l are in use in the province of Balochistan.

5.5 Geothermal Energy

Although there are numerous hot springs with temperatures ranging from 30°C to 170°C to be found in various parts of Pakistan, for example in the vicinity of Karachi and in the Pakistani part of the Himalayas, there has been no attempt to make use of geothermal energy in Pakistan yet.

6 Rural Electrification

Pakistan's increasing demand for energy is due in part to efforts designed to promote the process of rural electrification. Until 1995/96, the number of villages with access to grid power grew by 9 to 11% annually. Since then, however, the increasing connection costs have driven the growth rate down to about 2% per year. As of March 2003, approximately 73,000 (59%) of Pakistan's roughly 125,000 villages were receiving electricity (compared with approximately 46,000 villages, or 37%, in mid-1993. Recently the Government of Pakistan has publicly announced an ambitious plan to provide basic power to all the citizens through out the country by the end of 2007.

Annex 1

Year	Hydropower		Thermal		Nuclear		Total
	MW	%	MW	%	MW	%	MW
1984	2,547	48.7	2,545	48.7	137	2.6	5229
1985	2,897	51.6	2,580	46.0	137	2.4	5614
1986	2,897	46.8	3,160	51.0	137	2.2	6194
1987	2,897	43.9	3,560	54.0	137	2.1	6594
1988	2,897	42.6	3,760	55.3	137	2.0	6794
1989	2,897	39.1	4,370	59.0	137	1.9	7404
1990	2,897	35.0	5,235	63.3	137	1.7	8269
1991	2,897	32.6	5,864	65.9	137	1.5	8898
1992	3,329	35.7	5,872	62.9	137	1.5	9338
1993	3,761	37.6	6,099	61.0	137	1.4	9997
1994	4,725	41.0	6,664	57.8	137	1.2	11526
1995	4,825	38.8	7,476	60.1	137	1.1	12438
1996	4,825	37.9	7,763	61.0	137	1.1	12725
1997	4,825	31.9	10,149	67.2	137	0.9	15111
1998	4,825	30.5	10,876	68.7	137	0.9	15838
1999	4,825	30.2	10,993	68.9	137	0.9	15955
2000	4,825	29.1	11,637	70.1	137	0.8	16599
2001	5,039	28.5	12,188	68.9	462	2.6	17689
2002	5,039	28.0	12,473	69.4	462	2.6	17974
2003	5,039	28.0	12,473	69.4	462	2.6	17974
2004	6,493	33.3	12,567	64.4	462	2.4	19522

Source: WAPDA-Power System Statistics Twenty Ninth Issue

Annex 2

Year	Hydropower		Thermal		* Nuclear		Total
	GWh	%	GWh	%	GWh	%	GWh
1984	12,822	59.3	8,786	40.7			21608
1985	12,245	52.5	11,080	47.5			23325
1986	13,804	53.8	11,833	46.2			25637
1987	15,251	53.7	13,151	46.3			28402
1988	16,689	50.6	16,289	49.4			32978
1989	16,974	49.0	17,645	51.0			34619
1990	16,925	45.0	20,720	55.0			37645
1991	18,298	44.9	22,429	55.1			40727
1992	18,647	41.0	26,838	59.0			45485
1993	21,111	43.4	27,569	56.6			48680
1994	19,436	38.1	31,592	61.9			51028
1995	22,858	41.6	32,028	58.4			54886
1996	23,206	39.8	35,039	60.2			58245
1997	20,858	34.7	39,251	65.3			60109
1998	22,060	36.4	38,517	63.6			60577
1999	22,448	34.8	41,855	64.8	284	0.4	64587
2000	19,288	28.5	48,021	70.9	399	0.6	67708
2001	17,259	24.5	51,308	72.7	1997	2.8	70564
2002	19,056	25.9	52,257	71.0	2291	3.1	73604
2003	22,350	29.0	52,920	68.7	1740	2.3	77010
2004	27,477	33.2	53,450	64.6	1760	2.1	82687

Source: WAPDA-Power System Statistics Twenty Ninth Issue

* Source:HDIP

Annex 3

Year	Domestic		Commercial		Industrial		Agriculture		Public Lighting		Bulk Supply + Sale b/w WAPDA & KESC +Traction		Total TWh
	TWh	%	TWh	%	TWh	%	TWh	%	TWh	%	TWh	%	
1984	4.6	26.1	1.3	7.4	4.7	27.0	3.9	22.1	0.1	0.6	2.9	16.8	17.47
1985	5.1	27.5	1.4	7.4	5.1	27.4	4.0	21.8	0.1	0.6	2.9	15.4	18.55
1986	5.9	28.1	1.5	7.3	5.9	28.3	4.3	20.5	0.1	0.6	3.2	15.1	20.89
1987	6.8	28.9	1.7	7.2	6.5	27.2	5.0	21.1	0.1	0.6	3.5	14.9	23.70
1988	7.7	28.7	1.9	6.9	7.3	26.9	6.1	22.6	0.2	0.6	3.9	14.3	27.01
1989	8.7	30.3	1.9	6.7	7.6	26.6	6.2	21.7	0.2	0.7	4.0	14.0	28.61
1990	9.4	29.3	2.0	6.1	8.4	26.2	7.0	21.8	0.2	0.7	5.1	15.9	32.06
1991	10.4	30.0	2.1	6.0	9.1	26.4	7.6	21.9	0.3	0.8	5.2	15.0	34.68
1992	11.5	30.8	1.6	4.3	10.2	27.5	7.9	21.2	0.3	0.8	5.7	15.3	37.21
1993	13.2	33.1	1.7	4.3	10.9	27.4	7.7	19.3	0.3	0.7	6.1	15.2	39.95
1994	14.1	34.1	1.8	4.3	10.6	25.5	7.8	18.9	0.3	0.7	6.8	16.3	41.39
1995	15.6	35.1	1.9	4.4	10.6	24.0	8.1	18.4	0.3	0.7	7.8	17.5	44.38
1996	17.1	36.8	2.2	4.7	10.4	22.3	8.5	18.3	0.4	0.8	8.0	17.2	46.57
1997	17.7	36.6	2.2	4.6	10.2	21.0	8.9	18.3	0.4	0.8	9.1	18.7	48.51
1998	18.7	37.5	2.3	4.7	10.3	20.6	9.0	18.0	0.6	1.2	9.0	18.0	49.95
1999	19.3	38.9	2.4	4.8	10.0	20.2	7.8	15.8	0.2	0.5	9.8	19.8	49.48
2000	21.4	41.7	2.5	5.0	10.8	21.1	6.9	13.5	0.2	0.5	9.4	18.3	51.30
2001	22.7	41.6	2.8	5.1	11.8	21.6	7.5	13.7	0.2	0.4	9.6	17.6	54.57
2002	23.2	41.6	3.0	5.3	12.7	22.7	8.1	14.5	0.2	0.4	8.7	15.5	55.73
2003	23.6	43.9	3.2	6.0	13.5	25.1	8.7	16.2	0.2	0.5	4.4	8.3	53.68
*2004	25.8	45.0	3.7	6.4	17.4	30.2	6.7	11.6	0.3	0.5	3.7	6.4	57.49

Source: WAPDA-Power System Statistics Twenty Ninth Issue

Ref: HDIP for year 2004 only

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