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USAID

MISSION TO PAKISTAN AND AFGHANISTAN

PROJECT ASSISTANCE COMPLETION REPORT

Energy Planning and Development (391-0478)

Submitted by Private Enterprise and Energy Division
December 1994

TABLE OF CONTENTS

		Page
	List of Acronyms	
I.	Basic Project Data	1
II.	Project Goal and Purpose	1
III.	Background	2
IV.	Project Components	2
V.	Inputs	7
VI.	Project Accomplishments	8
VII.	Lessons Learned	13
VIII.	Sustainability	14

LIST OF ACRONYMS

ADB	-	Asian Development Bank
COALREAP	-	Coal Resource Assessment Program
DGER	-	Directorate General of Energy Resources
DGPC	-	Directorate General of Petroleum Concessions
ENERCON	-	National Energy Conservation Center
EW	-	Energy Wing
FBC	-	Fluidized Bed Combustion
GEF	-	Global Environment Facility
GOP	-	Government of Pakistan
GSP	-	Geological Survey of Pakistan
IBRD	-	International Bank for Reconstruction and Development
LCDC	-	Lakhra Coal Development Company
LOP	-	Life of Project
MW	-	Megawatt
ODA	-	Overseas Development Agency
OGDC	-	Oil and Gas Development Corporation
ORNL	-	Oak Ridge National Laboratory
PACD	-	Project Assistance Completion Date
PASA	-	Participating Agency Services Agreement
PCSIR	-	Pakistan Council for Scientific and Industrial Research
PMDC	-	Pakistan Minerals Development Corporation
PSC	-	Personal Services Contractor
RFP	-	Request for Proposal
TA	-	Technical Assistance
USAID	-	United State Agency for International Development
USGS	-	United State Geological Survey
WAPDA	-	Water and Power Development Authority

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PROJECT ASSISTANCE COMPLETION REPORT

ENERGY PLANNING AND DEVELOPMENT PROJECT

December, 1994

I. BASIC PROJECT DATA

Project Title and No.	Energy Planning and Development (EP&D) 391-0478
Date of Authorization:	July 13, 1983
Original Grant Agreement Signed:	July 30, 1983
Original Loan Agreement Signed:	September 20, 1987
Original PACD:	July 31, 1988
Revised PACD:	July 30, 1993
Amount Authorized:	$96.0 million
Amount Obligated:	$68.0 million
Pressler Deobligation:	$9.0 million
Amount Expended (as of 9/30/94):	$57.4 million
GOP Implementing Agencies:	Energy Wing, Ministry of Planning & Development Energy Conservation Center, Water & Power Ministry Geological Survey of Pakistan Director General of Petroleum Concessions, Ministry of Oil and Natural Resources Oil and Gas Development Corporation
Technical Assistance Contractors:	Mathtech, Inc.; Hagler Bailly, Inc. PASA/USG; PSCs
USAID Project Officer:	M. Waseem Choudhry

II. PROJECT GOAL AND PURPOSE

The goal of the Project was to increase Pakistan's energy self-sufficiency and thereby to improve the quality of life for its people. The purpose of the Project was to assist the Government of Pakistan (GOP) to formulate and implement plans and programs to assess, develop and use Pakistan's indigenous energy resources and increase the efficiency of energy use.

III. BACKGROUND

The Project was authorized in 1983 as a part of the $1.625 billion package of economic assistance for Pakistan that was negotiated between the U.S. Government (USG) and the GOP in 1981. USAID grant funding of $30 million was initially authorized for the Project. Through Project Amendment No. 2, dated June 1990, the LOP grant funding was increased to $86 million and $10 million in loan funds were added to the Project. Due to restriction resulting from the imposition of the Pressler Amendment in 1991, only $57.3 million in grant funds and $0.087 million in loan funds could be expended as of September 30, 1994. Other energy sector projects implemented by USAID during the same period were the Rural Electrification Project and the Energy Commodities and Equipment Program. The themes common to all of these projects were the attainment of energy self-sufficiency, the efficient utilization of energy, and balance of payments support.

Pakistan is an energy deficient country with very low levels of per capita energy consumption. The consumption levels are low even by developing country standards. The proven reserves of oil in Pakistan are very modest. However, the picture on the natural gas front is not too bad. In 1983, the coal resource was estimated to be 500 to 1000 million tons; barely enough for a 500-1000 MW power plant. The severe energy and power shortages in the country have made it absolutely essential to develop all indigenous energy resources, including hydro-electricity in the northern areas.

To address the above challenges, the Project aimed at the following activities/strategies: assessment of coal resources, use of indigenous coal in power generation with resultant improvement in mining techniques, energy conservation in industry, development of solar and small scale hydro potential, energy analysis, manpower development, and improvement of oil and gas regulatory agencies.

IV. PROJECT COMPONENTS

The Project consisted of three primary components: (1) Energy Policy, Planning and Manpower Development; (2) Indigenous Resource Assessment and Development; and (3) Energy Conservation. As a result of the Project Paper Amendment in June 1990, the project implementation strategy was slightly modified and several project sub-components were added while some others were curtailed. The project components and sub-components are briefly described below. The sub-components added in June 1990 are marked with an asterisk.

A. Energy Policy, Planning and Manpower Development

The purpose of this component was to strengthen the GOP's capability to conduct the integrated energy analyses necessary for sound development planning. These analyses entail the preparation of energy demand and supply balances and forecasts in light of economic development needs, and require estimating the inputs needed to meet the energy supply.

Before the start of the EP&D Project, integrated energy analyses were being carried out by the GOP's Planning and Development Division with the assistance of consultants. Other GOP organizations having sectoral energy analysis capabilities were the Directorate General of Energy Resources (DGER) within the Ministry of Petroleum and Natural Resources; the Water and Power Development Authority (WAPDA) within the Ministry of Water and Power; and the Applied Systems Analysis Group within the Pakistan Atomic Energy Commission. The plan was to form an Energy Analysis Group trained in integrated energy analysis methods within the Planning and Development Division, using existing GOP capabilities. The Project focus was to develop the GOP capabilities through the following activities:

- Strengthen the energy data collection and processing capabilities of the Energy Analysis Group and other organizations responsible for energy data collection. The Energy Analysis Group was turned into a full scale "Energy Wing" under the Ministry of Planning and Development.

- Develop the capabilities of the Energy Wing through technical assistance, training and provision of computer equipment. The plan was to have two long-term advisors and 189 person-months of short-term advisors.

- Undertake special studies in the energy area.

- Assessment of the manpower needs and long and short-term training in specific energy sub-sectors.

- Provide computers along with software packages.

- Upgrade laboratory equipment, computers, teaching aids and library materials at selected engineering institutions.*

- Provide assistance to federal and provincial governments to address impediments to development of modern large scale coal mining operations in Pakistan. The most important issue to be addressed was improvement of the existing leasing and mine development policies.*

B. Indigenous Resource Assessment and Development

1. Coal Resource Assessment Program (COALREAP) - To assist the GOP increase available energy resources, as well as to reduce dependence on petroleum imports and fuelwood, the EP&D Project provided support in coal exploration and extraction. This component supported GOP and private sector efforts to assess and develop Pakistan's coal resources and assisted the GOP in preparing for the implementation of the country's first large scale coal mine and power generation plant at Lakhra. These objectives were to be attained through the following activities:

- Strengthen the capability of Geological Survey of Pakistan (GSP) to carry out coal resource assessments. Also to strengthen the capabilities of the GSP and the Pakistan Council for Scientific and Industrial Research (PCSIR) to carry out coal analysis by providing laboratory equipment and training. One USGS long-term advisor was to be assigned in Pakistan for 45 months and short-term advisors were to be assigned for a total of 88 person-months.

- Exploratory drilling and coal analysis. The initial focus of this activity was to be on the Lakhra coal field. Two new drilling rigs were provided to the GSP in addition to refurbishing the existing drill rigs with bits and drill pipe. The GSP's geophysical logging capability was enhanced.

- Provide a computerized database center for the GSP.

- Enhance the GSP's reports publication capabilities.

2. Lakhra Coal Mine and Coal Fired Power Generation Development - As a first step, the Project assisted WAPDA and the Pakistan Minerals Development Corporation (PMDC) in setting up and training a Coal Projects Department within WAPDA to start performing field studies and surveys, and to assist private miners by transferring the latest coal mining technology. Technical assistance covered areas such as engineering studies, cost estimates, coal analysis, site surveys and analysis of barriers to private sector coal mining in Pakistan.

Under a separate effort, mine development drilling and geophysical logging was conducted for the detailed design of the mines. Later steps were: preparation of detailed mine development plans; technical specifications for mining, transportation and power generation equipment; and the preparation of invitations for bids for procurement of such equipment.

3. Coal Briquetting - Develop and thoroughly analyze "smokeless" coal briquettes using Pakistani coal, and assess the potential market for these briquettes. A demonstration plant was established at the Fuel Research Center of PCSIR.

4. Strengthening DGPC - The purpose of this component was to improve the functioning of the Directorate General of Petroleum Concessions (DGPC). DGPC, a Directorate within the Ministry of Petroleum and Natural Resources, is responsible for awarding exploration and mining concessions for oil and gas. As such, DGPC plays a critical role in the development of indigenous sources of energy. The following activities were undertaken:

- Establish automated databases for concessions, production, accounts, seismic surveys and well logs etc. Provide high-end computer hardware and software for

this purpose. On the job training in the use and modification of the databases were provided to the DGPC staff.

- Lease a new office building for DGPC with proper space for computers, the library and conference rooms. All necessary furniture and equipment for the new office were provided with Project funds.

- Conduct special studies in areas of current interest.

*5. OGDC Management Assessment - The purpose of this sub-component was to undertake a financial and management assessment of the Oil and Gas Development Corporation (OGDC) of Pakistan. This was considered an essential step towards the transition of OGDC from a subsidized state-owned corporation to a financially self sufficient corporation capable of competing internationally for credit and attracting investment in the oil and gas sector in Pakistan. This activity was drastically scaled back following the Pressler Amendment.

*6. Detailed Site Assessments for Small Hydropower - The purpose of this sub-component was to promote the use of this renewable resource by encouraging private sector investment in small hydropower plants (5 to 50 MW). The Project was to provide funding for detailed engineering and feasibility studies of 5-10 sites identified for small scale hydropower generation.

C. Energy Conservation

The major goal of this component was to create within the GOP and the private sector the capability of designing and implementing effective conservation policies, plans, programs, strategies and projects. This component consisted of two elements: (1) an energy conservation program to increase the efficiency of industrial energy use; and (2) a program to assess and develop renewable energy technologies. Specific activities were to be as follows:

1. Energy Conservation

- Establish an autonomous energy conservation entity responsible for energy conservation policies and programs.

- US experts and Pakistan counterparts to jointly undertake approximately 40 preliminary and 20 detailed energy audits of selected industries for a minimum of one unit in the following industries: cement, textiles, fertilizer, ferrous and non-ferrous, brick-making, ceramics and food processing. Each detailed audit produced energy flow maps and to sample measurements of key process parameters. The energy audit reports were to be used by the plant managers to design and obtain financing for low cost energy conservation measures. The data

compiled as a result of the energy audits were to be used to establish of an energy use database.

- Conduct short-term courses for industrial managers in energy conservation, GOP personnel and private sector consultants.

- Initiate four to eight demonstration projects for energy conservation in selected industries.

- Conduct energy conservation seminars and advertisement campaigns.*

- Publish manuals such as energy fact sheets for buildings, energy saving driving tips, agriculture energy fact sheets, and energy conservation-related equipment cost directories.*

- A loan fund was established to finance private sector projects to install energy saving equipment. The funds were made available to selected financial institutions.*

- Funds were set aside to construct a building with about 31,500 square foot of space to house the National Energy Conservation Center (ENERCON). This area was to be utilized for offices for ENERCON staff, training and exhibition facilities, conference room and laboratories.*

2. Renewable Energy Assessment and Development

- Assist the GOP in developing a renewable energy assessment and development program to delineate the long term role of renewable energy technologies and to accelerate implementation of promising technologies. Energy needs which can be met by renewable technologies will be surveyed and analyzed; technologies which are meeting, or which could meet, these needs will then be described and analyzed.

- Undertake an energy needs survey for residential and small commercial energy needs to evaluate alternative energy options.

- Install up to 6 small commercially available solar monitoring stations to acquire and publish solar data.

- Technology assessment of cooking stoves and biomass options.

V. INPUTS

The inputs provided by USAID are summarized in the following table:

PROJECT LINE ITEMS	OBLIGATIONS US$	EXPENDITURES US$
GRANT FUNDS		
Technical Assistance	39,324,230	39,313,051
Training	4,708,602	4,708,602
Commodities	6,280,984	6,280,984
Other Costs-Evaluation	839,045	839,045
Technical Assistance-LT	3,341,996	3,341,996
Vehicles	356,837	356,837
Training-LT	90,000	90,000
Construction	2,421,125	2,421,125
LOAN		
Commodities	87,101	87,101
TOTAL	57,449,920	57,438,741

In addition to the funding provided under the EP&D Project, the PDIF Project contributed a total of $40,000 in funding for Project-related activities.

A brief description of the technical assistance provided, broken down by Project component, follows:

A. Energy Policy, Planning and Manpower Development

Two long-term advisors were provided; one in the area of energy analysis and computer skills, and the other in human resource development. Short-term consultants were provided to supplement the long-term advisors and to carry out discrete activities such as development of databases, short-term training in computers, financial analysis and technology assessments etc.

The services of a US firm, Coopers and Lybrand, were provided to undertake management and financial audit of the Oil and Gas Development Corporation.

Mathtech Inc. was awarded a contract to assist in the establishment of automated data bases at DGPC and to undertake special studies such as Coal Concessions Improvement and Ministry of Petroleum and Natural Resources Reorganization study.

B. Indigenous Resource Assessment and Development

One long-term and several short-term USGS persons were assigned to assist in implementing the Coal Resources Assessment Program. L ng term advisors (general, mining and power) and several short term consultants were to be provided to assist WAPDA, PMDC and the private sector for feasibility studies, overall coordination and planning of the Lakhra project. WAPDA and PMDC staff was to be trained in US.

A PASA was awarded to Oak Ridge National Laboratory (ORNL) for emission testing of Lakhra coal processed briquettes for a comparison with the emissions from traditional fuels.

C. Energy Conservation

Project activities were coordinated by a US technical assistance team (Hagler Bailly Inc.) comprising one long-term and several short-term advisors in areas of energy audit techniques and energy conservation equipment and technologies. After the expiry of the Hagler Bailly contract several Pakistani consultants were hired under host country contracts for energy audits, training and advertising campaigns.

VI. PROJECT ACCOMPLISHMENTS

The major accomplishments of the Project are described below:

A. Energy Policy, Planning and Manpower Development

The EP&D Project has been a catalyst in drawing the attention of the GOP and other donors to the need for reform in petroleum policies. As a result, the GOP announced a new policy, aimed at increasing the private sector's participation in petroleum exploration and development. EP&D has also worked with the DGPD to modify its policies and regulations in order to facilitate increased private sector investment in the petroleum sector. The Project has also supported improvements in Pakistan's coal concession practices and policies, which should stimulate private sector interest in coal mining and lead to increased coal resources.

1. Establishment of Energy Wing - To increase the Ministry of Planning and Development's energy planning capabilities, the Project established a full-fledged Energy Wing within the Ministry. The Energy Wing has already completed many important studies, as listed

below, and has taken the lead in preparing Pakistan's Five Year Energy Plans. As a result of its strengthened institutional capability, the Energy Wing routinely advises the GOP regarding matters such as private power proposals, natural gas pricing, priority of natural gas usage, electricity tariff rationalization, commercialization of OGDC, and household fuels strategy.

The Energy Wing is organized into four sections, each with responsibility for one of the following substantive areas: energy appraisal plan formulation, energy information systems and computers and energy finance and economic section. The functions of these four sections have been carefully spelled out and each one is professionally staffed. The Energy Wing staff has been well trained in the use of new techniques and models. More than 30 candidates were sent to the U.S. for Master's degree programs and more than 150 were sent for short term training. The subjects covered were: energy systems analysis and training, energy supply and demand models, data base management, financial analysis and energy policies. Short-term courses arranged in Pakistan were on integrated energy planning, applied financial analysis, and practices and strategies for the energy sector.

Towards the end of the Project, a multi-story building was procured at a cost of about $1.0 million to provide office space for the Energy Wing staff. Computer hardware and software for integrated energy planning and analysis and establishment of an energy data base have been provided to the Energy Wing.

2. Studies - Under this component, the following major studies have been carried out under the umbrella of the Energy Wing:

- Feasibility study of Jamshoro units 4 to 7 (Bechtel)
- National Rural Electrification Master Plan (Mathtech Inc.)
- Management and Financial Audit of the OGDC (Coopers and Lybrand)
- Re-organization of the Ministry of Petroleum and Natural Resources (Mathtech Inc.)
- Improvement of Coal Concessions Regime (Mathtech Inc.)
- Economics of centralized versus decentralized power generation (Mathtech Inc.)
- Investigation of the price structure for household fuels (Mathtech Inc.)
- Economic and logistic considerations for natural gas import (Mathtech Inc.)

B. Indigenous Resource Assessment and Development

1. Coal Resource Assessment Program (CoalReap) - A major coal deposit has been discovered and broadly delineated in the Thar desert, Sindh province. Preliminary widely-spaced drilling to establish broad parameters of the coal field was undertaken by the GSP in collaboration with USGS. This discovery is of major significance and has great promise as a solution to Pakistan's future energy needs. The resource has been estimated to contain about 80 billion tons of coal based on drilling results from 28 drill holes completed. The total of previously known resources was 10 billion tons. The estimated reserves of the Thar deposit are

sufficient to support several thousand megawatts of power generation. Private sector interest in the Thar field has been keen, and negotiations are well underway for the development of this resource. Previous important coal field discoveries under CoalReap were made at Sonda, Jherruck and Badin (all south of Lakhra).

Approximately 30 GSP employees received training in the U.S. in the areas of coal resource assessment methodology, geochemical characterization, geophysical logging, data management and report preparation. One GSP employee obtained a Ph. D. degree in coal petrography from Southern Illinois University at Carbondale.

Coal analysis, petrography and publishing equipment has been supplied and installed at GSP laboratories. Other equipment provided to GSP included: two drill rigs, drilling and geophysical logging spares, analytical laboratory equipment, computers for geodata center, and photogrammetric equipment.

2. Lakhra Coal Mine and Power Generation - Detailed technical and economic feasibility studies for the Lakhra coal mine and the power plant (2X250 MW) were completed by John T. Boyd, Gilbert Commonwealth, and ICF Inc. respectively. With the exception of the economic feasibility report by ICF, the feasibility studies conclusively proved that a Lakhra coal mine supplying coal to a 2X250 MW conventional steam power plant was technically sound and socially and environmentally feasible. ICF undertook the economic and financial analysis of the integrated coal mine/power plant project and determined a threshold for the coal production cost below which the project would be economically and financially viable. The cost estimates provided by the mining consultants were somewhat higher than this threshold and indicated the project was not financially feasible.

To resolve this controversy, WAPDA issued an RFP for the supply of coal. Two proposals (Bechtel/Peabody and Amin Brothers) were received, but both were determined to be non-responsive. After the failure of this initiative, there was no significant USAID involvement in the Lakhra project.

3. Coal Briquetting - Combining its concern for coal utilization with new technologies for energy use efficiency, EP&D has developed and tested coal briquettes for household cooking and heating. The briquettes have proved to be an inexpensive, safe alternative to kerosene and firewood. ORNL has produced a market assessment report for coal briquettes titled, "Coal Briquetting in Pakistan-A Market and Business Assessment". The report concludes that a large and financially viable market exists for a coal briquetting industry based on Pakistani coal. Subsequently, ORNL undertook an emissions assessment of the processed Lakhra coal briquettes. Weighed samples of processed briquettes, briquettes made from raw Lakhra coal, wood and cow dung were burned in a controlled environment within a shed to compare the levels of hazardous emissions from the various fuels. The testing concluded that the harmful emissions from the processed Lakhra briquettes are no worse than the emissions from conventional Pakistani household fuels. Briquettes, which are used extensively in China

and other countries, appear to offer an exciting investment opportunity to Pakistan's private sector.

4. Strengthening of DGPC - Over 16,000 square feet was rented in December 1991 for the DGPC office. DGPC has been provided with furnishings for its offices, and with the state of the art SUN Sparc work stations, peripherals and software for the database system and a Z-Map Plus based colored map generation facility.

A major mapping data base has been established based on Z-Map Plus. The mapping database consists of a concessions database, a seismic database, a well database and a cultural database. Approximately 12 person months of effort were utilized to retrieve this data from DGPC, OGDC, and other operating companies functioning in Pakistan. DGPC now regularly produces various concession maps.

Other databases designed and developed by consultants under the Project are a concession monitoring system, a production monitoring system, and a financial monitoring system. An economic evaluation system based on "Giant" software package has also been established. Economic evaluations are now routinely done by the DGPC staff.

Exploration promotion seminars were held in London and Houston during April/May 1993. The seminars were well attended. As a result of these seminars many proposals for exploration have been received. A Petroleum Seminar was held in Islamabad, Pakistan in September 1991 to attract international oil and gas exploration firms.

The DGPC staff received extensive on the job training from the TA consultant's staff over the project duration. Training was provided in the following areas: Financial Reporting System, Giant, Production Monitoring System, Concessions Monitoring System, Z-Map and use of Sun Sparc stations.

5. OGDC Management Assessment - As a first step toward commercial operation and eventual privatization of the state-owned OGDC, EP&D funded a financial audit of the OGDC for the fiscal years ending June 30, 1990 and June 30, 1991 by a firm of international repute. Its financial statements for these years have now been certified in a qualified opinion of that firm. The auditors also submitted a comprehensive report on recommended management changes. This process has made the financial picture more transparent and acceptable to foreign investors. The same firm that did the audit has been hired by OGDC to implement its new automated management information system.

6. Detailed Site Assessments for Small Hydropower - This activity was curtailed due to imposition of the Pressler Amendment in 1991 and no significant work has since been undertaken.

C. Energy Conservation

Under this Project component, Pakistani counterparts received training in energy audit technologies, energy conservation technologies, economics and energy conservation policies. Energy conservation equipment was supplied to various industries.

1. Energy Conservation - As a result of USAID's efforts, the National Energy Conservation Center, or ENERCON, was established in December 1986. ENERCON's mission is to create a national awareness of the need for energy conservation through more efficient energy use. ENERCON has 14 authorized positions of which 11 have been filled. A building to house the ENERCON offices and laboratories was constructed at a cost of about $2.4 million. ENERCON moved into this new building in December 1993. This facility was constructed in accordance with energy-saving principles and is a prominent example of energy conservation

Computer equipment and software have been provided to ENERCON. Databases have been developed with valuable information on energy audits, retrofits and tune-ups at the individual plant, building, vehicle and farm level. These databases contain accurate information on measured efficiency improvements as a basis for documenting program results and long-range energy supply/demand planning.

As a part of its information dissemination campaign, ENERCON holds workshops and seminars in which 3,000 engineers and 11,000 housewives and working women have participated. In addition, about 200 engineers have been trained in three 3-week energy management courses.

ENERCON's efforts in industrial conservation have so far accomplished the following:

- Identification of $50 million worth of energy savings in industry.
- Detailed energy audits of 42 industrial plants identifying average energy savings of 22% per plant.
- Tune-up of 600 industrial boilers and furnaces for an average energy savings of 6%.
- Preparation of a National Building Energy Code which incorporates energy conservation principles.
- Distribution (and sale) of 50 combustion analyzers to private sector industry.
- Tune up of 10,000+ vehicles.
- Retrofits/tune ups for 500 agricultural tubewells.
- Steam system surveys for 15 industries.

2. Renewable Energy Assessment and Development - No significant activities have taken place under this sub-component because of a lack of consensus between USAID and GOP on exactly what should be done. This activity was deleted in project amendment #2.

VII. LESSONS LEARNED

1. Considerable difficulty was observed in getting the GOP to issue legislation creating ENERCON and Energy Wing. Thereafter, additional delays were experienced in staffing professional positions in these institutions due to unanticipated administrative delays in the hiring process. The institutional improvements sought through the creation of ENERCON and the Energy Wing were a significant element of the Project. In the case of ENERCON, these delays caused an approximately 18-month delay in the start up of this Project activity. In the future, if additional staff hiring is anticipated, a suitable allowance for the time this requires should be made in establishing the project schedule. Another possible avenue to minimize these problems would be to condition the release of funds for project implementation on the issuance of required legislation and on filling of specified percentage of vacant positions.

2. Difficulties were observed in commodity procurements. In many cases commodities were either short shipped or did not meet the specifications. This happened in particular towards the end of the Project. Since nearly full payment was made on presentation of shipping documents, when the commodities arrived in country and were found to be not in order, USAID did not have much leverage with the suppliers to make up the loss. In future projects it is recommended that full payment be made to the suppliers only upon successful commissioning of the equipment.

3. USAID should not enter into direct leases of space GOP offices. Rather, funds should be provided and the GOP should lease the space on its own. USAID encountered considerable difficulties in getting the GOP to vacate office space leased by USAID, which put it in an awkward position vis a vis the landlord (who has very little recourse against the Government).

4. Energy Wing - One area in which the EW lacks strength in the financial analysis of projects. The project should have provided more training in this critical area.

5. ENERCON Building - This building was constructed in the last 18 months of the project. Due to time constraints, the building design was done by ENERCON. The construction work and construction supervision were done under USAID direct contracts. USAID's Office of Engineering was assigned to manage these two contracts. The Project Office did not have much involvement in the matter. Construction of the building has been completed; a remarkable feat considering that only 18 months were available to finish the work; however, due to the fragmentation of the responsibilities, timely identification and resolution of problems that arose during construction was difficult. Assignment of responsibility for defects (such as for wiring that was inadequate to run the a/c system) involved much finger-pointing and dragged

on for months. In the end, because of ongoing contract disputes, the construction supervision firm was not available to confirm full conformance with the design and specifications.

In the future, it is recommended that a complex construction activity like the ENERCON Building not be undertaken so close to the end of the project. Also, it is inadvisable for USAID to accept a design from outside, as there is no contractual remedy for design defects, or if the GOP approves the design, USAID should use host country contracting rather that direct.

6. Coal Resources Assessment - Most of USGS initial effort was spent on theoretical analysis in connection with the regional framework studies with less stress on field drilling. A lot of this effort was utilized at the USGS home office. The little drilling that was done did not turn out to be very useful as the work was done by drilling firms who lacked the required professionalism. Many of the drilled holes subsided before geophysical logging could be done. The drilling in the Thar desert was done by GSP at the project end and gave much better results as compared to private drillers. USGS should have been mandated to lay a greater stress on field drilling and provide TA to GSP to improve institutional ability.

7. Lakhra Coal Mine and Power Plant - This project entailed the development of a detailed feasibility study for the power plant/coal mine complex at Lakhra to satisfy the World Bank requirements essential to funding the project construction. The project became bogged down due to a lack of consensus over the estimated cost of extraction of the coal, which prevented funding from materializing. If WAPDA had bid the project as a combined power plant/coal mine project (with power plant size open), it might have been more likely to receive some serious proposals for developing this site.

VIII. SUSTAINABILITY

The major institution building outputs of the Project have been successful and many of the project activities are being sustained by the newly created/enhanced institutions, as detailed below by component:

A. Energy Policy, Planning and Manpower Development

A new institution (Energy Wing) for planning of energy development and policy formulation has been created. The Energy Wing has been provided with its own fully furnished building and computers. The staff has received various kinds of training in Pakistan and in the US. With these inputs Energy Wing has the capability to undertake all routine tasks. The Energy Wing has now 27 filled professional positions. There are still some unfilled positions in the economic and financial analysis area. At the end of the EP&D Project in July 1993, partial assistance in area was provided by the World Bank. That assistance came to a close on June 30, 1994. Also, during the EP&D Project, funds were provided for undertaking various special studies by outside consultants. Alternate funds for this purpose have not so far become available. However, most

of the recurrent costs previously met through Project funds, such as utilities; building, vehicle, computer and photocopier repair/maintenance; and stationery, are now being met through GOP allocations.

B. Indigenous Resource Assessment and Development

1. Coal Resource Assessment - The GSP is an old and well-established GOP institution. Its capabilities have been considerably enhanced through staff training and the provision of computers, laboratory equipment and drilling commodities provided under the project. GSP scientists and drillers are capable of independently conducting coal resource analysis and undertaking drilling and geophysical logging. Unfortunately, the GSP has a very limited operating budget which restrains it from taking on large scale exploration operations. Ever since its inception in the early fifties, GSP management and scientists have worked with USGS scientists and have been dependent on USGS for day-to-day equipment and supply needs as well as training. Since the end of the EP&D project, no other donor funds have become available and the GSP's operations will be rather limited by GOP budget constraints. Further public-sector coal resource assessment is thus likely to be slowed down considerabiy after the end of the EP&D Project.

On the positive side, because of past successful drilling efforts, both the Lakhra and Thar coal fields have become very valuable assets. There is a strong expectation that further closely-spaced drilling work in the Thar desert will be picked up by private sector coal mine developers in the near future. The same is already being done by the public/private sector Lakhra Coal Development Company in case of the Lakhra "compact block" (where drilling at 1.0 KM intervals was done under the EP&D Project).

2. Lakhra Coal Mine and Power Plant - After termination of USAID assistance on the Lakhra coal mine and power project, GOP (WAPDA) turned to the Chinese for help. In September 1987, WAPDA signed an agreement with two Chinese firms for the supply of three 50 MW fluidized bed combustion (FBC) units based on the Lakhra coal. As the Chinese firms did not have design know-how above the 25 MW size they signed an agreement with Foster Wheeler Energy Corporation (USA) for technology and design. WAPDA also issued RFP's for the supply of coal. However, no suitable supplier could be found. Therefore, a new company (LCDC) was formed for the purpose of developing the coal mine. The construction of the three FBC units was delayed, but these are expected to be commissioned by the end of 1994. The experience gained by the GOP in implementing the Lakhra project will be very helpful in developing mining and power generation on the much bigger Thar coal field.

3. Coal Briquetting - The Lakhra briquettes have been successfully developed and determined to have emission levels equal to or below the traditional fuels. The pilot plant for manufacturing the briquettes is working full time to meet local demand. No further plants have been constructed. There is a need for a new market study to assess the economics and acceptability of the briquettes.

4. DGPC Strengthening - The technical assistance, computers and other facilities provided under the Project have been very well accepted. One major concern of the Project was the limited (and delayed) filling of professional positions within the DGPC as recommended by the consultants. Due to this delay in hiring, the new employees could not be adequately trained. There was a danger that the investment in the Project would be substantially lost. But, fortunately DGPC was able to get a World Bank loan to continue the activities started under the EP&D Project. Better still, it has been possible to retain the services of the same technical assistance team (Mathtech Inc.) up to approximately June 1995. Also, GOP funds have been authorized to lease the present office space until June of 1995. DGPC has its own account (separate from GOP central account) in which the income from the sale of data, documents, signing bonuses, etc. is deposited. DGPC is continuing with the efforts to get authorization for the use of these funds for its operations (i.e. hiring of technical assistance etc.)

C. Energy Conservation

ENERCON has been provided a permanent headquarters, computer facilities and well trained staff through Project funds. Like GSP, ENERCON presently lacks adequate operational funds and is having difficulty continuing with activities initiated under the Project. However, the following funding possibilities are actively being sought:

$5 million power factor improvement program from ADB (part of 11th WAPDA Power Sector Loan). The PC-I for this activity was approved in 1992.

$7 million in grant funds from the GEF for improvement of energy efficiency in the transport sector. The PC-I for this activity was recently approved by the Minister of Water and Power and the PC-I is expected to be signed very soon.

German and ODA assistance through ESMAP for the institutional improvement of ENERCON.

$80 million IBRD loan for energy sector efficiency.